Assessment of Rubber Tapping Technology Quality in Memot Rubber Plantation Co., Ltd., Cambodia

Davuth Chhim

A Thesis Submitted in the Fulfillment of the Requirements for the Degree of the Master of Science in Agricultural Development

Prince of Songkla University

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I hereby certify that this work has not been accepted in substance for any degree, and is not being currently submitted in candidature for any degree.

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ABSTRACT

The rubber smallholders and rubber company plantation in considered the correct tapping method and latex preservation methods as the most important techniques. Controlling tapping technology, 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 are attributed low rubber yields, these are important factors in increasing the rubber yields. This study aims to 1) to assess the quality of rubber tapping technology 2) determine the relationship between bark consumption and latex yield of rubber. The study was conducted 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 study was conducted from March 20 to June 20, 2018 by using questionnaires to interview with 140 tappers under 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 statistic used for data analysis were percentages to grade the quality of rubber tapping technology. Moreover, determining the 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 used Statistical Program in social science to analyze the relationship between eights factors with grade level of rubber tapping technology quality, then there was analyzed by binary logistic regression, and the latex yield and bark consumption by analyze linear regression. Latex yield collected from each tree by weighing the cup lump (kg/tree and g/tree/tapping). Bark consumption (cm) measured on the tapped panel along the tapping period (day/year). The results showed that 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 and there were only two plots were in fair grade level such as 11.6B, 15.7C approximately 76.82%, 75.09% respectively. Amongst of eights factors there was bark consumption (X_8) had relationship with rubber tapping technology quality (Y) ($P \leq 0.05$) and all of eights factors showed that horning of tapping knives (X_4), training (X_7), tapping quality (X_8) had relationship with rubber bark consumption (Y) ($P \leq 0.05$). According to the relationship between rubber bark consumption and latex yield, it showed that the significant difference at 0.046 ($P \leq 0.05$) the over bark consumption had relationship with latex yields. The equation showed that an increase over tapping knives per unit leading to latex yields decrease 1.630 times.

Keywords: Tapping, *Hevea brasiliensis*, Bark consumption

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CHAPTER I
Introduction

In 2009 was around 9.9 million tons of worldwide natural rubber production, of which Asia produced approximately 94% and Africa about 4%. The rest of the global made about 2% (Chantuma, P., *et al.*, 2011). Natural rubber is one of the most titlerole products in the world, and the world's natural rubber industry has been modified significantly over the years, while its market has become more open, with a greater degree of internationalization. The world natural rubber commodity capacity is rising remarkably, and the plantation zone and production of rubber are volatilities with the inconsistency of natural rubber price (Youke, Z. 2008). Rubber is an imperative plan not only world commercial strategies but also for the use of alive of humankind. The more society expansion, the more requirements of products made of latex for persons utilization is growing every day (Somboonsuke, B. 2009c). Latex obtained from *Hevea brasiliensis* is the largest source of latex feedstock for making gloves, condoms and pacifiers (Sakdapipanich, K., *et al.*, 2015), contains about 94% rubber hydrocarbons (cis-1,4 polyisoprence) and 6% non-rubber constituents such as proteins, lipids, carbohydrates, etc. (Nimpaiboon, A. *et al.*, 2013). Based on the amount of natural rubber (NR) and synthetic rubbers (SRs) used up, it is projected that the per capita NR used in India is hardly 0.76 kg, whereas the world average is 1.66 kg (Jacob, J., *et al.*, 2018). Rubber Trees have a financial life of about thirty years and the cost of institution of these trees are -very high. Therefore the assortment of the exploitation method is very vital (Mathew, M., *et al.*, 1997).The study showed by the Rubber Board has exposed that the harvest per hectare, qualifying the acceptance of rain guarding is 675 kg/hectare (Joseph, T., *et al.*, 1989). The transference of technique is an incessant procedure connecting synchronized efforts of the study and postponement agents. It also necessitate technologies suitable to the wants of the rubber cultivators and the condition of the holdings (Somboonsuke, B. 2009b). The rubber smallholdings were typically usual, conventional farm, sometime called rubber forestry or rubber community forestry (Somboonsuke, B. 2009a). Improving the yield of rubber farming systems is significant, particularly for rubber smallholding farms, which explanation for 70% of the world's natural rubber yield (Somboonsuke, B., *et al.*, 2009). Rubber tree contributes significantly to the profits of thousands of smallholder farmers (Ngobisa, A., *et al*., 2018). Sustained production is the basis stone of successful plantation and the yield of NR plantation could be maximized by the optimum consumption of better atmosphere for development by acceptance of good agronomic practices and practice of genetically better clones (John, A., *et al.*, 2018).

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. However, rubber tree is found in many places and its cultivation system also has flourished throughout Southeast Asia. At the beginning of the 20th century in Malaysia, industrial rubber cultivation was encouraged, while the rubber crop have become an important crop for farmers in Thailand, Indonesia and India (Rantala, L. *et al*., 2006). An economically important plant that produces natural rubber for various industrial uses is rubber tree (Pramoolkit, P., *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, P., *et al.*, 2005). Estimated by the association of natural producting countries from 2003 to 2010 more than 1,500,000 hectares of land were converted to rubber in Thailand, Vietnam, southern China, and Cambodia. As rubber cultivation provides for the livelihoods of smallholders and their workers, increasingly, the loss of community-based resource such as agricultural and land non-timer forest products must be weighed against the economic benefits, together numbering in the millions (Simien, A., *et al.*, 2011). 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, P., *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, there are around 40 to 50 of number of rubber tree clones available, actually about 20 of them have cultivated, for more than ten years (Phen, P., *et al.*, 2016). The S/2 d3 7d/7 tapping system normallys is used in routine in Cambodia. Not use any more intensive tapping frequency like d2 the estates, as well as smallholders(Hav, S., *et al.*, 2016). The rubber smallholders in 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 are attributed low rubber yields, these are important factors in increasing the rubber yields (Aun, S., *et al.*, 2010). 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 increasing the rubber yield and managing the age of economic is bark consumption of trees. A better result can be achieved by collaboration with the tappers and by means of understanding. Therefore, a study of rubber tapping technology quality in Memot rubber plantation Co., Ltd." is needed to improve yield.

1.1 Objectives of the study

This thesis aims to study on assessment of rubber tapping technology quality in Memot rubber plantation Co., Ltd., Cambodia

The specific objectives of this thesis are:

1. to assess the quality of rubber tapping technology, and
2. to determine the relationship between rubber bark consumption and latex yield.

1.2 Expected output/outcome

The author expects that this research will be of benefit to the people who involved in this field, including the participants and the researchers himself. The participants may improve their knowledge on tapping technique as relevant of 1) Assessment the quality of rubber tapping technology of the tappers while implementing tapping in

Memot Rubber Plantation Co., Ltd, Cambodia. 2) Determination of the relationship between rubber bark consumption and latex yield.

1.3 Scope of the research

Scope of research work described in thesis was to study the quality of rubber tapping technology of the tappers and determine the relationship between latex yield with rubber bark consumption and implement the tapping in Memot Rubber Plantation Co., Ltd.

CHAPTER II

Literature Review

2.1 The current situation of rubber production in Cambodia

Cambodia is small but quite dynamic player in the global rubber market. Which exports of USD 83 million in 2010, Cambodia was the 19th biggest exporters of natural rubber (HS 4001). The export quantity of rubber productions in Cambodia has been augmented year by year from 2010 to 2016. Cambodia exports of rubber products raised by 12 percent about 145,000 tons in 2016, compared to the last year of 128,047 tons natural rubber in 2015, while prices for Cambodian rubber on the world market augmented 3 percent, depend on Pol Sopha, director of the General Directorate of Rubber. The increase of exports was produced by more land being used for rubber production. Cambodia is a rubber-exporting country, not rubber-consuming one, and so when the land area for planting rubber growths, all of the rubber is produced for exported only.

2.2 Rubber production situation

The total grown area for rubber production in Cambodia of 432,126 ha, of which 127,292 hectares for collecting, yielding an average productivity of 145,700 tons by 2016 (table 1). Cambodia's rubber productivity in a several years will be substantially higher than nowadays according to the strong recently plantation (General Directorate of Rubber, GDR, 2016).

Table 1 Statistic of rubber plantation area, productions and yields during 2010 – 2016

Year	Cultivated area (ha)	Harvested areas (ha)	Production (tons)	Yields of rubber (kg/ha/yr)
2010	181,433	38,406	42,250	1,100
2011	213,104	45,163	51,339	1,137
2012	280,355	55,361	64,525	1,166
2013	328,771	78,493	85,244	1,086
2014	357,809	90,545	97,054	1,072
2015	388,955	111,232	126,861	1,141
2016	432,126	127,292	145,000	1,139

Source: General Directorate of Rubber (GDR, 2016)

2.3 Cultivated and harvested areas of rubber production

Natural rubber is grown in several provinces in Cambodia, particularly in Tbong Khmom is by far the most important province for rubber, with more than 80,000 hectares under cultivation in 2016, of which 56,578 hectares of mature rubber plantations that are tapped, followed by Kratie, Kampong Thom, Ratanakiri, Kompong Cham (Table 2). These five provinces are also home of Cambodia's traditional rubber estates, which are large, previously state-own plantations. The importance of Kampong Cham, Tboung Khmom province is due to the geographic focus by French colonial rubber companies in 1920, it's proximately that Cambodian rubber export into Vietnam.

Table 2 Cambodia's natural rubber areas (ha) by provinces and type of plantation in 2016

No	Rubber Plantation Area	Economic Land Concession (ELC)	Agro - industrial	Smallholders	Total
1	Tbong Khmom	3,010	31,233	47,257	81,500
2	Kampong Cham	-	11,558	21,010	32,568
3	Kratie	58,560	4,365	12,438	75,364
4	Steung Treng	13,547	-	4,103	17,650
5	Ratanakriri	27,038	2,498	36,349	65,885

Table 2 (Continued)

No	Rubber Plantation Area	Economic Land Concession (ELC)	Agro - industrial	Smallholders	Total
6	Mondul Kiri	29,275	-	9,654	38,929
7	Kampong Thom	59,624	3,036	7,552	70,211
8	Siem Reap	3,341	933	1,014	5,288
9	Preash Vihear	14,309	-	2,896	17,205
10	Oddar Meanchey	12,785	-	1,707	14,491
11	Pailin	-	-	1,526	1,526
12	Battambang	50	-	2,090	2,140
13	Pursat	2,219	-	615	2,834
14	Banteay Meanchey	0	25	942	942
15	Koh Kong	-	-	1,504	1,504
16	Preash Sihanouk	-	-	1,220	1,220
17	Kampong Speu	-	-	701	701
18	Kam Pot	-	-	421	421
19	Prey Veng	-	-	578	578
20	Svay Rieng	-	266	877	1,143
	Sub-total	223,758	53,914	154,454	432,126

Source: General Directorate of Rubber (GDR, 2016)

2.4 Rubber production

1) Clone is important factor to increase the productivity of rubber plantation. Under collaboration with rubber producers, Cambodia Rubber Research Institute (CRRI) imported some *Hevea* clone for experimental testing to evaluate the potential of these clones with soil conditions and climate of Cambodia before extension for cultivation and development. Obviously, large plot IR.AA.01 of experiment clone was established in 1996 at the CRRI and data from experiment plot to contribute significantly in recommended clones in Cambodia. Yields of the total dries rubber

production measured in gram per tree (g/t) (Table 3), yield performance of eight clones; GT1, RCA 130, PB 235, PB 330, PB 280, PB 260, IRCA 18 and IRCA 111 has been evaluated under the condition of rubber cultivation in Chup, Thboung Kmom province, Kingdom of Cambodia. The result from rubber tapping in 14 years revealed that for clones IRCA 130 gave the highest yields of dry rubber per tree, followed by PB 35, PB 330, PB 280, IRCA 18 and PB 260. Whereas clones IRCA and GT1 gave the lowest yield both upward and downward tapping. Clones with the lowest brown bast are GT1 and PB 280.

Table 3 Yields in cumulated g.t^{-1}during the tapping periods, downward (10 years) and upward (4 years)

Clones	Yields (downward)	Yields (upward)	Total yield in 14 years
IRCA 130	45264a	17514a	62778a
PB 235	41450b	15766ab	57216b
PB 330	37035c	16230ab	53265c
PB 280	36065cd	16509ab	52574c
PB 260	35791cd	14828b	50619c
IRCA 18	33912de	17284a	51197c
IRCA 111	32329e	14327b	46656d
GT 1	27858f	14069b	41927e

Source: Cambodia Rubber Research Institute (CRRI, 2017)

2) Incidence of trees dryness

Incidence of tree dryness varied from 1percent for clone GT1 to 20 percent for clone IRCA 130 (Table 4) during the downward tapping period. Incidence of tree dryness ranged from 7.5 percent for clone GT 1 to 26.2 percent for clone PB 260 when the trees were subsequently tapped upwards.

Table 4 Incidence of tree dryness (%)

Clones	Tapping direction	
	Downward	Upward
GT 1	1.0	7.5
IRCA 111	9.7	14.8
IRCA 130	20.0	16.8
IRCA 18	9.8	17.7
PB 235	10.0	12.7
PB 260	11.3	26.2
PB 280	2.2	7.8
PB 330	10.2	13.0

Source: Cambodia Rubber Research Institute (CRRI, 2017)

2.5 Different types of rubber products

The main kind of rubber productivity using in the rubber industry (Table 5).

Table 5 Rubber product forms

Rubber product forms	Descriptions
Coagulation	Irreparable agglomeration of particles firstly detached in rubber latex.
Concentrate latex	Latex, the rubber content of which has been greatly upsurge by centrifuging, evaporation, or creaming.
Crepe rubber	Rough-surfaced sheet rubber produced by passing coagulum through a series of rollers which rotate at dissimilar speeds.
Crump rubber	The particulate rubber form of technically specified by the adding or by mechanical granulation of crumbling agents to coagulum.
Dry rubber content	Rubber coagulated mass from one hundred portions mass of latex by acid.
Dry rubber	From field latex of rubber obtained by acid coagulation, sheeting, washing or drying, and crumbling.

Table 5 (Continued)

Rubber product forms	**Descriptions**
Field coagula	Poor grade coagulated rubber received from the farm, including scrap, cup lump and tree lace from the base of the plant, and pre-coagulated rubber strained from the latex.
Field latex	Latex gotten from tapping the *Hevea* tree.
Latex	Certain plastics or of aqueous colloidal emulsion of rubber (natural or synthetic). Generally, refers to the emulsion obtained from a plant, tree and produced by emulsion polymerization.
Raw rubber	Rubber which no elements have been supplemented, uncompounded rubber.
Sheet rubber	cured in smoke houses (Smoke sheet) or sheets of milled coagulum dried in air-drying tunnels (Air Dried Sheet).
Tree lace	Dried rubber formed strips on the tapping panel of the rubber tree after latex harvested.
Cup lump	It's the recently rubber latex coagulated in the cup that trapped with the rubber tree and not involved with the processing.

Source: Ministry of Commerce (MC, 2012)

2.6 Tapping operation and implements

Rubber tree is one of which worthy greater attention and it not more weighed in useful by even though the procedure of curing or approaches of establishing this classes. On the approaches of tapping based on not only the quality, quality of the rubber and latex, but this lifespan and upcoming terms of the plants.

The troubled through the *laticiferous* tubes in the external slice of the trees when the plants are complete for tapping. The thickness of this tissue may differ from 1/8 to approximately 1/9 inch or additional, depend on the age of the plant. The average thickness of the uninterrupted bark of 22 yrs old plants in Ceylon is around 3/8 inch (9.5mm). The external portion to a deepness of 1/8 inch (3 mm.) does not comprise numerous tubes, but the internal portion have a big amount, and from this internal 1/16 to 3/32 inch the latex mostly movements. The tube in the external part become dry and are frequently shed with the external bark tissues. When the first cortex has been detached novel tissue is made, mostly start up downwards and within outwards, and in this the latex tubes ascend *de novo* as in the first substantial. It's vital to reminisce that the delay of these tubes in the cortex of *Hevea* is a slow one, that in numerous examples the portions of the *laticiferous* structure aren't wide, and in tapping processes only a portion of the full milk-comprising tubes might haggard up. The researches have exposed how significant could be complete on the archaic technique of tapping very alternate year and procurement 1.1/2.1b of rubber per year, per tree from 11 yrs-old plants. It has been in progress that the harvests likely in the closely forthcoming may, if the prices are preserved, likes based on to deliberate the possibility of cultivation each 12 years. The products gotten in many fragments of Ceylon demonstrations that by rather radical approaches is conceivable to acquire from specific plants in a tapping year is the most confident only a previous year projected in 10 year's tapping, thought it should be bone in concentration that the consequence on the plants cannot, with current information, correctly predicted and many or might not demonstrate will be harmful (Wright, H., 1908). The organization of the bark consumption is one module of the tapping structure methods; much investigation and growth hard work has been practical to it in order to make the most of terrestrial and labouré productions, thinks the socio-commercial context of every yields zone. Then detection of stimulus by ethephon, mostly rudiments of the tapping systems, like the fine-tuning, tapping-cut length, or the tapping frequency of stimulation itself, had to be improved in combination with this main modernization (Gabla, O., *et al.*, 2006).

2.6.1 Effect of poor tapping

It's possible that the apparatuses of tapping and approaches of the forthcoming will be such as to guarantee that the minimum, if any, injury is completed to the cambium. For all owing admiration to the investors who have located their knives before the community, it may be in progress that the perfect or ideal trimming process has not yet been made, though there looks every possibility that it will quickly be on the marketplace. Still have some apparatuses traded and used which should be categorized as unsafe. For the purpose to excite most of growers of final result of poor tapping, a picture is at this point replicated. In the supplementary illustration the figure above demonstrations a portion of a large plant with the bark and portion of the timber detached. The big about V-shaped deep in showing slice is due to the decay of the timer, which happened inside to a deepness of quite a few centimeters, and was caused from the beginning by making a big V wound the threadbare under the cambium in to the wood all along the cut. The figure below on the similar plate demonstrations a unit of the timer with portion of the bark and external tissues detached. The timber was, with the unique tapping, noticeably injured, and more than a few years after the wound was completed the portions above it was originated to be more difficult and to offer less latex: the timber was enduringly injured. The specific circumstance of external appearance wasn't conspicuous of any method, and only the bad harvest of latex directed to a review which exposed the scope of the enduring wound had completed. The black V-shaped stripes of showing timber demonstration the way and scope of the long-standing Vicuts, these entered to the cambium. For all these points the putrefaction of an important portion of the plant has been prepared, and the vigour and long life of the plant substantially dangerous. More than a few other faults made by harmful the timber during implement cutting, as always the parts develop very ''warty'' and a current sequence of very big spheres firm timber tissue powerless of being cut, and which look relaxation in holes of the wood, another points of big marks happen on the location of the tapping knife has tap lower the cambium. Wound in the total points is perpetual and maybe sensed long terms after it has been completed. Such handles and marks are not owing to ''canker'' and the founding of a smooth superficial on like plants deprived of tapping into the timber is procedure an enablement. Cutting precarious external necessitate significant deliberation, but it would be happening that in no circumstance would timber swellings be happened, the cut would, if able, completed up or down both timber growths, letter permissible to do itself out in its own technique and period. For this point the zig-zag technique of tapping can be improved with benefit (Wright, H, 1908). The study was to assess the competence of dual cut alternative tapping system (DCA) on latex products and development of rubber plant in the nomination region. The consequence should be the alternative cutting system for the growers to growth the yields of the rubber plant in the non-traditional zone (Isarangkool, N., *et al*., 2016)

Figure 1 Effect of poor tapping on the timber (Showing decay of inside timber where wounded by tapping)
Sources: Wright, H. (1908)

2.6.2 Tapping knife

The tapping knife is treated as a very significant tools, as it's contributions in decisive the depth and thickness of tapping. It must be sharp adequate so as to allow it to slice gone competently best quantity of the bark. In contrast, a blunt knife desires better power to pierce it into the bark, interpretation it hard to control and lastly causing injury to the cambium. Fundamentally, there are dual kind of tapping knife- the one that cuts by pushing recognized as gouge, while the individual cut by pulling, identified as jebong. The jebong knife, if sharpened both ends have double purposes as pushing and pulling, and it also recognized as bidirectional tapping knife. An adapted gouge is required for upward tapping and the managed upward tapping (CUT) is appropriate for this determination. A prototype motorized tapping knife with battery power called Motoray was designed during the 1980's. However, it is not usage in presently (Ahmad, T., 2009). Figure 2 shows the development of the tapping knife from the early U-sharped gouge to the modern battery power Motoray

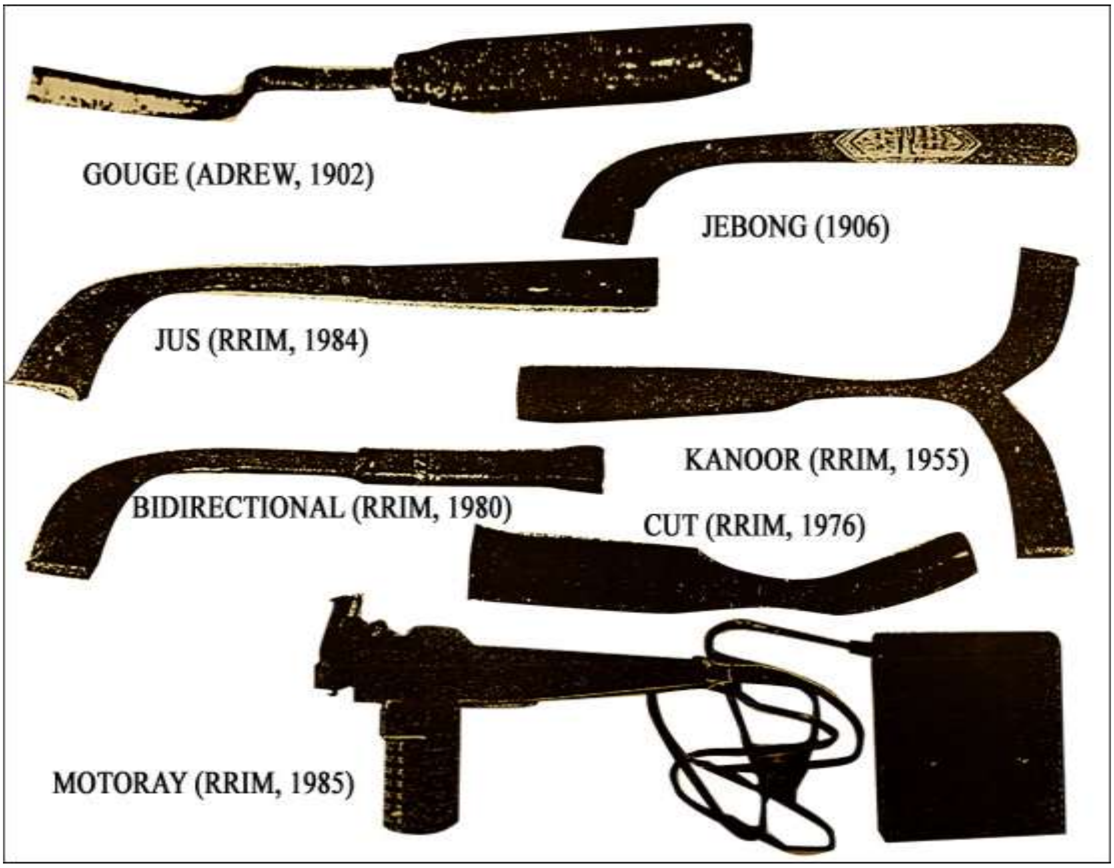


Figure 2 Development of tapping knives in Malaysia

Sources: Ahmad, T. (2009)

2.7 How to tap rubber trees

2.7.1. The method of tapping

Primary taps are complete apiece of bottom to overhead of the another and in the circumstance of a plant 45.72 centimeters in perimeter the furrow should be closely circular the tree. The tree 76.2 centimeters in perimeter double cables of cups on contrast parts of the plant would be compulsory, and a plant 137.16 centimeters in girth should make 3 cables of cups. The primary tap is complete by a chisel much using similar a plane, then next chisel would use afterwards everyday of cutting off the edge of the furrow initially completed. A month's cutting by unique chisel create the furrow double centimeters wide, for this full bark part should be tap away in the sequence of the year's effort, supposing that the cutting was approved on through the year in alternate months. This tapping face of number of 2 chisel, though, had summary to the sixteenths of a centimeter to 2.54 centimeters. A 3th tool had designed for practice in this procedure. For this formula of a round piercing tool, that's used to enter to the cambium at the edge of the former tap. The completed alternately with the tapping, this supposed to able the inside bark from any buildup of latex (Wright, H., 1908). Cutting system is a method to expand latex yield of rubber plant (Nhean, S., *et al.*, 2017)

2.7.2 Latex liquid storage and settling tanks

On minor lands located several and widely-scattered plants are being cut the grower is always forced to recourse to the yield of the rubber on smallholders; this regularly contains a regular recurrence of the similar progression and much petty hand labour. The latex can, though, reserved in a liquid disorder for more than a few days or even weeks, deprived of doing much damage to the ended product, and the rubber could be man-made on a large scale during adequate amount of harvested the latex.

The latex could reserve in the liquid disorder via the adding of formalin, alkaline, sodium carbonate, or any ammonia chemical that is willingly solvable in freezing water. It is well to uses both formalin, ammonia and circumvent any might seepage on dangerous to the air in the normal methods of research. For this creation, original by brown, the latex is reserved in enclosed tanks of settling complete links (1) a drip-tin device completed in substances to recollect the latex in an alkaline disorder, and (2) to a paddle to preserve the latex in gesticulation. If receivers covering ammonia is showing to the air, the mixture will evaporate and the latex coagulate in a several days. If, though, the holders are enclosed, closed, the ammonia couldn't simply seepage and the latex might accumulate in a liquid state indeterminately. Formalin has alike impact, then breaks decomposition, consequently avoids and progress in acidity. Aammonia perhaps neutralizes acids like shaped, so preserves the latex in a neutral stat, alkalin in that way avoiding the rainfall of the proteid substance. According of using like substances and device of countless profitability of labour might cause (Wright, H., 1908). latex has a importantly advanced profitable cost and usage than cup lump, which in fact commonly is of a small value (Viet, N., 1999).

2.7.3 Where to tap

It's renowned that of natural rubber plant the latex happens whole portions of the branches, stem and leaves. Nevertheless quantity, latex quality by branches, leaves, and young twigs are like to reduce of assortment stating from many parts un-remunerative.

Less and more effective yields of gutta-percha from leave directed very forestall which rubber could accessible starting of young, foliage twigs of *heavea brasiliensis*. “The latex in leave and young stems does not easily secretion out and mixture with water, but lumps where it radiates in name lumps, which cling to the smashed parts of tree.” Rubber starting of tissues is sticky and has strength and low elasticity than the rubber starting of trunks of old plants. Might carefully declared which harvesting of latex from these types should be create from the stem, and points of some maybe from foremost branches, and which all another section perhaps deserted as bases of paying amounts of notability rubber. on repetition not difficulty to cut the tree starting from 182.88 centimeters downwards than many another portion, over the stands of erection, scaffolding, by using stairs and working stilts for cutting taller portions and thickness oaks have been tried to effective consequences. Lands are recognizing where rubber in expending the amounts has been gotten from 2 to 6 meters, but cutting overhead two meters isn’t normally accepted. For detail which is maximum of 4.5 to concluded 9 kilograms of rubber/tr has been gotten starting from the lesser portion of the tree only in 12 months starting from beginning of cutting process made it pretty uncertain whether cutting of a smaller amount available portions will come into commonly power. Starting from 182.88 centimeters downwards is rather than it needs stand the strain on the tree to recover the injury part. Additionally, should be think of which of maximum amount that latex and rubber might gotten just a little bit by cutting original parts like via getting benefit of the injury answer and cutting, pricking the *laticiferous* pipes which cover the maximum quantity of latex (Wright, H., 1908). Tapping procedure is recognized to improve the metabolic actions of *laticiferous* leak tissues gradual to renew the mechanisms of latex amid consecutive cutting along within for injury curative(Annamalainathan, K., *et al.*, 2013).

2.7.4 When to tap

In deliberating this portion of the point, essential to consider that size, age of the stem which is define and perhaps cut of primary once.

More than a few botanists have contended the query, and as it is one which anxieties the quality amount of the latex and the physical condition, dimensions of the cutting parts, the requirements are well thought-out prudently (Wright H., 1908). the plantation at long immature period, which is around 7 years (Michels, T., *et al.*, 2012).

2.7.5 The significant of age for rubber tree

Seeligmann and Ule stated that the rubber at Amazon District needs fifteen years enable to cutting at the middle age in start fields and twenty-five years in the jungle, then harvesters are not as much of keen to begin cutting processes at Amazon district before in Ceylon and Malaya, or one can't assist completing derisive this declaration that both the planted trees in the East well flourish in their area and adaption than the forest in their traditional routine. Cross speeches that in natural rubbers were cut if most of them had a perimeter around 45.72 or 60.96 centimeters, the processes an investigation afoot till the plants were murdered. On farms in the East like scopes should be achieved in 4 to 6 years. Trimen, in 1884, supposed which the plants in Ceylon may be 10 years old earlier beginning cutting processes. Johnson is of the estimation which the size, and not the age, of the plant shows which it enables securely cut, and that cutting should be started when a plant has a girth of 50.8 to 60.96 centimeters a yard derisive the ground. The analyses of young Castilloa rubber, if one researches of the many studies of Castilloa rubber cited via Weber and the journals of the West Indian Botanic and Agricultural Developments, he can't assist being hit with the face which the eminence of the rubber derisive Castilloa plants according, in any case, at the age of the tree. In another cases, the rubber derisive old tree is exposed to comprise eighty two percent of the caoutchouc and seven percent of latex. The rubber derisive 4-year-old Castilloa plants has been exposed to comprise sixty-fourth percent of latex as in contrast to eight percent for 12-year-old plants. The advantage of age is additional demonstrated via evaluates viewing a regular reduction in percentage of latex materials, that happens with a growth at the age of the portion of the Castilloa plant derisive that the rubber is gotten, the young twigs producing five point eight percent, the big branches three point seventy seven percent, and the foremost stem only two point sixty one percent of latex materials. If the rubber comprises excessive percentage of resin, usually treated lower, and is in other cases closely impractical. Growth at age is definitely to be related with a development in the physical possessions and eminence of the rubber, how one regards farms of dissimilar ages or portions of the similar plant.

Table 6 Analyses of rubber from different aged plants

Age	Two yrs. old	Forth yrs. old	Six yrs. old
Moisture	0.70%	0.65%	0.55%
Ash	0.50	0.30	0.40
Resin by acetone extraction	3.60	2.72	2.75
Proteins	4.00	1.75	1.51
Rubber	91.2	94.58	94.79
	100.00	100.00	100.00
Resins extracted by glacial acetic acid	2.74%	2.62%	2.65%
Age	**Eight yrs. old**	**Ten-twelfth yrs. old**	**Thirty yrs. old**
Moisture	0.85%	0.20%	0.50%
Ash	0.85	0.22	0.50
Resin	2.66	2.26	2.32
Proteins	1.75	2.97	3.69
Caoutchouc	94.60	94.35	93.24
	100.00	100.00	100.00

Source: Wright, H. (1908)

The above examines exposed the chemical structure in Ceylon planted rubber arranged derisive plants differ at age from two to thirty years. It will be perceived which the 2-years-old rubber doesn't varying clearly derisive the elder mature rubber. The studies characterize of configuration only one sequence trials, and wouldn't be occupied like presentation the archdeacon configuration of rubber from plants at the ages cited. The rubber derisive 2-years-old plants was from, and snapped which a little elasticated; it was clearly out of shape for auction. The design here duplicated demonstrations the plant derisive that the rubber was gotten; it is impeccably obviously which obtainable cutting zone like plants is very minor. Parkin established which research of worth rubber derisive young trunks and leaves of *Hevea brasiliensis* was nonstarter, and another spectators had exposed which rubber derisive of young plants is sticky and absences the needed strength and elasticity; however, it's yet the issue of most talks as to how age is one principle for growers of rubber in the East. Stanley Arden has exposed which in portions of Malaya the rubber from plants 3,5 - 4 years old is definitely lower. The consequences had mentioned in the unit trading with ‘’Products of Rubber’’ and it’s one required to opinion out which the yields derisive plants up to 4 years old was exceptionally low, and which of rubber in expending amount was only gotten when the plants were over 7 years old. He analysist that via the time the plants in Malaya are 6 years old, seventy five percent would give a regular production of twelfth ounces. For convinced Malacca rubber possessions, the rubber plants, although vicious circle trees have been taken off the below through the initial several years, achieve in 4 years a perimeter of 45.72 centimeters, and in 7 years, 89- 101.6 centimeters. Most of these plants were grown fifteen feeds phase and would be very slice cut later the 4th year. Trials of rubber from 4-year-old plants have, nevertheless, the denounced in convinced quarters, and in first case they were categorized as being like to usual African category for rigidity, but greater in hygiene. They were detailed like starting lenient, and shouldn’t attitude much occupying on the engine, although the worth harassed them was one equal to which for ‘’Congo ball or a like class of African’’ (Wright, H., 1908). The main source of natural rubber is the rubber plant, *Hevea brasiliensis* (Willd. Adr. ex Juss.) Muell.-Arg. (family Euphorbiaceae), that’s recurrent and had an commercially beneficial lifecycle of 30-35 years (Gonçalves, P., *et al.*, 2005).

2.7.6 Age and size

Rubber tree commonly has an financial lifetime of more than thirty years, grown and controlled as a long- term plants once grown (Dongling, Z., *et al.*, 2014).With related to knowledge in Ceylon it would be remarkable out which is favorable conditions the rubber plant will demonstration an upsurge in perimeter of around 10.16 to 12.7 centimeters per year able to the initial 6 or 8 years, and which passed the rubber from 2 to 6-year-old plants is sticky, and might have a high percentage of sticky mixtures, it is by no means always the case. The investigation of rubber derisive two point four and six years-old plants have been formerly assumed, and however the consequences can’t be recognized like decisive, it was pointy out by Mr. Kelway Bamber which the rubber can’t control a very high percentage of latex, and in this deference was surely fairly different to what Weber and anothers have experiential in the rubber derisive young Castilloa plans. But which one treater which rate of plant of the para rubber plant in Ceylon is like that fourth, fifth, or six years, it's understandable that, under normal procedures of plantation, most of idea of removing rubber from plants under these ages wouldn't be heartened. One constructor is maintained like saving that the rubber does not achieve its whole power till the plant is at least eight or nine years old, and substantial derisive younger plants ''has not the strength of difficult treatment Madeira well Para, and is rough in strength.'' It is same as declared which there isn't transformation remarkable in the rubber from eight year-old plants from dissimilar estates, but it is not yet harmless to use it for the finest effort, like thread and the best bladders (Wright, H., 1908). The essential of the rubber productions from the rubber tree (*Hevea brasiliensis*) is now fine recognized. Newly, the useful of girth improved and therefore timber rubber tree has been highlighted. Genotypes with greater girth improve yield greater dimensions of wooden (Gouvêa, L., *et al.*, 2013).

2.7.8 Minimum size for tapping

When the plant has a perimeter of much smaller than 50 cm, cutting cannot suggested, because the obtainable cutting part is too small; however, on a few lands the plants having a perimeter of only 38 - 45 cm are cut. The yields of new tissue might a situation at young trees, and the thin bark tissues perhaps speedily cut away far previously the amount of rubber had been gotten. If the perimeter is whatever directly above 50 - 60.96 cm, a yard derisive down and the plant is 4 – 6 or more years old, it able, in Ceylon, be slender cut. Good rubber derisive such plants. A plant 60.96 cm in circumference couldn't have more than 2 spiral curves for cutting; it can be cut on the herring-bone system on one or both sides of the plant. On one farm in Ceylon forty-one plants of substantial height, but having a perimeter derisive 45.72 - 63.5 cm a yard from down gave with a very light cutting during March and April 8.84 kg of dry rubber, that was favorably informed upon in Europe. From the previous notes it's clear which the queries of enable cutting part and age cannot be deserted; they are as usefully at the ages of the plants. A minimum perimeter of 50 cm, a yard from the down, and a least age of 4 to 6 years could be recognized for most rubber possessions, the good established plants being cut initial (Wright, H., 1908). The rubber plant requirements a long growth dated beforehand it could be cut for latex, with the trunk size being a vital parameter assessment when tapping can begin. If 50- 70% of plants have a stalk circumference better than 50 cm at a height of 1.25 cm up the down, they can be cut (Sathornkich, J., *et al.*, 2010).

2.7.8 How to increase the tapping area

Previous reports mention to plants of recognized ages that have reached the minimum diameter which permissible to progress much elongated and thinner trunks. But it has been formerly observed which pruning the plants at a convinced phase the trees might completed to upsurge in circumference at the expenditure of the longitudinal progress, and a very striking illustration is to be gotten in the initial bunch of old rubber plants in the Henaratgoda Garden, Ceylon. The scopes of forked and straight-stemmed plants on many lands in Ceylon have been formerly specified (Wright, H., 1908). A high rate of cutting panel dryness also happens with like intensive cutting systems (Anekachai, C., 1989).

2.7.9 Compass tapping

More than a few trials have been investigated with the article of demonstrating that is the greatest portion of the plant to cut during before noon and evening. Could be given that the cutting parts of the plant could be suitably separated by 4 portions, a part to face north, then south, another two east and west in order. Side by side could be cutting on a certain system, can be one a day, twice a week, and etc. Which the east side has to be cut and greatest to achieve the process in the late noon or late afternoon, and cut the west side during the early portion of the day; such as technique, appropriate to the east and west side of the plant, avoid directly exposure of cutting part to the sun's rays during waged processes, and permits of movement of resin to continue for a little long period of while (Wright, H., 1908).

2.8 Effect of tapping on the trees

Rubber tree (*Hevea brasiliensis* Müll. Arg.) radial development dynamics were checked with movement devices, together with latex yields, explore 3 characteristics of the dual yields of latex and timber: (1) the beneficial of fine-scale dendrometry indicate as a physiological instrument to sense water lack through radial growing;(2) the dynamic features, both at the periodic and at the multi-year scale, of the rivalry between latex and timber yields; and (3) the spatial delivery of radial growing rates about the tapping cut (Silpi, U., *et al.*, 2006).

2.8.1 The effect of repetitional bark stripping

It's ordinary information which several of the furthermore productions have been gotten by fully removing full of the bark tissues derisive the base on to the height of 182 – 450 centimeters, and it's normal which many of queries would put onward like the probable impact the therapy at trees.

The inordinate purpose of the cortical or bark tissues is to commit the expounded nutrient ingredients established in the leaves, derisive up downwards, the numerous units of the planting trees, and also to stock above, in convinced of its cells, a number of foods as standby substantial. like stock places and leading canal, this dynamic essential of tree, and when this detached to much speedily the lifespan of the plant could threaten. The international timber, though of inordinate essential to the tree in establishing, derisive under upwards, liquid and substance nutrition sucked by the roots, is not as much of importance than the tissue, and the universal contribute might, to a convinced scope, be distributed not too extremely wounding the plant. Cortex tissues are reliant on its restitution at movement of the cambium-a fragile tissue unravelling the internal cortical derisive at timber-and in the normal development of actions slowly dehydrated on close the superficial and bark off in the formula of lifeless peel. The internal cortical initially covering the resin fibers, in consequently eventually cast off like lifeless peel, so which could be supposed that cortex stripping, on cutting process, is a way of accelerating the elimination of the peel tissues and might affected absent of extremely troubling the implementation of ordinary occupation of trees. This might understandable to everyone which undressing of the peel, like implemented of cutting, this abnormal procedure and not precisely similar with the similar phenomenon in wildlife. this fluctuates derisive the normal procedure in distant that the cortex cells are removed while it's in existing terms, and are completely detached a period when they comprise standby nutrition envisioned for the trees are using; this varies derisive the nature procedure in distant which is regular operative revelations the internal, more subtle, and dynamic tissues of the cortical and cambium to environment effects. like action disturb the vigor of plants, and if investigated this commonly might speed lifeless of trees. Under these situations it would be recommended which the whole stripping of the rubber peel, each year, is an onward but unsafe tree on that effort. Gotten some plants that aren't flourishing under like an action, and is persuaded to commend it one in cases that are thinning-out of the plants is wanted. On several lands where the equivalent cutting outlines or parts are virgins grown out 30.48 centimeters separately, the peel is removed at the rate of 2.54 centimeters by month, that mean comprehensive stripping in a year; on another possessions 2.54 centimeters is completed to previous derisive 2 - 4 months (Wright, H., 1908).

2.8.2 Effect of tapping on the periodicity of the plant

The conduct showed out of rubber plants might supposed to be fewer extreme than which accepted quickly removing or peeling the cortex and bark off Cinchona plans, and didn't like hard as the tapping out of the trunks of cinnamon undergrowth nearby the base in command to afterward protected the dry peeling out of bark; however, where latex removal is divisible from quick cortex tapping, the procedures repeat one of those accepted, previously, on some cinchona plantations. Next where likely effects on the plants that have been cutting in this manner? It would be regraded too primary to form any certain assumptions, but something might be considered like initial impacts of removing resin, and cortex strip off, would be noted.

The greatest prominent impact, even though on estates where that has been but little removal of the cortical and locate the resin has been mostly gotten by the using of piercing tools, which is on the foliar and other periodicities of the trees. Several tropical plants even they are planting in the similar plot often demonstration guardable changes in foliar periodicity; but uncut plants of *Hevea brasilensis* planting under around the similar physical situations didn't commonly demonstration noticeable modifications, like charted consequences, given elsewhere, have exposed (Wright, H., 1908).

2.8.3 Tapping and transformation in foliar periodicity

Cut the trees do, nevertheless, demonstration much changeable; the leafless stage of seriously taped plants might be approved over during dissimilar months of the year. that has been exposed somewhere else which the foliar periodicity of widespread, original and even though presented plants in Ceylon is primarily defined by the moisture of the soil and air, the mostly of the plants transitory over its leafless stages during the times thus smallest humidity is obtainable. A modification in foliar time is coincident with transformation in moisture and it seems quite enable which abstraction of resin, involving the elimination of practically half its eight in water might, from humidity modification one, be partially accountable some modification in foliar periodicity. If the transformation was only more commonly this assumption may more reasonable; it is the constancy in all periodicities of some seriously tapped plants of *Hevea brasiliensis* that avoids one from making a certain declaration this part.

The modification in foliar periodicity, made by purposely mutilating portion of the plant, only recognizes; perhaps much modification in *Hevea brasiliensis* is according to the disruption in the effort of the leading and stock cell of the cortical, rather than the elimination of liquid in the resin. this case the break might principal to further irregularities, to a decreasing of the vigour of the tree, and even quickening the decline and premature death of numerous portions. Description have been commonly established to the impact that scope and quantity of the germs made have been abridged on some plants, and in particular occurrences an growth in quantity of seeds per plant has been mark; the concluding is possibly showing of more risk than the previous (Wright, H., 1908). Root growth was periodic and associated to leaf extend (Thaler, P., *et al.*, 1996)

2.8.4 Frequent tapping and yield of rubber

Selecting an suitable tapping system is an important feature to define the physiology, yielding of rubber plants. Presently, high frequency tapping systems are normally practicing (Sainoi, T., *et al.*, 2017). That also frequent tapping might lesser the productions of rubber there could no hesitation. It has been formerly remarkable out which consequences of researches delineated to assesmet quite to dissimilar opinions have exposed an ordinary contract in so long that, when cutting has been completed to extensively or too frequently the productions of rubber has been down, and the peel or source of upcoming resin has left. In some cases the low productions from well-established plants can be related with too quick removing of the bark, then as soon as one understands that the bark is truly the ‘’mother of rubber’’ and its quick elimination means a decrease in following productions, the well for most worried.

At primary accomplish that, during the rubber tree infrequently unconditionally dry, and most of seem to comprise an unlimited store of resin, the more frequently the plants are cut the greater the amount of rubber available. In a sequence of researches, that would or might not be exceptional, this opinion as refuted. The plants in one part were daily cut from December, 1905, and those in other team every alternate day from the similar day. The plants which were daily cut (on 264 times) have obtained around 9lb. of dry rubber each, and most of first peel had been tap away; those plants that had been cut every alternate day (on 131 times) got aproximately11 lb of dry rubber each and only ½ of the first peel was detached. The artworks will help to create this exactly.

Reviewed these plants in April, 1908 (around 2 years later researches) and was persuaded which daily cutting as very unsafe and a probable to substantially touch the upcoming life of the tree.

Tapping at lower frequent between didn't only give a higher productions of rubber per plant, within precisely the similar times, but there was enough first peel residual to previous for other 9 months on each plant. The labor pays were decrease; the rubber productions augmented, and the plants fewer radically preserved by tapping every alternate day as an alternative of every day. have some down for trusting that, when cut of the *laticiferouse* is completed further perfect than at current, the interval between each cutting process would, with benefit, can be still extended and accompanied with a further upsurge in productions and saving of labour. In the opinion of the massive fluctuations in the producing ability of peel of the similar tee and the structure of the resin from the similar zone, it may be imprudent to respect these consequences as being constantly able; though, well-intentioned of thought and might formula a foundation for more investigation (Wright, H., 1908). The obtainable cutting trees of rubber farms also were one of the key issues moving rubber yields efficacy in Hainan State plantations (Dongling, Q., *et at.,* 2014).

2.8.5 Frequent tapping and lowering of quality

The lowliness of some trials of rubber plantation would be partially based on the other constituents and caoutchouc being young. The class of rubber starting from the similar plants in Ceylon differs from period to period. From the primary tapping rubber is further suitable to turn out to be tacky and soft than which obtained some period well along; which from the similar plants would, when gotten throughout the primary 2 - or 3-months' tapping, exceptional value, but later a period the excellence repeatedly worsens. The worsening in the rubber gotten later lengthy and recurrence tapping of first peel, or in which tenable from early rehabilitated peel, be able thought by the transformed chemical and physical consisting of the resin. The resin gotten under these conditions manage an inferior percentage of caoutchouc and other elements and seeing that in the transformed bark all the elements have ascended within a short-term of 1 or several years, they able predictable to have achieved the similar degree of phrase or strength, as those in the main bark of elder plants. In the African and Brazilian jungles, the vines and trees are only cute period convinced season and along interval is acceptable to elapse that might partially accountable for the types of the rubber protected.

The difference types of the mechanisms of latex is regarded, particularly if one guarder dissimilar aged portions of the similar trees, latex frequently being plentiful in the younger portions, but so established as to be uncoagulable. The connotation of the strong point of the ending production with the regularity of cutting would be accepted in attention and cases growers to vacillate previously cutting too rapidly or too frequently damaging the first bark during harvesting processes (Wright, H., 1908).

2.8.6 Thickness of tapping

Latex can only be found in the latex vessels, which have to be severed for the latex to flow out. This can be done by slicing away the bark. The same amount of latex is obtained irrespective of the thickness of the bark removed. But a thick slice definitely removes a lot of bark and this reduces the economic life of the tree. Therefore, good tapping is too just removing the plugs at the finals of the latex vessels severed during the previous cutting (Figure 3). It's estimated that, for alternate daily tapping, only 1mm thickness of the latex bark is required to be removed in the other to achieve a satisfactory flow out of the latex. As a guide, the yearly bark consumption is given in Table 7. Spot marks can be made on the tapping panel on the first day of each month to show the thickness of bark consumed in a month. To prevent excessive consumption of bark, spot marks on the bark to be consumed monthly are placed on the untapped panel instead. This can be easily implemented by using a roll marker (Figure 4).

Table 7 Yearly bark consumption guide

Frequency of tapping	Type of bark	Thickness of bark consumed (cm)
Alternate daily	Virgin	20-25
	Renewed	25-30
Third daily	Virgin	18-20
	Renewed	20-25

Source: Ahmad, T. (2009)

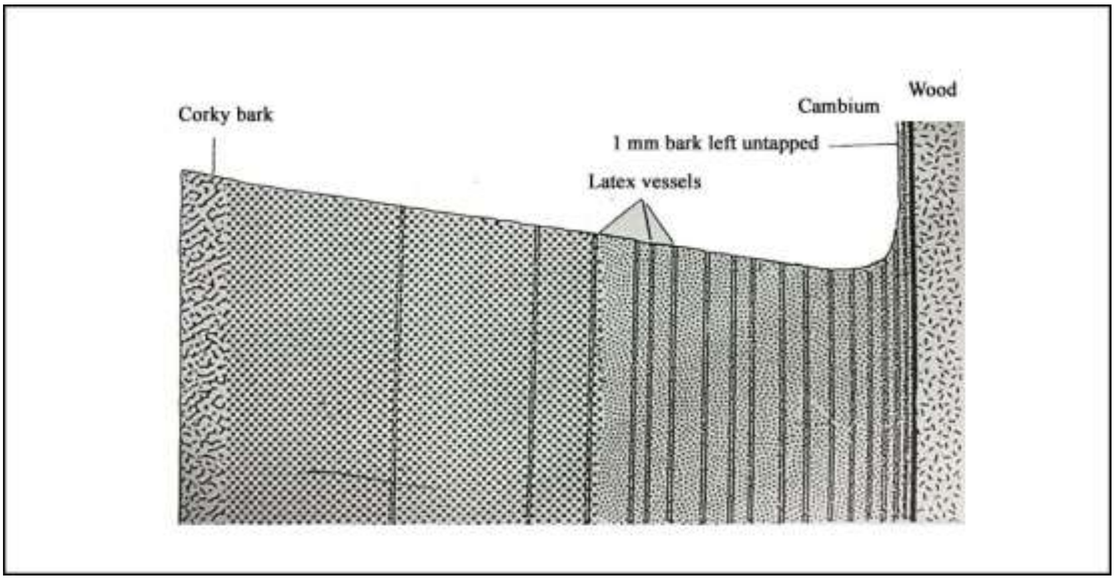


Figure 3 Cross-section of the bark showing thickness of bark consumption and depth of tapping

Source: Latex harvesting mrdp.da.gov.ph

(a) Thickness of bark consumption

(b) Thickness of bark to be consumed

Figure 4 Monthly bark consumption guide makings
Source: Rubber tree in Memot rubber plantation Co., Ltd

2.8.7 Depth of tapping

The rubber bark of the plant is assembled of more than a few layers. The out farthest is named the corky bark, that performances like defensive layer. next layer, that is the hard bark stone cells and some chaotic latex vessel rings could be found. The better quantity of latex vessel rings is found in the lenient bark, that formulae the 3rd layer. The latex vessels in the bark are in rings that are nearer to an additional like spread the timber. Amongst the timber and the bark is in the cambium layer, with the medullary rays running horizontally across the bark (Figure 5).

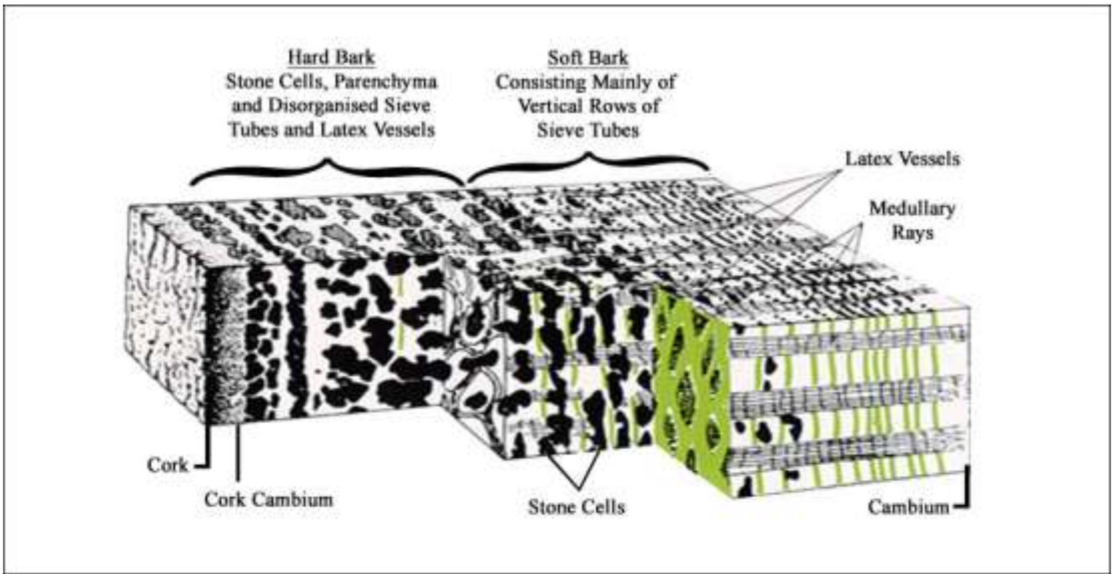


Figure 5 Three-dimensional cross-section of the bark of rubber tree
Source: Riches, J., *et al.*, (1952)

Tapping necessitates ability, that could be attained via relentless rehearsal. The competence of the tapper could inspiration the production gotten. like quantity of latex vessels rings are better in the direction of the inside, cutting need to be deep standard technique to cut as some latex vessels as enable (Table 8). Nevertheless, to circumvent communicating the cambium,1mm of bark would be left uncut. It'll possible quickly renewal of bark (Figure 6). enough tapping depth could let 3 times the quantity of productions associated to low dept of tapping. In contrast, too dept tapping consequence in less dry rubber content (DRC) of latex, as the consequential latex becomes mixed up with water from the cambium layer. Too tapping deep also destroyed the cambium and this consequence in injuries, and irregular renewed bark, execution cutting problematic later on. If cutting has been finished fine, the renewed bark is smooth and would be thick adequate for cutting in six years' time (Ahmad, T., 2009).

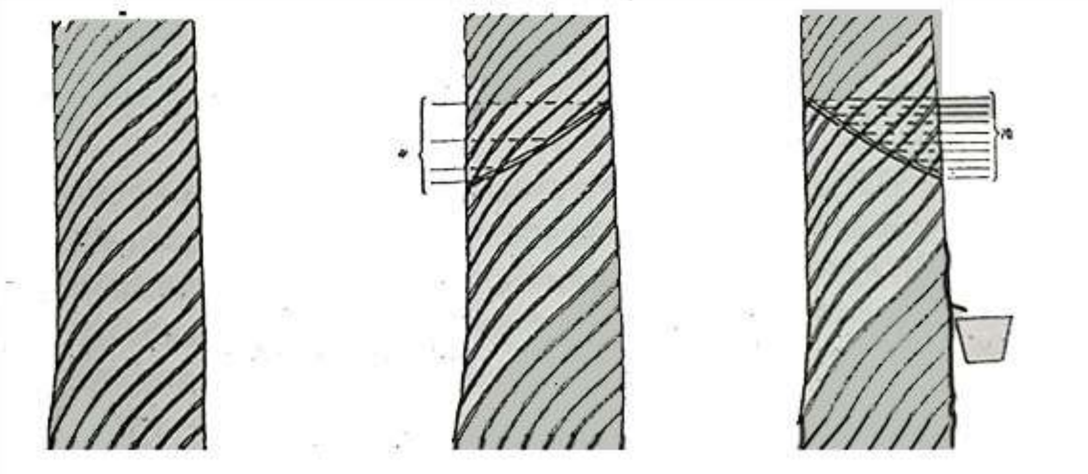
Table 8 Rings of latex vessels severed by deep of tapping

Depth of tapping (mm from cambium)	Number of latex vessel rings severed
2.0	38
1.5	48
1.0	62
0.5	80

Source: Ahmad, T., (2009)

2.8.8 Direction and slope of tapping cut

Latex flows throughout latex tubes identify in the bark of the rubber plant. Latex tubes lane spirally starts from low left to high right at an inclination of 3.7-5^0 from the vertical. Latex would be flow out of the peel, one if the latex tubes are cut or detached. The many latex tubes are detached, the further will be the flow of resin. Consequently, the cut of tapping is starting in the conflicting direction of the latex tubes, it's, from high left to low right (Figure 7)



1) Position of latex vessels in the bark

2) Wrong direction of tapping cut

3) Recommended direction of tapping cut

Figure 6 Direction and slope of tapping cut
Source: Latex harvesting mrdp.da.gov.ph

The slope of the tapping cut is cause like an angle which stretches maximum productions with minimum bark cutting out and a quick flow of resin lengthways the cut of tapping into the resin plate. The tapping cut angle of the slope effects the distance and bark consumption. that in turn is connected to productions. Fundamentally, a growth the angle of slope of tapping cut stretch advanced productions. Depend on researches, for clonal resources, the slope of tapping suggested at an angle of 30^0, while for the clonal seedings at 25^0 from the horizontal (Figure 8). It means that the slope of cut for clonal resources is 5^0 much more than the clonal seedings. The bark of the clonal resources is commonly thinner due to fewer corky layers but comprises additional latex tubes. Its growth slope is to allow the latex to flow quickly lengthways the tapping cut, hence circumventing run-off over the stem. Instead, the bark of the seeding plant is thick. The 25^0 slope is consequently enough to causes an effectual flow of its latex along the tapping cut (Ahmad, T., 2009).

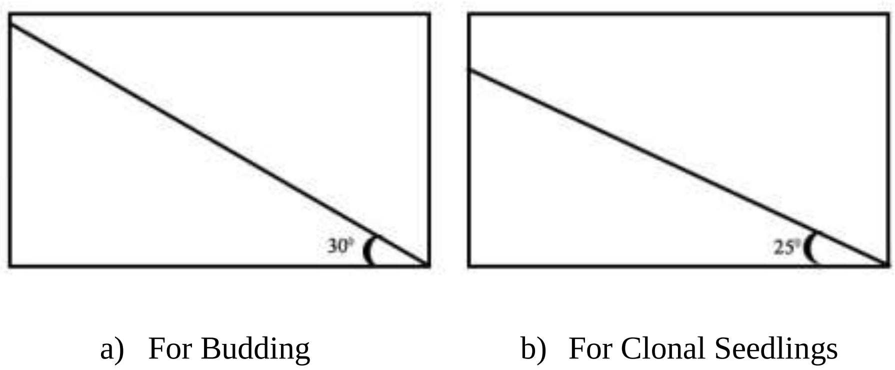


Figure 7 Angle of tapping cut

Source: Latex harvesting mrdp.da.gov.ph

2.8.9 Task size

Task size is the number of the trees in a task given to a tapper to complete tapping at a specified time. The number is based on the several factors such as girth size, density per hectare, tapping system and the topography of the area. Basically, when tapping alternate daily, at haft spiral, a tapper is given 500-600 trees per day of tapping task (Ahmad, T., 2009).

A comparison of tapping tasks ranging from 300 to 600 trees has shown that a marked increase in yield per tapper can be obtained with increased task size but that this is accompanied by some loss in yield per acre. The percentage of lower grades decreased slightly with increased task size. The standard of tapping was not affected in the larger tasks despite some increase in the speed of tapping. The speed of collection per tree remained unchanged for different task sizes (Jonge, P., *et al.,* 1962).

2.8.10 Tapping and collection

Good tapping and collection procedure are essential to obtain maximum yield. In addition, cleanliness is also important in obtaining clean raw materials and finally high-quality finished products. Collection of Latex, Natural rubber (NR) latex, containing principally of *cis*-1,4 polyisoprene, has been extensively used in the form of thin film in many programs such as balloon, glove and tubing (Tangboriboonrat, P., *et at.*, 2006). Generally, latex is only collected when it stops dripping. This may take two three hours, depending on various factors. Collection commences when the first few tapped tree cease dripping. During collection, the latex is completely scooped out of the cup and poured into the collecting bucket. The cup is then replaced on the hanger in the inverted position, unless late drip anticipated. Collection is continued until latex from all tapped trees in the task is collected latex is immediately sent to the collecting center of factory for processing (Figure 9). In tapping and collection, cleanliness must always be practiced to avoid contamination of the latex. This can be achieved by ensuring that all pieces of equipment (Ahmad, T., 2009).

Figure 8 Latex collection by tapper in Memot rubber plantation Co., Ltd

Source: Memot rubber plantation Co., Ltd

CHAPTER III
Materials and Methods

3.1 Location and experimental design

The procedures in this study will be 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.

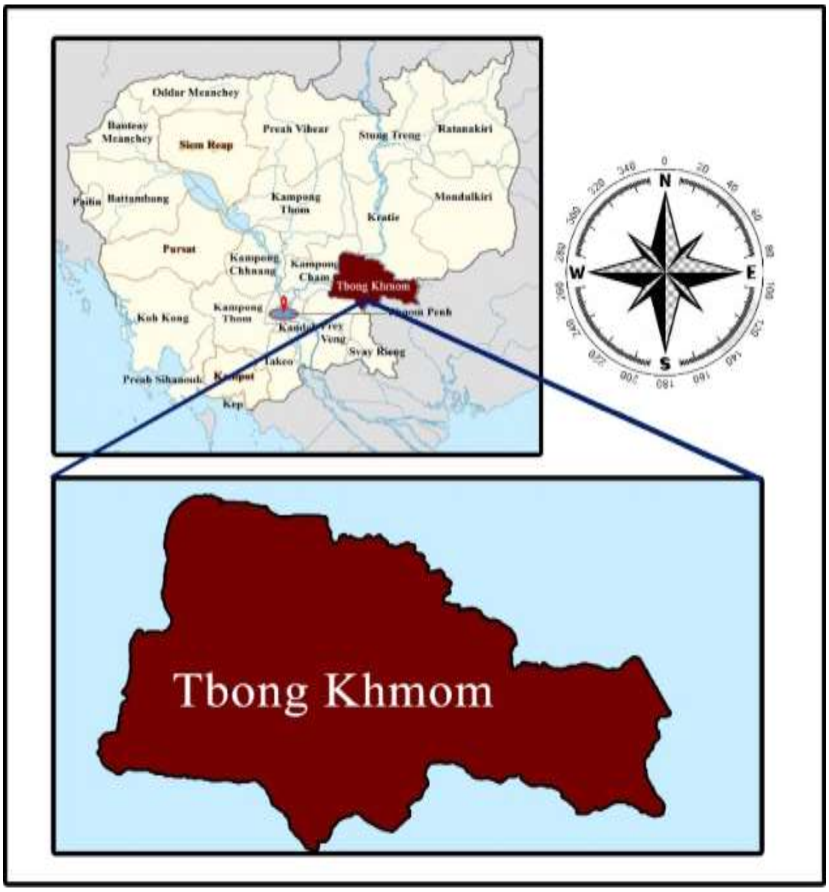


Figure 9 Map of Memot Rubber Plantation Co.,Ltd in Tboung Khmum province, Cambodia

The study will be conducted from March 20 to June 20, 2018. There are four stages to collecting sampling: 1) Purposive sampling is use to choose the cultivated plots, there are 13 plots with the clone GT1, RRIM 600 and growing year 2008. 2) Sample size is use to determine the sample size, a total of 140 tappers or 140 tasks will be selected from among of 216 tappers to observe by Taro Yamane formula as following : (Yamane, 1967) $n = \frac{N}{1+N(e)^2}$, 3) Stratified sampling is use to choose the number of tappers sample from the total plot by

Judith Zweers formula, (2002) $\mathrm{ni} = \frac{(n)Ni}{N}$ (Table 10). 4) Simple random sampling use to select the tappers that have to observe among of the total tappers in the plots.

Table 9 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 10 Tappers sampling in each plot

Plots	Number of total tappers (N_i)			Percentages (%)	Observation Sample (n_i)
	Tappers	Area (ha)	Clones		
12.7A	29	29	GT1	13	19
12.7B	22	22	RRIM600	10	14
12.7C	15	15	RRIM600	7	10
12.7D	29	29	GT1	13	19
12.6B	18	18	RRIM600	9	11
12.6C	18	18	RRIM600	9	11
11.6B	16	16	RRIM600	7	10
11.6C	15	15	RRIM600	7	10
15.7C	7	7	RRIM600	3	5
14.7B	12	12	RRIM600	6	8
14.7C	15	15	RRIM600	7	10
14.7D	11	11	RRIM600	5	7
14.6C	9	9	RRIM600	4	6
Total	216 tappers			100	140 Tappers

3.2 Data collection, analysis and hypothesis

The purpose of interviewing to get more detail information about tapper's tapping technology quality that they're practicing, by using questions with multiple choice answers and inspect the tapping technology quality each task in plots have been determined by inspecting the errors of tapping technology quality, one task ratio with the length cut (S/2) will be inspected six trees per tapping task. These are the parameters of the errors tapping technology that will be 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, j) Skip of latex harvesting (Table 11).

Data analysis and assessment the tapping technologies quality, the data obtained will be inserted into Microsoft Excel software to calculate.

(1) to assess the tapper's rubber tapping technologies quality after note on the controlling table (Table 11) then extract the number of tasks that were errors putting in each error column in the table (Table 11) to calculate the total rate of value phase.

Table 11 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 (48mm)**	**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	1	2
% x Coefficient	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Ministry of Agriculture, Forestry and Forestry (MAFF, 2001)

Calculating: (Line 1) is 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) is an error rate of task number from inspecting, will be calculates to percentage of the total task number. (Line 3) is a coefficient of errors types. (Line 4) is a multiply product between data of line 2 and 3. The percentage of over bark consumption will be calculated by formula below:

$$\text{Percentage of over tapping } \frac{\text{Number of all over tapping } \times 100}{\text{Number of control tapping task } \times \text{Number of tapping}}$$

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

Value phase $= \frac{2200-(3\times[\text{Sum}(\%\times\text{Coefficient})]\times 100}{2200}$, then presuming the observation base on each error parameters from the table, finally assessment the totally by putting grade (Table 12).

Table 12 Rate of value phase table

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

Source: Ministry of Agriculture, Forestry and Forestry (MAFF, 2001)

Note: ***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 will be inserted in Statistical Program in social science to analysis the relationship between other factors with grad of rubber tapping technology quality then will be analyzed by binary logistic regression (Table 13 and 14).

Table 13 Describing other factors with tapping technology quality

Independent variable	Descriptions
(X_1) Gender	(0) Female, (1) Male
(X_2) Age	Year
(X_3) Experience	Year
(X_4) Honing of tapping knives	Number of times
(X_5) Education level	(0) No, (1) primary, (2) Secondary, (3) High school
(X_6) Yield	Gram/t
(X_7) Training	(0) No, (1) yes
(X_8) Bark consumption	Number of tapping
Dependent variable	**Description**
(Y) Tapping technologies quality	(0) Poor, (1) 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 14 Describing other factors with bark consumption

Independent variable	Descriptions
(X_1) Gender	(0) Female, (1) Male
(X_2) Age	Year
(x_3) Experience	Year
(X_4) Honing of tapping knives	Number of times
(X_5) Education level	(0) No, (1) primary, (2) Secondary, (3) High school
(X_6) Yield	Gram/t
(X_7) Training	(0) No, (1) yes
(X_8) Tapping technologies quality	(0) Poor, (1) Fairly
Dependent variable	**Description**
(Y) Bark consumption	(0) Non-over, (1) Over

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

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

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)

(2) The study of relationship between rubber bark consumption and latex yield will be analyzed by linear regression. Latex yield will be calculated from each tree by weighing the latex cup lump and tree lace expressed kg/tree and g/tree/tapping (Cup lump is the recently rubber latex coagulated in the cup that trapped with the rubber tree and not involved with the processing and Tree lace is strip of dried rubber formed on the tapping panel of the rubber tree after latex collection. Bark consumption (cm) will be measured on the tapped panel from the beginning to the end of the tapping period (Jacob, J.L *et al.,* 1989).

For the options above the null and alternative hypotheses are given below:

$H_{0.2}$ = There are no relationship between bark consumption and latex yield

$H_{1.2}$ = There are relationship with bark consumption between and latex yield

CHAPTER IV
Results and Discussion

4.1 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 had prepared and analyzed as follows:

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 is 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 was 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 was 17 percent and Christian was 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 didn’t have tapping experience about12 percent. Result shown that 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 from the tapping of rubber hence, the attending on training of rubber tapping technique course was very important for tapping implementation. According to 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 shown 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 given by the office of the company. Due to the inspection from the rubber plantation, shown that amount of the total tappers approximately 92 percent of over bark consumption and around 8 percent was correct calibration bark consumption. Results showed that most of the tappers were over bark consumption. This 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 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 yields 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. Therefore, 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 follow as very good, good, fairly good, fairly, and poor grade approximately 13, 4, 18, 22, and 43 percent, respectively (Figure 1). 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 from inspection of rubber tapping quality are shown that most of tappers were in poor and fairly grade that the company must to improve the tapping training and restriction the tapping control to tappers to correct tapping method. 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.

Table 15 Social characteristics of rubber tappers

N= 140

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)		

Table 15 (Continued)

Items	Numbers	Percentages%
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	-	-
Rubber tapping and yield		
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 quality of tappers		
Very good	18	13
Good	5	4
Fairly good	25	18

Table 15 (Continued)

Fairly	31	22
Poor	61	44

Figure 10 The overall of tapping technology quality of rubber tappers

4.1.1 The Relationship Between Eights Factors with Rubber Tapping Technology Quality

The study relationship between eights factors with rubber tapping technology quality of the tappers (y) the options 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 16 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 difference at 0.000 ($P \leq 0.05$) 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 17 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 eights factors there was bark consumption(X_8) had relationship with rubber tapping technology quality (y) significant difference at ($P \leq 0.05$).

The logistic regression equation of eights factors relationship between eights factors with rubber tapping technology quality as follows:

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

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

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

- $H_{1.2}$ = There is a significant difference bark consumption (X_8) factor relationship with tapping technology quality (y)

Table 18 Omnibus tests of relationship between bark consumption (X_8) factors with tapping quality (y)

	Chi-square	Df	Sig.
Model	131.276	1	0.000

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

Table 19 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 bark consumption (X_8) with tapping technology quality are follows:

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

4.1.2 The Relationship Between Eights Factors with Rubber Bark Consumption

The study relationship between eights factors with rubber bark consumption (y) 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 20 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 difference at 0.000 ($P \leq 0.05$) 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 21 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 eights factors showed that Horning of tapping knives (X_4), Training (X_7), Tapping quality (X_8) had relationship with rubber bark consumption (y) significant difference at ($P \leq 0.05$) and others factors such as Gender (X_1), Age (X_2), Experience (X_3), Education level (X_5) and Yield (X_6) did not relationship with bark consumption significant difference at ($P > 0.05$). The logistic regression equation of relationship between eights factors with rubber bark consumption (y) as bellow:

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

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

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

- $H_{1.2}$ = There is a significant difference horning of tapping knives (X_4) factor relationship with rubber bark consumption (y)

Table 22 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 difference at 0.055 ($P>0.05$) thus hypothesis ($H_{1.2}$) had been accepted there was not significant difference horning of tapping knives factors relationship with rubber bark consumption.

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

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

- $H_{1.3}$ = There is a significant difference training (X_7) factor relationship with rubber bark consumption (y)

Table 23 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 difference at 0.223 was higher than 0.05 ($P>0.05$) thus hypothesis ($H_{1.3}$) had been accepted there was not a significant difference training factors relationship with rubber bark consumption(y).

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

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

- $H_{1.4}$ = There is a significant difference tapping quality (X_8) factor relationship with bark consumption (y)

Table 24 Omnibus tests of relationship between tapping quality (X_8) factors with bark consumption (y)

	Chi-square	Df	Sig.
Model	44.303	1	0.000

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

Table 25 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 tapping quality (X_8) with rubber bark consumption is follows:

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

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

Table 26 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 difference at 0.000 ($P \leq 0.05$) thus the independent factors had relationship with dependent factor.

Table 27 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	0.104	4.332	1	0.037	1.242
(X_7) Training	1.086	0.500	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 horning tapping knives (X_4), training (X_7), tapping quality (X_8) had relationship with dependent factor bark consumption (y) significant difference ($P \leq 0.05$).

Table 28 Comparing of -2 Log likelihood value

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

According to the comparing of -2 Log likelihood value showed that three independent models such as horning tapping knives (X_4), training (X_7), tapping quality (X_8) were correct models because of the -2 Log likelihood value was less than (109.757) than others.

Thus, the logistic regression equation of the relationship between three factors with bark consumption (y) as follows:

Log(y) = 1.282 + 0.216 horning tapping knives (X_4) + 1.086 training (X_7) - 4.258 tapping quality (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 increases one time and other factors are not fluctuation induce the bark consumption decrease 1.242 times. If training increases one time and other factors are not fluctuation induce the bark consumption decrease 2.961 times. If tapping quality increases one time and other factors are not fluctuation induce the bark consumption decrease 0.014 times.

All the equation above showed that three factors had relationship with rubber bark consumption. 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, S., *et al.*, 2010).

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, S., *et al*., 2010). The poor tapping was the most critical factor to make very low latex yields in the Philippines is recorded (Alcala, C., *et al.*, 2005).

4.2 The relationship between rubber bark consumption and latex yield

Table 29 Relationship between rubber bark consumption and latex yield

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta		
(Constant)	25.072	3.237		7.745	0.000
(X_8) Bark consumption	-1.630	0.810	-0.169	-2.012	0.046

According to table 29 showed that the significant difference at 0.046 ($P \leq 0.05$) the over bark consumption had relationship with latex yields. Equation as follows:

Y = 25.072 - 1.630 over tapping knives

The equation showed that if over tapping knives increase per unit hence obtained of latex yields decrease 1.630 times.

Thus, the company manager should consider and concentrate on standard of bark consumption while the implementation tapping.

CHAPTER V
Conclusions

The study showed that the amount of the total of rubber tappers 140 tasks the tapping technology quality were very good, good, fairly good, fairly, and poor grade approximately 13%, 4%, 18%, 22%, and 43%, respectively. 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 rubber bark consumption (X_8) factor with rubber tapping technology quality significant difference at 0.000 ($P \leq 0.05$). 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 horning of tapping knives (X_4), training (X_7), tapping quality (X_8) factors with rubber bark consumption (y) significant difference ($P \leq 0.05$). 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 relationship between rubber bark consumption and latex yield showed that the significant difference at 0.046 ($P \leq 0.05$) the over bark consumption had relationship with latex yields. The equation showed that if over tapping knives increase per unit hence obtained of latex yields decrease 1.630 times. Further study, the rubber smallholders and company owners should pay attention and consider the correct tapping method as the most importance technique to increase latex yields and life span of the rubber trees.

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Appendixes

Table 30 Yields of rubber by each task in gram of dry rubber per tree (g/t)

Number of tapping tasks	Total latex	Total cup lump	Average DRC of cup lump	Average DRC of latex	Total yields (kg/3months)	Total yields in gram	Yields (g/t/t)	Clones	Area (ha)
1	647	89	50.6	198.7	249.3	249325.8	17	GT1	1
2	533	89	50.6	163.7	214.3	214316.4	14	GT1	1
3	765	123	70.0	234.9	304.9	304906.2	20	GT1	1
4	615	107	60.9	188.9	249.7	249738.8	17	GT1	1
5	777	115	65.4	238.6	304.0	304040.2	20	GT1	1
6	541	115	65.4	166.1	231.6	231564.6	15	GT1	1
7	751	127	72.3	230.6	302.9	302882.4	20	GT1	1
8	489	128	72.8	150.2	223.0	222991.1	15	GT1	1
9	552	113	64.3	169.5	233.8	233804.9	16	GT1	1
10	527	111	63.1	161.8	225.0	224989.6	15	GT1	1
11	783	112	63.7	240.5	304.2	304176.1	20	GT1	1
12	492	98	55.8	151.1	206.8	206845.4	14	GT1	1
13	784	121	68.8	240.8	309.6	309603.3	21	GT1	1
14	586	105	59.7	180.0	239.7	239695.1	16	GT1	1
15	819	113	64.3	251.5	315.8	315800.6	21	GT1	1
16	792	106	60.3	243.2	303.5	303526.6	20	GT1	1
17	548	113	64.3	168.3	232.6	232576.5	16	GT1	1
18	774	121	68.8	237.7	306.5	306532.3	20	GT1	1
19	539	117	66.6	165.5	232.1	232088.2	15	GT1	1
20	538	119	67.7	165.2	232.9	232918.9	16	RRIM600	1
21	786	122	69.4	241.4	310.8	310786.4	21	RRIM600	1
22	510	118	67.1	156.6	223.8	223751.2	15	RRIM600	1
23	749	129	73.4	230.0	303.4	303406.0	20	RRIM600	1
24	490	102	58.0	150.5	208.5	208506.8	14	RRIM600	1
25	438	102	58.0	134.5	192.5	192537.6	13	RRIM600	1
26	478	114	64.9	146.8	211.6	211648.4	14	RRIM600	1
27	505	115	65.4	155.1	220.5	220509.0	15	RRIM600	1
28	726	143	81.4	223.0	304.3	304307.3	20	RRIM600	1
29	490	119	67.7	150.5	218.2	218178.1	15	RRIM600	1
30	755	133	75.7	231.9	307.5	307524.2	21	RRIM600	1
31	469	130	74.0	144.0	218.0	217986.9	15	RRIM600	1
32	466	136	77.4	143.1	220.5	220479.0	15	RRIM600	1
33	398	147	83.6	122.2	205.9	205854.1	14	RRIM600	1
34	395	126	71.7	121.3	193.0	192985.9	13	RRIM600	1

Table 30 (Continued)

35	730	140	79.6	224.2	303.8	303829.0	20	RRIM600	1
36	443	146	83.1	136.0	219.1	219104.7	15	RRIM600	1
37	473	124	70.5	145.3	215.8	215801.9	14	RRIM600	1
38	417	138	78.5	128.1	206.6	206568.9	14	RRIM600	1
39	447	123	70.0	137.3	207.2	207248.4	14	RRIM600	1
40	503	120	68.3	154.5	222.7	222739.3	15	RRIM600	1
41	713	162	92.2	219.0	311.1	311124.1	21	RRIM600	1
42	690	165	93.9	211.9	305.8	305767.5	20	RRIM600	1
43	463	156	88.7	142.2	230.9	230935.7	15	RRIM600	1
44	497	163	92.7	152.6	245.4	245359.4	16	GT1	1
45	735	152	86.5	225.7	312.2	312191.3	21	GT1	1
46	452	154	87.6	138.8	226.4	226419.8	15	GT1	1
47	427	158	89.9	131.1	221.0	221017.9	15	GT1	1
48	457	166	94.4	140.3	234.8	234782.1	16	GT1	1
49	682	169	96.1	209.4	305.6	305586.3	20	GT1	1
50	531	144	81.9	163.1	245.0	244991.7	16	GT1	1
51	538	151	85.9	165.2	251.1	251123.7	17	GT1	1
52	520	137	77.9	159.7	237.6	237631.3	16	GT1	1
53	716	149	84.8	219.9	304.6	304649.7	20	GT1	1
54	535	120	68.3	164.3	232.6	232566.5	16	GT1	1
55	535	121	68.8	164.3	233.1	233135.4	16	GT1	1
56	504	113	64.3	154.8	219.1	219064.1	15	GT1	1
57	714	155	88.2	219.3	307.4	307448.9	20	GT1	1
58	316	89	50.6	97.0	147.7	147675.7	10	GT1	1
59	469	114	64.9	144.0	208.9	208884.5	14	GT1	1
60	503	123	70.0	154.5	224.4	224446.0	15	GT1	1
61	738	145	82.5	226.6	309.1	309130.3	21	GT1	1
62	717	147	83.6	220.2	303.8	303819.0	20	GT1	1
63	728	145	82.5	223.6	306.1	306059.3	20	RRIM600	1
64	541	123	70.0	166.1	236.1	236115.8	16	RRIM600	1
65	564	117	66.6	173.2	239.8	239765.7	16	RRIM600	1
66	571	114	64.9	175.4	240.2	240208.7	16	RRIM600	1
67	718	156	88.7	220.5	309.2	309246.2	21	RRIM600	1
68	600	116	66.0	184.3	250.3	250252.4	17	RRIM600	1
69	746	146	83.1	229.1	312.2	312156.0	21	RRIM600	1
70	554	124	70.5	170.1	240.7	240677.0	16	RRIM600	1
71	718	155	88.2	220.5	308.7	308677.3	21	RRIM600	1
72	686	162	92.2	210.7	302.8	302832.4	20	RRIM600	1
73	721	152	86.5	221.4	307.9	307891.9	21	RRIM600	1
74	478	124	70.5	146.8	217.3	217337.4	14	RRIM600	1

Table 30 (Continued)

75	509	114	64.9	156.3	221.2	221168.5	15	RRIM600	1
76	751	140	79.6	230.6	310.3	310278.1	21	RRIM600	1
77	491	118	67.1	150.8	217.9	217916.3	15	RRIM600	1
78	494	105	59.7	151.7	211.4	211441.9	14	RRIM600	1
79	544	106	60.3	167.1	227.4	227365.8	15	RRIM600	1
80	736	136	77.4	226.0	303.4	303396.0	20	RRIM600	1
81	761	146	83.1	233.7	316.8	316762.5	21	RRIM600	1
82	554	132	75.1	170.1	245.2	245228.2	16	RRIM600	1
83	512	128	72.8	157.2	230.1	230054.4	15	RRIM600	1
84	363	123	70.0	111.5	181.5	181452.0	12	RRIM600	1
85	252	121	68.8	77.4	146.2	146226.1	10	RRIM600	1
86	374	129	73.4	114.9	188.2	188243.5	13	RRIM600	1
87	294	96	54.6	90.3	144.9	144901.8	10	RRIM600	1
88	406	124	70.5	124.7	195.2	195226.2	13	RRIM600	1
89	750	138	78.5	230.3	308.8	308833.2	21	RRIM600	1
90	765	129	73.4	234.9	308.3	308319.6	21	RRIM600	1
91	377	118	67.1	115.8	182.9	182906.9	12	RRIM600	1
92	471	121	68.8	144.6	213.5	213481.0	14	RRIM600	1
93	539	133	75.7	165.5	241.2	241190.6	16	RRIM600	1
94	747	141	80.2	229.4	309.6	309618.6	21	RRIM600	1
95	740	142	80.8	227.3	308.0	308037.8	21	RRIM600	1
96	556	125	71.1	170.7	241.9	241860.1	16	RRIM600	1
97	729	140	79.6	223.9	303.5	303521.9	20	RRIM600	1
98	482	117	66.6	148.0	214.6	214583.5	14	RRIM600	1
99	403	110	62.6	123.8	186.3	186340.3	12	RRIM600	1
100	743	132	75.1	228.2	303.3	303270.1	20	RRIM600	1
101	448	99	56.3	137.6	193.9	193901.9	13	RRIM600	1
102	448	111	63.1	137.6	200.7	200728.7	13	RRIM600	1
103	769	126	71.7	236.2	307.8	307841.3	21	RRIM600	1
104	515	100	56.9	158.2	215.0	215046.5	14	RRIM600	1
105	426	99	56.3	130.8	187.1	187145.7	12	RRIM600	1
106	767	125	71.1	235.5	306.7	306658.2	20	RRIM600	1
107	759	131	74.5	233.1	307.6	307614.8	21	RRIM600	1
108	419	99	56.3	128.7	185.0	184996.0	12	RRIM600	1
109	473	94	53.5	145.3	198.7	198734.9	13	RRIM600	1
110	860	103	58.6	264.1	322.7	322702.7	22	RRIM600	1
111	845	101	57.5	259.5	317.0	316958.4	21	RRIM600	1
112	723	107	60.9	222.0	282.9	282905.6	19	RRIM600	1
113	669	111	63.1	205.4	268.6	268597.8	18	RRIM600	1
114	816	135	76.8	250.6	327.4	327395.1	22	RRIM600	1

Table 30 (Continued)

115	679	107	60.9	208.5	269.4	269393.2	18	RRIM600	1
116	818	113	64.3	251.2	315.5	315493.5	21	RRIM600	1
117	662	94	53.5	203.3	256.8	256776.8	17	RRIM600	1
118	840	95	54.0	258.0	312.0	312009.5	21	RRIM600	1
119	700	103	58.6	215.0	273.6	273566.7	18	RRIM600	1
120	803	108	61.4	246.6	308.0	308042.5	21	RRIM600	1
121	673	102	58.0	206.7	264.7	264706.1	18	RRIM600	1
122	891	101	57.5	273.6	331.1	331085.0	22	RRIM600	1
123	689	105	59.7	211.6	271.3	271326.4	18	RRIM600	1
124	844	114	64.9	259.2	324.0	324047.0	22	RRIM600	1
125	816	119	67.7	250.6	318.3	318292.7	21	RRIM600	1
126	659	110	62.6	202.4	265.0	264957.9	18	RRIM600	1
127	862	114	64.9	264.7	329.6	329574.8	22	RRIM600	1
128	836	127	72.3	256.7	329.0	328985.9	22	RRIM600	1
129	727	107	60.9	223.3	284.1	284134.0	19	RRIM600	1
130	834	131	74.5	256.1	330.6	330647.3	22	RRIM600	1
131	529	96	54.6	162.5	217.1	217070.3	14	RRIM600	1
132	531	98	55.8	163.1	218.8	218822.3	15	RRIM600	1
133	521	100	56.9	160.0	216.9	216889.1	14	RRIM600	1
134	529	98	55.8	162.5	218.2	218208.1	15	RRIM600	1
135	774	117	66.6	237.7	304.3	304256.7	20	RRIM600	1
136	536	93	52.9	164.6	217.5	217513.3	15	RRIM600	1
137	520	104	59.2	159.7	218.9	218857.6	15	RRIM600	1
138	781	116	66.0	239.8	305.8	305837.5	20	RRIM600	1
139	773	119	67.7	237.4	305.1	305087.4	20	RRIM600	1
140	551	99	56.3	169.2	225.5	225533.2	15	RRIM600	1

QUESTIONNAIRES TO INTERVIEW WITH TAPPERS

Name: ……………..……………………address……………………………………......

Village:…………………Commune……………………District……………………....
Province:…………………………………………………Code:………………..……..
Date:………………………………………………Respondent:…………....…….

I. Social Characteristics

1. Sex
   1. ( ) Male
   2. ( ) Female

2. Age_________ year

3. Education experience (ordinal scale)
   1. ( ) None
   2. ( ) Primary School (Six years)
   3. ( ) Secondary School (Nine year)
   4. ( ) High School (twelve year)
   5. ( ) More than high school.

   Describe..

   Or (inform of interval scale)

   Educational Experience _________years (From start)

4. Status
   1. ( ) Married
   2. ( ) Single
   3. ( ) Divorced
   4. ( ) Widow

5. Number of family members
   1. Family agriculture labor........... persons, Female...........persons, Male..........persons

6. Religion
   1. ( ) Buddhism
   2. ( ) Muslim

3. (   ) Christian

7. Occupation experience

1. Tapping experience ____________years

2. Experience in agriculture ____________years

8. When do you working with this rubber company?___________Years

9. Have you attended the training course about rubber tapping by this company?

1. (   ) Yes

2. (   ) No

(if yes) how many times do you attend___________time/ year

II. Economic Characteristics

10. Total income ___________ baht/ month
11. Total expenditure ___________ baht/ month
12. Net income ___________ baht/ month
13. Income from rubber tapping _____________bath/month

13.1 Trading ________bath/month
13.2. Animal _______bath/month
13.3. Others (Descript)
1)______________bath/month or bath/year
2)______________bath/month or bath/year
3)______________bath/month or bath/year
4)______________bath/month or bath/year

III. Tapping Technology
14. Age of the rubber __________years
15. How long have you tapping?
1. (   ) years
16. How long from the ground do you open tapping cut?
1. (   ) Meters
17. What is tapping system do you use?
1. ____
2. ____
18. Bark consumption__________centimeters/month
19. Do you ever horn your tapping knives?
1. (   ) Yes
2. (   ) No

(if yes) how many times___________times/ month

20. Tapping qualities of tapper
1. (   ) Very good
2. (   ) Good
3. (   ) Fairly good
4. (   ) Fair
5. (   ) Poor

21. Tapping capacity (ability) per day
1. Number of tapping trees per day ___________ trees
2. Number of tapping hours per day__________ hours

Table 31 Rubber tapping plot 12.7A

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 (48mm)	Value Phase	Grad of tapping
	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)										
1	2	0	0	0	0	0	1	0	0	0	0	0	6	54	Poor
2	3	0	0	0	0	0	0	0	0	0	0	0	6	54	Poor
3	0	0	0	0	0	0	0	0	0	0	0	0	4	96	Very good
4	1	0	0	0	0	1	0	0	0	0	0	0	7	66	Poor
5	1	0	0	0	0	0	0	0	0	0	0	0	0	86	Good
6	0	0	0	0	0	0	0	0	0	0	0	0	3	97	Very good
7	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
8	0	0	0	0	0	0	1	0	0	0	0	0	3	84	fairly good
9	0	0	1	0	0	0	0	0	0	0	0	0	4	55	Poor
10	2	0	0	0	0	0	0	0	0	0	0	0	6	67	Poor
11	1	0	0	0	0	0	0	0	0	0	0	0	3	84	fairly good
12	0	1	0	0	0	0	0	0	0	0	0	0	5	68	Poor
13	1	0	0	0	0	0	0	0	0	0	0	0	0	86	Good
14	2	0	0	0	0	0	0	0	0	0	0	0	7	66	Poor
15	1	1	0	0	0	1	0	0	0	0	0	0	5	41	Poor
16	0	0	0	2	0	0	0	0	0	0	0	0	6	67	Poor
17	0	0	0	0	0	0	0	0	0	0	0	0	2	98	Very good
18	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
19	0	0	0	0	0	1	0	0	0	0	0	0	3	84	fairly good

Table 31 (Continued)

Total	Rate	Coefficient	% x Coefficient
14	73.68	1	73.68
4	21.05	2	42.11
1	5.26	3	15.79
2	10.53	1	10.53
0	0.00	2	0.00
3	15.79	1	15.79
2	10.53	1	10.53
0	0.00	1	0.00
0	0.00	1	0.00
0	0.00	2	0.00
0	0.00	1	0.00
0	0.00	3	0.00
70	12.28	2	24.56
			192.98
			73.68

Table 32 Rubber Tapping plot 12.7B

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 (48mm)**	**Value Phase**	**Grad of tapping**
	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)										
1	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
2	1	0	0	0	0	0	0	0	0	0	0	0	3	84	fairly good
3	2	0	0	0	0	0	0	0	0	0	0	0	6	67	Poor
4	0	0	0	1	0	0	0	0	0	0	0	0	5	82	fairly good
5	1	0	0	1	0	0	0	0	0	0	0	0	7	66	Poor
6	2	0	0	0	0	0	0	0	0	0	0	0	6	67	Poor

Table 32 (Continued)

7	0	0	0	0	0	0	0	0	0	0	0	0	3	97	Very good
8	1	0	0	0	0	0	0	0	0	0	0	0	3	84	fairly good
9	2	0	0	0	0	0	0	0	0	0	0	0	5	68	Poor
10	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly good
11	0	1	0	0	0	0	1	0	0	0	0	0	5	55	Poor
12	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
13	2	0	0	0	0	0	0	0	0	0	0	0	6	67	Poor
14	0	0	0	0	0	1	0	0	0	0	0	0	3	84	fairly good
Total	11	4	0	2	0	1	1	0	0	0	0	0	52		
Rate	78.57	28.57	0.00	14.29	0.00	7.14	7.14	0.00	0.00	0.00	0.00	0.00	12.38		
Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2		
% x Coefficient	78.57	57.14	0.00	14.29	0.00	7.14	7.14	0.00	0.00	0.00	0.00	0.00	24.76		189.05
															74.22

Table 33 Rubber Tapping plot 12.7C

Description	Parameters to be controlled													Value Phase	Grad of tapping
	Wound of panel tapping cut			Shortage of tapping depth		less longer tapping cut (S/2)	Slope of tapping cut	Cleanliness	Sequence of tapping	Movement of tapping walk and rubber collection	Skip of latex harvesting	Skip of tapping tree	Over bark consumption (48 mm)		
	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)										
1	1	0	0	0	0	1	0	0	0	0	0	0	7	66	Poor
2	2	0	0	0	0	0	0	0	0	0	0	0	6	67	Poor
3	1	0	0	0	0	0	0	0	0	0	0	0	4	83	fairly good
4		1	0	0	0	0	1	0	0	0	0	0	5	55	Poor
5	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
6	1	0	0	0	0	1	0	0	0	0	0	0	6	67	Poor
7	1	0	0	0	0	0	0	0	0	0	0	0	4	83	fairly good
8	0	0	0	0	0	0	0	0	0	0	0	0	3	97	very good
9	2	0	0	0	0	0	0	0	0	0	0	0	5	68	Poor
10	1	0	0	0	0	1	0	0	0	0	0	0	6	67	Poor
Total	9	2	0	0	0	3	1	0	0	0	0	0	46		
Rate	90.00	20.00	0.00	0.00	0.00	30.00	10.00	0.00	0.00	0.00	0.00	0.00	15.33		
Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2		

Table 33 (Continued)

% **x** Coefficient	90.00	40.00	0.00	0.00	0.00	30.00	10.00	0.00	0.00	0.00	0.00	0.00	30.67	200.67
														72.64

Table 34 Rubber Tapping plot 12.7D

Description	Parameters to be controlled: Wound of panel tapping cut			Shortage of tapping depth											
	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)	**less longer tapping cut (S/2)**	**Slope of tapping cut**	**Cleanliness**	**Sequence of tapping**	**Movement of tapping walk and rubber collection**	**Skip of latex harvesting**	**Skip of tapping tree**	**Over bark consumption (48 mm)**	**Value Phase**	**Grad of tapping**
1	1	0	0	0	0	1	0	0	0	0	1	0	6	54	Poor
2	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
3	0	1	0	0	0	1	0	0	0	0	0	0	6	54	Poor
4	0	0	0	0	0	0	0	0	0	0	0	0	2	98	Very good
5	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
6	0	0	0	0	1	0	1	0	0	0	0	0	0	59	Poor
7	1	0	0	0	0	0	0	0	0	0	0	0	4	83	fairly good
8	0	1	0	0	0	0	0	0	0	0	0	0	5	68	Poor
9	1	0	0	0	0	0	0	0	0	0	0	0	3	84	fairly good
10	2	0	0	0	0	0	0	0	0	0	0	0	6	67	Poor
11	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
12	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
13	0	0	1	0	0	0	1	0	0	0	0	0	6	40	Poor
14	1	0	0	0	0	0	0	0	0	0	0	0	3	84	fairly good
15	1	0	0	0	0	1	0	0	0	0	0	0	6	67	Poor
16	0	0	0	0	0	0	0	0	0	0	0	0	2	98	very good

Table 34 (Continued)

17	1	0		1	0	0	0	0	0	0	0	0	5	68	Poor
18	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
19	1	0	0	0	0	0	0	0	0	0	0	0	4	83	fairly good
Total	9	7	1	1	1	3	2	0	0	0	1	0	58		
Rate	47.37	36.84	5.26	5.26	5.26	15.79	10.53	0.00	0.00	0.00	5.26	0.00	10.18		
Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2		
% **x** Coefficient	47.37	73.68	15.79	5.26	10.53	15.79	10.53	0.00	0.00	0.00	5.26	0.00	20.35	204.56	
														72.11	

Table 35 Rubber Tapping plot 12.6B

Description	Parameters to be controlled													**Value Phase**	**Grad of tapping**
	Wound of panel tapping cut			**Shortage of tapping depth**		**less longer tapping cut (S/2)**	**Slope of tapping cut**	**Cleanliness**	**Sequence of tapping**	**Movement of tapping walk and rubber collection**	**Skip of latex harvesting**	**Skip of tapping tree**	**Over bark consumption (48 mm)**		
	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)										
1	0	0	0	0	0	0	0	0	0	0	0	0	3	97	Very good
2	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
3	0	0	0	0	0	0	0	0	0	0	0	0	2	98	Very good
4	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly

Table 35 (Continued)

5	0	0	1	0	0	0	0	0	0	0	0	0	6	54	Poor
6	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
7	1	0	0	1	0	0	1	0	0	0	0	0	6	54	Poor
8	0	0	0	1	0	0	0	0	0	0	0	0	0	86	Good
9	0	0	1	0	0	0	0	0	0	0	0	0	6	54	Poor
10	1	0	0	0	0	0	0	0	0	0	0	0	3	84	Fairly good
11	0	2		0	0	0	0	0	0	0	0	0	5	41	Poor
Total	2	5	2	2	0	0	1	0	0	0	0	0	31		
Rate	18.18	45.45	18.18	18.18	0.00	0.00	9.09	0.00	0.00	0.00	0.00	0.00	9.39		
Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2		
% x Coefficient	18.18	90.91	54.55	18.18	0.00	0.00	9.09	0.00	0.00	0.00	0.00	0.00	18.79		209.70
															71.40

Table 36 Rubber Tapping plot 12.6C

Description	Wound of panel tapping cut: Small (2x5mm)	Wound of panel tapping cut: Medium (3x10mm)	Wound of panel tapping cut: Big (5x10mm)	Shortage of tapping depth: Weak (1,6-2mm)	Shortage of tapping depth: Strong (2mm)	less longer tapping cut (S/2)	Slope of tapping cut	Cleanliness	Sequence of tapping	Movement of tapping walk and rubber collection	Skip of latex harvesting	Skip of tapping tree	Over bark consumption (48mm)	Value Phase	Grad of tapping
	Parameters to be controlled														
1	0	0	1	0	0	0	0	0	0	0	0	0	5	55	Poor
2	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
3	0	0	1	0	0	0	0	0	0	0	0	0	4	55	Poor
4	1	0	0	0	0	0	0	0	0	0	0	0	2	85	Fairly good
5	0	0	0	0	1	0	0	0	0	0	0	0	6	67	Poor
6	0	1	0	0	0	0	0	0	0	0	0	0	5	68	Poor
7	1	0	0	0	0	0	0	0	0	0	0	0	0	86	Good
8	0	0	0	0	0	0	0	0	0	0	0	0	3	97	very good
9	0	1	0	0	0	0	0	0	0	0	0	0	6	67	Poor
10	2	0	0	0	0	0	0	0	0	0	0	0	5	68	Poor
11	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
Total	4	4	2	0	1	0	0	0	0	0	0	0	36		
Rate	36.36	36.36	18.18	0.00	9.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.91		
Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2		
% x Coefficient	36.36	72.73	54.55	0.00	18.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.82	203.64	

Table 36 (Continued)

72.23

Table 37 Rubber Tapping plot 11.6B

Description	Parameters to be controlled: Wound of panel tapping cut			Shortage of tapping depth		less longer tapping cut (S/2)	Slope of tapping cut	Cleanliness	Sequence of tapping	Movement of tapping walk and rubber collection	Skip of latex harvesting	Skip of tapping tree	Over bark consumption (48 mm)	Value Phase	Grad of tapping
	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)										
1	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
2	0	0	0	0	0	0	0	0	0	0	0	0	4	96	Very good
3	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
4	0	0	0	0	0	0	0	0	0	0	0	0	3	97	Very good
5	0	0	0	0	0	0	0	0	0	0	0	0	4	96	Very good
6	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
7	0	0	1	0	0	0	0	1	0	0	0	0	6	40	Poor
8	0	1	0	0	0	0	0	0	0	0	0	0	5	68	Poor
9	1	0	0	0	0	0	0	0	0	0	0	0	3	84	Fairly good
10	0	1	0	0	0	0	0	0	0	0	0	0	5	68	Poor
Total	1	5	1	0	0	0	0	1	0	0	0	0	30		
Rate	10.00	50.00	10.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	10.00		
Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2		

Table 37 (Continued)

% x Coefficient	10.00	100.00	30.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	20.00	170.00
														76.82

Table 38 Rubber Tapping plot 11.6C

Description	Parameters to be controlled													Value Phase	Grad of tapping
	Wound of panel tapping cut			Shortage of tapping depth		less longer tapping cut (S/2)	Slope of tapping cut	Cleanliness	Sequence of tapping	Movement of tapping walk and rubber collection	Skip of latex harvesting	Skip of tapping tree	Over bark consumption (48 mm)		
	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)										
1	1	0	0	0	0	0	0	0	0	0	0	0	2	85	Fairly good
2	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
3	0	1	0	0	0	0	1	0	0	0	0	0	6	54	Poor
4	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
5	0	1	0	0	0	0	0	0	0	0	0	0	5	68	Poor
6	0	0	0	0	0	0	0	0	0	0	0	0	3	97	very good
7	0	1	0	0	0	0	0	0	0	0	0	0	2	71	Poor
8	0	0	0	1	0	0	0	0	0	0	0	0	2	85	Fairly good
9	0	2	0	0	0	0	0	0	0	0	0	0	6	40	Poor
10	0	1	0	0	0	0	0	0	0	0	0	0	5	68	Poor
Total	1	8	0	1	0	0	1	0	0	0	0	0	31		
Rate	10.00	80.00	0.00	10.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	10.33		

Table 38 (Continued)

Description	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)	less longer tapping cut (S/2)	Slope of tapping cut	Cleanliness	Sequence of tapping	Movement of tapping walk and rubber collection	Skip of latex harvesting	Skip of tapping tree	Over bark consumption (48 mm)	Value Phase	Grad of tapping
Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2		
% x Coefficient	10.00	160.00	0.00	10.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	20.67		210.67
															71.27

Table 39 Rubber Tapping plot 15.7C

Description	Parameters to be controlled: Wound of panel tapping cut: Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Shortage of tapping depth: Weak (1,6-2mm)	Strong (2mm)	less longer tapping cut (S/2)	Slope of tapping cut	Cleanliness	Sequence of tapping	Movement of tapping walk and rubber collection	Skip of latex harvesting	Skip of tapping tree	Over bark consumption (48 mm)	Value Phase	Grad of tapping
1	1	0	0	0	0	1	0	0	0	0	0	0	5	68	Poor
2	1	0	0	0	0	0	0	0	0	0	0	0	3	84	Fairly good
3	1	1	0	0	0	0	0	0	0	0	0	0	6	54	Poor
4	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
5	0	0	0	0	0	0	0	0	0	0	0	0	3	97	Very good
Total	3	2	0	0	0	1	0	0	0	0	0	0	17		
Rate	60.00	40.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	11.33		
Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2		

Table 39 (Continued)

% x Coefficient	60.00	80.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	22.67	182.67
														75.09

Table 40 Rubber Tapping plot 14.7B

Description	Parameters to be controlled													Value Phase	Grad of tapping
	Wound of panel tapping cut			Shortage of tapping depth		Less longer tapping cut (S/2)	Slope of tapping cut	Cleanliness	Sequence of tapping	Movement of tapping walk and rubber collection	Skip of latex harvesting	Skip of tapping tree	Over bark consumption (48 mm)		
	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)										
1	0	1	0	0	0	0	0	0	0	0	0	0	0	73	fairly
2	0	1	0	0	0	0	0	0	0	0	0	0	5	68	Poor
3	1	0	0	0	0	0	0	0	0	0	0	0	3	84	Fairly good
4	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
5	2	0	0	0	0	0	0	0	0	0	0	0	4	69	Poor
6	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
7	0	0	0	0	0	1	1	0	0	0	0	0	5	68	Poor
8	2	0	0	0	0	0	0	0	0	0	0	0	6	67	Poor
Total	5	4	0	0	0	1	1	0	0	0	0	0	23		
Rate	62.50	50.00	0.00	0.00	0.00	12.50	12.50	0.00	0.00	0.00	0.00	0.00	9.58		

Table 40 (Continued)

Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2	
% x Coefficient	62.50	100.00	0.00	0.00	0.00	12.50	12.50	0.00	0.00	0.00	0.00	0.00	19.17	206.67
														71.82

Table 41 Rubber Tapping plot 14.7C

Description	Parameters to be controlled													Value Phase	Grad of tapping
	Wound of panel tapping cut			Shortage of tapping depth		less longer tapping cut (S/2)	Slope of tapping cut	Cleanliness	Sequence of tapping	Movement of tapping walk and rubber collection	Skip of latex harvesting	Skip of tapping tree	Over bark consumption (48mm)		
	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)										
1	1	0	0	0	0	0	0	0	0	0	0	0	3	84	Fairly good
2	3	0	0	0	0	0	0	0	0	0	0	0	5	55	Poor
3	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
4	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
5	1	0	0	0	0	0	0	0	0	0	0	0	4	83	Fairly good
6	0	0	1	0	0	0	0	0	0	0	0	0	6	54	Poor
7	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
8	0	0	0	0	0	0	0	0	0	0	0	0	4	96	Very good
9	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
10	1	0	0	0	0	0	0	0	0	0	0	0	3	84	Fairly good
Total	6	4	1	0	0	0	0	0	0	0	0	0	25		

Table 41 (Continued)

Rate	60.00	40.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.33		
Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2		
% x Coefficient	60.00	80.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.67	186.67	
														74.55	

Table 42 Rubber Tapping plot 14.7D

Description	Parameters to be controlled													Value Phase	Grad of tapping
	Wound of panel tapping cut			**Shortage of tapping depth**		**less longer tapping cut (S/2)**	**Slope of tapping cut**	**Cleanliness**	**Sequence of tapping**	**Movement of tapping walk and rubber collection**	**Skip of latex harvesting**	**Skip of tapping tree**	**Over bark consumption (48 mm)**		
	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)										
1	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
2	0	0	0	0	0	0	0	0	0	0	0	0	2	98	Very good
3	1	0	0	1	0	0	1	0	0	0	0	0	5	55	Poor
4	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
5	0	0	1	0	0	0	0	0	0	0	0	0	4	55	Poor
6	1	0	0	0	0	0	0	0	0	0	0	0	0	86	Good
7	1	0	0	0	0	1	0	0	0	0	0	0	5	68	Poor
Total	3	2	1	1	0	1	1	0	0	0	0	0	16		

Table 42 (Continued)

Rate	42.86	28.57	14.29	14.29	0.00	14.29	14.29	0.00	0.00	0.00	0.00	0.00	7.62	
Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2	
% x Coefficient	42.86	57.14	42.86	14.29	0.00	14.29	14.29	0.00	0.00	0.00	0.00	0.00	15.24	200.95
														72.60

Table 43 Rubber Tapping plot 14.6C

	Parameters to be controlled														
	Wound of panel tapping cut			**Shortage of tapping depth**											
Description	Small (2x5mm)	Medium (3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)	**Less longer tapping cut (S/2)**	**Slope of tapping cut**	**Cleanliness**	**Sequence of tapping**	**Movement of tapping walk and rubber collection**	**Skip of latex harvesting**	**Skip of tapping tree**	**Over bark consumption (48 mm)**	**Value Phase**	**Grad of tapping**
1	0	0	0	0	0	0	0	0	0	0	0	0	2	98	Very good
2	1	0	0	0	1	0	0	0	0	0	0	0	6	54	Poor
3	0	0	1	0	0	1	0	0	0	0	0	0	5	41	Poor
4	0	1	0	0	0	0	0	0	0	0	0	0	0	73	Fairly
5	1	1	0	0	0	0	1	0	0	0	0	0	4	42	Poor
6	1	0	0	0	0	0	0	0	0	0	0	0	2	85	Fairly good
Total	3	2	1	0	1	1	1	0	0	0	0	0	19		

Table 43 (Continued)

% x Coefficient	Coefficient	Rate
50.00	1	50.00
66.67	2	33.33
50.00	3	16.67
0.00	1	0.00
33.33	2	16.67
16.67	1	16.67
16.67	1	16.67
0.00	1	0.00
0.00	1	0.00
0.00	2	0.00
0.00	1	0.00
0.00	3	0.00
21.11	2	10.56
254.44		
65.30		

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List of Publication and Proceeding

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