



Journal Homepage: -[www.journalijar.com](http://www.journalijar.com)

## INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/15213

DOI URL: <http://dx.doi.org/10.21474/IJAR01/15213>



### RESEARCH ARTICLE

#### ASSESSMENT OF TAPPING QUALITY IN RUBBER TREE CULTIVATION IN COTE D'IVOIRE: CASE OF YAMOOUSSOUKRO, TIASSALÉ AND ANGUÉDÉDOU PLANTATIONS

Soumahin Eric Francis<sup>1</sup>, Sey Junias<sup>1</sup>, Tonessia Dolou Charlotte<sup>1</sup>, Kouadio Yatty Justin<sup>1</sup> and Obouayeba Samuel<sup>2</sup>

1. Université Jean Lorougnon Guédé, UFR Agroforesterie, Laboratoire d'Amélioration de la Production Végétale, BP 150 Daloa, Côte d'Ivoire.
2. Centre National de Recherche Agronomique, Station de Recherche de Bimbresso, Programme Hévéa, 01 BP 1536 Abidjan 01, Côte d'Ivoire.

#### Manuscript Info

##### Manuscript History

Received: 15 June 2022

Final Accepted: 17 July 2022

Published: August 2022

##### Key words:-

Rubber Tree, Tapping Quality, Tapper, Tapping Knife

#### Abstract

Rubber tree cultivation is booming in Côte d'Ivoire, making the country rank 1<sup>st</sup> in Africa. However, plantations are destroyed prematurely due to poor tapping qualities. In order to improve tapping quality and by extension rubber yield, a study was conducted in Côte d'Ivoire in the towns of Yamoussoukro, Tiassalé and Anguédédou. This study was conducted on the basis of a survey on the characteristics of the plantations and the tappers of 23 plantations, followed by a tapping quality check. The results showed that tapping commencement of plantations was later in Yamoussoukro (9.2 years) than in Tiassalé (6.7 years) and Anguédédou (6.8 years). Furthermore, the Yamoussoukro plantations were younger and smaller (1 to 4 years of latex harvesting and 2 ha on average) compared to those of Tiassalé and Anguédédou (1 to 12 years of latex harvesting and 10 ha on average). The sociological characteristics of tappers showed that they are only men, most of whom have been trained in tapping techniques (91% of tappers). It appears from this study that tapping quality was poor in Anguédédou and good in Tiassalé and Yamoussoukro. Finally, the correlation analyses showed that tapping quality was not related to tappers but rather to their tapping knives. The tappers must therefore use a good tapping knife for tapping and perform the tapping in accordance with established tapping standards.

Copy Right, IJAR, 2022.. All rights reserved.

#### Introduction:-

Rubber tree, originating from Amazonia, is a plant whose very interesting economic contribution makes it a highly cultivated plant species in the tropical regions throughout the world (Compagnon, 1986). It is mainly cultivated for its latex. Rubber tree is a tree with high added value by-products. It is the only commercially exploited source of natural rubber, essential in the tire industry and in the daily life of populations (Houphouët et al, 2017). More than 70% of natural rubber is used to manufacture tires intended for the automotive and other industries. As a result, rubber tree cultivation has become an important economic activity, with global yield of natural rubber amounting to 13.7 million tons in 2018. Asia's share of this yield is over 88% (SIPH, 2019).

**Corresponding Author:- Soumahin Eric Francis**

Address:- Université Jean Lorougnon Guédé, UFR Agroforesterie, Laboratoire d'Amélioration de la Production Végétale, BP 150 Daloa, Côte d'Ivoire.

In West Africa and particularly in Côte d'Ivoire, rubber tree cultivation is a dynamic and rapidly expanding sector. It was introduced there in 1951 by agro-industrial companies as part of the crop diversification policy (Canh, 1999). Côte d'Ivoire ranks 1<sup>st</sup> in Africa and 4<sup>th</sup> in the world. Its yield in 2020 was 850,000 tons (APROMAC, 2021).

The latex is harvested by tapping, which consists of making a cut called tapping cut in the bark of the rubber tree using a tapping knife (Compagnon, 1986). Tapping is done according to quality standards. These include tapping depth and bark consumption. The poor quality of tapping therefore leads to damage in tree bark due to poor bark regeneration, thus making them unsuitable for subsequent tapping. This leads to drops in rubber yield (Soumahin, 2010). Despite the support of supervisory technical operators to improve tapping quality, some plantations are completely destroyed or are no longer viable due to poor tapping practices (FIRCA, 2016). It is therefore of paramount importance to ensure strict compliance with pre-established measures in terms of tapping quality in order to sustainably improve rubber yield in Côte d'Ivoire. It is in this perspective that this study, financed by the Fonds Compétitif pour l'Innovation Agricole Durable (FCIAD) and entitled: Assessment of tapping quality in rubber tree cultivation: case of Yamoussoukro, Tiassalé and Anguédédou plantations, has been initiated. The general aim of this study is to improve tapping quality in Côte d'Ivoire. Specifically, this will consist in:

1. Making the sociological characterization of tappers
2. Making the agronomic characterization of the plantations
3. Determining the tapping quality of plantations
4. Determining the factors influencing the tapping quality of plantations.

## Material And Methods:-

### Study site

The study was conducted in three towns, namely Yamoussoukro, Tiassalé and Anguédédou. Yamoussoukro is located in central Côte d'Ivoire between 6°40' and 7° north latitude and between 5°10' and 5°20' west longitude. Interannual rainfall vary from 900 to 1100 mm. The average interannual temperature is around 26°C (Brou, 2005). The average altitude is 200 m (N'Guessan et al., 2014).

Tiassalé is located in the southern Côte d'Ivoire between 5°32' and 6°24' north latitude and 4°29' and 5°14' west longitude. On average, its temperature is 27°C. The average annual rainfall reach 1287 mm (Avenard, 1971).

As for Anguédédou, it is located in southeastern Côte d'Ivoire and has rainfall of the order of 1800 to 2000 mm of rain per year, an average temperature of 26°C, sunshine ranging between 2000 and 2100 hours per year (Dick et al, 2014).

The selection of the sites for prospection was made with the help of the company Tropical Rubber Côte d'Ivoire (TRCI). This choice is justified by the fact that this company supervises a large number of farmers distributed in these rubber production areas and that it is the partner of this project. These plantations were selected on the basis of their accessibility in all seasons.

## Material:-

### Plant material

The plant material consisted of rubber tree (*Hevea brasiliensis*) clones from plantations in the towns of Yamoussoukro, Tiassalé and Anguédédou.

### Technical equipment

The technical equipment for carrying out this study consisted of:

- a survey sheet containing linear scale questions;
- a punch to measure tapping depth;
- a notebook to write down additional information not appearing on the survey sheet;
- a tape measure to measure the girth;
- a metal tape measure to measure tapping height and bark consumption.
- a camera for taking pictures.

## Methods:-

### Survey

The survey consisted in interviewing twenty-three tappers directly from a questionnaire sheet previously prepared. This sheet consisted of two main parts. The first part dealt with the sociological characteristics of tappers in the different study areas. The information sought related to the age, sex, nationality, level of education, marital status, number of children and seniority of tappers in tapping. The second part focused on the agronomic characteristics of rubber tree plantations, namely the clones cultivated, the surface area of the plot, the tapping knife, the tapping schedules, the number of trees tapped per day, the year of planting, the planting density, the year of latex harvesting, tree opening age, the number of knife cuts and the tapping cut length. The interview took place in the field in the morning (7 a.m. to 12 a.m.) by appointment with the producer. The surveys were carried out from December 2019 to January 2020.

### Tapping quality check

The tapping check focused on parameters such as tapping height, bark consumption, tapping depth, girth and wounds. To this end, ten rubber trees per plantation were chosen at random along a diagonal line.

### Tapping height

Tapping heights were measured from the lowest point of the cut to the ground using a metal tape measure (Figure 1). The measurements were expressed in cm.



Figure 1:- Measurement of the tapping height of a rubber tree.

**Bark consumption**

Rubber tree bark consumption was measured at the top, in the middle and at the bottom of the tapping panel using a metal tapemeasure (Figure 2). The measurements were expressed in cm.



**Figure 2:-** Measurement of the bark consumption of a rubber tree.

**Tapping depth**

The tapping depth of rubber trees was measured using a punch at the top, in the middle and at the bottom of the tapping panel. The values were expressed in mm.

**Girth**

The girth of the rubber trees was measured at 1.70 m from the ground using a tape measure (Figure 3).



**Figure 3:-** Measurement the girth of a rubber tree.

### Wounds

Wounds were rated on a scale of 0 to 10 according to the following codes:

- 0: No wound on the tappingpanel
- 1: Wounds on 1 to 10% of the tappingpanel
- 2: Wounds on 11-20% of the tappingpanel
- 3: Wounds on 21-30% of the tappingpanel
- 4: Wounds on 31-40% of the tappingpanel
- 5: Wounds on 41-50% of the tappingpanel
- 6: Wounds on 51-60% of the tappingpanel
- 7: Wounds on 61-70% of the tappingpanel
- 8: Wounds on 71-80% of the tappingpanel
- 9: Wounds on 81-90% of the tappingpanel
- 10: Wounds on 91-100% of the tappingpanel.

### Statistical analysis

The analysis of the data obtained from the different variables studied was carried out by the STATISTICA 7.1 software. A one-way analysis of variance (ANOVA) was performed and the significance of the differences between the parameters was determined. The Newman-Keuls test was then carried out at threshold  $\alpha=0.05$  in order to determine the similar groups. In addition, the Pearson correlation analysis was performed.

### Results:-

#### Characteristics of the plantations and tappers visited

##### Sociological characteristics of tappers

Table 1 shows the sociological characteristics of the 23 tappers interviewed in these three study areas. Among the tappers interviewed, 91% had received training in tapping against 9% who received no training. Tapping in those towns is carried out only by men.

The age range of the tappers varies from 18 to 50 years old. The dominant age group at 61% in this sector of activity is that of 18 to 35 years. Tapping in those areas is mostly held by the natives. Indeed, 87% of tappers are of Ivorian nationality against 13% who are Burkinabe. The majority of the tappers live together (52%) and are mostly illiterate (39%).

Nine percent (9%) of tappers had completed higher education and 26% had completed secondary and primary education. Sixty-one percent (61%) of the tappers surveyed had between 4 and 22 years of experience in tapping. Eighty-seven percent (87%) of tappers tap between 230 and 600 trees per day. Tapping schedules were overall between 2 a.m. and 12 a.m. (that is, 91% of tapping). Eighty-seven percent (87%) of tappers were paid by performance.

**Table 1:-** Sociological characteristics of tappers in Yamoussoukro, Tiassalé and Anguédédou areas.

Variable	Modality	Effective	Percentage
Age range	18-35 years old	14	61
	36-50 years old	9	39
Gender	Men	23	100
	Women	0	0
Nationality	Ivorian	20	87
	Burkinabe	3	13
Marital status	Married	12	52
	Single	11	48
Level of studies	Illiterate	9	39
	Primary education	6	26
	Secondary education	6	26
	Higher education	2	9
Experience in tapping	0-3 years	9	39
	4-22 years	14	61
Tapping training	Trained	21	91

	Untrained	2	9
Tapping schedule	2 a.m.-12 a.m.	21	91
	2 p.m. – 8 p.m.	2	9
Number of tapped trees per day	230-600 trees/day	20	87
	601-1000 trees/day	3	13
Mode of remuneration	Fixed monthly salary	2	9
	Salary based on performance	20	87
	No salary	1	4

### Characteristics of the plantations visited

Table 2 shows the characteristics of the plantations where the surveys were carried out. The surface areas of the plantations varied from 1 to 6 ha in Yamoussoukro (2.2 ha on average), from 4 to 26 ha in Tiassalé (9.83 ha on average) and from 1.5 to 22 ha in Anguédédou (10.16 ha on average).

The rubber tree clones were planted from 2006 to 2012 in Yamoussoukro, from 2000 to 2012 in Tiassalé and from 2005 to 2013 in Anguédédou.

In Yamoussoukro, the opening of rubber tree clones varies from 7 to 11 years (that is, 9.2 years on average) and the latex harvesting from 1 to 4 years (2.4 years on average). In Tiassalé, the opening of rubber clones is between 5 and 8 years (that is, 6.7 years on average) and the latex harvesting from 1 to 12 years (4.88 years on average). In the town of Anguédédou, the opening of rubber trees varies from 6 to 8 years (that is, 6.8 years on average) and the latex harvesting from 1 to 9 years (5.13 years on average).

Crop year 2019 started in Yamoussoukro from March to August 2019, from March to April 2019 in Tiassalé and in Anguédédou from April to June 2019.

The tapping system observed for the whole of the plantations visited was half-spiral downward tapping performed every 3 days (S/2 d3) with the exception of 3 plantations. These included plantation D in Tiassalé, half-spiral upward tapping every 4 days (S/4U d4), plantation C in Anguédédou half-spiral downward tapping every 2 days (S/2 d2) and plantation E of the same town tapped half-spiral downward every 4 days (S/2 d4).

The knives used to carry out the tapping in Yamoussoukro, Tiassalé and Anguédédou were Fauna and GM 777. The planting density of these towns varies from 555 to 666 trees per hectare.

The tapping task varies from 230 to 600 trees per day in Yamoussoukro, from 450 to 1000 trees per day in Tiassalé and from 400 to 1000 trees per day in Anguédédou.

The clones identified in the field were GT1, PB 217 and polyclones (mixture of several clones).

Two plantations out of the 23 were tapped upward, that is, 9%, and 21 plantations were tapped downward, that is, 91%. Concerning tapping frequency, tapping every three days (d3) was practiced over 20 plantations, that is, 87%, tapping every four days (d4) over 2 plantations, that is, 9% and tapping every two days (d2) in a single plantation, that is, 4%. Twelve plantations used Fauna knife against 11 plantations for GM 777 knife. These knives have blades that can be sharpened.

**Table 2:-** Characteristics of plantations visited.

Locality	Plantation	Surface area	Planting year	Opening year	Exploitation year	Start of crop year	Tapping system	Type of knives	Tapping task (trees/day)	Clone
<b>YAMOISSOUKRO</b>	A	1 ha	2009	8 years	3 years	August 2019	S/2 d3	Fauna	500	GT1
	B	1 ha	2012	7 years	1 year	April 2019	S/2 d3	Fauna	500	GT1
	C	6 ha	2006	10 years	4 years	June 2019	S/2 d3	GM 777	600	GT1
	D	1.5 ha	2006	11 years	3 years	March 2019	S/2 d3	GM 777	600	GT1
	E	1.5 ha	2009	10 years	1 year	May 2019	S/2 d3	Fauna	230	PB 217
<b>TIASSALE</b>	A	10 ha	2010	8 years	2 years	March 2019	S/2 d3	Fauna	1000	Polyclo ne
	B	10 ha	2012	7 years	1 year	March 2019	S/2 d3	Fauna	500	GT1
	C	5 ha	2000	7 years	3 years	March 2019	S/2 d3	GM 777	600	PB217
	D	6 ha	2001	7 years	12 years	March 2019	S/2U d4	GM 777	625	GT1
	E	5.5 ha	2007	8 years	5 years	April 2019	S/2 d3	Fauna	800	PB217
	F	4 ha	2009	5 years	6 years	April 2019	S/2 d3	Fauna	500	Polyclo ne
	G	26 ha	2009	6 years	5 years	April 2019	S/2 d3	Fauna	500	GT1
	H	8 ha	2008	7 years	5 years	April 2019	S/2 d3	Fauna	484	Polyclo ne
	I	14 ha	2009	6 years	5 years	April 2019	S/2 d3	Fauna	450	Polyclo ne
<b>ANGUÉDÉDOU</b>	A	4 ha	2007	6 years	7 years	April 2019	S/2 d3	Fauna	600	GT1
	B	15 ha	2008	8 years	4 years	April 2019	S/2 d3	GM 777	600	Polyclo ne
	C	6 ha	2008	8 years	4 years	April 2019	S/2 d2	GM 777	1000	Polyclo ne
	D	1.5 ha	2010	8 years	2 years	April 2019	S/2 d3	GM 777	400	Polyclo ne
	E	10 ha	2005	6 years	9 years	April 2019	S/2 d4	GM 777	600	GT1
	F	10 ha	2007	6 years	7 years	April 2019	S/2U d3	GM 777	600	GT1
	G	8 ha	2005	7 years	8 years	April 2019	S/2 d3	GM 777	600	Polyclo ne
	H	15 ha	2007	7 years	6 years	April 2019	S/2 d3	GM 777	555	GT1
	I	22 ha	2013	6 years	1 year	June 2019	S/2 d3	Fauna	500	Polyclo ne

S/2 d3: Tapping in downward half spiral, every three days;

S/2U d4: Tapping in upward half spiral, every four days;

S/2 d2: Tapping in downward half spiral, every two days.

### Tapping quality of plantations

#### Tapping quality in Yamoussoukro rubber tree plantations

The rubber trees in Yamoussoukro plantations had girths ranging between 49.75 and 64.60 cm. The tapping heights varied from 82.20 to 124.40 cm (Table 3).

**- Tapping depth**

The greatest tapping depths were measured in plantations D (0.73 mm from the cambium) and E (0.80 mm from the cambium) while the lowest were observed in plantations A (1.13 mm from the cambium), B (1.33 mm from the cambium) and C (1.50 mm from the cambium) (Table 3).

**- Bark consumption**

The rubber trees of plantation C showed high bark consumption (17.32 cm/year) while those of plantations B and E recorded the lowest bark consumption (7.96 and 8.25 cm/year, respectively) (Table 3).

**- Tapping wounds**

The rubber trees of plantations A, D and E showed the greatest wounds (2.6; 2.5; 2.8, respectively) unlike plantation B where the wounds were lower (1.6) (Table 3).

**Table 3:-** Tapping quality in Yamoussoukro rubber tree plantations.

Plantations	Girth (cm)	Heigh(cm)	Tapping quality		
			Depth (mm)	Consumption(cm/an)	Wounds
A	61.45 a	124.40 a	1.13 b	10.60 c	2.60 a
B	51.20 c	101.20 c	1.33 ab	07.96 d	1.60 b
C	64.60 a	82.20 e	1.50 a	17.32a	2.10 ab
D	56.50 b	93.00 d	0.80 c	14.12b	2.50 a
E	49.75 c	106.00 b	0.73 c	08.25 d	2.80a
Pr > F	0.000	0.000	0.000	0.000	0.000
Significant	Oui	Oui	Oui	Oui	Oui

The depths expressed are the distances close to the cambium (reference value of 1 to 1.5 mm). Bark consumption reference value is 15 cm/year. The results assigned the same letter are not significantly different (Newman-Keuls test at 5%).

**Tapping quality in Tiassalé rubber tree plantations**

The rubber trees in Tiassalé plantations had girths ranging between 52.05 and 73.55 cm. The tapping heights varied from 42.30 to 140.60 cm (Table 4).

**- Tapping depth**

The greatest tapping depths were measured in plantation B (0.53 mm from the cambium) while the lowest ones were observed in plantation C (1.30 mm from the cambium) (Table 4).

**- Bark consumption**

Rubber trees from plantations B, C, D, F and G showed high bark consumption with a value greater than 15 cm/year, while those from plantations A, E, H and I showed the lowest bark consumption (less than 15 cm/year) (Table 4).

**- Wounds**

The rubber trees from plantation D showed the most serious wounds with a score of 4.3, unlike those from plantations A, C, E and H which recorded the lightest wounds (0.58; 2.10; 0.60; 6.60, respectively) (Table 4).

**Table 4:-** Tapping quality in Tiassalé rubber tree plantations.

Plantations	Girth (cm)	Heigh (cm)	Tapping quality		
			Depth (mm)	Consumption (cm/an)	Wounds
A	58.72 c	97.72 b	1.00ab	07.75 h	0.58d
B	52.05 d	93.40 b	0.53 c	19.29 c	2.10 bc
C	64.80 b	42.30 f	1.30 a	18.93 d	0.60 d
D	73.55 a	140.60 a	0.86 b	20.96 b	4.30 a
E	66.10 b	100.60 b	1.03 ab	11.80 g	0.60 d
F	65.00 b	51.90 e	0.96 ab	15.06 e	1.90 c
G	52.75 d	67.00 d	1.06 ab	21.53 a	2.60 b



H	71.00 a	95.10 b	0.93 ab	13.80 f	0.60 d
I	55.35 cd	86.10c	0.86 b	11.13 f	2.20 bc
Pr > F	0.000	0.000	0.000	0.000	0.000
Significant	Oui	Oui	Oui	Oui	Oui

The results assigned the same letter are not significantly different (Newman-Keuls test at 5%).

### Tapping quality in Anguédédou rubber tree plantations

The rubber trees of Anguédédou plantations had girths ranging between 55.6 and 71.7 cm and were tapped at heights that varied from 60.40 to 160.10 cm (Table 5).

#### - Tapping depth

The greatest tapping depths were observed not only in plantation C (0.3 mm from the cambium), but also in plantations B and H (0.53 mm from the cambium) while the shallowest depths were measured in the plantation F (1.30 mm from the cambium) (Table 5).

#### - Bark consumption

The rubber trees from plantations F and G showed high bark consumption with values greater than 35 cm/year while those from plantation I showed the lowest bark consumption (10.07 cm/year) (Table 5).

#### - Wounds

The most serious wounds were measured on plantations F, G, H and I (from 4.20 to 4.80) and the lightest ones in plantations E, A and B (from 2.10 to 2.60) (Table 5).

**Table 5:-** Tapping quality in Anguédédou rubber tree plantations.

Plantations	Girth (cm)	Heigh (cm)	Tapping quality		
			Depth (mm)	Consumption (cm/an)	Wounds
A	65.50 b	67.70 f	0.66 bcd	15.36 d	2.30 cd
B	55.60 d	75.80 e	0.53 cd	17.80 d	2.60 cd
C	60.55 b	100.40 c	0.30 d	15.63 d	3.50 b
D	64.60 b	60.40 g	0.80 bc	17.26 d	3.00 bc
E	71.70 a	160.10 a	1.06 ab	30.53 b	2.10 d
F	57.04 cd	154.95 a	1.30 a	36.96 a	4.80 a
G	62.00 bc	78.30 de	1.00 ab	39.50 a	4.30 a
H	62.60 bc	83.70 d	0.53 cd	22.26 c	4.50 a
I	60.55 bc	107.50 b	0.96 ab	10.07 e	4.20 a
Pr > F	0.000	0.000	0.000	0.000	0.000
Significant	Oui	Oui	Oui	Oui	Oui

The results assigned the same letter are not significantly different (Newman-Keuls test at 5%).

### Comparative study of tapping quality in the three areas

Tapping quality differed from one area to another (Table 6). The greatest tapping depth was recorded in Anguédédou area (0.79 mm from the cambium). This depth was greater than that of Tiassalé (0.96 mm from the cambium) which in turn was greater than that of Anguédédou (1.1 mm from the cambium).

Moreover, high bark consumptions were recorded in Anguédédou (22.8 cm/year) and Tiassalé (15.9 cm/year). The lowest bark consumptions were observed in Yamoussoukro (10.2 cm/year).

The tapping wounds observed in Anguédédou were higher (3.47) than those in Yamoussoukro (2.32), which were greater than the ones in Tiassalé (Table 6).

**Table 6:-** Average tapping quality in the study areas.

Locality	Depth(mm)	Consumption(cm/an)	Wounds
Anguédédou	0.79 c	22.82 a	3.47 a
Tiassalé	0.95 b	15.91 b	1.72 c
Yamoussoukro	1.10 a	10.23 c	2.32 b

Pr > F	0.000	0.000	0.000
Significant	Oui	Oui	Oui

The results assigned the same letter are not significantly different (Newman-Keuls test at 5%).

### Parameters influencing tapping quality

#### Human factors

Table 7 shows the correlations between human factors and tapping quality. The values observed were all less than 0.5.

No significant correlation was determined between human factors and tapping quality.

**Table 7:-** Correlation between human factors and tapping quality.

Variable	Depth	Wounds	Consumption
Age	0.15	0.00	- 0.22
Tapping training	- 0.35	0.03	- 0.35
Level of studies	- 0.18	0.36	0.44
Experience in tapping	- 0.10	0.17	0.19
Mean	0.92	2.53	17.38
Standard deviation	0.60	1.68	9.11
Nb.obs	690.00		

$r > 0.5$ : strong positive correlation between a and b (evolution in the same direction)

$r < -0.5$ : strong negative correlation between a and b (evolution in the opposite direction)

$r < 0.5$ : weak positive correlation between a and b (regression in the same direction)

$r > -0.5$ : weak negative correlation between a and b (regression in the opposite direction)

Nb.obs: Total number observed

#### Other factors

Table 8 shows the correlations between the other factors and tapping quality.

A significant positive correlation was determined between the type of knife used and bark consumption ( $r = 0.59$ ) as well as between the type of knife used and tapping wounds ( $r = 0.59$ ).

The duration of latex harvesting, the tapping schedule and the number of trees tapped per day therefore had no influence on tapping quality.

**Table 8:-** Correlation between the other factors and tapping quality.

Variable	Depth	Consumption/year	Wounds
Type of knives	-0.28	<b>0.59*</b>	<b>0.59*</b>
Latex harvesting years	0.05	0.12	0.05
Tapping hour	-0.49	0.06	0.26
Tapping task	- 0.32	-0.03	0.08

\*Significant correlation

### Discussion:-

The study conducted in Yamoussoukro, Tiassalé and Anguédedou is a contribution to improving tapping quality in rubber tree cultivation. It made it possible to characterize the rubber tree environment, to assess tapping quality and to determine the factors influencing tapping quality in these towns.

#### Sociological characteristics of tappers

The surveys carried out in these three towns made it possible to interview 23 tappers. Regarding tapping training, 9% of tappers had not received any training. This low rate of untrained tappers can be explained by the fact that the supervision of the rubber sector was established by the Ivorian government to help farmers have all the technical skills and tools to better conduct their activity. Thus, more than a hundred tapping schools have been set up across the country with the aim of training new tappers and perfecting old ones in the art of tapping. More than 20,000 tappers have therefore been trained or retrained for this purpose (FIRCA, 2016).

Regarding the gender aspect of tappers, the study revealed the exclusive presence of men (100%), to the detriment of women. This is explained at first sight by the arduous work of tapping (Soumahin, 2010). These results are different from those of other authors who reveal that the profession of tapper, formerly mainly occupied by men, is of increasing interest to women nowadays (APROMAC, 2020). In the profession of tapper, men and women have the same responsibilities on the plots. Furthermore, in their career plan, one or the other can progress and become a tapping team leader or tapping controller by validating acquired experience (Anonymous, 2018).

Moreover, the age groups identified during the surveys revealed that 61% of tappers are between 35 and 50 years old. This implies a certain maturity of the tappers making them therefore more active in the accomplishment of their task. In addition, the fact that tapping is a delicate activity explains the low proportion of young people in this activity.

Sixty-one percent (61%) of the tappers surveyed had between 4 and 22 years of experience in tapping. These results show that tapping is an activity like any other and not a hobby. This stability of tappers and their interest in tapping could be explained by the fact that tappers receive monthly income over the entire economic life of the plantations (40 years). These results confirm those of Keli et al. (2005) who state that rubber cultivation plays an important socio-economic role. It provides monthly financial income to farmers throughout the year.

Finally, the high participation of married people (52%), whose main source of income is rubber tree cultivation, shows that this activity helps make a living by generating substantial income that can cover family expenses. These results are in agreement with those of Ruf (2009) who attests that the rubber producer can educate his children without resorting to loans.

#### **Characteristics of the plantations visited**

The surveys revealed that the year of planting, the duration of latex harvesting and the surface areas of the plantations differed from one zone to another. The oldest plantations are in Tiassalé and have an latex harvesting period that varies from 1 to 12 years. These plantations have a larger surface area (4 to 26 ha). The same is true for Anguededou plantations, whose latex harvesting periods varies from 1 to 9 years and whose surface areas are between 1.5 and 22 ha. The smallest and youngest plantations were observed in Yamoussoukro with surface areas of 1 to 6 ha and latex harvesting periods of 1 to 4 years. These results are explained by the fact that the traditional rubber growing area is located in the southern part of Côte d'Ivoire (Anguédedou and Tiassalé) where the climate is more favorable to this crop. Anguédedou and Tiassalé, being located in southern Côte d'Ivoire, are the towns that have older plantations with larger surface areas. These results are in agreement with those of Kéli et al. (2005) who claim that the first rubber tree plantations were created in southeastern Côte d'Ivoire. According to Koulibaly (2014), rubber tree cultivation, which was only practiced in southern Côte d'Ivoire, has spread in recent decades to the east, center, center-west and north-west, areas formerly qualified as marginal. The town of Yamoussoukro, located in central Côte d'Ivoire is qualified as a new rubber growing area.

Moreover, the average tapping commencement year of the plantations were 6.7 years in Tiassalé, 6.8 years in Anguédedou and 9.2 years in Yamoussoukro. The normal age for tapping commencement is 6 years (Compagnon, 1986). In Yamoussoukro, the trees therefore showed growth delays (late tapping commencement) because this region is less favorable to rubber tree cultivation than those of Anguédedou and Tiassalé, which are the traditional regions of rubber tree cultivation (Keli et al., 2005; Koulibaly, 2014). Indeed, Yamoussoukro is characterized by lower rainfall (Brou, 2005).

#### **Tapping quality in the study areas**

Tapping quality differed from one area to another. In Anguédedou, tapping depth was very significant (0.79 mm). This town showed many more wounds (3.47) with high bark consumption per year (22.82 cm/year). Unlike Anguédedou, the plantations of Tiassalé and those of Yamoussoukro showed less significant depths, wounds and bark consumption.

#### **Parameters influencing tapping quality**

The analysis of correlations between human factors and tapping quality showed that none of the human factors (age of tappers, training in tapping, level of education of tappers, seniority in tapping) is significantly correlated with tapping quality. In other words, according to our studies, tapping quality does not depend on the tapper. These results are contrary to those of Compagnon (1986) and Atsin (2013) who stipulate that the standards

for carrying out tapping being set, the human factor intervenes in the rigor and in the quality of execution of these standards. The good yield of a plantation therefore requires sufficient, stable and qualified labor. The lack of qualified tappers and their instability is one of the major problems in rubber tree cultivation. Rubber tree tapping being delicate, the tappers, in order to be effective, must necessarily undergo training in a "tapping school". The high rate of tappers trained in tapping schools (91%) could justify the lack of correlation between the human factor and tapping quality.

As for the other factors, the analysis showed the existence of positive correlations between the type of knife and tapping quality. These correlations were positive with bark consumption ( $r=0.59$ ) and tapping wounds (0.59). Tapping quality is therefore linked to the type of knife. These results are in agreement with those of Compagnon (1986) who states that there are many types of knives varying in their length, their weight, and the angle of the cutting edge. It is essential that the tool be of good quality because the good sharpening of these instruments determines the quality of the incision (lactiferous vessels must be sliced and not crushed).

### **Conclusion:-**

The aim of this study was to improve tapping quality in rubber tree cultivation in Côte d'Ivoire for sustainable rubber production.

At the end of our study, it appears that the tappers of the plantations visited, made up only of men, have for the most part received training in tapping (91%) and have an experience in tapping ranging between 4 and 22 years. They are generally adults who live together, for whom tapping is the main activity.

Regarding the characteristics of the plantations, the plantations of Yamoussoukro are younger with smaller surface areas (1 to 4 years of latex harvesting and 2 ha on average) than those of Tiassalé and Anguédédou (1 to 12 years of latex harvesting and 10 ha on average). Tapping commencement of plantations is later in Yamoussoukro (9.2 years) than in Tiassalé (6.7 years) and Anguédédou (6.8 years). With regard to tapping quality, the town of Anguédédou shows a poor tapping quality characterized by very high values of tapping depth (0.79 mm from the cambium), bark consumption (22.82 cm/year) and tapping wounds (3.47). Tapping is of better quality in Tiassalé and Yamoussoukro.

The study of the parameters influencing tapping quality showed that tapping quality is not dependent on the human factor (tapper). It is however dependent on the type of knife used for tapping. The choice of a good tapping knife is therefore essential to ensure good quality tapping and to guarantee the sustainable use of rubber trees.

For a better tapping quality, we recommend that the bodies supervising tappers carry out regular capacity building for tappers during the practice of their activity. We also recommend that tappers comply with tapping quality standards that are established in terms of bark consumption and tapping depths. Finally, we recommend that farmers provide their tappers with good quality tapping knives and that tappers ensure that their knives are properly sharpened.

The study was conducted over a short period and was limited to a few plantations supervised by TRCI. It would be wise to extend it to other rubber growing sectors and over the long term in order to better assess tapping quality in Côte d'Ivoire.

### **Acknowledgement:-**

This work was carried out thanks to the financial support of Fonds Compétitif pour l'Innovation Agricole Durable (FCIAD) and to the technical support of Tropical Rubber Côte d'Ivoire (TRCI). We express our gratitude to them.

### **References:-**

1. Anonymous (2018). L'APROMAC recrute 56 000 jeunes pour être saigneurs d'hévéa en Côte d'Ivoire. Commodafrica. [www.commodafrica.com/23-10-2018-lapromac-recrute-56-000-jeunes-pour-etre-saigneurs-dhevea-en-cote-divoire](http://www.commodafrica.com/23-10-2018-lapromac-recrute-56-000-jeunes-pour-etre-saigneurs-dhevea-en-cote-divoire), consulted the 24/06/2022
2. APROMAC (2021). Le succès de la filière hévéa en chiffre. APROMAC 2021. [apromac.ci/le-succes-de-la-filiere-hevea-en-chiffre/](http://apromac.ci/le-succes-de-la-filiere-hevea-en-chiffre/) consulted le 24/06/2022

3. APROMAC (2020). Ecole Verte de Proximité Saigneur / Les femmes se mettent au métier de saigneur. [facebook.com/551074542062161/videos/1086441011689687/](https://facebook.com/551074542062161/videos/1086441011689687/) consulted the 24/06/2022
4. Atsin G. J. O (2013). Mise au point de techniques de récolte de latex moins consommatrices de main-d'œuvre saigneur chez *Hevea brasiliensis* (Muell.Arg.): Influence de la réduction de la fréquence de saignée et l'intensification de la stimulation hormonale sur les paramètres agronomiques et physiologiques et la rentabilité du clone PB 260 cultivé au Centre-Ouest de la Côte d'Ivoire. Mémoire de Master en Gestion et Valorisation des Ressources Naturelles. Université Nangui Abrogoua, Laboratoire de biologie et amélioration des productions végétale, 71p
5. Avenard J. M. (1971). Aspects de la géomorphologie. In Le milieu naturel de la Côte d'Ivoire. Mémoire ORSTOM, n° 50, Paris, 7-72 pp.
6. Brou Y. T. (2005). Climat, mutations socio-économiques et paysages en Côte d'Ivoire. Mémoire de synthèse des activités scientifiques présenté en vue de l'obtention de l'habilitation à diriger des recherches. Université des Sciences et Technologies de Lille, 212 p.
7. Canh (1999). Les champignons agents de pourridiés en Afrique de l'Ouest. Sonderdruck, aus European Journal of Fomest pathology, Heft 5-6, 263-268p.
8. Compagnon P. (1986). Le caoutchouc naturel. Paris, France : Coste R. Ed. G. P. Maisonneuve & Larose. 595 p.
9. Dick E. A., Traore M.S., Elabo A. A. E., Soumahin E.F., Assi G. M., Atsin G. J. O., Alle Y. J., N'Guessan A. E., Kouamé C., Obouayéba S. (2014). Effets de différentes fréquences annuelles de stimulation éthylénique sur les paramètres agro physiologiques et de sensibilité à l'encoche sèche de *Hevea brasiliensis* au sud-est de la Côte d'Ivoire : Cas des clones PB235 et PB 260 de la classe d'activité métabolique rapide, 958p.
10. FIRCA (2016). La filière hévéa évaluée quatre ans d'encadrement. Actualité des filières, hévéa, [FIRCA.firca.ci/actualite-des-filieres/la-filiere-hevea-evalue-quatre-ans-dencadrement/](http://FIRCA.firca.ci/actualite-des-filieres/la-filiere-hevea-evalue-quatre-ans-dencadrement/) consulted the 24/06/2022.
11. Houphouet J. C. D., Simplicite Y. K., Joseph P. A. (2017). Impacts environnementaux de l'hévéaculture dans le département d'Aboisso, Sud-Est de la Côte d'Ivoire. European scientific journal october 2017 édition Vol.13, No.29 ISSN :1857-7881 (Print) e- ISSN 1857-74431.
12. Koulibaly T. (2014). Développement de l'hévéaculture en Côte d'Ivoire : menaces ou opportunités pour les cultures vivrières. Etude de cas des secteurs hévéicoles de Daloa et d'Abengourou. Mémoire de Diplôme d'Ingénieur en Agro-économie, ESA-INP HB, Yamoussoukro, Côte d'Ivoire, 64 p.
13. Kéli Z. J., Omont H., Assiri A. A., Boko K. A. M., Obouayéba S., Dea B. G., et Doumbia A. (2005). Associations culturelles à base d'hévéa : Bilan de 20 années d'expérimentations en Côte d'Ivoire. Agronomie Africaine 17 (1) : 37-52
14. N'Guessan K. A., Kouassi A., Traoré K.S., Houenou P (2014). Analyse de phénomènes hydrologiques dans un bassin versant urbaniser : cas de la ville de Yamoussoukro (centre de la Cote d'Ivoire). Larhyss Journal, ISSN 1112-3680, n°17, Mars 2014, 135-154p.
15. Ruf F. (2009). L'adoption de l'hévéaculture en CI. Prix, imitation et changement écologique. INRA/SFER/CIRAD, 22p.
16. SIPH (2019). Société Internationale de Plantations d'Hévéas. Leader de la production de caoutchouc en Afrique. [Siph.wipv.com](http://Siph.wipv.com) consulted the 06/11/2019
17. Soumahin (2010). Optimisation des systèmes d'exploitation en hévéaculture par la réduction des intensités de saignée. Thèse de doctorat de Physiologie végétale, Université FHB, Abidjan, Côte d'Ivoire, 117p.