

Assessment of Traditional Palm Wine Tapping Practice Effect on Vegetation in Nasarawa State, Nigeria

E. H. Mba^{1*}, A. S. Ekpo¹, E. C. Ozim¹ and S. O. Oladeinde²

¹*Department of Environmental Management, Nasarawa State University, Keffi, Nigeria.*

²*National Space Research and Development Agency, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all author's. Author EHM conducted the study, collected, analyzed and interpreted the data under the guidance of author ASE. Authors ECO and SOO managed the literature searchers. All the authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2019/v9i1230165

Editor(s):

(1) Dr. Alice Maria Correia Vilela, Assistant Professor, University of Trás-os-Montes and Alto Douro, Portugal.

Reviewers:

(1) Robson Da Paixão De Souza, Universidade Federal Da Bahia, Brazil.

(2) Julian Gonzalez Trinidad, Autonomous University of Zacatecas, Mexico.

(3) Fabian Chinedu Ogonne, Nigerian Institute for Oceanography and Marine Research, Nigeria.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/53114>

Original Research Article

Received 11 October 2019

Accepted 15 December 2019

Published 25 December 2019

ABSTRACT

Palm wine is an alcoholic drink obtained by the natural fermentation of the sap of various type of palm trees, it produced and consumed in various part of the country and beyond. This rich beverage is been used for different traditional practices not only for occasional consumption, so it is of high demand product. The tapping process starts from traditional dealers known as Palm Wine Tappers, that climbs to the top most part of the palm trees, cut it open from the side or middle, or cut down the tree for the liquid sap and this produces lactic-alcoholic-acetic fermentation that is conducted by the lactic acid bacteria (LAB), yeast and acetic acid bacteria (AAB).

The tapping process practiced in difference part of the country are; burning/falling, pruning and trimming. They poses a threat to palm trees that serves other environmental, economic, health and nutritional benefits to human and the ecosystem. This practice renders high number of palm trees less productive or dead in a society with no food security, shaky economy, poor environmental practice/awareness and tree planting habit. Due to high demand for the product, 4 out of 10 palm trees are been converted to palm wine production source, this implies that the palm tree can not

*Corresponding author: E-mail: emodimba@gmail.com, abrahamsalamat@gmail.com;

produce palm fruit that is more of high economic benefits and also contributes to the shortage of palm tree lifespan that serves as a good absorbent of carbon and gives out oxygen through photosynthesis process, a measure that adds value to living organism and reduces warming of the environment. This study recommends proper public awareness especially to the people involve in the trade "Palm Wine Tappers" and introduction of more sustainable way of tapping, monitoring and emphasis on tree planting.

Keywords: *Palm tree; palm wine; palm wine tappers; vegetation; fermentation.*

1. INTRODUCTION

Palm wine is the collective name for a group of alcoholic beverages produce by natural fermentation of the sap obtained from various tropical plants of Palmae family *Okafor* [1]. It is one of the many brand of native wine consumed in Nigeria and beyond, that is predominantly collected from Oil palm tree *Elaies guineensis* [2] and Raffia palm trees *Raphia sp.* The collection process known as palm wine tapping comes in difference methods mostly determined based on each cultures and practices, this tapping process takes place almost all over the country. There are difference method of palm wine tapping but this paper focused more on the particular one being practiced within the study area, some of this method destroys palm tree and an adverse effects on the stem of palm trees which effect regeneration process of the physiological renewal, replacement, repair of plant tissues , also a central component of tropical forest ecosystem dynamics and restoration of the degraded forest lands Thamani [3]. This different tapping methods depends on the location and type of palm wine they want to produce for there are up wine and down wine. Sustainable forest utilization can only be possible if adequate information on the regeneration dynamics and factors influencing important tree species are available Tesfaye et al. [4].

Difference tapping methods are:

- i. Fall and Burning process.
- ii. Pruning process.
- iii. Trimming process.

Fall/Burning process: Burning process predominantly practiced in Ghana, west Africa region and also takes place in some part of South Eastern Nigeria but differently because they do not engage on burning activities only fall.

This practice requires that the palm tree will be cut down before the tapping process began, after cutting down the palm tree, it will be allowed to

stay for minimum of five days, after that next stage will be dressing of the palm by removing the palm fronds, inflorescence and spathe.

Then the construction of a rectangular hole at the very neck of the palm tree or few meter before the neck, a maximum rectangular size that will be enough for the burning process, a pipe or funnel will be fixed on the hole already made during the drilling process and connect to container placed below, then the extraction of the sap will now begin Anonymous [5].

The extraction takes place early in the morning while by mid day is for the burning process, from that drilled rectangular cavity hole heat will be applied as shown in Fig. 1, reasons for this heat application are; to increased the quantity of sap the palm tree will produce next morning and also increase the alcoholic content through fermentation.

This process continues until the palm tree can no longer produce any sap and it can last between 25 to 35 days depending on the tree size.

This particular practice does not only renders palm tree useless but cause the death and also contributes to deforestation which adds up to the warming of our environment, for on average 50liters of palm wine produced from this process we lose one palm tree which is totally not sustainable for the vegetation and prevent the palm tree from producing fruits that are of great benefits.

Pruning process: This practice predominantly takes place in some North central and South South part of Nigeria and the process also poses danger to the palm trees after fall/Burning practice.

The process starts from identifying small palm tree that is ready to be tapped, like when young leaf (spear) spring out that is the sign that it is ripe, next will be bending of the palm fronds, the bending process takes two to three days

depending on the size of the palm tree. When they are done with the bending of the leaf, it will be left alone for minimum of three days so as to allow the sap to settle from the stress of the bending process.

Then next stage is pruning of the topmost part of the palm tree by cutting off the young leaf(spear) and construction of a hexagonal shape hole right at the topmost center of the palm tree with sharp knife, most cases especially during dry season

once they cut off that spear center the sap will rush out but during raining season, it come out gradually and not that fast. After construction of that shape, a bamboo trunk that serves as host or funnel channels the sap coming from the shape to a bucket tied up by the neck side of the palm tree, waterproofed with leather and well tighten, reasons according to palm wine tappers are; to increase pressure, prevent contamination and water mixture especially during raining season.



Fig. 1. Ongoing fall/burning process
Source: Pilgrimkels.wordpress.com



Fig. 2. Ongoing pruning process



Fig. 3. Ongoing trimming process
Source: Vanguardngr.com

After all this process the palm wine tapper will check on it three times per day morning, afternoon and evening, this process last for 30 days or more, till the sap stops coming out. This particular method is being practice in the study area and that is what the paper focus, to check the sustainability.

Trimming process: Among the three methods, this is the most sustainable of them all and predominantly practiced in South East, some part of North central and south south and it support regeneration and the palm tree can also produce fruit later, if it was not tapped too early.

The process start when palm wine tappers climb the topmost part of the tree, trim the neck of the palm tree by removing the fronds and inflorescence parts, the neck will be well trimmed and will be left alone for some days like two days before the drilling process and on that small drilled hole a gallon or local calabash will be fixed that will be connected to a bamboo trunk from the hole which serves as funnel and the gallon fasten with rope tied on the tree MaPhilips [6].

Same three times daily checking process same with pruning process, but it last much longer over 35 days and later the palm tree can still produce fruit if left alone for minimum of two years.

Palm trees has many environmental and economic benefits like; Photosynthesis, Prevents erosion, Palm oil, Palm kernel oil, Cooking, Construction, Livestock feeding. All this environmental and the economic importance, minimum information are available based on the

photosynthesis of the oil palm Dufrene [7]; Ibrahim et al. [8]; Jaafar, [9]; Wahid et al.[10], MPOC,2012. This little information has not properly been explored with the early studies of oil palm growth characteristic Corley [11,12]. This same photosynthesis and growth of oil palm has been modeled and such model benefits more from a better information on photosynthesis of the plant Van Kraalingen et al. [13]. Kingkaew et al. [14]. Palm tree bears both male and female flowers on same tree “monoecious crop” and as a C3 plant from gas exchange data Dufrene [7]; Ibrahim et al, [8] and also exploit increasing atmospheric CO₂ level more than C4 plant species Ibrahim et al, [8]; Jaafar et al. [9].

1.1 Environmental, Economic and Health/Nutritional Benefits of Palm Tree

1.1.1 Environmental benefits

Every agricultural activities, development requires conversion of once forest reserves or wild areas and increase in production of a particular commodity puts more pressure to the particular things that serves as source for the product, this same scenario with palm trees being used for palm wine production.

This production of sap contributed to damaging or cutting down palms which result to deforestation and tree serves as carbon absorbent. This trees helps to decrease the atmospheric temperature through photosynthesis that reduces the level of pollutants resulting from industrial activities Kadhim, [15]. Research

shows that the gross photosynthesis of fronds in the top of palm trees is about 16 - 17gm² and fronds at the bottom had photosynthesis rate of only 4.6 gm² Corley [16]. and this process are beneficial to human for it produces oxygen and remove carbon dioxide from our atmosphere.

The cutting down of palm tree as result of palm wine tapping practices also contributes to deforestation that contribute to the increase in temperature, because those carbons that suppose to be absorbed by these trees will be trapped in the atmosphere and there is more emission also created when felled trees releases the carbon they had been storing inside rot or burn on the forest floor, so not only that tree act as carbon dioxide mitigation but cutting them down also increase carbon dioxide emission through carbon cycle process *Emeodilichi*, 2018.

According to United state of environmental agency [17], trees are used to manage runoff, leaf canopy helps in reduction of erosion caused by rainfall, also by providing surface areas where rain water drops and evaporate and the roots takes up water that creates some condition in the soil and this process promotes infiltration.

1.1.2 Economic benefits

Every part of palm tree are useful economically Otedoh, 1976. Researchers like Otadoh, [18,19] and Ndo, [20]. both described different economic benefits of all the parts of palm trees in the following ways;

Leaves: The leave of raphia palm derives the following products like; piassava, Bamboo, raffia, brooms.

Bamboo: The bamboo or pole is useful for construction of thatcher houses, ladder used for climbing and also to tie framework together for mud houses mostly in rural and riverine areas. It

is the combination of petiole midrib of the front without leaflet.

Piassava: These are mostly used for weaving process like hats, bags, fish traps and also used in making of ropes being used for different purposes like animals and canoes to post in the riverine areas.

Brooms: The mid-ribs produce brooms that is being used for many domestic activities like sweeping purposes.

Raffia: This is used as a twine to weave mats, baskets, hats, shoe, school bag etc when it is being twisted.

Roofing mats: The leaflets of the palms are being converted to roofing mats for thatch houses constructed in rural areas and even some recreation centers and ceiling because of its cooling effects.

Trunks: The trunk is used for construction of houses, mostly local houses, fuel wood and also breeds maggots and insects. Three type of maggots have been identified *Otedoh*, 1976 like; Ukolo, Edon, Ugbaen. All this maggots are consumable, nutritional mostly used for cooking purposes in different part of Nigeria.

From Table 1 and Fig. 4, shows that palm oil contributes the highest average yield(ton/ha/year) among the top major oil seed crops in the world and that shows the increasingly wide range uses for palm oil product and that's of huge economic benefits to any nation if well managed and preserved.

1.1.3 Health/Nutritional benefits

The oil palm produces two different type of oil; crude palm oil (CPO) from the fibrous meson-carp and crude palm kernel oil (CPKO) from the

Table 1. Major oil seed crops

Oil crops	Average oil yield (ton/ha/year)	Planted area (Million hectares)	% of total planted area	Production (Million ton)*	% of total production
Oil Palm	3.72	13.58	5.35	55.88	36.3
Soybean	0.42	10.,9	40.92	41.41	26.9
Sun Flower	0.55	23.99	9.45	13.24	8.6
Rapeseed	0.72	33.07	13.02	23.71	15.4
Others		79.38	31.26	19.71	12.8
Total		253.93		153.95	

Source: Oil world database (June 2012). *MPOC, Palm Oil Fact Slide; 2011. **Total for 10 major oil seed crops

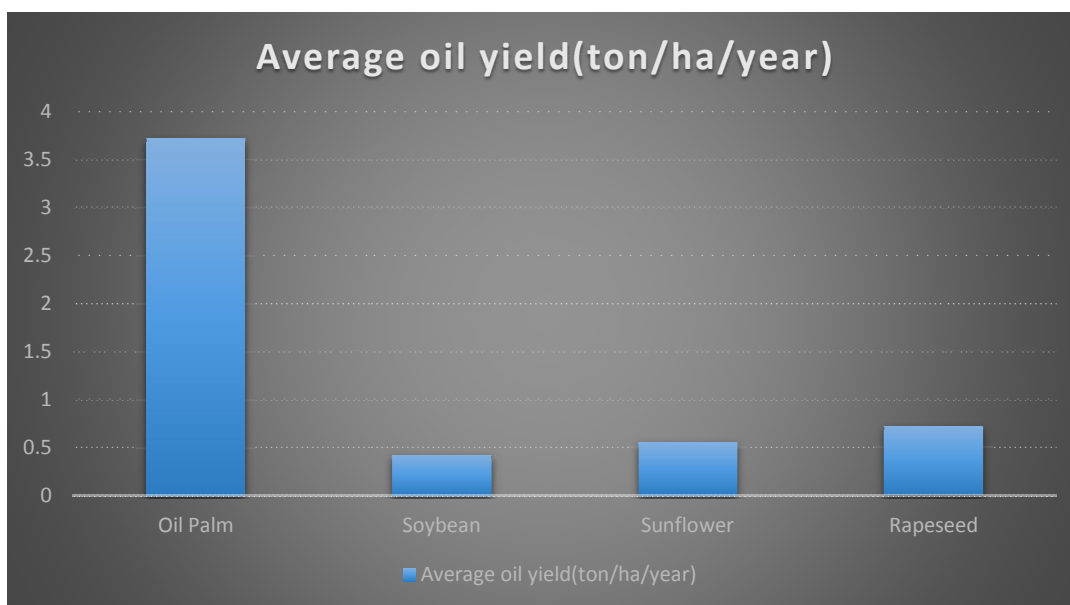


Fig. 4. Average oil yield of major oil seed crops

seed kernel that its composition is close to coconut oil. According to report this palm oil product, 80% to 90% are widely used for human consumption like frying, cooking and other source of ingredient. While other 20% to 10% are being consumed by industries as bio-diesel, cosmetics and pharmaceutical Hiroko et al. [21].

Contrary to previous believe that palm oil is not all that healthy compare to other oil seed product, but research has it that it's much healthier source of fat than hydrogenated vegetable oil, palm oil already solid on the room temperature and it contains rich anti-oxidant, carotene (Vitamin A), Vitamin and other benefits Hiroko et al. [21].

2. MATERIALS AND METHODOLOGY

This study was conducted in Nasarawa state of Nigeria, located in the North Central geopolitical zone of the country, bounded in the North by Kaduna state, in the West by Abuja Federal capital territory, in the south by Kogi state and Benue state and in the East by Taraba state and Plateau state. This traditional practice is the major threat to palm tree in these area, predominantly pruning process is widely practiced all over the place and combined with the high demand of the product it put more pressure on young palm tree in these areas. Qualitative and quantitative mode of inquiries

was used to explore this traditional tapping practice and the effects on the vegetation in four selected areas namely:Keffi, Garaku, Gudi and Akwanga of Nasarawa state.

This paper is based on primary and secondary source through in-depth interviews and discussion with selected 40 respondents known as "palm wine tappers", 10 of these respondents were selected from each location. Information's was accessed through review of relevant texts, journals, newspapers, official publications, magazines and internet which served as tangible source of insight into traditional practices of palm wine tapping practices in Nigeria and beyond.

Data was collected from these four areas and total number of (80) palm trees sample was monitored, only for the pruning tapping process in these selected location with the help of the respondents. Already stated, pruning is the only tapping process being practiced in these four areas, difference palm trees were used for the two major seasons "Rain and Dry Season", these selected palm trees undergo 30days tapping process and were tapped same period of days. This research was carried out from March to September for rainy season and October to April for dry season, reason because the production and after effect defers from one season to another and we needed to figure out which season experienced more loss of palm trees as result of these pruning tapping process.

Table 2. Record of palm tree used for both season

Location	Rain season	Dry season
Keffi	10	10
Garaku	10	10
Gudi	10	10
Akwanga	10	10

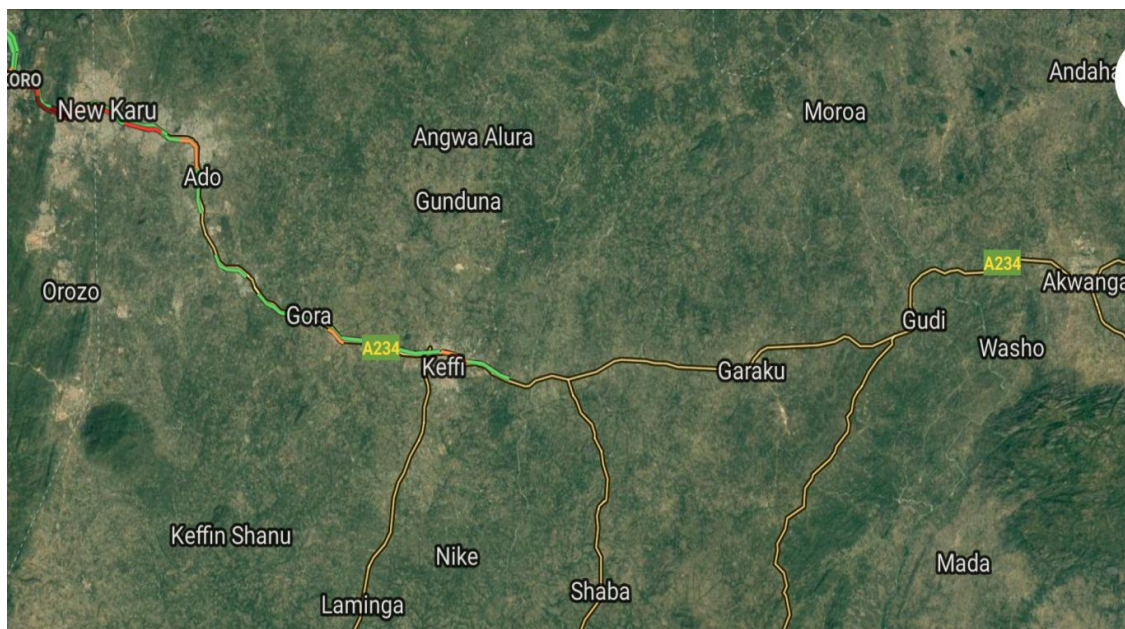


Fig. 5. Aerial view of the 4 location

Source: Google Earth

Table 3. Survived and ceased recorded

Location	Survived Rain Season. SRS.	Ceased Rain Season. CRS.	Survived Dry Season. SDS.	Ceased Dry Season. CDS.
Keffi	8	2	7	3
Garaku	9	1	4	6
Gudi	7	3	6	4
Akwanga	8	2	5	5
Total	32	8	22	18

The first 3 months are the critical period of the palm tree after been tapped, these period determines if it will survive the after effect of the pruning tapping activities.

These four areas was visited twice a month to monitor the progress of the palm trees and selected samples are all young palm trees, because of their height the palm wine tappers finds it easy to prune since it does not require climbing much height to access the center of the palm tree for the sap, equal number of palm trees was used for both seasons.

Survived Rain Season SRS, Ceased Rain Season CRS and Survived Dry Season SRS, Ceased Dry Season CDS was used for the analysis.

3. RESULTS AND DISCUSSION

Life span of palm trees with economic activities rangers from 25 - 30 years and maximum height of (65.6 - 98.ft) and this traditional practice in Nasarawa areas reduces most palm trees life span. Like previously stated pruning method was used because that is the method being practiced by palm wine tappers within this environment.

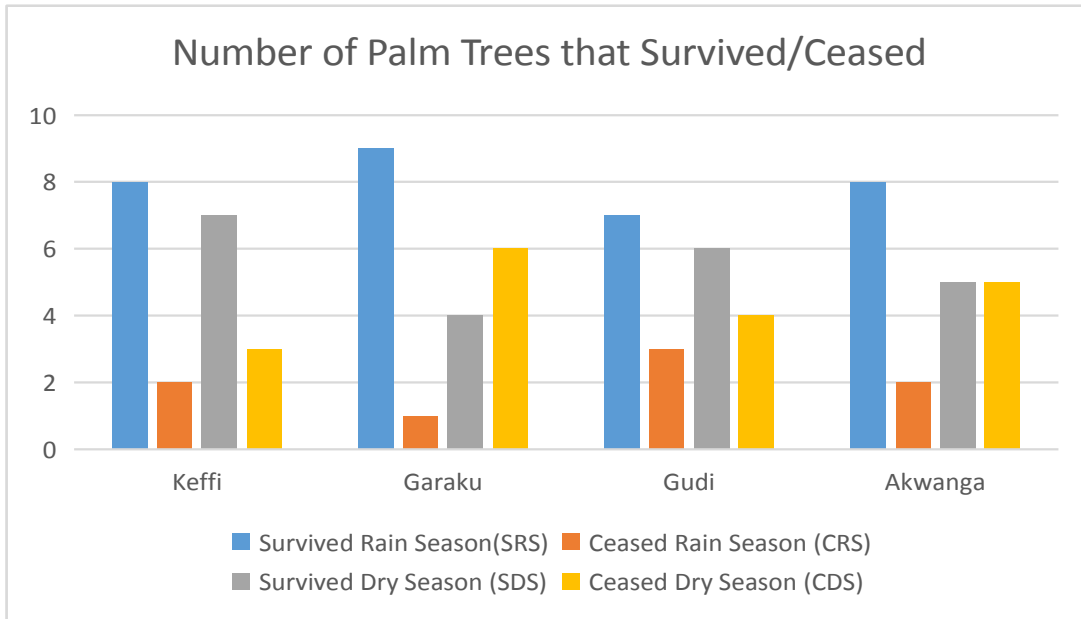


Fig. 6. Number that survived/ceased

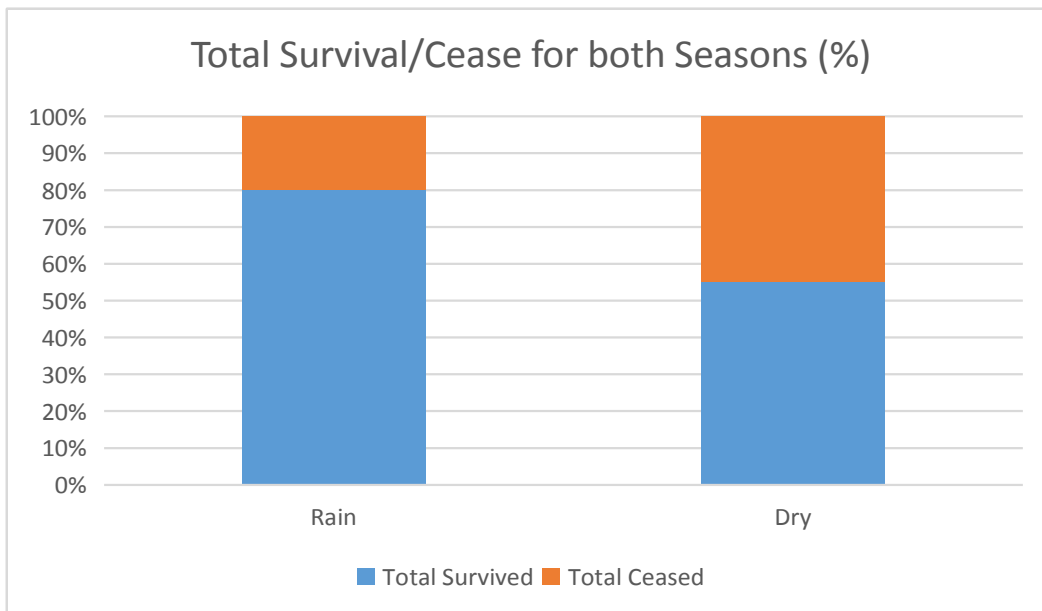


Fig. 7. Percentage that survived/ceased both season

Fig. 6 shows that Keffi recorded high SRS and drop on SDS, Garaku recorded second lowest CRS and SDS rate.

Gudi recorded high SRS and drop on SDS, while Akwanga recorded equal SDS and CDS.

The palm trees produces sap but it has peak season like harmattan dry season, there is

more production during this season more than rain season, many don't normally engage on palm wine tapping process during rain season because the palm trees produces less sap and also there is difficulty in covering the top most part from water and also risk of climbing the palm trees due to it's slippery tendency after rainfall.

According to palm wine tappers 30% of them normally don't engage on the business during rain season because it is more stressful, dangerous and less yield of the sap. Rain season also puts more pressure on the palm trees because more drilling needed to be done before that sap comes out compare to dry season especially harmattan season that is the peak period and the more drilling at the center of the tree creates less possibility of it's survival.

Fig. 7 shows that 80% survived during raining season and 55% during dry season, 20% ceased during rain season and 45% during dry season, 25% survival difference between both season and same % ceased also.

This record shows that we lost more palm trees during dry season to palm wine production more than rain season reasons; because more people engage on the trade and palm wine tappers visit's the site regularly during dry season, also the palm produces more sap during this season so more people engage on the trade during this season. This pruning tapping process largely affect the defence mechanism palm tree exhibits in fight against drought like;

- Stomata closure during hours of high evapotranspiration and the more this period last the stomata may remain close most of the day.
- In a situation when water stress is severe, older leafs will dry up earlier in other to reduce this evapotranspiration and same

time the inflorescence cease to grow in other to reduce carbohydrate intake.

- The opening process of the leaf will be slow which reduces the leaf areas and transpiration and also a drop-in spear leaf extension rate.
- A conversion of process in the trunk which consist of starch and other polysaccharides into sugar in other to maintain bunch development and respiration.

Total number of 80 palm trees was used for both season rain/dry season and only 54 palm trees survived while 26 palm trees ceased to exist due to effect of this pruning tapping method.

Fig. 8 shows 32% palm trees were lost during this research alone and this are the regular practice all over the state and beyond, also this palm trees that survived some of them will still be tapped after 3 years or less depending on how fast the growth. This is a clear indication that the practice is not sustainable for our palm trees vegetation and plant regeneration and this plant serves many benefits to human and environment like previously highlighted on introduction.

80% of palm wine tappers don't think this calls for concern because they believe that "palm trees will never finish" that it grows on there own, while 20% admitted that it's of a great concern because they are losing more trees and soon there maybe shortage of palm trees for their trade.

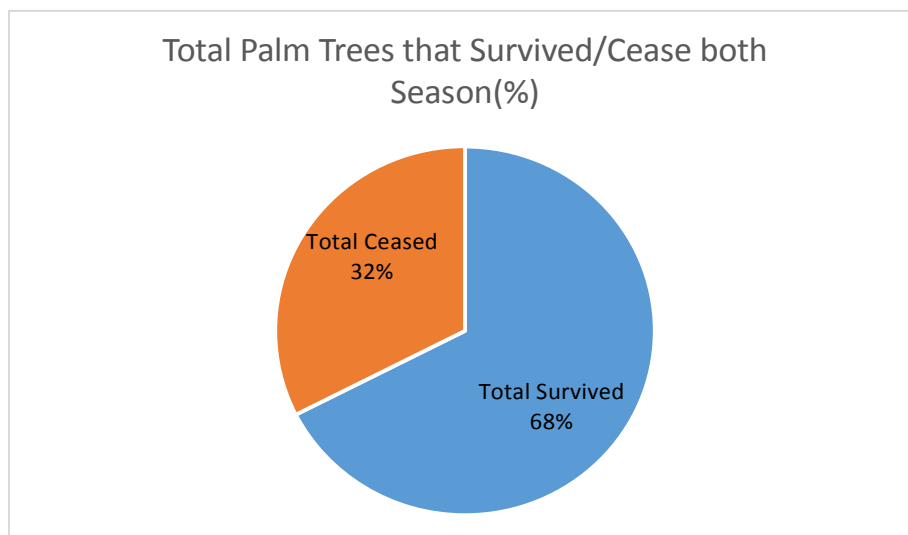


Fig. 8. Total percentage that survived/ceased

The topmost fronds of the palm tree removes high number of carbon dioxide from our atmosphere compare to the bottom fronds through photosynthesis Corley [16] and this topmost fronds are the most affected part during this pruning tapping process.

This palm tree are very important sun plant with high photosynthesis rate at high irradiance, adult plants exhibits higher photosynthesis rate ($0.272 \pm 0.018e \text{ photon}^1$) more than juvenile plant ($0.204 \pm 0.034e \text{ photon}^1$) Kingkaew et al. [14] and mostly effected by this pruning activities are the juvenile palm tree dues to the height and also high demand of this sap which endangers young palm trees around the study area. This makes it more difficult for young palm trees growth to adult stage for this higher photosynthesis rate to take place, which is very important to human and environment. This study shows that more palm wine production puts more young palm trees in danger.

4. CONCLUSION AND RECOMMENDATIONS

Solution to this challenge posed by this pruning tapping techniques being practiced in this study area depends mainly on awareness, policy and getting involve the private sectors because in every developing nation it is not advisable to remove people livelihood without a substitute, since this pruning technique is not sustainable to the vegetation and even to the people engaging on the trade there are other technological innovations like installation and running system of tapping unit which consist of nozzles, flow ducts, electric tapper and a reservoir with down stream that consist of tank and others. This process will be sustainable but costly and due to the cost this traditional wine tappers will find it difficult and will not be encouraging because of the cost and combined with poverty rate, Trimming technique still remain the best option and an alternative with high percentage of sustainability to our vegetation because it only require trimming off the side of the palm tree and removing the lower fronds that are overgrown and no impact to the inflorescent and topmost parts of the tree. This is the main reason awareness is the key so the tappers should be made to understand the after effect of loosing any tree not just the palm to our environment.

This tapper should be engaged, educated them the advantage of palm trees and the impact of this practice to see reasons why they should

switch from that technique to much better and sustainable method that will also help to keep their business going without loosing most of the palm trees which is their major source of income.

The forestry department of the state government also need to invest more on rural awareness because without the rural community there wont be no forest, for research suggest that each hectare of forest can absorb the annual carbon emission of 90 cars. We should not just seat and let the nature do all the work of regeneration when we can help enlighten the public the need to preserve and plant trees, for natural climate solution will help our society to adapt to the inevitable ahead for plants has the perfect process of turning carbon in the air into solid, living materials over billions of years and they need to be protected for safety of our environment, for every vegetation matters.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Okafor N. Microbiology and Biochemistry of oil palm wine. Journal of Applied Bacteriology. 1987;42:279-284.
2. "Elaeis guineensis" Germplasm Resources Information Network(GRIN). Agricultural research service(ARS), United States Department of Agriculture(USDA); 2017.
3. Thamani M, Babitseng and Demel Teketay. Impact of wine Tapping on the population structure and regeneration of hyphaene petersiana Klotzsch ex mart in Northern Botwana. Ethnobotany research and Applications. 2013;11:i1547-3465-11-009.
4. Tesfaye G, Teketay D, Fetene M. Regeneration of seven indigenous tree species in a dry Afromontane forest, Southern Ethiopia. FLORA. 2010;205:135-143.
5. Anonymous. Palm wine brewery and local gin distillation; 2012. Available: Eheritage.blogspot.com
6. MaPhilips Nwachukwu. How we drink palm wine. Vanguard Nigeria. 2012;5-23.
7. Dufrene E, Saugier B. Gas exchange of oil palm in relation to light, vapour pressure deficit, temperature and leaf age. Funct, Ecol. 1993;7:94-104.
8. Ibrahim MH, Jaafar HZE, Haruna MH, Yusop MR. Change in growth and

- photosynthesis patterns of oil palm (*Elaeis guineensis* jacq) juvenile exposed to short term CO₂ enrichment in a close top chamber Acta Physiol. Plant. 2010;32:305-313.
9. Jaafar HZE, Ibrahim MH. Photosynthesis and quantum yield of oil palm juvenile to elevated carbon dioxide in Najafpour; M. M(Ed), Advances Photosynthesis fundamental aspects. IntechPubli, Rijeka Croatia. 2012;16:321-340.
 10. Wahid MB, Abdullah SNA, Henson IE. Oil Palm - Achievements and potential. In: New directions for a diverse planet. In: Proceeding of the 4th international Crop Science Congress. Brisbane, Australia; 2004.
 11. Corley RHV. Effect of plant density on growth and yield of oil palm. Exp Agric. 1973;9:169-180.
 12. Corley RHV, Hardon JJ, Tan GY. Analysis of growth of the oil palm (*Elaeis guineensis* jacq). Estimated growth parameter and application in breeding. Euphytica. 1971; 20:307-315.
 13. Van Kraalingen DWG, Breure CJ. Simulation of oil palm growth and yield, Agric. For. Meteorol. 1989;46:227-244.
 14. Kingkaew A, Chadapust JS, Reymond JR. Photosynthesis of oil palm (*Elaeis guineensis*) Scientia Horticulturae. 2017; 214:34-40.
 15. Kadhim M. Ibrahim. The role of date palm tree in improvement of the environment. Acta horticulturae. 2010;882(882);777-778. DOI: 10.17660.
 16. Corley RHV, Teo C. Disbudding of mature oil palm as a method of controlling yield fluctuation. Malaysian Agric. Res. Dev. Inst. Res. Bull. 1976;4:1-6.
 17. United State Environmental Agency. Soak rain trees helps reduce runoff; 2017. Available:<http://www.epa.gov/soakuptherain>
 18. Otedo MO. Raphia oil, It's extraction, properties and utilization. J. Niger, Institute of Palm Oil Research. 1974;5(19): 45-49.
 19. Otedo MO. Raphia palm: The production of piassava in Nigeria, Nigeria Field. 1975; 40(1):4-16.
 20. Ndo BA. The raphia palm, 1st Ed, Concept Publication LTD, Lagos Nigeria. 2003;16.
 21. Hiroko Shimizu, Pierre Desrochers. The health, environmental and economic benefits of palm oil. Institut Economique Molinari; 2012.

© 2019 Mba et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/53114>