CLIMATE VARIABILITY AND SEASONAL ASPECTS OF PALM WINE PRODUCTION *(RAPHIA SPP)* IN IKOT EKPENE LOCAL GOVERNMENT AREA OF AKWA IBOM STATE, NIGERIA.

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ABSTRACT

The research work examined the relationship between climate variability and seasonal aspects of palm wine production (raphiaspp) in Ikot Ekpene Local Government Area of Akwa Ibom State, Nigeria. The study was carried out to examined the effect of climate variables on raffia palm wine production seasonally in Ikot Ekpene. Primary source of data was obtained through the direct field measurement. The secondary sources of data include meteorological records obtained from Nigeria meteorological station, Uyo for 2018. The cross-sectional multiple regression was used to infer the relationship between climatic variables and seasonal aspects of palm wine production. The result revealed that about 263,000 litres of raffia palm wine was produced in 2018 from the field measurement. The impact of seasonal variation on raffia palm wine production revealed that dry season produced wine more than rainy season. The researcher concluded that the climatic variation has impacted negatively on the production of raffia palm wine in the study area leading to reduction in production of raffia palm wine. The researcher recommended that appropriate climate forecasting and early warning system should be made part and parcel of planning and development so as to increase the production of raffia palm wine in order to improve the local dry gin industry.

Key words: Climate variability, raffia palm wine yield, seasonality, temperature, rainfall and environment

1. INTRODUCTION

The issue of climatic variability has generated discussions in this millennium among the stake holders in both agriculture and economic development. Climate variability is one of the major environmental problems globally that threatens the entire human survival through temperature rise, drought and frequent flooding in farmlands increasing and it has become a global recurrent subject of concern. In other countries of the developing world, the action of global warming and climate variability is large especially in Africa due to widespread poverty, firewood burning, and erosion. It is a serious threat globally with implication on natural ecosystem, agriculture, health, water supply, atmosphere and soil which all these are elements that support life on earth for a long-term sustainability. Climate variability is a factor which redefines the world food equation through their effects on productions mainly in the agro-based dependent livelihoods. It causes death to crops which leads to crop failure, crop destruction and reduction in productions. Climate can be seen as the average or mean atmospheric elements of a particular place over a period of time. It considers recording, observation and processing of the different elements of the climate systematically which include temperature, rainfall, winds, humidity, air

pressure, sunshine and clouds before the climatic averages or means standardization is achieved. Variation in human and social environment usually affects land use patterns and has serious implications of varying magnitude for climate variability within the fresh water swamps zone in which raffia palm is grown.

Raffia palm (*Raphia hookeri*) belongs to the family of *Palmea* and it is a monocotyledonous tree crop of the fresh water swamp that thrives on soil saturated with continuous presence of water. Due to climate variability, quantity, quality and duration of moisture availability for crop growth and development is now unpredictable (Imogie, Ogeh, Ugbah&Eruaga, 2016). Raffia palm trees are grown in the tropical region of Africa (Madagascar, Gambia, Cameroon, Gabon, Congo, Angola and Nigeria). It is also grow outside Africa in Malaysia, India and Singapore. The entire raffia palm tree is used for various purposes: from its nuts, one extracts edible and cosmetic oil; from its sap, a white sweet alcoholic liquid is collected, known as palm wine which can be fermented and distilled for alcohol. The fibre extracted from the leaves are used for making dresses, shoes, carpets, blankets, ligatures for grafting and as construction materials. But the study will dwell on the palm wine.

All agricultural activities are relying upon and inherently related to weather and climate; raffia palm is not exempted. Any fluctuation in weather and climate patterns may possibly influence the production of raffia palm wine. As a constant interest for both human economic activity and development, raffia palm wine is an agricultural product and also economic commodity, which both are at risk because of the variability in climate. Production is mainly decided by ecological factors such as climate, pests and diseases and soil. Farm operational schedules Changes could lead to productivity changes and these therefore causes changes in inter-annual production in crop. However, following acceptable wisdom considers changes in inter-annual production of crop to mainly climate, this is because of the same annual time determination of crop productivity. The cropping growth and development are affected by rainfall, solar radiation, temperature, cloud cover and relative humidity which contribute to produce the observed climate impacts in crop production (Daubenmire, 1974). Each of the factors also formed some elements, which individually affect the functions of their crop growth and development differently. This can be seen that the physiological and phenological effects of maximum and minimum climate variables on crop plants may significantly different. The same crop plants always require specific maximum and minimum temperatures for good production at different stages of cycles in life.

The economy of this region is based on the natural environment which is usually influenced by climate conditions. Agriculture is one of the most industries so sensitive to climate, with outdoor production processes that relay on particular levels of climate variables controlled by weather conditions. Scientifically, there is a growing agreement that in the few decades, the world would witness changing rainfall levels and higher temperatures due to climate variability, which would lead to poor agricultural production. This is true particularly in countries of low-income, in which climate is the major determining factor for agricultural productivity primarily and low adaptive capacities. This vulnerability is shown in the damaging effects of recent flooding in the Niger Delta region and the prolonged

droughts that are seen in northern parts of the country. Thus, Nigeria as one of the poor countries are vulnerable to high climate variability effects, the responses of farmers to variation in climate is crucial and needs appropriate understanding, as it would help in coping strategies design.The tappers and other related businesses (raffia palm wine distributors, sellers and local dry gin producers) used this product as a means of living (feeding. education, accommodation and tax payment) as expected of African traditional system. It was observed that a litre of palm wine was one hundred and fifty (150) naira only and the local dry gin (alcohol) was one thousand five hundred (1500) naira only which generates a huge financial amount for the indigenes. This makes Ikot Ekpene a regional centre as far as raffia palm wine is concerned.

The variability of the climate in recent times has led to a reduction in the production of most crops. It has been seen that raffia palm wine productions are reducing in Ikot Ekpene. Although many factors can be attributed to the low production problem. The production is much affected by the up and downward movement of climate variables, which in turn will reduce the production of raffia palm wine seasonally. The problem of low production in raffia palm wine might have been attributed by climate parameter's variations. Even though there seems to be much research regarding the impact of climate variability and change on agriculture, very little information is available in the area of climate variability on seasonal aspects of raffia palm wine production, both in Nigeria and the study area, which is noted for its large- scale production of raffia palm wine (Awotoye& Matthew, 2010). Based on the aforementioned, the study seeks to examine the relationship between climate variability and seasonal aspects of palm wine production in Ikot Ekpene Local Government Area of Akwa Ibom State. determine the impact of seasonal variation on raffia palm wine production in Ikot Ekpene.

2. STUDY AREA

Ikot Ekpene is located part of Cross River Basin lying between Latitudes 5° 7' 10'' and 5° 16' 20`' North of the Equator and Longitudes 7° 38' 30`' and 7° 44` 0'' East of the Greenwich Meridian as seen in (FIG. 1.1). It lies on the north-western flank of Akwa Ibom State. It shares boundary in the north and west with ObotAkara L.G.A., Ikono L.G.A. by east and Essien Udim L.G.A. by south. Land area covered is about 125 km^2 (48 square miles). The climate of the study area is described by two seasons; the dry season and the wet (rainy) season. It has an annual rainfall of 1350mm. However, due to the closeness of the study area to the coast, the harmattan dust haze, ("ekarika"locally known) is not too severe as compared to the northern Sahelian zone of Nigeria. Sometimes, it may take about two weeks between December and January. Temperature values are very high in Ikot Ekpene, with the mean annual temperatures ranging between 26℃ and 36℃ throughout the year. The study area with relative humidity which varies between 75 per cent and 95 per cent; July and January having the highest and lowest values respectively. The relief of the study area is characterized by coastal plain of the south-eastern Nigeria (Wokocha & Kamalu, 2009); where there is no part of the area constituting high relief. The landscape of the study area has a low-lying plain which no portion exceeds 175m above sea level.
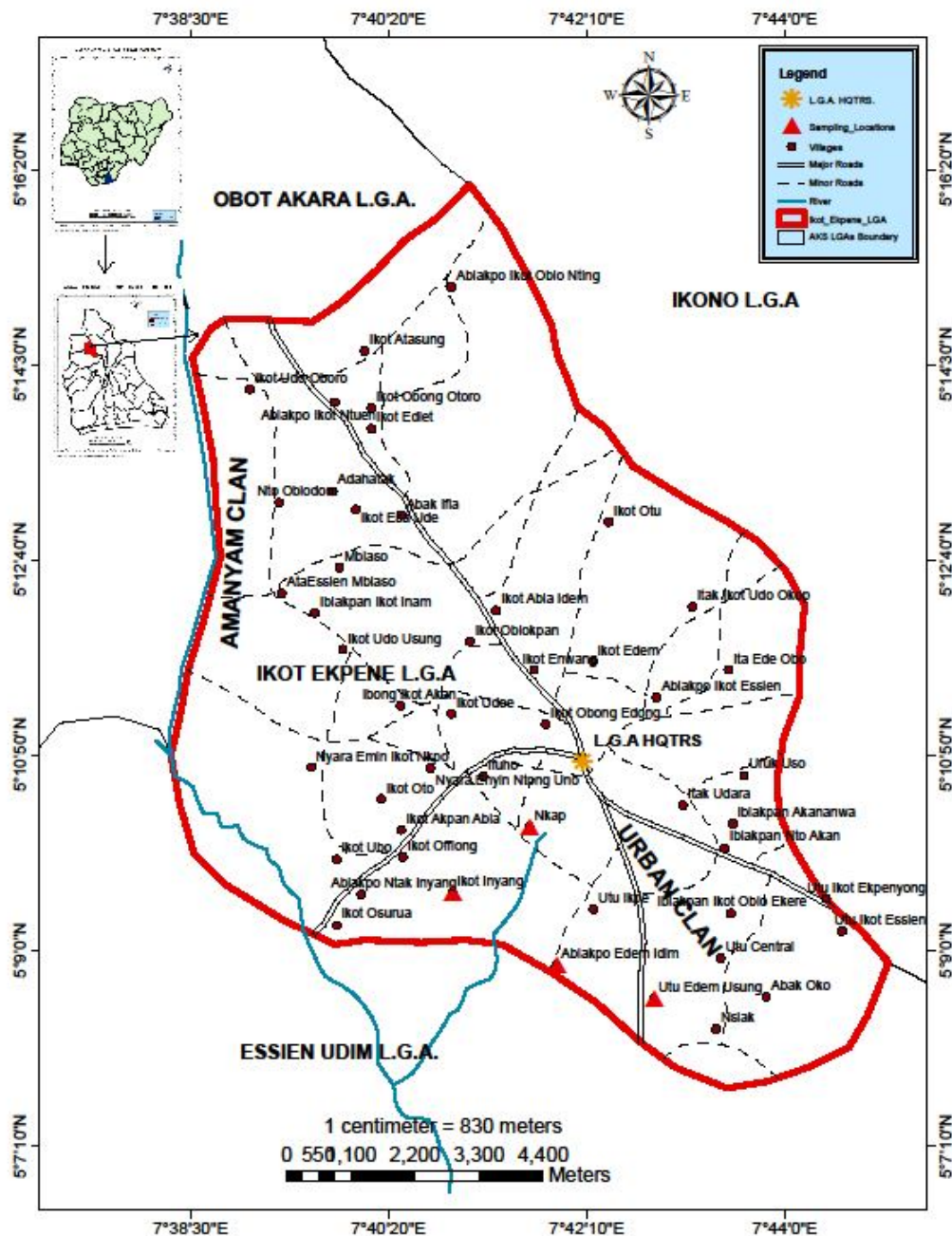
FIG. 1: Map of Ikot Ekpene Local Government Area showing sampling location.

Source: Office of the Surveyor General, Uyo, Akwa Ibom State.

The socio-economic activities of the people of Ikot Ekpene are predominantly subsistence farmers and peasants producing arable crops such as cassava, vegetables and maize. Raffia and oil palms are the tree crops popular amongst others in the study area. Some of the indigenes are traders while others are civil servants. The area is

popularly known for its exports of palm produce especially raffia products including raffia wine and its fibres, raffia cane furniture, basket weaving and carving, palm oil and kernels as well as crafting. Some common food crops grown in the area are; cassava, plantain, fluted pumpkin, waterleaf, sweet yam, maize, cocoyam, taro, banana (Okeke, 1980) and micro-livestock (Umoh, 1997).

3. METHOD OF STUDY

The research adopted across - sectional research designs. Survey, which is one of the cross-sectional research designs oriented towards the determination of the status of a given phenomenon. The area of research survey encompasses procedures of measurement that result in asking of questions to the respondents, objectively describing the existing phenomena and the collection of data accurately. The adoption of this method was to determine the impact of seasonal variation on raffia palm wine production. The study adopted two types of probability sampling techniques namely: stratified and random sampling techniques. Stratified sampling technique was based on two political wards out of ten political wards in Ikot Ekpene Local Government Area to ensure good coverage of the population of study where the four communities are under. Random sampling was also used in the questionnaire administration to sixty-eight (68) raffia palm wine tappers, thirty-one (31) distributors, thirty-nine (39) sellers and eighteen (18) local dry gin producers (LDGPs) within the four communities selected.

One hundred and fifty-six (156) respondents were selected for the purpose of analysis as depicted in Table1. The respondents were selected based on the years of experience which was above five (5) years to give response to the questionnaire on the climate variability effects on raffia palm wine production. Data were presented using descriptive and quantitative statistics. The descriptive statistics include tables, percentages and graphs. The quantitative techniques employed were the time series which describes the pattern and trend of fluctuation in most series data otherwise known as component (time series). Crop-weather model which is the multiple regression analysis was used to examine the influence of climate variables on raffia palm wine production seasonally.

**TABLE 1:**The occupational distribution of the respondents in Ikot Ekpene

Communities	Tappers	Sellers	Distributors	LDGPs
AbiakpoEdemIdim	9	6	5	3
Ikot Inyang	30	15	13	5
Nkap	15	10	8	6
Utu EdemUsung	14	8	5	4
Total	68	39	31	18

Source: Author's Fieldwork, 2018

4. RESULTS AND DISCUSSING OF FINDING

The impact of seasonal variation on raffia palm wine production was graphically represented in FIG. 4a and FIG. 4b. It was observed that about 263,000 litres of raffia palm wine were produced in 2018 by 68 tappers from the field measurement. The production was high between November – May which is the dry season and low production during rainy season from June – October, with the peak in February which was 40,000 litres. The reason for the high production in dry season is that the temperature (maximum and minimum) heats the sap to rise and bring out more wine why the rainy season condensed the sap. This means that the higher the temperature, the higher the production of raffia palm wine and the higher the rainfall, the lower the production of raffia palm wine in the study area and vice versa.
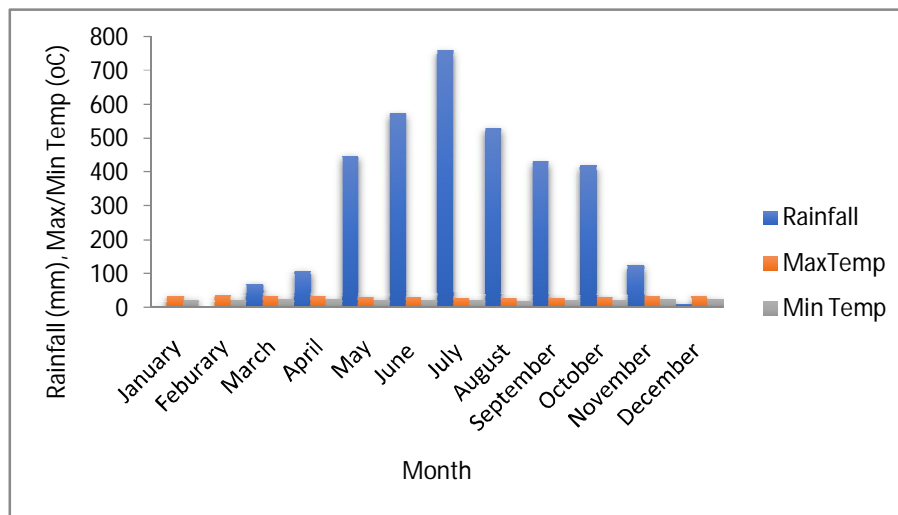
FIGURE2a: Chart showing the climate variation in season
Source: Author's Analysis, 2018
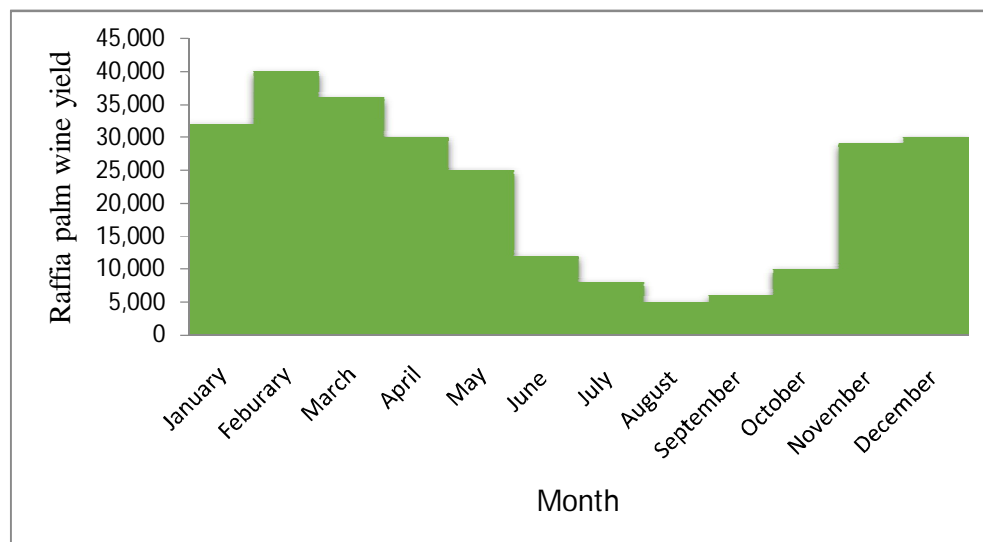
FIGURE 2b: Chart showing raffia palm wine variation in season
Source: Author's Analysis, 2018

To examine the climate variables effect (annual rainfall and temperature) on raffia palm wine production in Ikot Ekpene. Data on climate variables (temperature and annual rainfall) and raffia palm wine production were used in analysing the cross-sectional regression to show the relationship and influence between climate variables and raffia palm wine production. The relationship between climate variables and raffia palm wine production shows that annual rainfall (-17.24478) and minimum temperature (-1013.508) had negative relationship with raffia palm wine production while maximum temperature (3799.187) have positive relationship. This implies that variations in maximum temperature account most for the variations in raffia palm wine production.

Cross-sectional regression analysis summaries the mathematical relationship between raffia palm wine production (Y - dependent variable) and maximum temperature (x_1), minimum temperature (x_2)

and rainfall (x_3) (independent variable). From the result, the value -69877.09 is known as the base constant. This is the fixed amount of raffia palm wine production that will occur before the influence of the independent variables (rainfall, maximum and minimum temperature) begins to make an input. The value -17.2, -1013.5 and -3799.2 are the coefficient or slope of the regression line. In this study, the coefficient for x_1 (-17.2) means that each unit increase in rainfall (x_1) would lead to a -17.2 decrease in the production of raffia palm wine, holding slope angle (x_2 and x_3) constant. Similarly, the coefficient for x_2 (-1013.5) means that each unit increase in minimum temperature (x_2) would lead to a -1013.5 decrease in the production of raffia palm wine, holding slope angle (x_1 and $x3$) constant and the coefficient for x_3 (-3799.2) means that each unit increase in maximum temperature (x_3) would lead to a -3799.2 decrease in the production of raffia palm wine, holding slope angle (x_1 and x_2) constant. This is shown in table 2.

TABLE 2: Cross-sectional Regression of the effect of mean rainfall

Variable	Coefficient	Std. Error	t-Statistic	Prob.	R-squared	Adjusted R-squared	F-ratio	Prob(F-statistic)
C	-69877.09	73880.46	-0.945813	0.3719	0.720655	0.615901	6.879482	0.013200
LOG(RAINFALL)	-17.24478	21.92295	-0.786608	0.4542				
LOG(T_{min})	-1013.508	3546.762	-0.285756	0.7823				
LOG(T_{max})	3799.187	3452.404	1.100447	0.3031				

Coefficient is significant at 0.05 confident level

Source: Author's Analysis, 2018

From the cross-sectional regression result on the effect of mean annual rainfall, T_{max} and T_{min} on the RPWP in the study area. It was observed that annual rainfall and T_{min}

negatively influenced the production of RPWP and statistically significant at 5 percent level. This means that rise in annual rainfall and T_{min} could have a negative effect

on raffia palm wine production. In contrast, T_{max} was statistically insignificant and has no effect on raffia palm wine production. It showed that the cross-sectional regression coefficient of multiple determination which is the Adjusted R^2 was 0.615901, it can be noted that about 61.6 percent of variation in raffia palm wine production could be explained by means of rainfall, T_{max} and T_{min}. The remaining 38.4 percent of the variations in the production of raffia palm wine can be caused by other unexplained factors like raffia palm varieties, soil characteristics, pest and diseases, tapping methods by the tapper and other climatic factors.

The season of tapping have a significant effect on the production of raffia palm wine. Tappers that tapped during raining season confirmed that raffia palm production less than dry season. Tappers confirmed that the temperature makes the sap to rise and bring out more wine why the rainy season condensed the sap. This implies that the higher the temperature, the higher the production of raffia palm wine and the higher the rainfall, the lower the production of raffia palm wine in the study area and vice versa. This finding agreed with Schlenker and Robert (2006) that productions increase as temperature increases until about 29^0C for corn and soybeans and 33^0C for cotton, but temperatures above these thresholds quickly become very harmful. The finding also disagreed with the work of Monizi, Mayawa, Fernando, Neinhuis, Lautenschlager and Koto-te-Nyiwa (2018) that raffia produce during the rainy season is better than dry season. In contrast, the study agreed that raffia palm wine produced during dry season has a better flavor and taste than the one from the rainy season.

The result of the cross-sectional regression analysis shows that the coefficient of multiple determination (R^2) is 0.616 (61.6%) meaning that the independent variables (X_1…. X_3) jointly explained 61.6 percent of variation in raffia palm wine production. Consequently, the interpretation of the results of the cross-sectional regression indicates that Rainfall (X_1) was positively related to raffia palm wine production however it was not significant statistically. Minimum temperature (X_2) and Maximum temperature (X_3) have a negative relationship with raffia palm wine yield but they are statistically significant. This shows that rainfall and minimum temperature influenced raffia palm wine production negatively while maximum temperature influenced raffia palm wine production positively. The F-ratio was statistically significant at the 0.05% level and as F-calculated value (6.879) was greater than F-tabulated value. The researcher concluded that there is a significant relationship between climate variability and raffia palm wine production. Raffia palm wine production is affected by climate variability as shown in the result. Thus, the distribution of annual rainfall and T_{min} has been the major determinant of crop production in the area. This confirms the findings by Kirttii, Phanindra and Mishra (2010) that rainfall and temperature are the two important weather factors that affect crop productions due to their direct and indirect influences which lead to unacceptable low productions. Also, it has been observed by Obafemi and Adebolu (2018) in Ondo State, Nigeria that annual rainfall amount has a strong influence on crop yield. It is important to note however that, the significance of the climate variables in influencing production in this case could be due to the period of harvesting which in turn affects the production but these were not available.

The production of raffia palm wine is negatively affected by the climatic variables at a 5 percent significance level which strongly justified the climatic influence on raffia palm wine production. This study disagreed with the study of Akinbile, Akinlade and Abolude (2015) that crop yield had drastically decreased due to erratic rainfall, increase in sunshine hours, increased in temperature and pest infestation.The effect of climate variables (annual rainfall and temperature) and raffia palm wine production show a strong and positive relationship. This is in agreement with the work of Malla, (2008) in the study of the yield of millet in Nepal. Therefore, the researcher concluded that temperature extremes favour the production of raffia palm wine and intense rainfall disastrously affected this major tree crop.

5. CONCLUSION

This study has examined the trend of climate variables and production of raffia palm wine from 1989 - 2018 in Ikot Ekpene Local Government Area of Akwa Ibom State, Nigeria. Based on the results, it can be concluded that temperature has significantly decreased over years and that rainfall has significantly increased. The climatic variation has impacted negatively on the production of raffia palm wine in the study area leading to reduction in production of raffia palm wine. From the field survey, it was seen that the production of raffia palm wine was high during dry season and low during raining season which indicates that temperature influences or affects raffia palm wine production positively while rainfall affects the production of raffia palm wine negatively.

Based on the observed problems and findings from the research, the following recommendations have been put forward to reduce the effects of climate variability on raffia palm wineyield. Climate variability is noteworthy, sothereis an optimum need to sensitize the general public about its existence in order to take the necessary measures and adaptation options for its mollification and management, because of its influence on agricultural activities and other aspects of human lives and also, appropriate climate forecasting and early warning system should be made part and parcel of planning and development so as to increase the production of raffia palm wine in order to improve the local dry gin industry.

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