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Prediction of oil palm production (*Elaeis guineensis* Jacq.), using agroclimatic data, grown in South-Eastern Côte d'Ivoire

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Abstract

The knowledge of the expected production, allows managers of agro-industrial plantations to better organize their technical and financial management. The estimation methods must be easy to apply, while having sufficient precision. This study was initiated to contribute to the development of a method for estimating oil palm production through the use of rainfall data. Experiments were conducted on experimental stations Robert-Michaux of CNRA at Dabou, of PALMCI at Ehania and of PALMAFRIQUE at Anguédedou, located in the south-east of Côte d'Ivoire. The proposed methodology is based on the time between initiation and maturation of the palm regimes. This evolution of the inflorescence is influenced by the climate, through the effects of rainfall. The hydric deficit provides information on the tonnage that will be harvested in the next three years. The results obtained showed that the water deficit was higher in Dabou and Anguédédou than in Ehania. The yields over the four years studied were 16.07 tons/ha/year at Ehania, 12.77 tons/year at Anguédédou and 10.37 tons/ha/year at Dabou. The variations of hydric deficit and that of the production carried out previously make it possible to estimate the production in three years. The climate-based model shows satisfactory results, with error accuracies between 0 and 10% and determination coefficients (R^2) of more than 0.97. They demonstrate the economic and technical interest of such a method in the case of these production localities having information on the climatic conditions of oil palm cultivation.

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Introduction

Agriculture is an essential economic sector and remains today the first field of activity in many African countries, particularly in Côte d'Ivoire. With a world population rising from one billion in the early nineteenth century to more than seven billion today, food needs have grown steadily. A considerable increase in global food production is thus required each year in an increasingly severe climate (IPCC, 2014). Indeed, agricultural systems are very vulnerable to climate variability and farmers have to deal with this factor in order to make their activity profitable (Hoogenboom, 2000). Agriculture is therefore a complex sector comprising different main parameters (environmental, economic and social). It is now well recognized that harvests are very sensitive to climate change (Easterling *et al.,* 2007), with different effects depending on the region. In this context of food insecurity and climate change, it is essential to improve the means of monitoring agricultural production to face development challenges and reduce the vulnerability of populations.

Predicting crop production is a strategic issue for developing countries, both in terms of food security and economic. It is therefore increasingly important in developing countries and, as well as in developed countries, to forecast agricultural yields accurately and punctually, on regional and even national scales (Meyer-Roux, 1990). Crop yield forecasting is an exercise in pre-harvest preparation and dissemination of quantitative or qualitative information on the expected yield of a crop. Production forecasting is of particular importance in the area of food security (FAO and AFRISTAT, 2000) in developing countries where climate disasters sometimes exist. The evolution of climatic factors is, in spite of everything, decisive for the evolution of yields, in the short, medium and sometimes long term.

Like the developing countries, the Ivorian economy is essentially based on agriculture, particularly the exploitation of industrial crops (cocoa, oil palm, coffee, rubber). Palm oil, with an annual production of around 400,000 tons, has been the second largest export after cocoa (1,300,000 tons) since 2007 (Anonyme, 2012). Palm oil is the most consumed vegetable oil in the world (Koné, 2012), with 42 million tons in 2011, or 25% of all edible oils.

However, there is often an approximate management of the agricultural operators of oil palm production, leading to a mismatch between the volume of production and the resources mobilized. Mastering production in terms of regimes makes it possible to partially overcome the vagaries of supply and demand, and to better control stocks. With the aim of improving this control of the eleaicole production, this study aims to provide a method of forecasting oil palm production in Côte d'Ivoire. More specifically, it will be necessary to predict the yield from meteorological data. Climate has a strong influence on agricultural production, which can be considered as the most weather-dependent human activity (Hansen, 2002). Its impacts on agriculture vary from one region of the globe to another with particularly important socioeconomic consequences in the developing countries of tropical latitudes.

Advances in climate research are improving day-to-day seasonal climate prediction based on models representing the dynamics of the atmosphere and oceans (Palmer *et al.,* 2004). Regional statistical schemes using (Fontaine *et al*., 1999; Ward, 1998), climate information for agriculture remains marginal in Africa. Among the reasons that can be invoked, there are several major problems resulting from the coupling between climate and agriculture.

The main limiting factor in oil palm production is the water supply. A fairly good estimate of this is given by the simplified assessment of the water deficit. Rainfall is the main climatic factor for good oil palm productivity (Diahuissié and Boaké, 2000). The rainfall deficit has an effect on the oil palm reproduction process (Houssou, 1985).

These predictive models can also be used to simulate the impacts of specific climate changes, such as changes in temperature, humidity, availability of water, length of crop cycle, phenology and oil palm productivity.

These predictions, according to Zoundi *et al.* (2007) and Bacci *et al.* (2008), reduce the effect of climate variability on harvests. These climatic data will make it possible to quantify the future production of the oil palm, provided that the planting unit can be representative of the whole.

The general objective of this study is to partially overcome the uncertainties of supply and demand, and to better control stocks, through a better control of the future production of oil palm, based on data from the rainfall. In order to improve the control of oil palm production, the specific objectives of this study are (i) to provide a reliable method for forecasting production in one of the main growing areas of Côte d'Ivoire and (ii) to evaluate the sensitivity of the method to the data required for this forecast.

Material and methods

Study sites

The studies were conducted in open field in three different localities in south-eastern Côte d'Ivoire. These are the localities of Ehania, Anguédédou and Dabou.

The experiments were conducted on three plots distributed in the three localities. The tests were set up on a single type of operation. These are industrial plantations belonging to the Ivorian oil palm agro-industries and a research center. These agro-industries are PALMCI and PALMAFRIQUE which hold respectively the Ehania plantation and the Anguédédou plantation. The Dabou plantation belongs to the National Center for Agronomic Research (CNRA). These are agro-industries of oil palm production and research center, with what it implies as rigor in data collection.

The climate of South-East Côte d'Ivoire is of humid subtropical type with marked seasons and Attiean type with coastal facies. The soils, derived from tertiary sands, are ferralsols and strongly desaturated, deep, sandy on the surface and without coarse elements. The kaolinite clay has a low exchange capacity. These pedoclimatic conditions are adapted to oil palm cultivation.

Materials

The plant materialsare composed of oil palm hybrids obtained by crossing between *Dura* (female) and *Pisifera* (male). The *Dura* type is characterized by fruits having a thin pulp and a thick shell. The *Pisifera* type is characterized by a high abortion rate of the fruit and by a very thin shell or completely absent. The *Tenera* hybrid, called C1001F, derived from the crossing "La Mé x Deli" was used. This plant material, characterized by a high yield and a resistance to *Fusarium*, comes from the second cycle of recurrent reciprocal selection. This new plant material is currently being popularized in all Ivorian oil palm growing areas.

In the oil palm, after the natural opening of the spathe of the female inflorescence, then occur the flowers which will be fertilized, at most three days later, by the pollen grains of neighboring trees. The female inflorescence is then transformed into a diet, which reaches maturity 5.5 to 6 months after fruit set. However, from the flower initiation to the maturity of the diet, it elapses 30 to 33 months.

Choice of the sample

In plantation, a sample of about 5% of trees is generally considered sufficient. To account for edaphic variations on a crop unit, this sample must be distributed throughout the plot. Therefore, one in 20 trees (for small areas per harvesting system) or one line in 20 of which all trees were observed (for large areas) was chosen systematically. In total, these trees or lines were chosen and spread over the entire test plot. The same trees or rows have been kept in order to possibly adjust the results obtained after several series of harvests compared to the actual results obtained. The lines were marked with an identical mark on all the study plantations, with metal tags bearing the numbers of the line and the tree. This practice makes it possible to better organize the weighing of diets and to carry out the systematic controls.

Determination of bunches yield

Performance components were determined from individual harvests. For this operation, carried out every fortnight, a team comprising a harvester, a weigher and a pointing clerk visits each identified tree of the plot to collect the production data, according to each harvesting system. These are bunches number per tree (NR/tree) and the weight of bunches per tree (PR/tree), from which the bunch average weight per tree (PMR/tree) and the tonnage of bunches or yield (TR/ha/year). The number of bunches per tree is determined by counting all bunches harvested on each useful tree. The weight of bunches is determined by weighing, using a balance (weighing scale with support) of all the harvested crops per tree. The data collected is used to calculate the yield from which output per unit area is deducted.

Production of one hectare of plantation of one year of plantation:

TR/ha/year= (DP*NR/tree/year* PMR/tree/year)/1000, where DP is the actual density of plantation; NR/tree/year is the number of bunches per tree per year and PMR/tree/year isbunches average weight per tree per year.

For an entire plantation, the total production for a given planting year:

TTR/year = (DP * NR/tree/year * PMR /tree/year * Areas)/1000

Determination of the rainfall and hydric deficit of the three localities

Meteorological data were recorded over the last decade, from rainfall and water deficit, in the localities of the study, in order to monitor their influence on oil palm production.

All the PALMCI and PALMAFRIQUE agro-industrial complexes and the CNRA station have rainfall gauges, which have made it possible to collect rainfall data and total numbers of rainy days. Five-year series of data made it possible to follow the evolution of rainfall in the south-east of Côte d'Ivoire. These rainfall data were used to calculate the annual hydric deficit (DH) from 2001 to 2004, using the simplified water balance method (Dufour *et al.,* 1988), which does not take into account runoff (Rushton *et al.*, 2006), because of the presence of cover plants.

The water balance (BH) is expressed from a very simplified formula, established in the West African climate conditions by the IRHO (Yao *et al.,* 1995), which makes it possible to calculate the hydric deficit. (DH) by taking the accounting balance of the rains, to which is added the soil water reserve (maximum reserve estimated at 200 mm).

BH = P + R - E, where

BH: Hydric balance (mm);

P: Rainfall (mm);

R: Initial soil water reserve from one period to another (limited to a maximum of 200 mm, due to the sandy soil texture) (Yao *et al.*, 1995);

E: Simplified evaluation of the evapotranspiration of the adult oil palm, which takes the value of 120 mm per month when the number of rainy days is greater than 10, and 150 mm per month, if this number is less than 10 (Yao *et al.*, 1995).

The water balance was based on the difference between inputs (precipitation and initial soil reserve) and water losses (annual evapotranspiration) in the soil. When the water balance is negative, there is a water deficit (DH). The hydric deficit (DH) is expressed according to the formula below:

DH = - BH

This hydric deficit obtained from the water balance allowed to establish the climatic model used for the determination of the oil palm production.

The approach was to calculate the DH in year's n, n-1, n-2 and n-3 and these values were correlated with the annual yields to choose those closely related to the expected harvest. The choice is made on the DH, 3 years before the harvest.

Development of the climate model

The climatic or mathematical model was developed from the simulation of yield per hectare and crop year (TR/ha/year of crop) by DH, three years before harvest.

The observed results of this simulation are quadratic equations whose form is "a * x² + b * x + c", with a, b and c; constants in a definition domain related to the extremums of the DH used.

Evolution of the annual hydric deficit at the different sites studied

For the study, the annual hydric deficit (DH) was calculated, from the pluviometry, on all the studied localities, over the period 2001 to 2004. Fig. 1 presents the evolution of the DH in the three localities studied.

Results

Table 1. Average precision between estimated production (TRE) and realized production (TRR) on the Ehania plantation.

Years	DH	TRR/ha	TRE/ha	TRE-TRR	%TRR
1997	580	8	10	2	25
1998	424	11	12	1	09
1999	240	13	15	2	15.3
2000	467	14	11	-3	-21.4
2001	272	13	14	1	7.7
2002	635	15	10	-5	-33.3
2003	110	19	18	-1	-5.2
2004	300	17	13	-4	-23.5
2005	486	18	11	-7	-38.8
2006	239	16	15	-1	-6.2
2007	459	15	11	-4	-26.6
2008	195	19	16	-3	-15.8
2009	329	23	13	-10	-43.5
2010	200	20	16	-4	-20
2011	95	14	18	4	28.5
Average	335	16	13	-3	-18.7

DH: Hydric deficit; TRR: Tonnage of bunches realized; TRE: Tonnage of estimated bunches: ha: hectare.

The variability of DH is a function of localities and years of measurement. DH, with annual values varying between 115 (Ehania) and 640 mm of water (Dabou), was significantly higher in Dabou compared to other localities, in general. In Ehania, the year 2003 was the wettest, with a DH of 115 mm of water per year and the driest was 2002. In Anguédédou, with a DH of 430 mm of water per year, the year 2001 was the driest. In Dabou, the year 2004, with a DH of 640 mm of water per year, was the driest (Fig. 1).

Evolution of the annual yield in schemes realized in the different localities

Fig. 2 shows the average annual yields obtained by locality studied during the period 2001 to 2004.

During these 4 years observation, the average annual yields varied according to localities and years of study. Yields were highest in Ehania (Southeast), averaging between 12.5 (2001) and 19.4 tons/ha/year (2003). With average values varying between 9.01 (2001) and 11.3 tons/ha/year (2004), yields were significantly lower on the Dabou plantation, compared with other plantations in the localities studied. These yields, obtained in Anguédédou, ranged from 10.4 (2001) to 16.7 tons/ha/year (2004). In general, the year 2001 was the least productive on all the plantations of the different localities. The years 2003 and 2004 were more productive, respectively, on the Ehnaia plantation and on the Anguédédou and Dabou plantations (Fig. 2).

Evolution of annual average precision between estimated production and realized production carried out on the various sites

Case of the plantation of Ehania

Production realized (TRR) and estimated (TRE) were evaluated during the period from 1997 to 2011 on the PALMCI plantation in Ehania (South-east). The productions produced ranged between 8 and 23 tons/ha/year and those estimated were between 10 and 18 tons/ha/year (Table 1). The productions produced, the highest, were obtained during the years 2003, 2005, 2008, 2009 and 2010. These years of high productivity are preceded by a year of low water deficit, located more than 2 years ago.

Table 2. Average precision between estimated production (ERR) and realized production (TRR) on the Anguédédou plantation.

Years	DH	TRR/ha	TRE/ha	TRE-TRR	%TRR
2001	444	10	10	0	0
2002	364	11	11	0	0
2003	356	12	11	-1	-9
2004	271	16	12	-4	-25
2005	89	13	17	4	30
2006	164	17	15	-2	-12
2007	219	11	14	3	27
Average	272	13	13	0	0

DH: Hydric deficit; TRR: Tonnage of bunches realized; TRE: Tonnage of estimated bunches; ha: hectare.

This Table 1 also presents the summary results of the precision of the estimated production compared to the production carried out. Differences observed between the achievements (TRR) and the estimate (TRE) reached 10 tons/ha/year, over the 14 years of observation. The average difference observed between completion and estimation (Table 1) during the study period is 3 tons/ha/year on this plot of PALMCI in Ehania.

Fig. 3 presents the evolution of the estimated average yield according to the annual water deficit. The equation that links the estimated production and the DH is in the form:

$TRE/ha = 2.308 * 10^{(-5)} * DH^2 - 0.03218 * DH + 21.04$, with a coefficient of determination (R^2) of 97%. This quadratic equation is only valid for DHs between 0 and 635 mm of water/year. The estimated yield changes according to the progression of the DH obtained three years before the harvest year. The more the water deficit increases, the estimated yield decreases.

The mathematical model, developed from the simulation of the yield (TR/ha/year) and the DH of a year n, makes it possible to determine the estimated yield of the year n + 3.

Case of the Anguédédou plantation

On the Anguédédou parcel, the annual production realized (TRR) and estimated (TRE) were recorded and calculated over the period 2001 to 2007. Table 2 presents the summary values of the production data for this period. Estimated production has varied between 10 and 17 tons/ha/year. As for the tonnage achieved, it also oscillated between 10 and 17 tons/ha/year.

The highest productions achieved during 2004 and 2006, with respective productions of 16 and 17 tons/ha/year. These two years of high production are preceded by two years back of low hydric deficit (DH) (Table 2). The average production achieved and estimated is 13 tons/ha/year, over the 7 years of observation. The average difference between the realization and the estimate is 0, on this plantation of Anguédédou.

The evolution of the estimated production (TRE) as a function of the water deficit (DH) is presented in Fig. 4. The quadratic type equation relates the estimated annual production and the water deficit.

This equation is of the form:
TRE/ha = 3.89 * 10^{-5} * (DH) ^{2} - 0.04137 * DH + 20.72, with a coefficient of determination (R^2) of 96%.

This equation is justified only for water deficits between 89 and 444 mm of water per year. The estimated annual production changes according to the annual water deficit. The water deficit evolves in the opposite direction of the estimated annual production. When the water deficit increases, the estimated production decreases.

Table 3. Average precision between estimated production (ERR) and realized production (TRR) on the Dabou plantation.

Years	DH	TRR/ha	TRE/ha	TRE-TRR	%TRR
2001	366	9.01	11	2	18
2002	342	10,3	11	1	11
2003	403	10,9	9	-2	-20
2004	540	11.3	10	-1	-13
Moyenne	272	13	13	0	0

DH: Hydric deficit; TRR: Tonnage of bunches realized; TRE: Tonnage of estimated bunches; ha: hectare.

Case of Dabou's plantation

Table 3 presents the summary data of the annual production carried out and estimated on the Dabou plantation. These production data were recorded over the period from 1997 to 2011.

The production carried out varied from 6 to 14 tons/ha/year and that estimated oscillated from 6 to 12 tons/ha/year, according to the recorded annual water deficit. In the region. The highest realized productions recorded during the years 2009 and 2010, with respective values of 14 and 12 tons/ha/year. These years (2009 and 2010) are preceded by years of lower hydric deficit from 2005 to 2008.

As for the estimated production, the years 2010 and 2011 were the most productive, with respective estimates of 11 and 12 tons/ha/year. These years are preceded by years ago, with recorded water deficits being the lowest.

The evolution of the estimated production is related to the annual water deficit, of which Fig. 5 shows the dependence of productivity on rainfall. The corresponding equation linking the estimated production and the water deficit is in the following form:

TRE/ha = -0.009615 * $(DHR/100)^2$-0.7404 * (DHR/100) + 13.23, with a coefficient of determination (R^2) of 91%.

This equation is only valid for water deficits between 200 and 900 mm of water per year. Estimated production and water deficit change inversely. The more the water deficit increases, the estimated production decreases.

Discussion

In recent years, rainfall has been declining, which has led to an increase in DH in West Africa, and more particularly in south-eastern Côte d'Ivoire. This finding, confirmed by this study, has already been mentioned by authors such as Buisson (1989) and Yao (1989).

The decrease in rainfall and the rise in DH are due to the combined action of man and nature (Yao, 1989). Abuse of forests in the wetland, associated with natural phenomena, has contributed to significantly reduce rainfall. Seasonal bush fires, anarchic deforestation without sufficient reforestation, and extensive slash-and-burn agriculture in southern Côte d'Ivoire are contributing to further declines in rainfall (Tanina *et al*., 2011).

According to Péné and Assa (2003), the decrease in rainfall can be explained by a climate deregulation, linked to the adverse influence of certain environmental factors, on the intertropical front migration mechanism (ITF). The various positions of the ITF determines the climate in West Africa, including Ehania, Anguedédou and Dabou. The highest rainfall recorded in the town of Ehania can be explained by the proximity of the sea and the presence of dense evergreen forests. Numbers of rainy days, markedly high recorded in both localities, explain the high rainfall in Ehania. The rains, being well distributed throughout the year, favor, thus, a continuous production of the oil palm, all year long in the South-East of Côte d'Ivoire.

The results presented in this study highlight the importance of the production forecasting method using agroclimatic data. The reliable estimate of the production in regimes therefore uses climate data (water deficit), because the average differences, between estimation and realization, are between 0 and 10%. The forecast also makes it possible to establish projected operating accounts, to make production estimates and to meet the anticipated sales commitments, thus creating a climate of trust between producers and trading partners (FAO, 1991).
Production forecasting, according to Whisley *et al.* (1986), is part of a series of statistical activities, which are conducted in the following order: assessment of crop condition, crop forecasting, crop estimation and final estimate. For Horie *et al.* (1992), the data obtained make it possible to derive the forecast of returns by means of regression models, empirical rules or informal models based on sectorial experience. This is an effective and reliable method.
"Precision" refers to the difference between the yield forecasts and the production data obtained. Such differences have multiple origins: sampling errors, unforeseen crop damage, and specification errors. Other measures of "precision" must then be used, such as the correlation coefficient (r) and the average deviations (%) between forecasting and realization.
The average difference makes it possible to easily assess the degree of similarity between realization and forecast, and also makes it possible to measure the relative error made on the estimate.
A small mean difference means that the error is small, so the results obtained are reliable (Vossen, 1993). In our study, the difference between 0 and 10% was observed between forecast, using climate data, and realization. These values are less than 10%, which the threshold below which the estimate is of very good credibility. This highlights the reliability of the prediction method, based on the water deficit.

The correlation coefficient (r) is used to describe the percentage change in real returns explained by the forecasts. It helps to explain the variations in yield. In other words, the higher the value of r (value tending towards 1), the more the forecast model presents the same variations as the real values. The coefficients of variation of about 0.97 obtained on all the parcels explain the smallest variation of yield between the forecast and the realization. This approach is of great benefit because the international community has an interest in developing an operational model for early assessments of major crops (King and Meyer-Roux, 1990). The studies of Nacambo (2010) and Kiendrebeogo (2010) have shown that in some localities peasant forecasts were based on natural factors, such as climate.

The sensitivity of agriculture, in the face of climate, originates in a set of fundamental factors, such as, the length of the growing season, the accumulation of heat (temperature), the level of precipitation, the evapotranspiration, the hour's sunshine and available moisture, and act directly on the yield of a crop. These factors, some of which are positive and others negative for agriculture, collide, canceling out the effects of both and making the net impact estimate very difficult to predict (Brklacich ans. Smit, 1992, Arthur and Van Kooten, 1992, Weber and Hauer, 2003).

The tropical water deficit, associated with a higher risk of drought, appears to be the most important climate factor for agriculture (Watson *et al.,* 2001). This climate index is used to evaluate the production potential of crops. The rainfall deficit/surplus and the actual rain day numbers are the main climatic variables used to estimate crop production (Agronomic Interpretation Working Group, 1995).

The climate, through rainfall, is the main climatic factor for good productivity of the oil palm. The optimum annual requirement is 1800 mm of rainfall, well distributed during the year (Diahuissié and Boaké, 2000). The rainfall deficit has an effect on the oil palm reproduction process (Houssou, 1985). Three critical periods of production are particularly sensitive to a lack of water (Houssou 1985, Frère 1986). A lack of water during the period from floral initiation to sexualization, that is, 42 to 36 months before the harvest of the diets, leads to a higher rate of male inflorescences at the expense of female inflorescences. . When the water deficiency occurs during the period preceding the issue of the leaf bearing the inflorescence, 24 to 20 months before harvest, the risk of abortion of this floral draft becomes high. A lack of water during the growth phase of the female inflorescence also increases the risk of abortion, and significantly reduces the size and weight of diets. This period is between 15 and 6 months before the harvest of the future bunch.

According to Caliman (1992), hydric deficit is a factor of the yield, because an increase of 100 mm of the annual deficit, in the deficit range from 0 to 500 mm, causes a variation of the yield of 2.1 tons of diets, or 10% of the potential production with no water deficit. For Frère (1986), the existence of a climate with marked dry and rainy seasons results in cycles of inflorescences females and males, very pronounced. As a result, there are strong productions in some months, which can represent more than 15% of the annual production, whereas in some months production only represents less than 3% of total production.

The climate has a very strong influence on oil palm production, which can be considered as one of the most weather-dependent crops. Its impacts on oil palm production vary from one area to another, with socioeconomic consequences, particularly important in the tropics.

In reality, the yield is conditioned by relatively stable parameters, such as soil and climate. Cropping practices will also affect performance and will depend on the skill and skills of farmers.

The use of fertilizers and protection against diseases are related to these skills, but also to economic conditions. The variability of weather conditions, within normal climatic conditions, often explains most of the annual variability over relatively short periods of time. For longer periods, changes climate change and soil improvement or degradation may be the main factors affecting yield. These various elements are not independent of each other; some agricultural practices mitigate or, on the contrary, increase the variability due to weather conditions.

Conclusion

Reducing the vulnerability of populations to a given risk is an essential link for the proper management of this risk. In Côte d'Ivoire, faced with the various climatic hazards experienced by the country, for decades, in particular, the decline in rainfall, vulnerability of rural populations has increased especially as their agricultural products are largely dependent on conditions climate. The oil palm, which is one of the preferred sources of income as a major cash crop, is not excluded. The climate, through rainfall, is the main factor for a good production of oil palm. The water deficit influences the production of oil palm bunches.

The method described in this study is a simple way to evaluate the production of the year, but it must be considered as an indicative management element. Indeed, despite relatively sufficient production, it can sometimes be slightly overestimated or underestimated, due to seasonal variation and maturation time. It has, however, the merit of an easy job and to give sufficient information.

The predictive model elaborated, as part of this study based on agrometeorological data, allows a relatively good estimate of the yield of oil palm cultivation, on the scale of South-East Côte d'Ivoire (R^2 = 0.97). The variations of hydric deficit and that of the production carried out previously make it possible to estimate the production in three years.

However, it is obviously necessary to improve this model for forecasting oil palm production. Improved oil palm yield forecasting capabilities depend on a better ability to model the interactions between yields and the variables affecting these yields; such variables affect areas as diverse as soil and farming techniques. Only by integrating all the factors involved in this model can forecast errors be reduced. This condition of integration of many variables is essential to the development of this technique on a large scale.

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