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RESEARCH ARTICLE

A COMPARATIVE INVESTIGATION OF EVAPOTRANSPIRATION (ET) OBTAINED FROM TWO METHODS AND DETERMINING A BEST CULTIVATION PERIOD. CASE OF BAFATA – GUINEA BISSAU

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ABSTRACT

This investigation has permitted us to come to the conclusion that the INSTAT+3.37 and CROTWAP8.0 methods of computation of the evapotranspiration are coherent in Guinea Bissau. Therefore, they can be quietly introduced in operative works in the country. The best period of cultivation period is very short in Bafata, approximately 50 days. Consequently, irrigation is unavoidable there as the vegetative cycle of many agricultural species is around 90 days.

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INTRODUCTION

According to all scientists around the world, the today global climate change has tremendous catastrophic consequences which vary with geographic regions. Between other consequences, hunger is the most encountered one. In particular, this investigation mainly concerns the research of the solutions to this problem. In developed countries some has been found. In developing ones the situation still remains crucial. Concerning the problem of hunger, finding its solution will pass through a good management of the water resources in the soil. This will need a better knowledge on the rainfall and evapotranspiration regimes. As the problem is general and because of poverty, some developing countries have grouped themselves under regional organizations with common projects in order to facilitate the findings of scientific tools and financial aids from friend countries and other donators (Cedeao*et al*., 2016). One of such projects where Guinea Bissau is involved is the "Adaptation au changementclimatique et la réduction des risques de catatrophesen agriculture" which is understood as the adaptation to the climate change and the reduction of the risks of catastrophes in agriculture, (PAAC/RRC).

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The financial aid came from the "Agence de Coopération Italienne pour le Développement", i.e. Italian Agency of Cooperation for Development, under the supervision of the World Meteorological Organization. This work is structured into five paragraphs. This one introduces the problem. The second presents it while recalling some previous publications on the similar theme. Material and methodology are exposed in the third paragraph. Results are presented and discussed in the fourth while the conclusion and recommendation are in the fifth paragraph. The bibliography ends the work.The present work is done under this program. We cease this opportunity to sincerely thank the donators for their contributions.

Position of the problem

It is obvious that if we well manage the soil water resources, the agricultural productivity will be increased and the problem of hunger will be reduced (Njipouakouyou *et al*., 2017b). As it was already mentioned, information on evapotranspiration (ET) and rainfall regime (RR) will be needed. It is understandable why the present investigation has two parts: the first one concerns the computation of the evapotranspiration, and the second one – the determination of the best period of cultivation activities in Bafata, a locality situated some 150 kilometers from Bissau in the east direction. For what concerns the first part, recall that we have many methods of computing

the ET, as the methods of Penman, Turc, Boucher, Thornwhaite. The use of these methods is not homogenized. Even in a same country computation of ET are often done by different methods and it is evident that they will give different results. In Guinea Bissau, two methods,INSTAT+.3.37 and CROPWAT8.0, are implemented in some localities as Bissau. They have given good results without significant difference between themselves. The problem is to investigate if the results in other localities will be the same. As Bafata is a locality with good active meteorological station, it is obvious that data from there should be accurate. Thus, this locality was chosen for the verification of coherency of the above methods. For the second part of the work, beside the data on ET, we also need data on the rainfall regime, RR, coming from direct observations in the station. The curves of ET and RR were plotted in a same graph and their points intercept determined. In the abscissa axis, ot, is the time t in decades and in the ordinate axis – ET or RR in mm per decade (mm/decade). It is evident that the period included between the points intercept is the best time for cultivation activities. The ideal for these points is to be the more distant from one another. Thus, a sufficient quantity of water in the soil will be guaranteed, depending on the agricultural species. Instead, irrigation will be probable.

MATERIAL AND METHODOLOGY

Material

All the daily data used in this work come from meteorological station in Bafata, Figure 1. It concerns the rainfall, the minimal and maximal temperatures of the air, relative humidity of the air, insolation and windvelocity. All the chronological series on each parameter were complete and concerned the unique year 1983. This year was chosen because it is one of those with full time series. All these data were obtained using standard meteorological instruments.

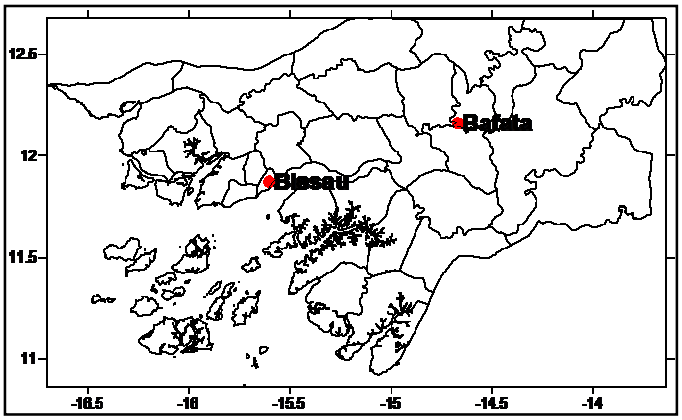

Figure 1. Positions of the two localities, Bissau and Bafata, in Guinea Bissau

Methodology

For the computation of ET, the needed data were introduced in a computer equipped with the program CROPWAT8.0.The whole year was divided into 36 decades which correspond to 36 points to be plotted in a coordinate plane *toy* to have two curves: one for ET, another for RR. For what concerns the comparative study, the ET was presented in its corresponding graph by their decade mean values. To have these mean values, we summed the ET in a decade and divided the result by 10.To determine the best cultivation period, the RR and ET were plotted in a same coordinate plane. Their values were in mm per decade. They should have two points intercept, one slightly by the end of the first semester, another slightly by the middle of the second semester. The analysis of the position of these points relatively to one another will enable us to determine the accurate period for cultivation activities in the considered locality.

RESULTS AND ANALYSIS

Comparative investigation of ET obtained from two methods

The results are presented in Figure 2. The time variation of both curves is similar. In fact, they increase and decrease the same way. In the dry season, i.e. from January to May and from October to December the values of ET are greater the ones in the rainy season. In the dry season slight differences between corresponding values are observed, but they are not significant. From January, both curves increase to their absolute maximums in April then they decrease to their absolute minimums in August from where both start to increase again. From January to around June and from earlier October to late December, the values generated by CROPWAT8.0 are slightly greater their corresponding ones from INSTAT+3.37. In the remaining period of the year the values issued by both methods are almost equal. Concerning both magnitude and time variation of ET, similar studies made for other geographic regions indicate the same results, (Njipouakouyou *et al*., 2017a, 2017b).The time tendency in the present study can be explained by the nebulosity and consequently the solar activities during the year. It is obvious that during the dry season the clouds are not enough to block a lot of solar radiation. Thus, a big quantity of radiation reaches the earth surface and creates intensive evapotranspiration. The first partial conclusion to which this investigation brings us is that both methods of computation the ET can be introduce into operative work in Guinea Bissau as there is no significant difference between their results.

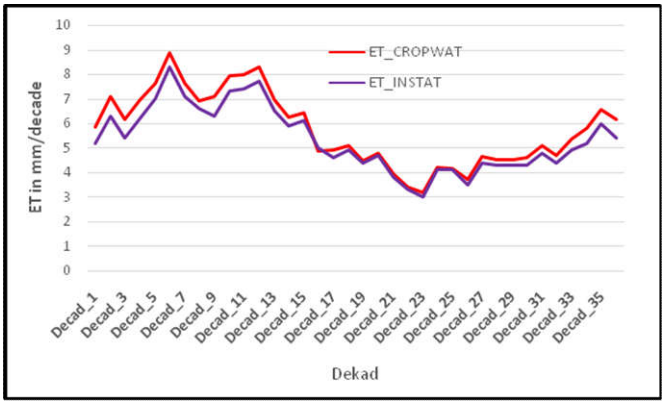

Figure 2. Comparison of the INSTAT+3.37 and CROPWAT8.0 methods of computation of the ET

Determining the best cultivation period in Bafata

The results presenting the curves of annual variation of the ET and RR are plotted in Figure 3. It shows that the rainy season in the considered locality starts in decade 13 and ends in decade 29, approximately. It also shows a false beginning of the rainy season between decades 13 and 18, and a false end between decades 27 and 29.

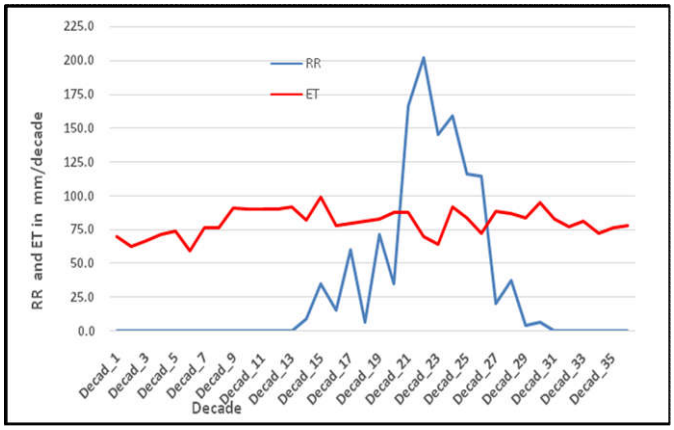

Figure 3. Determining a best cultivation period in Bafata in 1983

That is why it can be reasonably said that the rainy season in Bafata goes from decade 18 (around end of June) to decade 27 (around October).Thus, as from earlier July, the rainy season is effectively there and the quantity of rainfall increases from zero to its absolute maximum (202.1 mm/decade) in decade 22 (beginning of August). Then it decreases to zero in decade 27 (around end of September). When increasing, it cuts the curve of ET around decade 20 (July) and when decreasing, it cuts the curve of ET around decade 24 (beginning of September).This part of investigation brings us to the second partial conclusion that the cultivation period in Bafata starts from July and ends in September as during this period the soil water reserve is sufficient for agriculture. This time is short (around 50 days) for many agricultural species whose vegetative cycles are around 90 days. Therefore, irrigation during cultivation period seems to be unavoidable, particularly by the second half of the vegetative cycle of plants (Njipouakouyou *et al*., 2017b, Zare, 2011). To reduce the coast of this activity, fields should be early prepared for on time seeding.

Conclusion and recommendation

This study brings us to the conclusion that INTAT+3.37 and CROPWAT8.0 methods of computation of the ET can be usedin operative work in Guinea Bissau as the results generated by them are coherent.Irrigation is an obligatory activity particularly by the second half of the vegetative cycle of plans as the period of sufficiency of soil water reserve seems to be very short, only around 50 days.It is strongly recommended to investigate the year to year time variation of the point intercepts of the curves of ET and RR to find their earliest and latest position. This will help us to have a clear and precise idea on the time variability of the cultivation period in Bafata and Guinea Bissau (Mendes, 2014).

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