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Effects of Climate Fluctuations on the Flow of Rivers, Case of Milo in the Republic of Guinea

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Abstract— *This article was written to understand the effects of climatic fluctuations on the flow of rivers and in an educational context. The research focused on temperatures, humidity, insolation, evaporation and a series of gauges over the same period of 2007, 2008 and 2009 and the data obtained was analyzed and compared. At the end of the work, the study revealed that there are variations which influence the quantity and quality of the flows, the amount of precipitation. The results obtained are as follows: the average surface speed equal to 0.25 m/s, the wetted section of the channel equal to 53.24 m^2, the maximum depth equal to 1.18 m, the wetted perimeter equal to 110.19 m and the final flow rate of all the gauges equal to 11.16m^3/s.*

Keywords— *Fluctuation, climatic, flow, effect, watercourse, Guinea.*

I. INTRODUCTION

The exploitation of information on water resources has many and varied aspects: almost every sector of the nation's economy requires hydrological information for planning, development or other practical purposes. Water is an invaluable resource for any country. As competition for the exploitation of this resource grows, this information tends to become more and more crucial.

Detailed information on the characteristics and evolution of a country's water resources, whether surface or underground, both in quantity and quality, is necessary on the one hand for economic and social development and secondly to the preservation of the quality of the environment.

Knowing the flow regime allows us to prevent floods by choosing the appropriate cultivation techniques and seed varieties. The successful development of a country's agricultural economy depends to a large extent on how the major hydro-climatic elements are used [1-6].

The measurement of the flow of rivers finds its utility primarily in the assessment and prevention of the risks associated with flooding but also in the knowledge of the volumes available for the purposes of supplying drinking water to populations, a major use but sometimes called into question for for either quantitative or qualitative reasons. The flow measurement in

The correct evaluation of the resource comes up against many difficulties and only rare chronicles of observations existing since the beginning of the 20th century make it possible to follow the fluctuations in a very global way" [7, 8].

Over the past two decades, the downward trend that tropical rivers seem to have exhibited since the end of the last century has worsened; the contributions of large rivers to the Sahelian zone are reduced by 40% on average and the lakes in this zone have very low levels, or even total drying up for some of them [9-12].

Guinea has a relatively dense hydrographic network with 1161 rivers. This network is characterized by the irregularity of the regime.

The climate of the Upper Guinea region is of the Sudanese type, with two contrasting seasons. Its total rainfall does not exceed 1500mm / year. In the alluvial valleys, fragments of more or less wide plains are located, inundated during winter by flood and runoff. The development of extensive crops and bush fires have profoundly altered it and reduced it over vast areas to wooded savannah [13, 14].

The primary purpose of this publication is to provide information to decision-makers on the characteristics and evolution of water resources in Upper Guinea. This information may be required in the following areas of application:

a) Estimation of the water resources of rich wetlands (quantity, quality, spatiotemporal distribution), the development potential of this resource, the capacity to meet present and future food self-sufficiency needs;
b) Planning, design, and implementation of water-related projects;
c) Processing and archiving, quality control and security of archived data;
d) Ensuring the accessibility of data to users for the periods, places and according to the specifications requested, in particular:

- The creation of databases accessible by geographic information systems, the provision of educational documents for a wide audience, the information media and schools;
- Information on flood frequencies for project design;
- Informing potential users of the information available and helping them to make the best use of it;

It is in view of this importance that we are publishing the results of this research on the theme "Effects of climatic fluctuations on the flow of rivers" case of Milo in the Republic of Guinea.

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II. Materials and Method

A. Materials

During this series of measurement campaign, we used the following materials: reel, pole, salmon and the current meter.

B. Method

To measure the flow of a natural flow (watercourse, canal, diversion, etc.), there are four main categories of methods. But here we will use the "velocity field exploration" method, which consists of determining the velocity of the flow at different points in the section, while measuring the area of the wetted section. This technique requires specific equipment (reel, pole, salmon, current meter, etc.) and personnel trained in its use. Among the many methods of exploring the velocity field, we use current meter gauging.

To carry out this research, we have set ourselves a general objective and specific objectives which are among others:

a. Main objective

- Introduce students to measurement with a hydraulic current meter, and related calculations.

b. Specific objectives

- Identify and handle a hydraulic reel;
- Gauging with a hydraulic reel;
- Calculate velocities, wetted surfaces and flow rates per section;
- Compare the current rate to the rates for a number of years.

1. Carrying out the gauging

The measurement was carried out as follows:

First, we identified and read the coast at the station installed downstream of the point.

The methodology used is that of BARGO, then, we identified and defined the hydrometric current meter which makes it possible to measure the point speed of the flow. The number of measurements on a vertical is chosen so as to obtain a good description of the distribution of speeds on this vertical. In general, we made between 1, 3 or 5 measurements depending on the depth of the bed; we have described the different parts, define the role of each, and take the usual precautions; the type of reel: 0TT; fixing on pole diameter 20mm; Propeller number 2-146656- Propeller pitch = 0.25, the Formula used for the calculation is as follows:

For a value of: $n < 0,32$, we take $V = 0,396n + 0,030$ (1)

For a value of: $n > 0,32$, we take $V = 0,4772n + 0,004$ (2)

Or: n is the number of turns of the propeller per second.

The principle of this method therefore consists in calculating the flow from the speed field determined in a cross section of the watercourse (at a certain number of points, located along verticals judiciously distributed over the width of the watercourse.). Along with this exploration of the velocity field, the cross section of the stream is noted by measuring its width and taking depth measurements along this width.

Remember that "the flow velocity is never uniform in the cross section of a watercourse". The flow Q [m3 / s] flowing in a flow section S [m^2] of a river can be defined from the average speed V [m/s] perpendicular to this section by the relation:

$$Q = V*S \quad (3)$$

The flow section can be evaluated by reading the water depth in various verticals distributed evenly over the entire width. Several methods are used to determine the average water speed.

III. Results and Discussion

In order to gain a better understanding of the effects of climatic fluctuations on the flow of the Milo River; we did the gauging and compared our results to others done years ago in the same period (June).

By way of illustration of the approach used, we will take as an example a group of measurements, noting that the repetition of the measurements consisted in increasing the precision, and that the approach is the same for all the measurements with a few exceptions. The various measurements carried out on June 5, 2009 are recorded in table 1.

We will finally give the final flow which will be the sum of the flow rates of all the gauges along the width of the course considered is $Q = 11.16 m^3/s$.

We present in table 2 the gauging sheet (IRD) which was used to carry out our field and office work.

Table 2 represents the sheet or the gauging book which allowed us to collect the various information in relation to the measurements on the site using the current meter, the values of which are recorded in this same table.

Figure 1 illustrates the graphic representation of the results of calculation of the areas of the wetted sections and of the flow rates for the various gauges. The green colored curve represents the cumulative flows and colored represents the depths according to the section of the channel chosen. According to this figure, we notice that each given depth represents an accumulated flow whose maximum values are observed at point 4.

The comparison of the parameters in Table 3 shows us more or less significant fluctuations, which allowed us to understand that the year 2007 is less rainy, with greater evaporation, and with weak flow. So much so that the year 2008 is at low temperature, with medium evaporation and greater flow, and that the year 2009, which represents the year of gauging, is relatively moderate.

This fluctuation shows not only a general downward trend in precipitation but with temporal nuances that must be underlined.

TABLE 1. Different values of the first gauging

Parameters	Beginning hour	Vms(m/s)	Stream width (m)	Wet section (m^2)	Maximum Depth (m)	Wet perimeter (m)	End time
Valeurs	10h00	0,25	110	53,24	1,18	110,19	10h15

TABLE 2. Measuring sheet or logbook

RIVER	**MILO**	**GAUGE N ° 2**		**MARK**	**START SIZE**	**-9**
STATION	**KANKAN**	**MOULINET**		**0TT**	**END SIDE**	**-9**
N° HYDRO		**PROPELLER**		**2-146656**	**RATE ADOPTED**	**-9**
DATED	**05/06/2009**	**TOPS/TOURS**		**30**	**BEGINNING HOUR**	**9h40**
OPERATOR	**SAGNO and CAMARA**			**PERCH**	**END TIME**	**10h15**
	Arms	**Bank**	**Distance (m)**	**Depth (cm)**	**nb Tours**	**Tough (s)**
1	**Right bank**	**Right bank**	2,4	0		30
2						
3		V1	3,5	0,18		
4				0,13	92	30
5				0,08	76	30
6						
7		V2	5,2	0,12		
8				0,07	78	30
9						
10		V3	8,2	0,08	0	30
11						
12		V4	17	0,18		
13				0,13	106	30
14				0,08	94	30
15						
16		V5	20	0,3		
17				0,25	115	30
18				0,15	106	30
19				0,07	88	30
20						
21		V6	23,3	0,34		
22				0,29	138	30
23				0,2	117	30
24				0,12	105	30
25				0,07	82	30
26						
27		V7	28	0,31		
28				0,26	56	30
29				0,15	52	30
30				0,07	46	30
31						
32		V8	31,5	0,52		
33				0,47	72	30
34				0,4	69	30
35				0,3	71	30
36				0,2	61	30
37				0,12	59	30
38				0,07	41	30
39						
40		V9	34	0,31		
41				0,26	87	30
42				0,17	67	30
43				0,07	61	30
44						
45		V10	35,7	0,14		
46				0,08	10	30
47						
48		V11	36,5	0	0	30

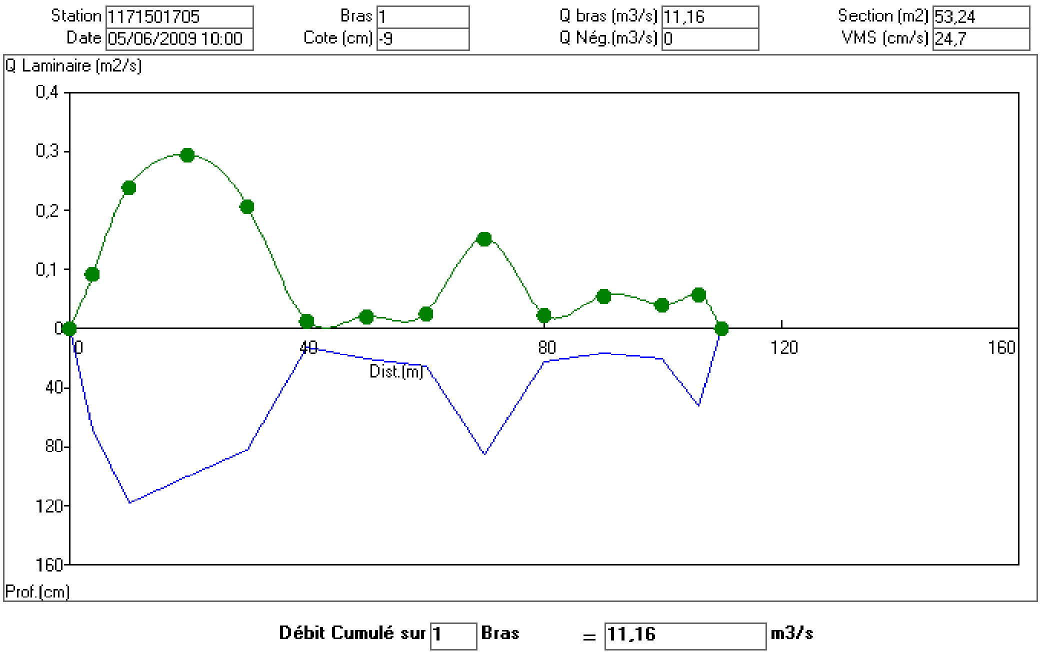

Fig. 1. Calculation results for the areas of the wetted sections and the flow rates for the different gauges

TABLE 3. Comparison of flow rates and observation of the annual fluctuation of climatic parameters for a gauging period (months of June 2007, 2008 and 2009)

Month	Q(m^3/s) cumulative	Precipitation heights (mm)	Temperatures in °C	Evaporation in mm
Jun 2007	0,059	132,8	28	137,8
Jun 2008	38 ,34	187,3	26,8	108,3
Jun 2009	11,16	188,7	27,6	97,1mm

The trend analysis of the variation in temperatures compared to that in rainfall allows us to deduce the following findings:

- Periods of temperature increase correspond to periods of lower rainfall and thermal drops correspond to periods of greater rainfall;
- The comparative analysis of rainfall and evapotranspiration from 2007 to 2009 shows a water deficit from mid-October to the end of May;
- The average monthly wind speeds recorded in the reference station are low (1.09 to 2.5m/s) and are not significant to be considered as a factor of erosion and silting of the Milo.

IV. Conclusion

The previously targeted objectives (Identify and operate a hydraulic reel; Gauging with a hydraulic reel calculate speeds, wetted surfaces and flow rates per section compare current flow to flow rates for a number of years), were monitored and carried out theoretically and practically.

The few results which have just been briefly exposed suggest the complexity of the genesis of the flows. In general, however, we can say that in absolute value, the deficits could be very significant in Guinea (2000 to 2500 mm). This rapid analysis was obtained from the study of climatic data from 65 years (temperatures, flows, evaporation, rainfall etc. from Upper Guinea).

One would think that the decrease in precipitation seems stabilized, or even less important, in the last ten years, yet the climate has changed a lot; the flow of the rivers continues to be impoverished in worrying proportions (Comparison gauging 2007, 2008 and 2009 of the Milo river) it is very hot; The main negative consequences are the variation in stream flows, the disappearance of certain aquatic species and forest animals.

We recommend the monitoring of certain parameters to allow to specify the physiognomy of climatic variations. In addition, we should point out that the weather station shelters are currently dilapidated with incomplete equipment and some measuring instruments have been out of order for several years.

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