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Impacts of agricultural activities on water resource in the basin of Sota in Benin

Mickael V. M.K Saizonou, Léonce Dovonon, Magloire Gbaguidi, Alassane Youssao, Sègbégnon Medjigbodo B., H. Henri Soclo, Dominique Sohounhoulé.

Unit of Research in Ecotoxicology and Quality Study, Laboratory of Study and Research in Applied Chemistry, Polytechnical School of Abomey-Calavi, University of Abomey,-Calavi, 07 BP 507 Ste Rita Cotonou, Benin.

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ABSTRACT

For thirty years the cultivation of cotton has become very widespread in Benin. This has led to a sprawl of agricultural land and a significant increase in the use of chemical fertilizers and pesticides and by extension, the pollution of the water resource in many parts of the country. In the north, high levels of nitrogen components are measured in the waters of the basin of Sota. Indeed the average value of 181mg / L measured for nitrate levels exceeding that permitted by the standards of quality of drinking water in the Republic of Benin. This study contributes to the knowledge of the impacts of agricultural activities on water resource in the basin of Sota in Benin.

Introduction

Over the last thirty years, Benin farming techniques have evolved very quickly and have experienced the implementation of practices characterized by intensive use of chemicals such as fertilizers, insecticides, herbicides and pesticides. These practices negatively impact the environment and expose people to health problems. This is the case in Benin and especially in the basin of Sota where the water resource is subject to the influences of the various agricultural inputs used extensively for growing cotton [1].

This work is a sketch of the assessment of the impact of agricultural activities on the physical and chemical qualities of surface and groundwater of the bassin of Sota that are characterized by high levels of nitrate. Nitrates are highly stable and soluble in water with a slow penetration in the soil. The migration rate would be about 1m per year. The World Health Organization (WHO) has set the nitrate Acceptable Daily Intake (ADI) based on measured or perceived risk as 3.65 mg / kg for body weight or 50 mg/ L [2]. Nitrates are not toxic in themselves, but their transformation into nitrite and nitroso compounds (nitrosamines and nitrosamides) may cause disorders characteristics [2].

Materials and methods

Location of study area

The study area is located in the north-east of the Republic of Benin between latitudes 9° 54 '35 " and 11° 55'2" north latitude on the one hand and meridians 3° 46'44 "and 3° 33'6 "east longitude on the other. The total area of this zone is 13.410 km² with a tropical climate sudano guinean type, characterized by alternating dry season from november to march and a rainy season which runs from june to september. The monthly average temperature is 25°C in december, which is the coldest month and 27.3 ° C in april wich is the hottest month. Sota is the main river that runs through this study area and flows to the north. With its tributaries, they cut into an undulating peneplain[3]. The upper basin of the Sota, at south of Gbassè[1], covers training terrazzo-gneissic basement essentially comprising precambrian gneiss migmatites, mica schists, quartzites and some diorites accompanied locally by granites. A part maize, sorghum, millet, cassava and yams, cotton and groundnuts are the main cash crops. Some vegetable crops including onion and potato are thriving in the region.

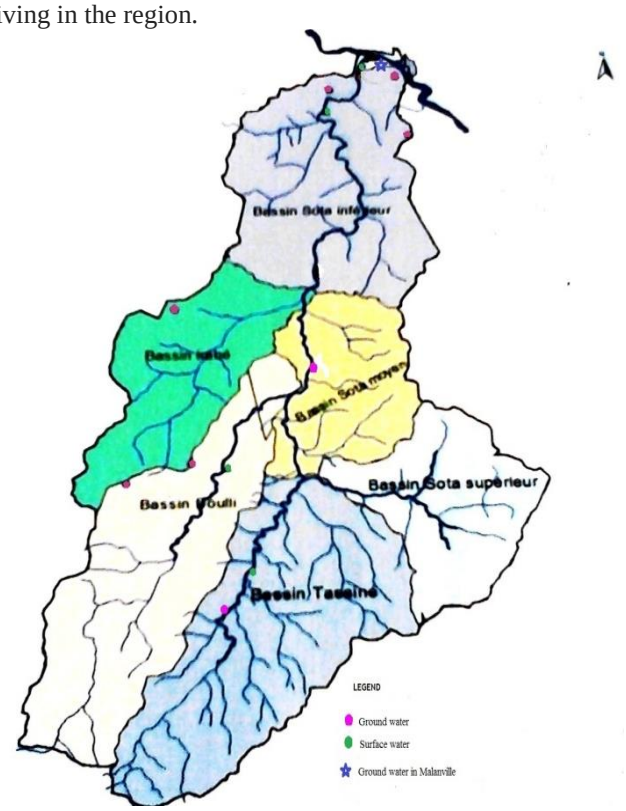

Figure 1. Sampling points

Collection of samples and study methodology

Samples were collected during june and october at 4 points for surface water. These four points are Boulli, Bensekou, Monkassa and Kotchi. For groundwater, we made 6 samples in wells in the town of Malanville in june and in 8 other wells in october. These wells are in Kandi, Molla, Pantrossi, Ferekine, Garou, Ouessene and Sende Gourou Temperature and pH

[1]Village located in the bassin of Sota

Tele:

E-mail addresses: kpessou67@hotmail.com

were measured in water by using a metric electro sensor type WTW 340i Precision Δp = ± 0.1.

The rates of major chemical pollution indicators related to agricultural activities in water as nitrite ions, nitrate ions, phosphate and ammonium ions were determined according to methods of analysis recognized by the French Association for Standardization (AFNOR) and the Protection of the Environment Agency of the United States (USPEA) [4].

Results and discussion

Temperature

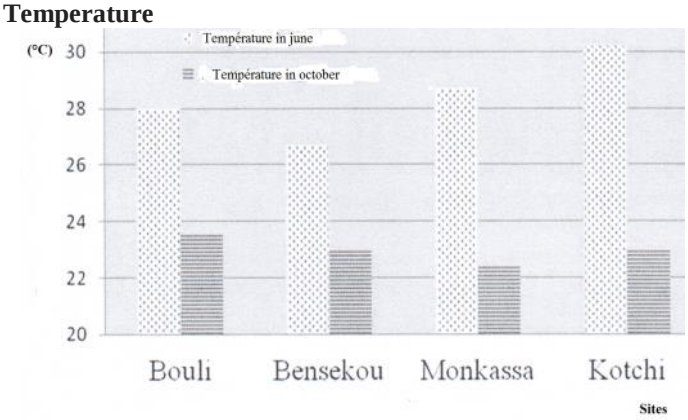

Figure 2. Temperature of surface water

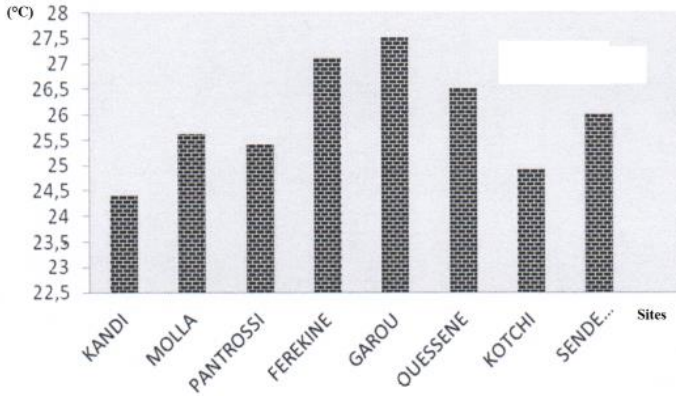

Figure 3. Temperature of groundwater in october

In surface water, the temperature varies from 26.7°C to 30.2°C with an average of 28.4°C in june and between 22.4°C and 23.6°C with an average of 23°C in october. It is between 24.4°C and 27.5°C for groundwater with an average of 25.9°C.

According to figure 2, we notice on all the sites that the temperatures obtained in june are superior to those obtained in october for surface water.The month of june marked the first rains with a stream of water which is less than in october, explain the temporary change in temperature. The recorded temperature values are consistent with those obtained by Dèdjiho [5].

Potential of Hydrogen (Ph)

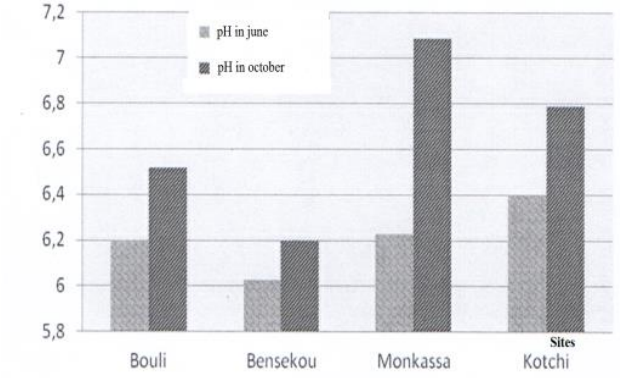

Figure 4. pH of surface water

The pH values recorded in june are between 6.05 and 6.4. In october they vary from 6.2 to 7.1. For all sites, the average pH values are 6.2 and 7.6 respectively in june and october for surface waters. According to Boyd reported by Dèdjiho [5] the water can be used in aquaculture with these values from the standpoint of pH, the latter being located between 6.1 and 9.

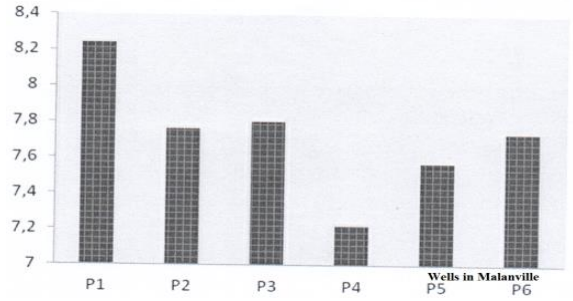

Figure 5. pH of groundwater in june in Malanville

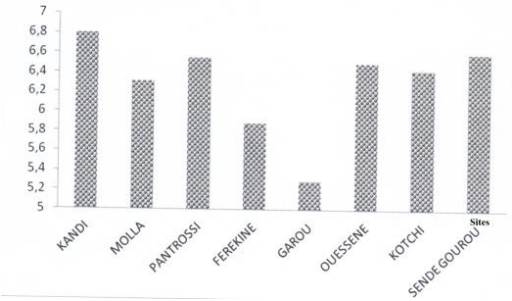

Figure 6. pH of groundwater in October

For groundwater pH values obtained in june are between 7.2 and 8.2 with an average value of 7.3. In october they vary from 6.3 to 6.8 with an average of 6.4. These values respect Benin pH standards of potable water [5]. The water of the localities Molla, Kotchi, Ferikine and Garou is however considered slightly acidic as pH values are below the lower limit of 6.5 in Benin. These results are similar to those obtained by Odoun-Iran [7] on well water in Seme Kpodji in southern Benin.

Levels of nutrients

Ion ammonium

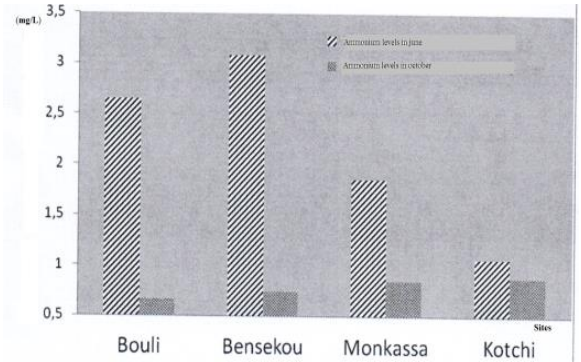

Figure 7. Levels of ammonium ion in surface water

The observation of figure 7 shows that in surface waters, the ammonium ion concentrations ranging from 1.07 mg / L and 3.08 mg / L with an average of 2.16 mg / L in june and then 0.67 mg / L to 0.89 mg / L with a mean of 0.79 mg/L in october. According to the World Health Organization concentrations normally found in surface water are less than 0.2 mg / L in the aerobic zone. The very high values recorded on the sampling sites especially in june would come from animal manure and human activities. This calls for raising public awareness about the dangers of their behavior on their health.

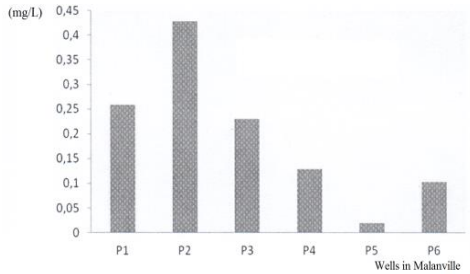

Figure 8. Ammonium ion in groundwater in june in Malanville

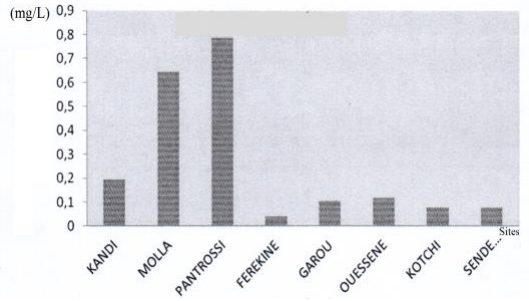

Figure 9. Ammonium ion in groundwater in October

For groundwater, the ammonium ion concentrations ranging from 0.02 mg / L to 0.42 mg /L with an average of 0.19 mg / L in june and 0.03 mg / L to 0.79 mg /L with a mean of 0.25 mg /L in october. These values respect the limit of 1.5 mg / L indicated by WHO for drinking water.

Nitrite ion

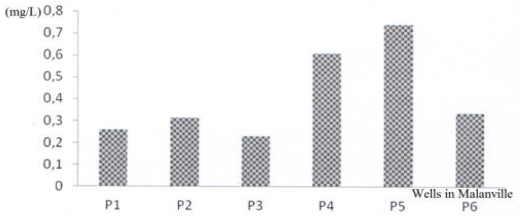

Figure 10. Nitrite ion in groundwater in Malanville

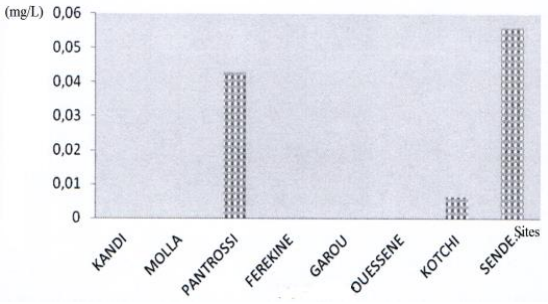

Figure 11. Nitrite ion groundwater in October

Analysis of the results of figure 10 and 11 shows that concentrations of nitrite ion obtained in june and october comply beninese standards for water for human consumption [6]. Indeed in june they are between 0.23 mg / L and 0.74 mg / L with an average of 0.41mg / L and in october they are between 0 and 0.055mg / L and Benin standard requires a value maximum of 3.2 mg / L.

Nitrate ion

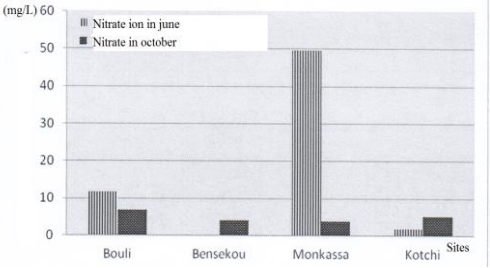

Figure 12. Nitrate ion content of surface waters

On different sites, levels of nitrates in surface water are below limit value required by Benin and international standard for consumption water wich is 50 mg/L. That means that during those two months there has been no significant contribution to nitrate runoff.

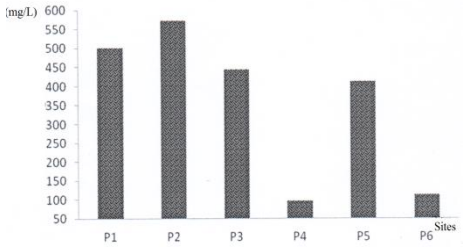

Figure 13. Nitrate ion in groundwater in june in Malanville

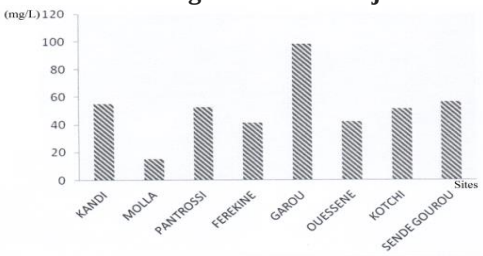

Figure 14. Nitrate ion in groundwater in October

Analysis of the results shows that the groundwater nitrate ion contents do not meet the beninese standards and WHO guidelines for drinking water wich is 50 mg/l. Nitrate ion contents vary between 15 mg / L and 572 mg / L with a mean of 181.66mg/L.The very high values of these levels highlight the poor quality of the groundwater resources of the basin of Sota and reflect a significant deterioration compared to the natural state.

Conclusion

This study assessed changes in physical and chemical parameters in surface water as well as those of some wells in the basin of Sota victim of excessive use of pesticides and chemical fertilizers. These products induce more or less disturbing pollution of water resources in the basin. This pollution has been demonstrated by the increase in nitrate levels in groundwater in the basin. These results call for awareness of local authorities to protect people from harmful consumption of these waters on their health.

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