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Impact of Anthropization on the Copper and Zinc Contents of Urban Soils. Case of the Concession of the Company Textile for Kisangani (SOTEXKI) in Kisangani in the Province of Tshopo in DR Congo

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Abstract: *This research has set itself the task of studying the impact of anthropization on the copper and zinc contents of urban soils in the concession of the Textile company of Kisangani (SOTEXKI) in Kisangani in the Province of Tshopo in the DR. Congo. To do this, the soil samples were taken from 6 soil slices: 0-10, 10-20, 20-30, 30-40, 40 -50 and 50-60 cm, thus giving a total of 18 spot samples per substation, i.e. a total of 126 grab samples with the reference station (dense forest). The 126 composite samples were reduced to 42 composite samples for all 7 substations using the auger. Conditioned, these samples were subjected to copper and zinc assays using an atomic absorption spectrophotometer using the ammonium acetate method at pH7 in the presence of EDTA. The results obtained show the following trends:- Soil copper content is higher is 387.95 µg/g and lower with 2.08 µg/g compared to all other land uses, the average soil zinc content is higher with 632 .98 µg/g and lower with 3.85 µg/g compared to all the other land uses of our neighboring station at the SOTEXKI/Kisangani plant. In general, the surface slices of the soils of different substations are richer in copper and zinc. Although generally higher than those of our reference (dense forest), the average values of the levels observed in our various substations are also higher compared to the global critical threshold (20-30 mg/kg of soil). - At this level of research, it is too early to certify that these levels are dangerous for human consumption of agricultural products from the soil of these substations. The impacts of anthropization are negative at the level of zinc, which means that the activities practiced in all the substations in our neighboring station to the factory of the textile company of Kisangani/Kisangani have drawn on the reserves of their soil in zinc more than copper, although in smaller quantities than for the latter.*

Keywords: *impact; anthropization; contents; copper; zinc; SOTEXKI; Kisangani*

I. Introduction

At present, the presence of metallic trace elements (ETMs) in the soil is mainly due to human activities. They currently represent a major problem because they can contaminate all levels of the food chain and increase the risks to human health and the maintenance of ecosystems. This is why the tolerance to metallic trace elements (ETMs) and their transfer to plants are widely studied. Certain metallic trace elements (ETMs) such as zinc are generally trace elements for living organisms (Pedro and Delmas, 1970).

Soil is a natural resource, little or slowly renewable, globally sends degradation especially in poor countries, where it is not compensated by the increases in productivity currently allowed by mechanization, fertilizers and pesticides. These assets are also in quantitative decline (Mathieu and Pieltain, 2003).

The metallic trace elements of the soil result first of all from natural evolutions of geological origin and of pedological origin of the environment, apart from any contribution of human origin (anthropogenic). The concentration of a naturally occurring substance in a soil horizon is called the natural pedogeochemical background. As clearly shown (Baize, 1997), from one place to another, this bottom can be very variable depending on the nature of the parent material and, moreover, the type of soil. Agricultural soils often contain micropollutants originating from the geochemical background (Baize, 2009), the aftermath of wars or more often atmospheric fallout and sometimes irrigation water (Juste et al., 1995).

In forest regions, the soil loses as much material by solubilization and transport as it gains by deconstruction of the source rock. The system is then in equilibrium which its summit reconstitutes. It therefore sinks into the landscape without changing its thickness. (Houot et al., 2009; Legros, 2016). On the other hand, the surface horizons of cultivated soils no longer correspond to the natural pedogeochemical background after several centuries of agriculture and several decades of intensive fertilization (Baize, 2009.). In some cases, such as the spreading of urban sludge or other types of input, the presence of metallic trace elements (ETMs) in significant quantities can result in a risk for natural and human food chains due to their toxicity. for plants and other organisms following their transfer and bioaccumulation.

II. Review of Literature

2.1 Environment

The city of Kisangani, to which our study environment and capital of the Province of Tshopo belongs, straddles the length of the Congo River and in the northeastern part of the central Congolese basin. This study was carried out within the Makiso Commune; in the city of Kisangani located at 0°31' North, 25°11' East and 428 meters above sea level (Kumumbeya., 2018) within the textile company of Kisangani and the dense forest PK42 as a reference.

2.2 Material

a. Soil Samples

These are soil samples taken from the Kisangani/Kisangani textile company concession station and the dense forest taken as a reference.

b. Technical Equipment

The technical materials used during our study consist of:

- Auger: for taking soil samples
- Pedologist's hammer: to drive the cylinder into the ground
- Knife: to scrape the samples to have a determined volume
- Bags: for packaging soil samples
- Labels: for sample identification
- Tape measure: used as a measure for the sizing of the profiles
- G P.S: to measure geographic coordinates
- Machete: for the opening of the land used for our study

c. Laboratory Equipment

The equipment used in the laboratory consisted of 200 and 1000 ml volumetric flasks, 125 ml conical flasks, 1 per sample, Stoppered 200 ml brown bottle, One line pipettes of 5, 10, 15, 25, 50 and 100 ml, Analytical balance at 0, 1 mg, Precision balance at 0.1 g, Plastic powder hand, 125 ml vials to receive the test sample, with rigid or flexible walls, hermetically closed but except for rubber stoppers, 1 per sample, Filters plastic tube Ø 100 mm, Rocker arm can be set at 40 rpm, Filter papers free of copper, manganese and zinc (ashless), Centrifuge at speed ≥ 2000 rpm and 50 ml tubes, pH- meter, Atomic absorption spectrophotometer, Refrigerator.

III. Research Methods

3.1 Experimental Apparatus

Our experimental device consisted of a field (study station) where there were single or associated crops. Each targeted crop constituted a substation as shown in Figure 2 below.

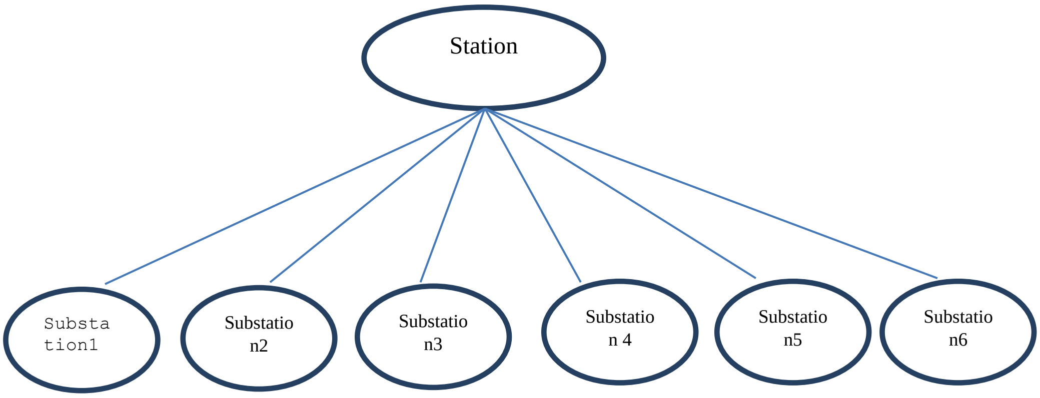

Figure 1. *Study Station*

Each culture or association of cultures was the subject of a collection of soil samples for laboratory analysis. Thus, substation 1 was an associated crop of tomato and cassava, substation 2 was a palm grove, substation 3 was a pure cassava crop, substation 4 a natural vegetation of grasses crossed by the he wastes water outlet from the factory of the Kisangani textile company (SOTEXKI), substation 5 was an associated crop of cassava and palm oil and finally substation 6 was a banana plantation.

3.2 Collection of Soil Samples and their Conditioning

Our device consisted of a station itself subdivided into 6 substations as shown in Figure 2 above, each substation being a plot carrying a pure crop or an association of crops. In each substation, the investigations are made by auger sounding more or less 60cm deep. Soil samples are taken from 6 soil slices: 0 - 10, 10-20, 20-30, 30-40, 40 -50 and 50-60 cm, i.e. a total of 18 point samples per substation (in three replicates) and 108 grab samples for all 6 substations.

The composite samples on which the analyzes were carried out were obtained by mixing during grinding and sieving of the point samples of the same slice. 6 composite samples were obtained in each substation, i.e. 36 composite samples for the 6 substations. The composite samples were obtained by mixing grab samples from the same section of a substation.

As for the reference soil samples, they were taken under an old secondary forest (dense forest) of the IFA concession located at PK41 Ituri road. A total of 18 spot soil samples reduced to 6 composite samples.

3.3 Conditioning of Soil Samples Taken

The soil samples taken were put in plastic bags, labeled and brought to the IFA/Yangambi laboratory in Kisangani. Their packaging consisted of drying in the open air, grinding and sieving on the 2 mm mesh sieve. The fine earth thus obtained was subjected to the various analyzes of our work, including the copper and zinc contents.

3.4 Laboratory Analyzes

Copper and zinc were determined using an atomic absorption spectrophotometer using the ammonium acetate method in the presence of EDTA. A method of analysis which normally makes it possible to analyze in addition to these two elements, manganese. But the content of the latter has not been determined for lack of a reagent including manganese acetate.

Principle of the method: the extraction of the soluble forms of copper from manganese and zinc is carried out by a mixed solution of ammonium acetate and EDTA at pH 7 in a ratio of test sample to solution equal to 1/ 10 (m/v). The determination of the elements present in the extraction solution is carried out by atomic absorption spectrophotometry. This method leads to an estimation of the copper and zinc contents likely to be assimilated by plants. The equipment, the operating mode and the mode of expression of the results are listed in appendix A of the.

3.5 Statistical Analyzes

From the data obtained, we performed calculations of means, standard deviations and coefficients of variation. Calculations were performed using Microsoft Excel software.

IV. Results and Discussion

4.1 Results

The average copper contents (µg.g-1) and their standard deviations are presented in table 2 and the evolution of this parameter is illustrated in figures 2 and 3 below.

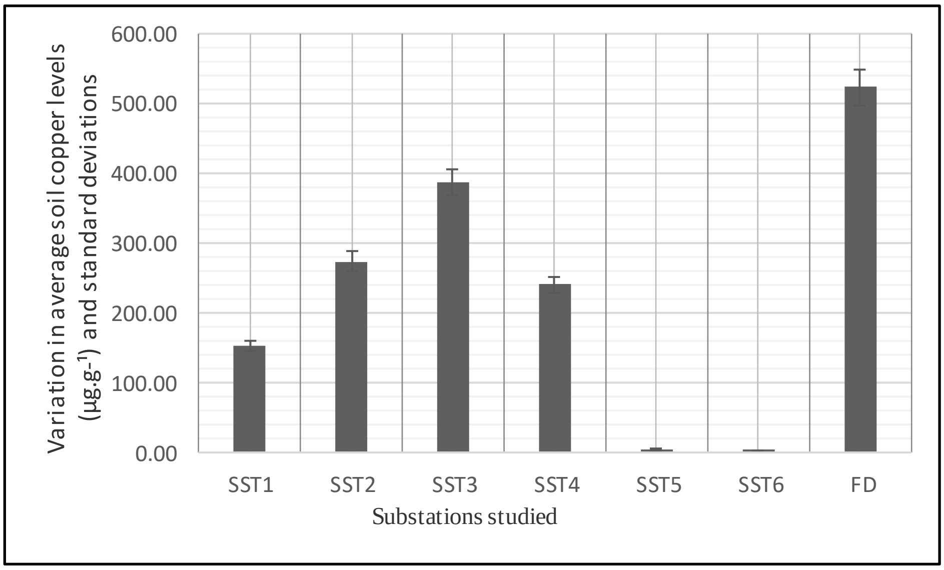

Figure 2. *Variations in Copper Content and Standard Deviations (µg. g-1) in the Soil of Seven Substations Studied*

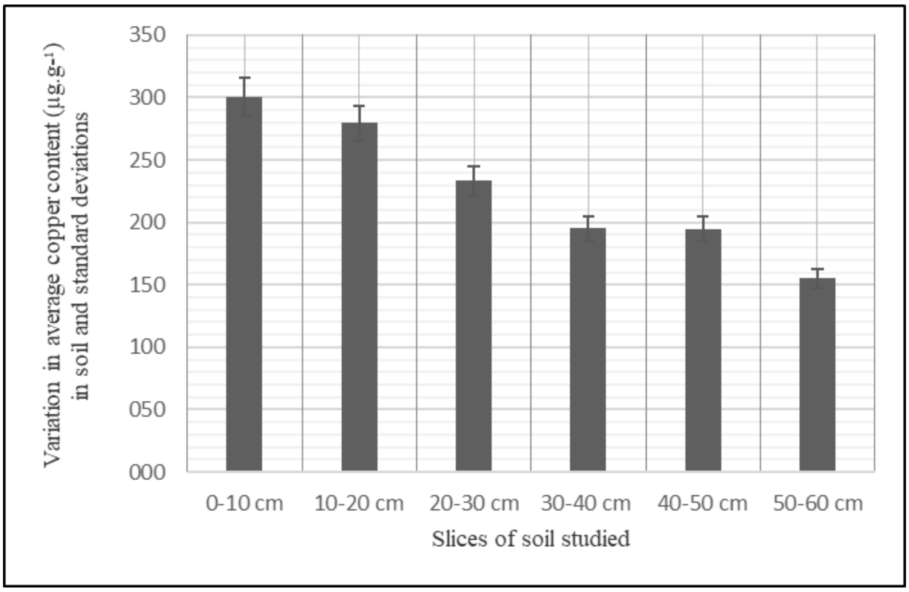

Figure 3. *Variations in Copper Content and Standard Deviations (µg. g-1) in the Soil of the Slices Studied*

In general and in space, the mean and standard deviation levels present the descending order as follows: 387.95 ±112.41 µg. g-1 under SST3 (maize-cassava-peanut combination) which is higher compared to 273.61 ± 79.54 µg. g-1 under SST2 (cassava-sweet potato combination) which is higher compared to 240.76 ±44.19 µg. g-1 under SST4 (combined corn-peanut) which is higher compared to 152.31±50.73 µg. g-1 under SST1 (maize-cassava combination) which is higher compared to 4.41±5.41 µg. g-1 under SST5 (corn-soya combination) which is higher compared to 2.08 ±1.84 µg. g-1 under SST6 (pasture) and on the other hand 524.19 ±311.98 µg. g-1 under FD (dense forest) taken as reference.

From the average contents obtained, it can be seen that: the soils under the substations carrying the crops have relatively high Cu contents up to 387.95 µg. g-1, while the highest is noticed in the dense forest taken as a reference with 524.19 µg. g-1. Depending on the soil slices studied, we observe a higher average surface content (557.61 µg. g-1) under SST3 in the 40-50 cm slice and the lowest content in the 50-60 cm slice with 0.68 mcg. g-1); this indicates that the copper contents of the soils of these substations are of anthropogenic origin.

a. Soil Zinc Levels

The average zinc contents (µg. g-1) and their standard deviations are presented in table 3 and the evolution of this parameter is illustrated by figures 4 and 5 above.

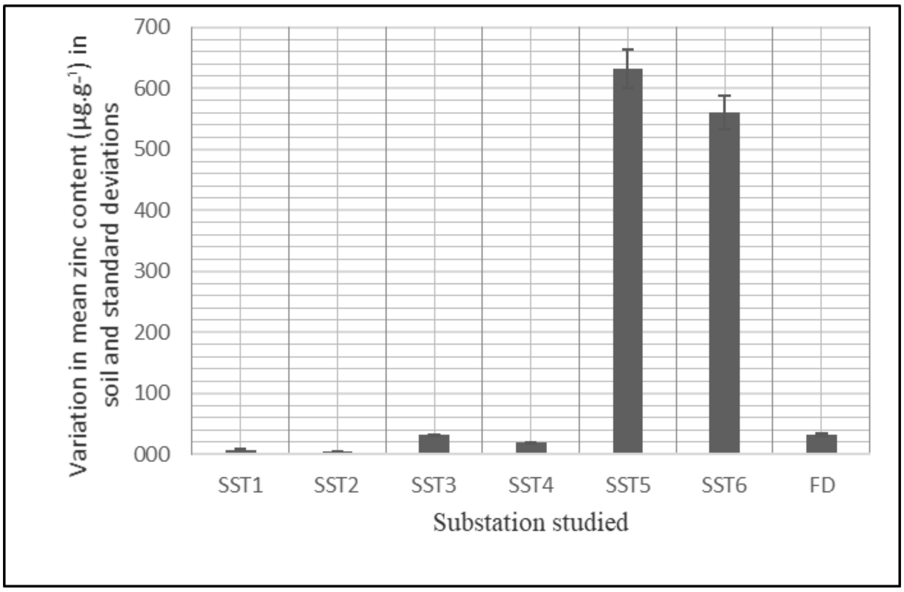

Figure 4. *Variations in Average Zinc Contents (µg. g-1) of the Soil and Standard Deviations of the Substations*

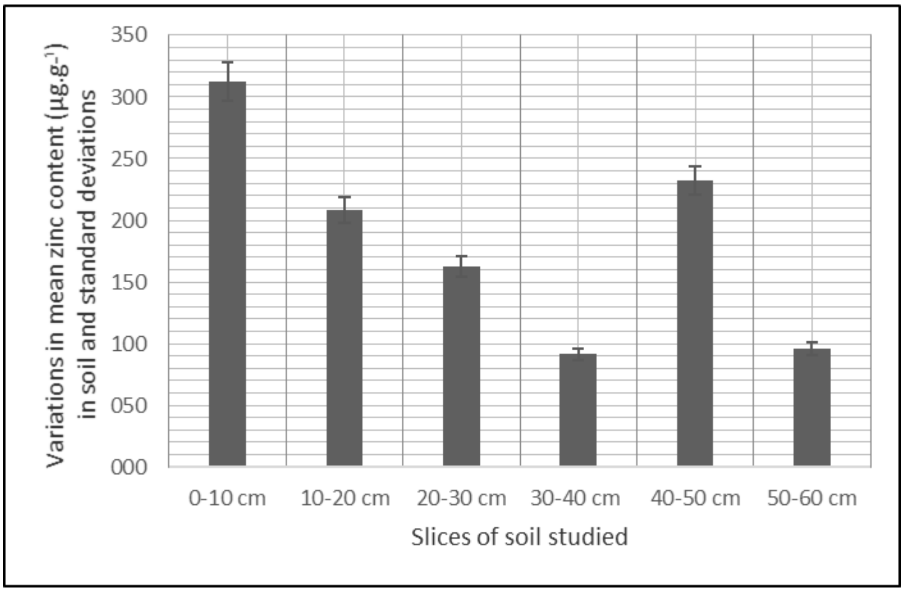

Figure 5. *Variations in Average Soil Zinc Levels (µg. g-1) and Standard Deviations between Slices*

In general and in decreasing order, the mean zinc contents and their standard deviations presented in Table 3 above are 632.98±287.49 µg. g-1 under SST5 (corn-soya combination) higher compared to 560.64±371.34 µg. g-1 under SST6 (grazing) higher compared to 31.15±21.01 µg. g-1 under SST3 (maize-cassava-peanut combination) higher than 18.26±18.60 µg. g-1 under SST4 (corn-peanut association) higher compared to 7.50±6.06 µg. g-1SST1 (combined maize-cassava) higher compared to 3.85±4.08 µg. g-1 under SST2 (association-cassava-sweet potato) and on the other hand, that of the dense forest FD taken as (reference) is 32.42±14.19µg. g-1.

Taking into account the Zn content in the slices, we notice that only the slices of (0-10cm) depth of the soil of the substations SST5 and SST6 i.e. under the corn-soya association and grazing presented high levels compared to the other which vary from 1071.16 to 1012.54 µg. g-1 and the lowest levels in the 50-60cm deep section from 0.85 to 1.27 µg. g-1 under the maize-groundnut association substation and the cassava-sweet potato substation (SST4 and

SST2). These values are low compared to the global critical threshold of 20-30 mg/kg (Sciences Eaux & Territoires, 2019).

b. Impacts of Anthropization

1. Compared to Copper

The results obtained under the impacts related to the effect of anthropization on the average copper content of the soil (µg. g-1) of our various substations compared to that of the dense forest taken as a reference are illustrated by the elements of Figures 6 and 7 below. Compared to the level of the substations and their slices of soil, these data are obtained by difference between the average soil contents of the substations and their slices with those of the dense forest taken as a reference (control).

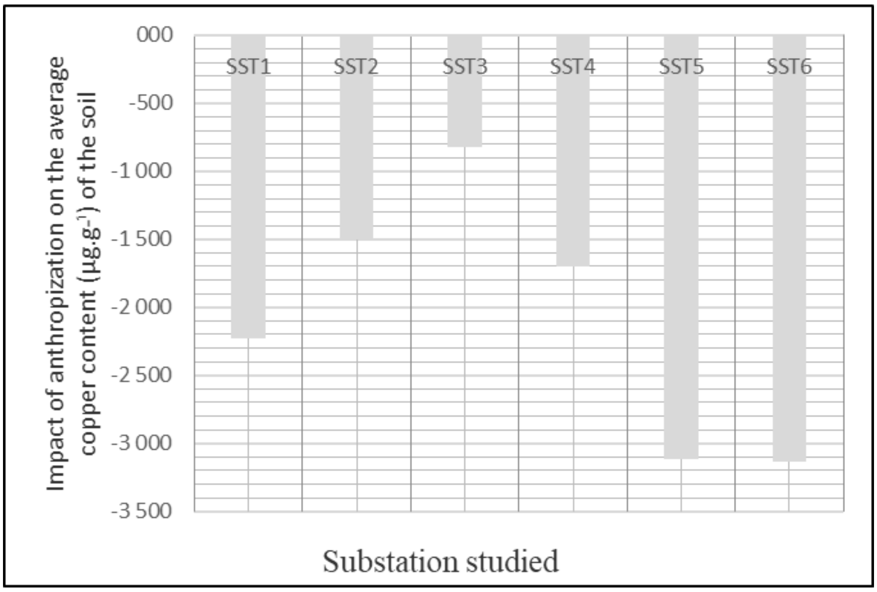

Figure 6. Variations in Anthropization Impacts on Average Soil Copper Levels (µg. g-1) of the Substations Studied Compared to those of the Reference (Control)

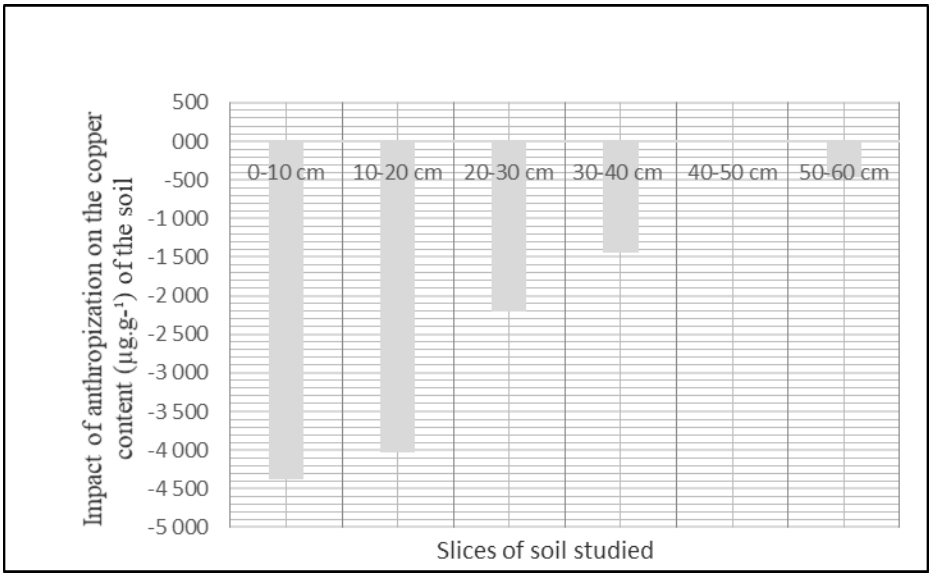

Figure 7. Variations in the Impacts of Anthropization on the Average Copper Content of the Soil (µg. g-1) of the Slices Studied Compared to those of the Reference (Control)

With regard to the impacts of anthropization on the soil copper levels of the substations and slices studied compared to those of the reference, we note that they are globally negative

(-1253.97 µg. g-1). The greatest impact within the substations is observed at the level of the SST6 substation (-3132.62 µg. g-1) and the smallest at the level of the SST3 substation (-817.42 µg. g-1). As for the slices of soil studied, the greatest negative impact is observed at the level of the superficial slice of 0-10 cm (-4376.36 µg. g-1) and the smallest at the level of the deepest slice of 50 -60 cm (-457.52 µg. g-1. This indicates that the quantities of copper drawn from the soil of the substations and units studied are generally of anthropogenic origin.

The quantities of copper taken from the ground of the substations and their sections are generally high. Most of these quantities of copper can be absorbed by crops and other activities, infiltration and runoff from incident rains also constitute another way out of these quantities of copper. At this stage of research, we do not know how to certify whether the quantities of copper absorbed by crops (although we must also determine) and consumed in food by the population are harmful to human health (research must still be carried out on it).

2. Compared to Zinc

The impacts of anthropization in relation to zinc are recorded with their variations illustrated by the elements of figures 8 and 9.

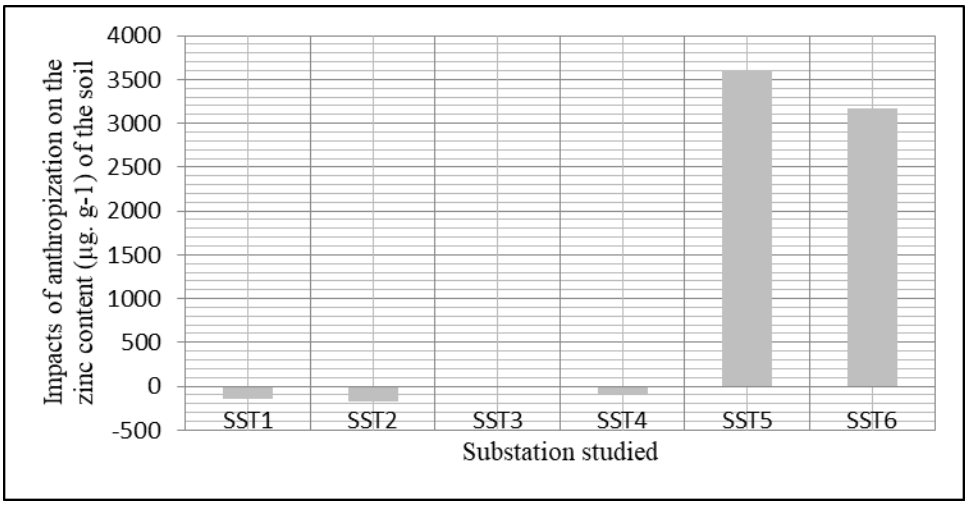

Figure 8. *Variations in Anthropization Impacts on Average Soil Zinc Levels (µg. g-1) of the Substations Studied Compared to those of the Reference (Control)*

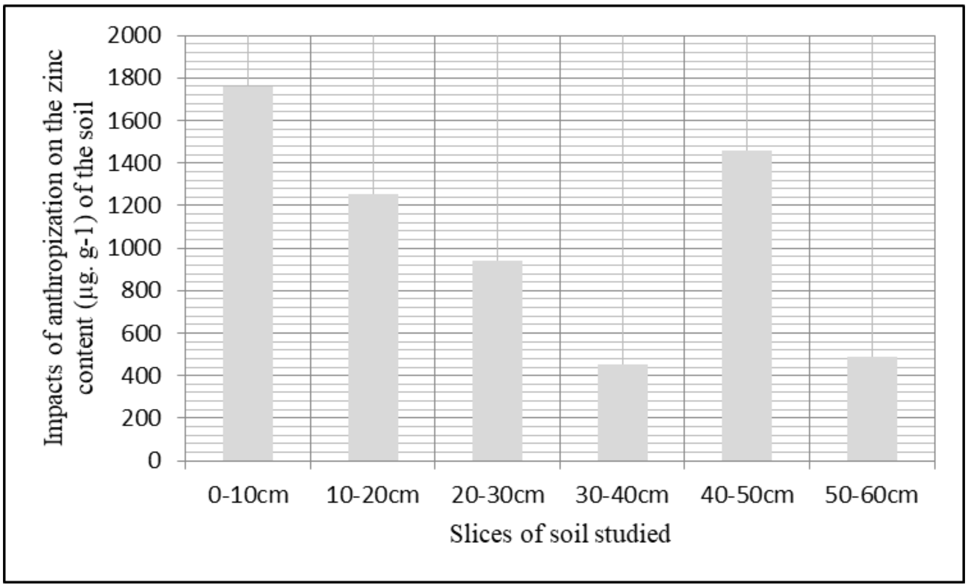

Figure 9. *Variations in the Impacts of Anthropization on the Average Zinc Content of the Soil (µg. g-1) of the Slices Studied Compared to those of the Reference (Control)*

The observation that we make of the elements of table 5 above shows the impacts of anthropization on the average zinc contents of the soil (µg. g-1) are positive at the level of the SST5 substations with +3603.38 µg. g-1 and SST6 with +3169.30 µg. g-1. They are totally positive within all the soil slices studied. Overall, they are positive with +6354.24 µg. g-1. This means that the activities (agricultural and others) carried out in this station have greatly enriched the soil in place with zinc. At this stage of research, it is too early to say where this enrichment of the soil in place with zinc may come from in these two substations (SST5 and SST6).

The other substations (SST1, SST2, SST3 and SST4) presented negative anthropization impacts; they have therefore drawn on the zinc reserves of the soil.

Finally, it can be seen that the activities carried out within the various substations of our station bordering the Society Textile de Kisangani/Kisangani factory drew much more copper (-1253.97 µg. g-1) than copper. zinc (+6359.24 µg. g-1) from the soil. It should be noted the presence of significant quantities in the products drawn from this station through its substations.

4.2 Discussions

a. The Copper

Soil copper content is one of the main indicators or chemical properties and soil quality from an agricultural point of view as well as for environmental related functions. In tropical areas (as in the Kisangani region), ferralitic soils deeply altered by the action of the hot and humid climate are generally sandy, acidic, poor in exchangeable bases and assimilable phosphorus and rich in iron oxides. and aluminum (Boyer, 1982; Kombele, 2004). Regarding the natural dynamics on the effect of the impact of anthropization, the data obtained in figure 6 show that their negative values mean that in a substation that carries the crops or its units, the activities related to the agricultural and other effects that were practiced there drew totally on the copper reserves of the soil compared to the control; a positive impact has enriched the soil with copper. In both cases, the situation is normally dangerous because the quantities of copper exported from the soil by the crops are not known and even their critical safety threshold (case of negative impacts), or even the critical enrichment threshold of the ground by the various activities developed there.

Nevertheless, the elements of figure 7 above show that the maize-cassava association, cassava-sweet potato association, maize-cassava association, maize-cassava-peanut association, maize-peanut association, maize-soya association, pasture and dense forest (reference) present negative anthropization impacts. The greatest impact is observed in the soil of the maize-cassava-peanut association (SST3), then that of the cassava-sweet potato association (SST2), then that of the maize-peanut association (SST4) followed by the maize-cassava association (SST1) followed by that of the maize-soya association (SST5) and finally, that of pasture (SST6). Only the maize-cassava-peanut association (SST3) and maize-peanut association (SST4) substations show positive anthropization impacts as shown by the histograms in Figure 6.

The mean contents and standard deviations show, in decreasing order, mean contents and their standard deviations change as follows: 387.95 ±112.41 µg. g-1 under SST3 (maize-cassava-peanut combination) is higher compared to 273.61 ± 79.54 µg. g-1 under SST2 (cassava-sweet potato combination) is higher compared to 240.76 ± 44.19 µg. g-1 under SST4 (corn-peanut association) is higher compared to 152.31 ±50.73µg. g-1 under SST1 (maize-cassava combination) is higher compared to 4.41±5.41µg. g-1 under SST5 (corn-soya combination) higher compared to 2.08±1.84 µg. g-1 under SST6 (pasture) and on the other hand is 524.19 ±311.98µg. g-1 under FD (dense forest) taken as reference.

b. Compared to Zinc

The average zinc contents and their standard deviations presented in Table 3 are 632.98±287.49 µg. g-1 under SST5 (corn-soya combination) higher than 560.64± 371.34µg. g-1 under SST6 (grazing) higher than 31; 15 ±21.01 µg. g-1 under SST3 (maize-cassava-peanut combination) higher than 18.26 ± 18.60 µg. g-1 under SST4 (corn-peanut combination) higher than 7.50 ±6.06 µg. g-1SST1 (maize-cassava combination) superior to 3.85 ± 4.08 µg. g-1 under SST2 (association-cassava-sweet potato) and on the other hand that of the dense forest taken as (reference) is 32.42±14.19µg. g-1.

Taking into account the Zn content in the slices, we notice that only the slices of (0-10cm) depth in the SST5 and SST6 substations, i.e. under the corn-soya association and pasture have presented high average levels compared to the others, which vary from 1071.16 to 1012.54 µg. g-1. The lowest levels are observed in the depth range (50-60cm) and range from 0.85 to 1.27µg. g-1 under the maize-groundnut combination substation and the cassava-sweet potato substation (SST4 and SST2). These values are generally higher than the global critical threshold of 20-30 mg/kg (Sciences Eaux & Territoires, 2019).

V. Conclusion

The objective pursued by this study was to know the impacts of anthropization on the contents of copper and zinc (ETMs) of the soil of the SOTEXKI station compared to those of the dense forest (control).

Our device consisted of a station itself subdivided into 7 sub-stations (including the control); each substation being a plot carrying a pure or associated crop. In each substation, the investigations are made by auger soundings of more or less 60cm deep. Soil samples are taken in 6 slices: 0-10, 10-20, 20-30, 30-40, 40 -50 and 50-60 cm, thus giving a total of 18 spot samples per substation and 42 samples composites for all 7 substations. The metal trace elements copper and zinc were analyzed and measured by the ammonium acetate method using an atomic absorption spectrophotometer in the presence of EDTA at pH7.

After the laboratory analyzes of the soil samples of our study, the results obtained show the following trends in relation to the two parameters studied:

- The average soil copper content is higher in the corn-cassava-peanut sub-station with 387.95 µg/g and lower in the pasture sub-station with 2.08 µg/g compared to all the other land occupations from our neighboring station to the factory of the textile company of Kisangani / Kisangani.
- The average soil zinc content is higher in the corn-soya association with 632.98 µg/g and lower in the cassava-sweet potato association substation with 3.85 µg/g compared to to all other occupations of the ground of our neighboring station at the factory of the textile company of Kisangani/Kisangani.
- In general, the superficial slices of the soils of different substations are richer in copper and zinc.
- Although in general higher than those of our reference (dense forest), the average values of the contents observed in our various substations are also compared to the global critical threshold; they are difficult to classify as dangerous at this stage of research.
- The impacts of anthropization are negative at the level of zinc, which means that the activities carried out in the substations of our neighboring station to the factory of the textile company of Kisangani/Kisangani have drawn on the reserves of their soil in zinc more than copper, although in small quantities for the latter

However, in view of these results we suggest and recommend the following:

That other investigations be carried out and several repetitions to be able to draw adequate conclusions and make a comparison between the different urban and peri-urban land uses.

References

Alongo L., 2019. Climatologie. Cours Universitaire inédit, IFA Yangambi, p 73

Baize D. 1997. Un point sur les teneurs totales en éléments traces métalliques dans les sols (France), INRA.

Baize D, 1997: teneurs totales en éléments traces métalliques dans les sols (FRANCE): référence et stratégie d'interprétation.

Ciesielski H. et Soignet G., 1990. Comparaison de quelques méthodes d'extraction du Bore des sols. Etude des mécanismes de solubilisation. Sc. du sol. Vol. 28, 1, pp71-96.

Daby., 2006. Impacte de l'Industrialisation sur les écosystèmes dans le sol urbain.

Darracq dauguet S, Denaix L, Nguyen C, Elicroyer, Levasseur P, Potin-Gautier M, Elespes G, 2013: transfert des éléments traces métalliques dans les sols agricoles vers une plante à vocation alimentaire: la laitue.

Girard, 2011: responses of gutmicrobiota and glucose and lipidmetabolism to prebiotics in genetic obese and diet-inducedleptin-resistantmice.

Honoret, 2016: comparative genomic and phylogeographicanalysis of mycobacteriumleprae

Juste, 1995: impact of markethunting on mammalspecies in equatorialguinea.

Kakuni J.J., 2009. Hydrodynamique approfondie des sols.

Kumumbeya M.,2018. Evaluation de la chaleur nutritionnelle et quelques propriétés physico-chimiques des fruits de FlacourtiaindicaetBelluciapentameraconsommés à Kisangani

Lemonde, 2009: quantum physicsexploringgravity in outersolar system.

Mambani, 1998: une comparaison de quatre traitements pour l'état de mal convulsive généralisé.

Matthieu et pieltain, 2003: influence de la salinité des eaux d'irrigation sur la minéralisation du carbone organiquedans le sol.

Mosango, M. 1990: contribution à l'étude botanique et biogéochimique de l'écosystème forêt en région équatoriale (île kongolo, zaîre). Thèse de doctorat Université Libre de Bruxelles: 442 pages.

Ngongo, M van ranst, E Baert, G kasongo, E verdoudt, A Mujinya, B MUkalay, 2009: Guide des sols en République Démocratique du Congo, tome1: étude et gestion.

P Mambani Banda, JJ Kakuni Mbuyi: tentative d'une substitution de l'engrais classique.

Pain, 1978: endogenous pain control mechanism: review and hypothesis.

Pedro et delmas, 1970: les principes géochimiques de la distribution des éléments traces dans les sols.

Stengel, 2009: timing of onset of CKD-relatedmetabolic complications.

Sys, 1961: indexedsystems of neighborhoods for generalspaces.

Van Wembeke ET Liben, 1957: carte des sols et de la vegetation.

Vandenp, 1981: la syntaxe du pronom en dans la construction quantitative.