

Levels of trace elements in soils on the Apodi-Mossoró River margin in Brazil

Monalisa Gurgel De Medeiros^A, Francisco Nildo Da Silva^B, Glécia Mesquita Freire^C, Humbelina Silva Siqueira Lopes^A and Fábio Henrique Nascimento^A

^AUniversidade Federal Rural do Semi-árido – UFERSA. Br 110 – Km 47/ Presidente Costa e Silva, CEP: 59625-900, Mossoró – RN, Email monalisa_gurgel@hotmail.com, humbelinas@hormail.com, fa_bill05@hotmail.com

^BDepartment of Environmental Sciences, Universidade Federal Rural do Semi-árido – UFERSA. Br 110 – Km 47/ Presidente Costa e Silva, CEP: 59625-900, Mossoró – RN, Email fnildos@yahoo.com

^CUniversidade Federal Rural do Semi-árido - UFERSA. Br 110 – Km 47/ Presidente Costa e Silva, CEP: 59625-900, Mossoró – RN, Email glecia_freyre@yahoo.com.br

Abstract

The study examined the levels of trace elements in soil on the margin of the river Apodi / Mossoró, which has great importance for the state, being the largest river in Rio Grande do Norte. Samples of the soil layer 0-20 cm were taken at 24 points on the river Apodi-Mossoro, distributed along its length from the begin (Luiz Gomes-RN) to the end on the Atlantic Ocean (Areia Branca-RN). Samples were collected in July and October 2008. Zn, Mn and Pb were determined for Luiz Gomes, Rafael Fernandes, Pau dos Ferros, Apodi, Governador Dix-Sept Rosado, Mossoró and Areia Branca in the state of Rio Grande do Norte. The worst values were in Mossoró city high concentrations of Pb and Mn of 106 and 41,095 mg/kg, respectively, while cities that were less affected are those located closer to the beginning of the river, like Pau dos Ferros.

Key Words

Trace elements, monitoring, soil pollution.

Introduction

The rivers have been used like deposit of variety products, from human activity. The presence of potentially toxic elements is responsible for adverse effects on the environment, with repercussions on the economy and public health. The introduction of metals in aquatic systems occurs naturally through geochemical processes in the weathering and the contribution to human activity is a reflection of its widespread use by industry. (Campos 2005; Yabe and Oliveira 1998). According to KICuen and Watkins, cited by Schwanz (2008), some metals are considered essential to the development of plants or animals, however, the tolerance limits for these trace elements, in general, are very low. Among them we highlight the cobalt (Co), manganese (Mn) and nickel (Ni). However, all the elements in high concentrations may cause damage to the body. Apodi River has a great importance to the state, being the largest river in Rio Grande do Norte, with approximately 210 km long. According to Mitchell and Spencer (2008), it is a resource of great economic importance, enabling the use of fisheries, the use of its water for agriculture and livestock, and the source of income and livelihood of many rivers. According Petta *et al.* (2007), the most dominant economic activities in the region, such as salt production, irrigated horticulture, extraction of oil and gas, fishing and shrimp grow so significantly dependent on water bodies. However, since the spring, the river shows clear signs of environmental problems such as pollution from the release of sewage, reduction of near vegetation and sedimentation. The framework of environmental degradation is further aggravated because of the degree of contamination of water in the urban area of Rio Grande do Norte. According to Oliveira and Queiroz (2008) is this breakage that the problem is more serious, since it is launched, directly, the liquid waste from industrial activity, the provision of services and even organic household waste, generating high levels of chemical pollution, evidenced by the existence heavy metals. Thus, the monitoring of soil, over time, is of fundamental importance to verification of changes in the levels of chemical elements, mainly heavy metals. The contamination of rivers, usually associated with land on margins of rivers, which has contributed greatly to the increase of contaminants in river water and decreased agricultural productivity of soils. This study aimed to verification the accumulation and distribution of the trace elements Cu, Zn, Mn, Ni, Pb and Co in soils along the River Apodi / Mossoró.

Methods

There were two samples of the soil layer 0-20 cm in 24 points on the river Apodi-Mossoró, distributed along the begin (Luiz Gomes-RN) to the end (Areia Branca-RN). Samples were collected in July and October, both in 2008. The samples were air dried, then pass through harrowing and mesh wire 2mm. To perform the digestion, we used the method USEPA 3050B, the U.S. Environmental Protection Agency, as described by

Campos *et al.* (2005). After digestion took place in the reading atomic absorption of quantity of zinc, manganese, nickel, lead, cobalt, calcium, magnesium. The potassium was determined by flame photometer, and boron in the spectrophotometer for each sample collected.

Results

In agreement with the obtained results, after analysis in laboratory, it was observed that were present in the soil the following elements: Cu, Zn, Pb, Co and Ni, as values presented in the Table 1. Among the certain points for the evaluation, Luiz Gomes, Rafael Fernandes, Pau dos Ferros, Apodi, Governador Dix-Sept Rosado, Mossoró and Areia Branca in the state of Rio Grande do Norte, the most affected city was Mossoró, because obtained larger presence of chemical elements and larger concentration of Cu, Zn, Co and Ni with 108.48; 173.83; 17.60 and 9.61 mg/kg respectively, while the less affected cities were the located ones closer to the begin of the river, like Pau dos Ferros city, presenting low values for the elements compared to other places.

Table 1. Points, collected sites and averages of values trace elements studying (mg/kg). Nd = Not detected.

Points	Identification Local collection and coordinated	Trace Elements				
		Cu	Zn	Pb	Co	Ni
1	Luiz Gomes-RN (6°22'8.00"S e 38°27'22.60"O)	0.87	nd	26.77	7.33	5.79
2	Luiz Gomes-RN (6°22'11.00"S e 38°26'6.00"O)	4.02	8.88	37.98	13.39	3.08
3	Rafael Fernandes-RN (6°14'50.00"S e 38°14'54.00"O)	nd	nd	24.91	6.93	nd
4	Pau dos Ferros-RN (6°8'50.00"S e 38°11'35.00"O)	nd	nd	35.49	8.51	nd
5	Pau dos Ferros-RN (6°6'28.00"S e 38°12'13.00"O)	nd	nd	27.4	7.19	nd
6	Apodi-RN (5°45'46.86"S e 37°48'4.76"O)	nd	nd	28.64	7.46	nd
7	Apodi-RN (5°45'46.86"S e 37°48'4.76"O)	nd	nd	24.28	9.83	1.60
8	Governador Dix-Sept Rosado-RN (5°28'9.65"S e 37°31'29.99"O)	nd	nd	26.15	8.64	0.86
9	Mossoró (5°13'9.13"S e 37°21'46.25"O)	nd	nd	26.77	7.85	0.25
10	Mossoró (5°13'9.13"S e 37°21'46.25"O)	nd	15.56	27.4	13.39	6.40
11	Mossoró-RN (5°12'22.64"S e 37°21'1.84"O)	nd	173.83	36.11	17.60	9.61
12	Mossoró-RN (5°12'22.64"S e 37°21'1.84"O)	nd	0.93	23.66	9.44	2.71
13	Mossoró-RN (5°12'16.61"S e 37°20'22.66"O)	nd	1.18	31.13	8.64	1.23
14	Mossoró-RN (5°12'11.72"S e 37°20'14.76"O)	nd	5.25	27.39	10.09	4.92
15	Mossoró-RN (5°11'43.32"S e 37°20'26.59"O)	nd	11.81	25.53	12.20	7.63
16	Mossoró-RN (5°11'43.32"S e 37°20'26.59"O)	nd	12.72	21.79	11.80	4.43
17	Mossoró-RN (5°11'43.32"S e 37°20'26.59"O)	nd	1.63	20.55	9.96	1.97
18	Mossoró-RN (5°11'52.55"S e 37°19'36.54"O)	nd	nd	25.53	6.8	nd
19	Mossoró-RN (5°11'45.60"S e 37°19'43.48"O)	nd	nd	13.07	5.74	nd
20	Mossoró-RN (5°10'36.81"S e 37°19'46.99"O)	nd	nd	16.81	12.33	4.68
21	Mossoró-RN (5°9'21.11"S e 37°17'8.99"O)	nd	41.48	22.42	16.02	7.39
22	Mossoró-RN (5°7'35.07"S e 37°16'5.37"O)	nd	nd	1.24	3.50	nd
23	Mossoró-RN (5°7'35.07"S e 37°16'5.37"O)	nd	nd	2.49	2.32	nd
24	Areia Branca-RN (4°57'15.17"S e 37°8'11.81"O)	180.48	132.02	35.49	8.38	2.46

The Company of Technology of Environmental Sanitation, Cetesb (2005) it determines prevention values (VP) and intervention values (VI) for metals in soils. VP is concentration that can cause harmful alterations to the quality of the soil, VI is the concentration above which risks potential, direct or indirect exist to the human health. In agreement with the company, VP in soils is of: Cu 60 mg/kg; Zn 300 mg/kg; Pb 72 mg/kg; Co 25 mg/kg; Ni 30 mg/kg, while the value of VI established for agricultural soils for the metals is: Cu 200 mg/kg; Zn 450 mg/kg; Pb 180 mg/kg; Co 35 mg/kg; Ni 70 mg/kg. The results for zinc presented values varying from 0 to 173.83 mg/kg, in other words, not presenting superior values to the established. The variation along the points can be observed in the Figure 1. Studies accomplished by Zuliani (2006), Duarte and Pasqual (2000) and Ramalho *et al.* (2000) observed values of Zn varying from 2.9 to 191 mg/kg; 0.5 to 5.0 mg/kg; 21.07 to 109 mg/kg respectively, similar to the results obtained this work. The concentration of cobalt and nickel were found along the river with grand intensity, like can be observed on Figure 2 with highest value in Mossoró city. This result can be happen because the largest pollution associated with the biggest population liven on this city, about 250.000 habitats.

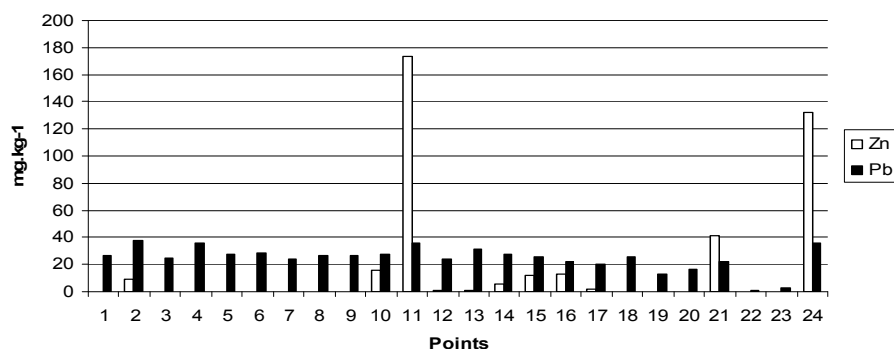


Figure 1. Variation of the concentration of zinc (Zn) and lead (Pb) in mg/kg along the collected points.

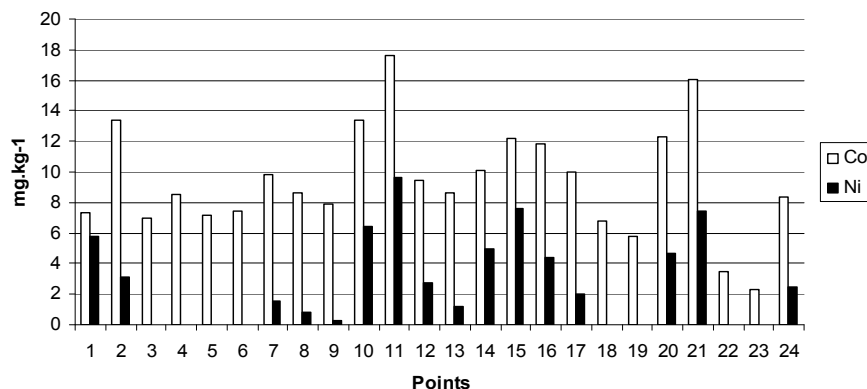


Figure 2. Concentration of cobalt (Co) and nickel (Ni) in mg/kg along the collected points.

The lead, cobalt and nickel were also inferior to the value established by CETESB (2005), being found along the points values among 1.24 to 37.98 mg/kg for Pb, 2.32 to 17.60 mg/kg for Co and 0 to 9.61 mg/kg of Ni. Duarte and Pasqual (2000), evaluating soil sample near highways of intense traffic in the state of São Paulo, verified values of Zn varying from 0.5 to 5.0 mg/kg, besides Pb varying from 1.3 to 8.9 mg/kg. Ramalho *et al.* (2000), evaluating the contamination of Caetés River by agrochemistry use, observed values in soils of Zn varying from 21.07 to 109.0 mg/kg and Pb varying from 18.34 to 30.73 mg/kg. In the present work, it is possible to observe in the river Apodi/Mossoró, higher values of the elements in some collected points when compared to the other mentioned authors. The presence of those metals in great amounts, as it happened in Mossoró city, it can take several consequences, like unavailability of drinking water for consumption, or soil for planting and of the use of fishing by the people live near the river.

Conclusion

The analysis made clear show the importance of studying the presence of trace elements in soil, with the objective to removal or treatment this lands, divide nearest soil river is present in an area of great economic importance for the region, this pollution can cause permanent damage to population.

References

- Campos ML *et al.* (2005) Determinação de cádmio, cobre, cromo, níquel, chumbo e zinco em fosfatos de rocha. *Pesquisa Agropecuária Brasileira*, Brasília **40**, 361-367
- Yabe MJS, Oliveira E (1998) Metais pesados em águas superficiais como estratégia de caracterização de bacias hidrográficas. *Quím. Nova* **21**, 551-556.
- Schwanz M, Ferreira JJ, Fröhlich P, Zuanazzi JAS, Henriques AT (2008) Análise de metais pesados em amostras de *Peumus boldus* Mol. (Monimiaceae). *Rev. bras. farmacogn.* **18**, 98-101.
- Morais PRF, Souza LD (2008) 'Efeito da sazonalidade e das ações antrópicas no teor de sólidos e na turbidez das águas da Bacia do Rio Apodi Mossoró-RN'. <http://www.abq.org.br/cbq/2008/trabalhos/5/5-265-3026.htm>
- Petta RA, Gomes RC, Erasmi S, Campos TFC, Nascimento PSR (2007) 'Análise da Bacia Hidrográfica do Rio Apodi-Mossoró no contexto de alterações ambientais e socioeconômicas ligadas a exploração de petróleo'. http://www.portalabpg.org.br/PDPetro/4/resumos/4PDPETRO_6_2_0289-2.pdf
- Oliveira MA, Queiroz RAC (2008) 'A poluição do Rio Mossoró (RN) e a Ação Intervencionista do

Ministério Público'. <http://www.anppas.org.br/encontro4/cd/ARQUIVOS/GT6-518-1004-20080517230550.pdf>

CETESB (2005) Valores orientadores para solo e água subterrânea no Estado de São Paulo.

<http://www.agsolve.com.br/pdf/artigos/novatabelacetesb2005.pdf>

Zuliani DQ (2006) Elementos-traço em águas, sedimentos e solos da bacia do rio das Mortes, Minas Gerais. 168f. Tese (Doutorado em Solos e Nutrição de Plantas) – Universidade Federal de Lavras, Lavras-MG.

Duarte RPS, Pasqual A (2000) Avaliação de cádmio (Ca), chumbo (Pb), níquel (Ni) e zinco (Zn) em solos, plantas e cabelos humanos. *Energia na agricultura* **15**.

Ramalho JFGP, Sobrinho N, Velloso ACX (2000) Contaminação da microbacia de Caetés com metais pesados pelo uso de agroquímicos. *Pesq. Agroppec.bras.* **35**, 1289-1303.