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Elemental Nutrients Environmental Pollution Load Assessment in the Soils of Three Selected Rice Farms in Yola Metropolis, Adamawa State, Nigeria

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Abstract: Trace element environmental pollution has been a source of concern to man over the past decades. The rice farms studied received varied amount of environmental pollution load from atmospheric deposition, non-point sources, anthropogenic inputs and agro-allied practices. The rice plant passes these pollutants ultimately to man via the food chain of the ecosystem. Possible bioaccumulation may occur in the human body with the attendant manifestation of chronic diseases in the human population that feeds on the rice produce. The status and distribution of cobalt, iron, manganese, nickel, nitrogen, cadmium and copper in five profiles each, during the dry and rainy seasons in three selected rice farms in Yola metropolis, Adamawa State, Nigeria, were examined using EDXRF spectrometer (mini pal version) and UV-visible spectrophotometry in order to determine their environmental pollution load. The soil profile distribution of Co, Mn and Fe showed a marked variation within the same farm and spatially different ones. The mean elemental contents ranged from 0.43-16.71 mg/kg, 114.52-613.17 mg/kg and 125.20-3027.57 mg/kg, respectively. However, the soil contents Ni and N vary between 17.80-20.13 mg/kg and 0.16-0.33 %, respectively. Furthermore, Ni and N contents were higher in the topsoil (0-5cm) than in the subsoil (5-20 cm) in all the farms. On the whole, the distribution of Fe and Mn on one hand and Co on the other, with depth, however did not show any distinct pattern in Farm "C" and Farms "B" and "C", respectively. Cd and Cu were not detected in any of the soils of the studied area. In comparison with the established critical levels for each element investigated, the studied area was not contaminated by these elements. Nevertheless for good rice yield, improvements or ameliorative amendment of the farm soils are needed in order to replenish used-up, leached and washed-away elements and the enhancement of the physical and biological programme of the soils. This can be achieved via supplementary mineral fertilizer application.

Key words: Soil · Elemental nutrients · Environmental · Pollutants and Critical levels

INTRODUCTION

Rice which was considered as food for the affluent before the 1970s is now a staple food and delicacy in Nigeria and it is eaten in various forms [1]. Furthermore, it is the preferred meal in social functions. Soil is one of the dynamic, primary reservoirs for trace elements from environmental pollution. The rice plant absorbs its nutrients from the soil and passes it ultimately to the humans, on top of the trophic level in the food web of the ecosystem [2]. Thus, any adverse effect on the plant consequent upon the absorption of pollutant elements will have a devastating, deleterious health impact on the consumer of the unsuspected rice produce as was the case in Shimoga Prefectory, India at the dawn of this century [3].

The studied area comprises three selected rice farms, namely Farms "A", "B" and "C" which receives environmental pollutant elements from atmospheric deposition, non-point sources, annual flooding anthropogenic inputs from urban activities and agricultural practices.

The pollution load may contain different toxic elements which accumulate gradually in the soil and, as stated previously, are taken up by the rice plant and eventually to man via the food chain. With time, the levels of these pollutant elements become higher than the acceptable limits in the human body and may be

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responsible for some of the chronic or strange ailments that can plague the human population that feeds on this unsuspected rice produce.

Our aim in this paper therefore, is to assess the environmental pollutant load as well as the spatial distribution at specified depths of the farm soils by cadmium cobalt, copper, iron, manganese, nickel and nitrogen.

MATERIALS AND METHODS

The Study Area: The study area has been described in detail [4], in their discourse of the soil fertility component of the project.

Yola is located between latitude $9^0$16’ 48”N and 9.23^{0}N and longitude 12^{0}27’ 36”E and 12.46^{0}E (en.wikipeda.org/wiki) covering the entire area of interest drained by the four major watersheds Lake Crerio, Chouci River, Njuwa’a Lake and River Benue. The area has humid tropical wet-dry climate type, coded Aw (https://en.m.wikipedia.org/000/koppen...).

It is characterized by slightly cold harmathan period in January and high temperature, with sunshine from February to May. June to July is marked by sporadic rainfalls, while the month of August is noted for its heavy torrential rains. The temperature drops with the onset of the rains. The rains cease from the end of October to early November. From mid-november to the end of December, the area experiences cold harmattan again. The annual temperature ranges from 20-41^{0}C, while its annual rainfall is between 500 and 1000mm.

Analytical Procedures: Pretreated composite soil samples were air-dried, pulverized, sieved through a 2 mm-aluminium sieve, pelletized and analyzed for elements contents using EDXRF spectrometer (mini palversion) at the Ahmadu Bellow University Energy Centre, Zaria, while the nitrogen content was determined as nitrate spectrophometrically [5].

RESULTS AND DISCUSSIONS

Cobalt (Co): In Farm “A”, Co was detected in four samples. Its mean contents in the other Farm types ranged from 8.55$\pm$2.27 – 19.39$\pm$ 0.89 mg/kg (Table 1). The distribution of Co in the soils of the studied area did not show any definite pattern. Cobalt contents in Farms “B” and “C” were higher than the range of 8.4-10.1 mg/kg recommended by [6], but was within the range of 25-50 mg/kg [7].

Nickels (N,): The mean concentration of Ni in the six farm types were pretty close, with the dry-season Farm “A” recording the highest concentration and dry-season Farm “C”, the least.

The trends of distribution of nickel in the soil profile were similar in all the Farms (Table 6). Its concentration was higher in the topsoil than that of the subsoil. This supports the report by [8] that Ni accumulates mostly in the surface (topsoil) in agricultural soils. The concentrations of Ni in the soil were far below the critical value of 100 mg/kg reported by [7], suggesting that the area studied was not contaminated by this metal.

Iron (Fe): The dry-season Farm “B” recorded the highest Fe concentration followed by the rainy-season Farm “C”. This high iron content might be due to the high concentration of hemaetite and iron oxides in the soils.

There was no distinct distribution pattern of this metal with soil depth. However, a significant difference in iron content in the topsoil and subsoil was observed in the dry and rainy season soil samples of Farm “A”, with topsoil values of 2912.20 and 1094.15 mg/kg respectively against the subsoil values of 2099.89 and 1094.15 mg/kg. The soil samples of the dry-season Farm “C” displayed a similar variation trend as that of Farm “A”, with the topsoil value of 3188.40 mg/kg in comparison with the subsoil value of 2431.35 mg/kg.

Manganese (Mn): Manganese was detected in highest concentration in the dry-season Farm “C” with a range of 147.10-1691.09 mg/kg and mean value of 613$\pm$424.09 mg/kg, while its concentration in the other farms ranged from 114.5$\pm$109.5-553.75$\pm$358.19 mg/kg. The values were far below the lower critical limit of 604 mg/kg recommended by [6], suggesting that the soils of rainy-season Farm “C”, Farm “A” and “B” were deficient in Mn.

The distribution of Mn in the soil profile was similar to that of iron. However, a considerable difference in Mn content in the topsoil was recorded in the soil samples of rainy-season Farm “B” with values 866.52 and 324.31 mg/kg for the former and later soil types, respectively.

Nitrogen (N): The values of N decrease with the soil depth (Table 5). The results of this empirical determination corroborate an earlier work of [9], on the fertility status of selected hydromorphic soils in AKamkpa Local Government Area, Cross River State. By adapting a similar reasoning to their report, the values in Table 5 were rated medium for Farms “A” and “C” and dry-season Farm “B” and, high for rainy-season Farm “B” soil samples.

Cadmium and Copper (Cd & Cu): The elements Cd and Cu were not detected in any of the soil samples in the studied area. This might be due to their low natural abundance, scavenging capacities of manganese and iron [10], or extensive leaching of the metals into levels below the maximum specified depth of sample collection and/or their concentrations were below the detection limit of the EDXRF spectrometer used for their determination.

CONCLUSION

The concentration of the elements investigated differed from farm to farm due to their occurrences in the parent materials and contribution from anthropogenic pressure or inputs, leaching run-offs, plant uptake and plant harvesting (or plant removal). The results of this research in comparison with established critical levels for each element investigated, the studied area was not contaminated by these elements

Recommendations: For achieving good rice yields, improvement or ameliorative amendments of the soils of interest are needed in order to replenish the depleted elemental nutrients. This can be achieved via appropriate supplementary mineral fertilizer applications. Besides, concerted use of organic manure with mineral fertilizer should be practiced; since they play a complementary significant role in the maintenance of long term fertility of rice fields via improvements of the physical and biological properties of soils [11].

Table 1: Concentration (in mg/kg) of cobalt in the soil of the studied area

Horizon (cm)	Sample	Co	Sample	Co	Sample	Co	Sample	Co	Sample	Co	Sample	Co
0 – 5	DABY 11	___	RABY 11	___	DWTP 11	4.86	RWTP 11	28.80	DCLG 11	17.00	RCLG 11	8.30
5 – 10	DABY 12	___	RABY 12	1.27	DWTP 12	2.43	RWTP 12	6.48	DCLG 12	12.96	RCLG 12	16.20
10 – 20	DABY 13	___	RABY 13	1.46	DWTP 13	19.44	RWTP 13	7.92	DCLG 13	___	RCLG 13	11.89
0 – 5	DABY 21	___	RABY 21	___	DWTP 21	10.53	RWTP 21	4.54	DCLG 21	17.82	RCLG 21	15.50
5 – 10	DABY 22	3.75	RABY 22	___	DWTP 22	23.49	RWTP 22	24.48	DCLG 22	7.94	RCLG 22	1.78
10 – 20	DABY 23	___	RABY 23	___	DWTP 23	19.44	RWTP 23	18.72	DCLG 23	13.77	RCLG 23	2.27
0 – 5	DABY 31	___	RABY 31	___	DWTP 31	20.25	RWTP 31	0.22	DCLG 31	16.60	RCLG 31	1.62
5 – 10	DABY 32	___	RABY 32	___	DWTP 32	31.59	RWTP 32	___	DCLG 32	14.58	RCLG 32	23.49
10 – 20	DABY 33	2.90	RABY 33	___	DWTP 33	30.00	RWTP 33	6.73	DCLG 33	22.68	RCLG 33	39.61
0 – 5	DABY 41	___	RABY 41	2.33	DWTP 41	4.86	RWTP 41	2.18	DCLG 41	38.88	RCLG 41	36.00
5 – 10	DABY 42	___	RABY 42	___	DWTP 42	22.68	RWTP 42	9.65	DCLG 42	42.72	RCLG 42	31.19
10 – 20	DABY 43	___	RABY 43	1.43	DWTP 43	16.20	RWTP 43	5.82	DCLG 43	5.72	RCLG 43	12.96
0 – 5	DABY 51	___	RABY 51	___	DWTP 51	1.94	RWTP 51	4.55	DCLG 51	5.67	RCLG 51	23.48
5 – 10	DABY 52	___	RABY 52	___	DWTP 52	10.53	RWTP 52	6.73	DCLG 52	15.39	RCLG 52	21.87
10 – 20	DABY 53	___	RABY 53	___	DWTP 53	28.35	RWTP 53	1.46	DCLG 53	25.11	RCLG 53	17.82
RANGE		1.05-		1.27 -		1.94 -		0.22		6.67		8.30 -
X ± S		2.92		2.33		31.59		29.48		42.72		39.61
		0.44		0.43		16.12		8.55		16.71		12.63
		1.10		0.66		9.70		2.22		10.14		11.45

The dash (-) means "not applicable." The results are mean of triplicate determination ± standard deviation

Table 2: Nickel content (in mg/kg) of cobalt in the soil of the studied area

Horizon (cm)	Sample	Ni	Sample	Ni	Sample	Ni	Sample	Ni	Sample	Ni	Sample	Ni
0 – 5	DABY 11	20.28	RABY 11	18.85	DWTP 11	20.81	RWTP 11	17.68	DCLG 11	20.15	RCLG 11	19.49
5 – 10	DABY 12	19.11	RABY 12	17.75	DWTP 12	14.56	RWTP 12	18.70	DCLG 12	18.85	RCLG 12	18.80
10 – 20	DABY 13	19.63	RABY 13	19.53	DWTP 13	18.59	RWTP 13	19.04	DCLG 13	20.80	RCLG 13	18.96
0 – 5	DABY 21	20.61	RABY 21	27.95	DWTP 21	19.50	RWTP 21	21.04	DCLG 21	18.85	RCLG 21	16.89
5 – 10	DABY 22	25.42	RABY 22	18.21	DWTP 22	10.43	RWTP 22	19.04	DCLG 22	19.54	RCLG 22	17.68
10 – 20	DABY 23	19.50	RABY 23	18.20	DWTP 23	19.48	RWTP 23	19.72	DCLG 23	19.50	RCLG 23	17.55
0 – 5	DABY 31	18,54	RABY 31	18.35	DWTP 31	18.20	RWTP 31	20.40	DCLG 31	15.30	RCLG 31	18.29
5 – 10	DABY 32	19.58	RABY 32	17.57	DWTP 32	17.50	RWTP 32	20.40	DCLG 32	24.30	RCLG 32	17.88
10 – 20	DABY 33	20.05	RABY 33	17.15	DWTP 33	19.52	RWTP 33	17.55	DCLG 33	20.15	RCLG 33	16.79
0 – 5	DABY 41	18.85	RABY 41	18.14	DWTP 41	18.85	RWTP 41	18.85	DCLG 41	18.20	RCLG 41	17.30
5 – 10	DABY 42	20.00	RABY 42	19.19	DWTP 42	18.85	RWTP 42	14.93	DCLG 42	18.85	RCLG 42	16.90
10 – 20	DABY 43	19.50	RABY 43	18.35	DWTP 43	21.45	RWTP 43	18.85	DCLG 43	20.80	RCLG 43	17.52
0 – 5	DABY 51	20.28	RABY 51	17.51	DWTP 51	21.45	RWTP 51	17.55	DCLG 51	20.15	RCLG 51	17.82
5 – 10	DABY 52	20.29	RABY 52	18.20	DWTP 52	19.50	RWTP 52	16.90	DCLG 52	19.55	RCLG 52	17.86
10 – 20	DABY 53	20.41	RABY 53	19.52	DWTP 53	20.15	RWTP 53	19.53	DCLG 53	17.86	RCLG 53	17.42
RANGE		18.54		17.15		17.50		14.93		15.93		16.90
		-20.61		-27.95		- 21.45		-21.08		-24.30		-18.96
X ± S		20.12		17.82		19.39		19.28		19.46		17.80
		1.53		2.83		0.89		2.22		1.90		0.81

The dash (-) means "not applicable." The results are mean of triplicate determination ± standard deviation

Table 3: Concentration of Manganese (in mg/kg) in the soils of the studied area

Horizon (cm)	Sample	Mn	Sample	Mn	Sample	Mn	Sample	Mn	Sample	Mn	Sample	Mn
0 – 5	DABY 11	352.37	RABY 11	45.22	DWTP 11	255.00	RWTP 11	866.52	DCLG 11	1102.00	RCLG 11	420.81
5 – 10	DABY 12	53.24	RABY 12	482.00	DWTP 12	167.31	RWTP 12	189.24	DCLG 12	605.00	RCLG 12	115.40
10 – 20	DABY 13	240.83	RABY 13	127.84	DWTP 13	595.73	RWTP 13	229.91	DCLG 13	249.30	RCLG 13	628.68
0 – 5	DABY 21	75.63	RABY 21	14.62	DWTP 21	365.00	RWTP 21	169.32	DCLG 21	438.56	RCLG 21	774.00
5 – 10	DABY 22	706.42	RABY 22	119.00	DWTP 22	749.50	RWTP 22	650.72	DCLG 22	245.10	RCLG 22	218.86
10 – 20	DABY 23	390.45	RABY 23	45.40	DWTP 23	485.88	RWTP 23	428.28	DCLG 23	663.00	RCLG 23	208.72
0 – 5	DABY 31	395.46	RABY 31	166.47	DWTP 31	922.74	RWTP 31	360.22	DCLG 31	540.60	RCLG 31	212.94
5 – 10	DABY 32	797.68	RABY 32	139.17	DWTP 32	1257.36	RWTP 32	23.24	DCLG 32	429.26	RCLG 32	976.82
10 – 20	DABY 33	396.30	RABY 33	356.76	DWTP 33	1020.00	RWTP 33	378.42	DCLG 33	1275.00	RCLG 33	1412.10
0 – 5	DABY 41	273.78	RABY 41	35.90	DWTP 41	179.14	RWTP 41	148.76	DCLG 41	1055.41	RCLG 41	596.77
5 – 10	DABY 42	144.50	RABY 42	68.76	DWTP 42	866.41	RWTP 42	860.00	DCLG 42	1691.00	RCLG 42	580.52
10 – 20	DABY 43	316.88	RABY 43	245.11	DWTP 43	486.72	RWTP 43	307.70	DCLG 43	253.50	RCLG 43	646.34
0 – 5	DABY 51	281.22	RABY 51	54.61	DWTP 51	39.72	RWTP 51	307.94	DCLG 51	___	RCLG 51	___
5 – 10	DABY 52	269.93	RABY 52	45.93	DWTP 52	222.24	RWTP 52	528.00	DCLG 52	147.10	RCLG 52	___
10 – 20	DABY 53	199.42	RABY 53	127.84	DWTP 53	673.47	RWTP 53	127.84	DCLG 53	502.77	RCLG 53	
RANGE		75.63		35.90		39.72		23.24		142.10		208.72
		-797.68	-482.00	-1257.36		-866.52		-1691.00		-1417.10		
X ± S		326.27		114.52		553.75		375.41		613.17		474.95
		204.08		109.05		358.19		249.86		424.09		226.89

The dash (-) means "not applicable." The results are mean of triplicate determination + standard deviation

Table 4: Iron content (in mg/kg) in the soils of the studied area

Horizon (cm)	Sample	Fe	Sample	Fe	Sample	Fe	Sample	Fe	Sample	Fe	Sample	Fe
0 – 5	DABY 11	2912.28	RABY 11	663.85	DWTP 11	3219.66	RWTP 11	3000.43	DCLG 11	3118.40	RCLG 11	2977.75
5 – 10	DABY 12	1534.97	RABY 12	2412.09	DWTP 12	1741.40	RWTP 12	3174.70	DCLG 12	1812.87	RCLG 12	3295.11
10 – 20	DABY 13	2650.91	RABY 13	663.85	DWTP 13	3256.22	RWTP 13	3889.88	DCLG 13	3256.22	RCLG 13	3532.64
0 – 5	DABY 21	1293.04	RABY 21	1000.80	DWTP 21	2780.51	RWTP 21	3101.84	DCLG 21	3492.80	RCLG 21	3330.47
5 – 10	DABY 22	2782.14	RABY 22	1496.80	DWTP 22	3441.66	RWTP 22	3544.63	DCLG 22	1653.20	RCLG 22	2888.81
10 – 20	DABY 23	3006.40	RABY 23	1115.32	DWTP 23	2782.78	RWTP 23	4111.52	DCLG 23	1733.20	RCLG 23	2888.09
0 – 5	DABY 31	270.83	RABY 31	1663.44	DWTP 31	3668.40	RWTP 31	3523.49	DCLG 31	1733.20	RCLG 31	2497.09
5 – 10	DABY 32	3210.91	RABY 32	1597.36	DWTP 32	3538.10	RWTP 32	2795.87	DCLG 32	3038.57	RCLG 32	3074.42
10 – 20	DABY 33	2693.35	RABY 33	1911.89	DWTP 33	3622.54	RWTP 33	3442.79	DCLG 33	3973.76	RCLG 33	3471.40
0 – 5	DABY 41	1520.40	RABY 41	2005.96	DWTP 41	3300.30	RWTP 41	2901.30	DCLG 41	3156.80	RCLG 41	3105.56
5 – 10	DABY 42	285.97	RABY 42	937.10	DWTP 42	3306.21	RWTP 42	3611.53	DCLG 42	2772.56	RCLG 42	3600.90
10 – 20	DABY 43	1977.87	RABY 43	2146.18	DWTP 43	2292.88	RWTP 43	2954.70	DCLG 43	2676.00	RCLG 43	3519.90
0 – 5	DABY 51	1296.00	RABY 51	428.94	DWTP 51	2001.24	RWTP 51	2764.44	DCLG 51	2000.20	RCLG 51	3534.77
5 – 10	DABY 52	2699.33	RABY 52	539.59	DWTP 52	2565.09	RWTP 52	3483.54	DCLG 52	2052.40	RCLG 52	3042.22
10 – 20	DABY 53	1272.23	RABY 53	663.85	DWTP 53	3262.78	RWTP 53	1695.24	DCLG 53	3118.40	RCLG 53	3263.78
RANGE		1293.04		428.94		1741.40		1695.25		1653.20		2497.09
		-3210.91		-2412.09		-3668.40		-4111.52		-3973.76		-3600.90
X ± S		2092.94		1252.20		3019.17		2789.53		2639.24		3027.37
		711.23		729.31		1859.43		699.45		1067.59		380.50

The dash (-) means "not applicable." The results are mean of triplicate determination + standard deviation

Table 5: Nitrogen (in mg/kg) in the soils of the studied area

	Farm "A"				Farm "C"				Farm "C"			
Horizon (cm)	Sample	N	Sample	N	Sample	N	Sample	N	Sample	N	Sample	N
0 – 5	DABY 11	0.20	RABY 11	0. 24	DWTP 11	0. 24	RWTP 11	0. 27	DCLG 11	0. 17	RCLG 11	0. 23
5 – 10	DABY 12	0.18	RABY 12	0. 20	DWTP 12	0. 19	RWTP 12	0. 24	DCLG 12	0. 15	RCLG 12	0. 20
10 – 20	DABY 13	0.16	RABY 13	0. 17	DWTP 13	0. 16	RWTP 13	0. 18	DCLG 13	0. 14	RCLG 13	0. 18
0 – 5	DABY 21	0.11	RABY 21	0. 30	DWTP 21	0. 16	RWTP 21	0. 35	DCLG 21	0. 17	RCLG 21	0. 16
5 – 10	DABY 22	0.10	RABY 22	0. 28	DWTP 22	0. 12	RWTP 22	0. 33	DCLG 22	0. 10	RCLG 22	0. 14
10 – 20	DABY 23	0.09	RABY 23	0. 25	DWTP 23	0. 10	RWTP 23	0. 30	DCLG 23	0. 90	RCLG 23	0. 10
0 – 5	DABY 31	0.22	RABY 31	0. 16	DWTP 31	0. 30	RWTP 31	0. 72	DCLG 31	0. 30	RCLG 31	0. 32
5 – 10	DABY 32	0.20	RABY 32	0. 14	DWTP 32	0. 28	RWTP 32	0. 56	DCLG 32	0. 30	RCLG 32	0. 30
10 – 20	DABY 33	0.17	RABY 33	0. 13	DWTP 33	0. 24	RWTP 33	0. 46	DCLG 33	0. 24	RCLG 33	0. 26
0 – 5	DABY 41	0.19	RABY 41	0. 22	DWTP 41	0. 24	RWTP 41	0. 33	DCLG 41	0. 17	RCLG 41	0. 16
5 – 10	DABY 42	0.18	RABY 42	0. 19	DWTP 42	0. 21	RWTP 42	0. 26	DCLG 42	0. 15	RCLG 42	0. 14
10 – 20	DABY 43	0.16	RABY 43	0. 18	DWTP 43	0. 10	RWTP 43	0. 25	DCLG 43	0. 13	RCLG 43	0. 13
0 – 5	DABY 51	0.16	RABY 51	0. 16	DWTP 51	0. 24	RWTP 51	0. 26	DCLG 51	0. 18	RCLG 51	0. 20
5 – 10	DABY 52	0.15	RABY 52	0. 14	DWTP 52	0. 23	RWTP 52	0. 22	DCLG 52	0. 15	RCLG 52	0. 15
10 – 20	DABY 53	0.13	RABY 53	0. 11	DWTP 53	0. 22	RWTP 53	0. 10	DCLG 53	0. 14	RCLG 53	0. 16
RANGE												
X ± S		0.16		0.19		0.20		0.33		0.23		0.19
		0.04		0.06		0.06		0.16		0.20		0.06

The dash (-) means "not applicable." The results are mean of triplicate determination + standard deviation

Table 6: Distribution profile of Co, Ni, Fe, Mn (in mg/kg) and N (in%) in the soils of the studied area.

Farm	Sample	Horizon (cm)	Co	Ni	Fe	Mn	N
"A"	Dry – season topsoil	0 – 5	____	20.28	2912.28	352.37	0.17
	Dry – season subsoil	5 – 20	____	18.77	2099.89	302.72	0.15
	Rainy – season topsoil	0 – 5	____	18.85	663.09	45.22	0.22
	Rainy – season subsoil	5 – 20	____	11.21	1094.15	135.43	0.18
"B"	Dry – season topsoil	0 – 5	4.86	20.81	3219.66	255.00	0.24
	Dry – season subsoil	5 – 20	15.78	17.34	3078.51	110.08	0.20
	Rainy – season topsoil	0 – 5	28.80	17.68	3000.43	866.52	0.40
	Rainy – season subsoil	5 – 20	6.63	17.50	2999.69	324.31	0.30
"C"	Dry – season topsoil	0 – 5	17.00	20.15	3118.40	1102.00	0.20
	Dry – season subsoil	5 – 20	15.16	18.85	2431.35	539.71	0.24
	Rainy – season topsoil	0 – 5	8.30	19.49	2977.25	420.81	0.21
	Rainy – season subsoil	5 – 20	17.08	16.49	3048.53	514.49	0.16

The dash (-) means "not detected".

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