Supplementary Materials

Table S1**.** XRF analysis of the standard reference material (SRM 2711a), %SR values (n=5), and detection limits.

Metal	Mass (Da)	Measured value ($mg.kg^{-1}$)	Certified value ($mg.kg^{-1}$)	%SR	DL (mg/kg)	QL (mg/kg)
Cr	52	49.4 ± 4.1	52.3 ± 2.9	20	1.13	11.3
Mn	55	600.0 ± 69.1	675.0 ± 18	20	4.89	48.9
Fe	56	27,595.1 ± 478	28,200.0 ± 400	5	13.27	132.7
Ni	59	20.6 ± 3.4	21.7 ± 0.7	23	2.13	21.3
Cu	64	140.1 ± 42	140.0 ± 2.0	19	8.71	87.1
Zn	65	397.8 ± 13.5	414.0 ± 11	11	6.00	60.0
As	75	101.1 ± 2.1	107.0 ± 5	15	0.05	0.5
Pb	207	1,366.2 ± 48	1,400.0 ± 10	8	1.16	11.6

DL: Detection Limit

LQD: Quantification Limit

Table S2. Geographic location and physicochemical parameters of Bonao, Dominican Republic.

Sample	Latitude	Longitude	pH (1:2)	OM (%)	CEC meq/100 g	CE (µs/cm)	% Sand	% Silt	% Clay
Bo-01	18.885480	-70.367170	6.22	4.06	21.16	0.11	26.52	38.00	35.48
Bo-02	18.882037	-70.372637	5.52	4.54	7.26	0.08	26.52	34.00	39.48
Bo-03	18.880639	-70.375088	6.08	4.28	10.82	0.13	18.52	36.00	45.48
Bo-04	18.879107	-70.377610	5.35	5.12	8.99	0.09	27.96	34.56	37.48
Bo-05	18.877427	-70.380424	5.77	5.49	10.27	0.11	36.52	28.00	35.48
Bo-06	18.892437	-70.368395	5.36	4.32	6.74	0.12	34.52	29.28	36.20
Bo-07	18.890360	-70.369930	5.82	5.41	15.57	0.07	48.52	21.28	30.20
Bo-08	18.887533	-70.374721	5.53	5.49	8.10	0.06	19.80	30.00	50.20
Bo-09	18.884433	-70.379935	5.95	4.14	15.91	0.14	73.24	18.56	8.20
Bo-10	18.882732	-70.382802	5.59	13.40	17.63	0.13	27.80	28.00	44.20
Bo-11	18.881081	-70.385646	6.73	3.55	10.15	0.19	29.80	33.28	36.92
Bo-12	18.896518	-70.369513	4.78	4.71	5.21	0.15	27.08	34.72	38.20
Bo-13	18.895080	-70.373000	5.78	4.92	13.69	0.17	45.24	33.28	21.48
Bo-14	18.893173	-70.376694	5.75	7.13	18.24	0.12	27.08	34.72	38.20
Bo-15	18.890849	-70.380399	6.10	3.56	19.63	0.14	30.52	27.28	42.20
Bo-16	18.888528	-70.383638	5.63	5.53	11.31	0.22	35.24	33.28	31.48
Bo-17	18.886795	-70.386774	5.67	6.27	13.49	0.21	31.80	26.00	42.20
Bo-18	18.901730	-70.371963	4.96	6.87	6.25	0.23	24.52	32.00	43.48
Bo-19	18.899730	-70.375610	5.47	4.06	19.21	0.15	32.52	27.80	40.20
Bo-20	18.898032	-70.379737	5.89	5.97	14.65	0.12	39.80	24.00	36.20
Bo-21	18.895164	-70.384823	5.78	5.27	10.79	0.19	30.52	33.28	36.20
Bo-22	18.893845	-70.387188	6.00	4.87	12.16	0.14	30.80	31.28	24.80
Bo-23	18.892247	-70.391841	6.39	3.84	16.35	0.16	30.08	36.72	30.20
Bo-24	18.901871	-70.377588	5.95	5.52	11.69	0.22	29.80	38.72	31.48
Bo-25	18.905912	-70.375702	5.41	6.57	12.40	0.16	32.52	41.28	26.20
Bo-26	18.905225	-70.379455	5.36	5.67	7.60	0.15	36.52	21.28	42.20
Bo-27	18.904270	-70.382482	6.17	4.43	12.32	0.12	46.52	29.28	24.20
Bo-28	18.901350	-70.386914	5.88	4.05	3.81	0.60	41.08	16.72	42.20
Bo-29	18.900003	-70.388939	6.23	2.55	10.68	0.12	35.80	32.00	32.20
Bo-30	18.898694	-70.390746	6.17	3.12	11.64	0.17	31.80	28.00	40.20
		MIN	4.78	2.55	3.81	0.06	18.52	16.72	8.20
		MAX	6.73	13.40	21.16	0.60	73.24	41.28	50.20
		MEAN	5.78	5.16	12.12	0.16	33.63	30.42	35.43
		STD	0.41	1.90	4.45	0.09	10.25	5.91	8.48

*STD standard deviation

Table S3. Total heavy metal concentrations in surface soils of Bonao, Dominican Republic.

Sample	Latitude	Longitude	Fe	Mn	Cr	Cu	Ni	Zn	Pb	As
			mg/kg							
Bo-01	18.88548	-70.3672	121600	4200	121	9.2	7.6	20.3	< 0.1	3.7
Bo-02	18.88204	-70.3726	144300	2600	203	35.5	2.0	14.3	< 0.1	4.1
Bo-03	18.88064	-70.3751	109200	1900	437	8.4	82.2	40.3	< 0.1	4.3
Bo-04	18.87911	-70.3776	57800	700	467	23.6	24.0	38.9	< 0.1	4.3
Bo-05	18.87743	-70.3804	134000	5300	343	8.7	149.0	2.0	< 0.1	3.7
Bo-06	18.89244	-70.3684	119200	1900	232	9.6	10.8	16.5	< 0.1	4.2
Bo-07	18.89036	-70.3699	121600	1700	199	9.3	42.3	33.2	24.2	4.0
Bo-08	18.88753	-70.3747	77700	2700	345	10.0	256.0	42.8	36.8	4.1
Bo-09	18.88443	-70.3799	78600	2000	228	8.7	11.2	15.1	< 0.1	4.3
Bo-10	18.88273	-70.3828	82400	2400	181	185.0	35.1	11.4	< 0.1	4.1
Bo-11	18.88108	-70.3856	71800	2600	176	102.0	79.6	38.7	< 0.1	4.7
Bo-12	18.89652	-70.3695	113700	1300	514	9.6	261.9	16.1	58.5	5.0
Bo-13	18.89508	-70.373	123300	2000	478	39.7	125.5	11.1	24.2	3.8
Bo-14	18.89317	-70.3767	76900	1700	180	76.0	202.7	4.4	< 0.1	4.6
Bo-15	18.89085	-70.3804	65900	1300	556	8.4	77.7	38.7	< 0.1	4.9
Bo-16	18.88853	-70.3836	82200	1200	461	8.7	331.7	27.2	< 0.1	4.2
Bo-17	18.8868	-70.3868	86500	400	147	71.4	80.3	28.3	31.2	4.4
Bo-18	18.90173	-70.372	95400	2400	843	9.1	87.5	18.1	< 0.1	4.1
Bo-19	18.89973	-70.3756	136500	2000	361	9.5	11.5	2.2	< 0.1	4.0
Bo-20	18.89803	-70.3797	157700	1100	420	8.0	28.9	12.9	< 0.1	3.9
Bo-21	18.89516	-70.3848	67800	1000	232	78.4	120.2	121.1	< 0.1	4.2
Bo-22	18.89385	-70.3872	118100	2500	475	9.6	7.1	28.0	38.5	3.9
Bo-23	18.89225	-70.3918	115100	1000	236	94.7	4.6	13.5	38.5	4.1
Bo-24	18.90187	-70.3776	110600	3000	617	114.0	5.0	39.3	< 0.1	4.7
Bo-25	18.90591	-70.3757	87200	2400	268	9.2	194.5	21.0	36.8	4.5
Bo-26	18.90523	-70.3795	135500	3000	400	9.8	2.0	35.4	< 0.1	3.6
Bo-27	18.90427	-70.3825	98400	1800	320	13.5	114.4	19.2	< 0.1	4.3
Bo-28	18.90135	-70.3869	99800	1400	421	9.5	213.4	26.9	< 0.1	4.0
Bo-29	18.90000	-70.3889	92400	1200	179	7.7	17.2	114.2	< 0.1	4.3
Bo-30	18.89869	-70.3907	96100	2500	379	85.8	177.7	103.1	< 0.1	5.0
		MIN	57800	400	121	7.7	2.0	2.0	< 0.1	3.6
		MAX	157700	5300	843	185.0	331.7	121.1	58.5	5.0
		MEAN	102577	2040	347	36.1	92.1	31.8	9.6	4.2
		STD	25569	1014	164	44.3	92.8	30.0	17.1	0.4

*STD standard deviation

Table S4. Descriptive statistics of pH, % Organic Matter (OM), and the heavy metal concentrations of local background samples in soils of Bonao, Dominican Republic (n=3).

Sample	Latitude	Longitude	pH	MO	Fe	Mn	Cr	Cu	Ni	Zn	Pb	As
				(%)	(mg/kg)							
BG-01	18.89592	-70.37319	7.10	0.52	7700	1900	374	31.3	0.0	54.2	7.5	< 0.1
BG-02	18.87798	-70.3736	5.90	0.74	78800	1400	359	24.4	59.4	18.6	6.4	< 0.1
BG-03	18.88992	-70.39272	6.40	0.76	127400	2400	331	12.3	56.2	31.1	22.8	< 0.1
MIN			5.90	0.52	7700	1400	331	12.3	0.0	18.6	6.4	< 0.1
MAX			7.10	0.76	127400	2400	374	31.3	59.4	54.2	22.8	< 0.1
MEAN			6.47	0.67	71300	1900	354	22.7	38.5	34.6	12.2	< 0.1
STD			0.60	0.13	60201	500	22	9.6	33.4	18.1	9.2	< 0.1

*STD standard deviation

Table S5. Single Pollution Index (PI) in surface soils of Bonao, Dominican Republic.

Sample	% Mn	Cr	Cu	Ni	Zn	Pb	As
Bo-01	2.21	0.34	0.41	0.13	0.59	0.00	0.93
Bo-02	1.37	0.57	1.56	0.03	0.41	0.00	1.03
Bo-03	1.00	1.23	0.37	1.38	1.16	0.00	1.08
Bo-04	0.37	1.32	1.04	0.40	1.12	0.00	1.08
Bo-05	2.79	0.97	0.38	2.51	0.06	0.00	0.93
Bo-06	1.00	0.66	0.42	0.18	0.48	0.00	1.05
Bo-07	0.89	0.56	0.41	0.71	0.96	1.98	1.00
Bo-08	1.42	0.97	0.44	4.31	1.24	3.02	1.03
Bo-09	1.05	0.64	0.38	0.19	0.44	0.00	1.08
Bo-10	1.26	0.51	8.17	0.59	0.33	0.00	1.03
Bo-11	1.37	0.50	4.48	1.34	1.12	0.00	1.18
Bo-12	0.68	1.45	0.42	4.41	0.47	4.80	1.25
Bo-13	1.05	1.35	1.75	2.11	0.32	1.98	0.95
Bo-14	0.89	0.51	3.35	3.41	0.13	0.00	1.15
Bo-15	0.68	1.57	0.37	1.31	1.12	0.00	1.23
Bo-16	0.63	1.30	0.38	5.58	0.79	0.00	1.05
Bo-17	0.21	0.42	3.15	1.35	0.82	2.56	1.10
Bo-18	1.26	2.38	0.40	1.47	0.52	0.00	1.03
Bo-19	1.05	1.02	0.42	0.19	0.06	0.00	1.00
Bo-20	0.58	1.18	0.35	0.49	0.37	0.00	0.98
Bo-21	0.53	0.65	3.45	2.02	3.50	0.00	1.05
Bo-22	1.32	1.34	0.42	0.12	0.81	3.16	0.98
Bo-23	0.53	0.67	4.17	0.08	0.39	3.16	1.03
Bo-24	1.58	1.74	5.01	0.08	1.14	0.00	1.18

Bo-25	1.26	0.76	0.41	3.27	0.61	3.02	1.13
Bo-26	1.58	1.13	0.43	0.03	1.02	0.00	0.90
Bo-27	0.95	0.90	0.59	1.93	0.55	0.00	1.08
Bo-28	0.74	1.19	0.42	3.59	0.78	0.00	1.00
Bo-29	0.63	0.50	0.34	0.29	3.30	0.00	1.08
Bo-30	1.32	1.07	3.78	2.99	2.98	0.00	1.25
MIN	0.21	0.34	0.34	0.03	0.06	0.00	0.90
MAX	2.79	2.38	8.17	5.58	3.50	4.80	1.25
MEAN	1.07	0.98	1.59	1.55	0.92	0.79	1.06
STD	0.53	0.46	1.95	1.56	0.87	1.40	0.09

*STD standard deviation

INTEGRATED POLLUTION INDEX (IPI):

$IPI = \frac{1}{N}\sum_{i=1}^{N} PI_i$=[1.1 (Mn) + 1.0 (Cr) + 1.6 (Cu) + 1.6 (Ni) +0.9 (Zn) + 0.8 (Pb) + 1.06 (As)] / 8 = 1.1
IPI= 1.1

Table S6. Enrichment Factor in surface soils of Bonao, Dominican Republic.

Sample	%Mn	Cr	Cu	Ni	Zn	Pb	As
Bo-01	2.02	0.31	0.37	0.12	0.10	0.00	0.85
Bo-02	1.06	0.44	1.21	0.03	0.32	0.00	5.70
Bo-03	1.02	1.26	0.38	1.41	1.19	0.00	0.15
Bo-04	0.71	2.54	2.00	0.78	2.16	0.00	0.50
Bo-05	2.32	0.80	0.32	2.08	0.05	0.00	0.07
Bo-06	0.93	0.61	0.39	0.17	0.45	0.00	1.08
Bo-07	0.82	0.51	0.37	0.65	0.88	2.37	0.26
Bo-08	2.04	1.40	0.63	6.17	1.77	3.36	0.04
Bo-09	1.49	0.91	0.54	0.27	0.62	0.00	1.07
Bo-10	1.71	0.69	11.03	0.80	0.45	0.00	0.33
Bo-11	2.12	0.77	6.94	2.08	1.73	0.00	0.16
Bo-12	0.67	1.42	0.41	4.32	0.46	5.56	0.05
Bo-13	0.95	1.22	1.58	1.91	0.29	0.56	0.08
Bo-14	1.29	0.74	4.85	4.94	0.18	0.00	0.06
Bo-15	1.16	2.65	0.62	2.21	1.89	0.00	0.18
Bo-16	0.86	1.76	0.52	7.56	1.06	0.00	0.04
Bo-17	0.27	0.53	4.05	1.74	1.05	0.40	0.15
Bo-18	1.47	2.78	0.47	1.72	0.61	0.00	0.13
Bo-19	0.86	0.83	0.34	0.16	0.05	0.00	0.97
Bo-20	0.41	0.84	0.25	0.34	0.26	0.00	0.38
Bo-21	0.86	1.07	5.67	3.32	5.75	0.00	0.10
Bo-22	1.24	1.26	0.40	0.11	0.76	3.66	1.53

Bo-23	0.51	0.65	4.03	0.07	0.38	0.37	2.48
Bo-24	1.59	1.75	5.04	0.08	1.14	0.00	2.62
Bo-25	1.61	0.97	0.52	4.18	0.77	3.65	0.06
Bo-26	1.30	0.93	0.35	0.03	0.84	0.00	5.01
Bo-27	1.07	1.02	0.67	2.18	0.63	0.00	0.10
Bo-28	0.82	1.32	0.47	4.01	0.87	0.00	0.05
Bo-29	0.76	0.61	0.41	0.35	3.98	0.00	0.70
Bo-30	0.40	1.24	4.38	3.46	3.45	0.00	0.08
MIN	**0.27**	**0.31**	**0.25**	**0.03**	**0.05**	**0.00**	**0.04**
MAX	**2.32**	**2.78**	**11.03**	**7.56**	**5.75**	**5.56**	**5.70**
MEAN	**1.14**	**1.13**	**1.97**	**1.91**	**1.14**	**0.66**	**0.83**
STD	**0.5**	**0.6**	**2.6**	**2.0**	**1.3**	**1.5**	**1.4**

*STD standard deviation

Table S7. Potential Ecological Index (RI) in surface soils of Bonao, Dominican Republic.

Sample	%Mn	Cr	Cu	Ni	Zn	Pb	As
Bo-01	2.21	0.68	0.41	0.64	0.59	0.00	9.25
Bo-02	1.37	1.14	1.56	0.17	0.41	0.00	10.25
Bo-03	1.00	2.46	0.37	6.92	1.16	0.00	10.75
Bo-04	0.37	2.64	1.04	2.02	1.12	0.00	10.75
Bo-05	2.79	1.94	0.38	12.54	0.06	0.00	9.25
Bo-06	1.00	1.31	0.42	0.91	0.48	0.00	10.50
Bo-07	0.89	1.13	0.41	3.56	0.96	9.92	10.00
Bo-08	1.42	1.95	0.44	21.55	1.24	15.08	10.25
Bo-09	1.05	1.29	0.38	0.94	0.44	0.00	10.75
Bo-10	1.26	1.02	8.17	2.95	0.33	0.00	10.25
Bo-11	1.37	0.99	4.48	6.70	1.12	0.00	11.75
Bo-12	0.68	2.90	0.42	22.05	0.47	23.98	12.50
Bo-13	1.05	2.70	1.75	10.56	0.32	9.92	9.50
Bo-14	0.89	1.02	3.35	17.06	0.13	0.00	11.50
Bo-15	0.68	3.14	0.37	6.54	1.12	0.00	12.25
Bo-16	0.63	2.60	0.38	27.92	0.79	0.00	10.50
Bo-17	0.21	0.83	3.15	6.76	0.82	12.79	11.00
Bo-18	1.26	4.76	0.40	7.37	0.52	0.00	10.25
Bo-19	1.05	2.04	0.42	0.97	0.06	0.00	10.00
Bo-20	0.58	2.37	0.35	2.43	0.37	0.00	9.75
Bo-21	0.53	1.31	3.45	10.12	3.50	0.00	10.50
Bo-22	1.32	2.68	0.42	0.60	0.81	15.78	9.75
Bo-23	0.53	1.33	4.17	0.39	0.39	15.78	10.25
Bo-24	1.58	3.48	5.01	0.42	1.14	0.00	11.75
Bo-25	1.26	1.51	0.41	16.37	0.61	15.08	11.25
Bo-26	1.58	2.26	0.43	0.17	1.02	0.00	9.00
Bo-27	0.95	1.81	0.59	9.63	0.55	0.00	10.75
Bo-28	0.74	2.37	0.42	17.96	0.78	0.00	10.00
Bo-29	0.63	1.01	0.34	1.45	3.30	0.00	10.75
Bo-30	1.32	2.14	3.78	14.96	2.98	0.00	12.50
MIN	**0.21**	**0.68**	**0.34**	**0.17**	**0.06**	**0.00**	**9.00**
MAX	**2.79**	**4.76**	**8.17**	**27.92**	**3.50**	**23.98**	**12.50**
MEAN	**1.07**	**1.96**	**1.59**	**7.75**	**0.92**	**3.94**	**10.58**
STD	**0.53**	**0.93**	**1.95**	**7.81**	**0.87**	**7.00**	**0.92**

*STD standard deviation

THE INTEGRATED POTENTIAL ECOLOGICAL RISK INDEX (IRI)

$IRI = \Sigma RI_{mean} = [1.07\ (Mn) + 1.96\ (Cr) + 1.59\ (Cu) + 7.75\ (Ni) + 0.92\ (Zn) + 3.94\ (Pb) + 10.58\ (As)] = 27.8$