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APPENDICES

Appendix A

Table I: Sampling Locations

Sample ID	position		Note
	X	Y	
A1	457140	1841210	Residential area (relocate because the site become a factory :knitting)
A2	457740	1841010	Paddy field Behide the factory
A3	457920	1841000	Paddy field
A4	458170	1841000	Paddy field
A5	458420	1841000	Paddy field
A6	458630	1841000	Paddy field beside pond
A7	458920	1841040	Paddy field beside house
A8	459170	1841080	Paddy field beside school
A9	459420	1841000	Paddy field
A10	459670	1841000	Paddy field
A11	460000	1841000	Paddy field
B1	457420	1840750	Paddy field near road
B2	457540	1840770	Paddy field beside house
B3	457940	1840710	Paddy field
B4	458160	1840750	Paddy field
B5	458420	1840750	Paddy field
B6	458670	1840750	Paddy field
B8	459170	1840750	Paddy field
B9	459420	1840750	Paddy field
B10	459670	1840750	Paddy field
B11	460000	1840750	Paddy field
C1	457420	1840500	Paddy field
C2	457670	1840500	Paddy field
C3	457880	1840580	Paddy field
C4	458170	1840550	Paddy field
C5	458420	1840550	Paddy field
C6	458670	1840540	Paddy field
C10	459670	1840500	Paddy field
C11	460000	1840520	Paddy field
D1	457410	1840250	Paddy field
D2	457670	1840250	Paddy field
D3	457920	1840250	Paddy field

Appendix A

Table I: Sampling Location (Cont')

Sample ID	position		Note
	X	Y	
D5	458450	1840220	Paddy field
D6.1	458660	1840190	Paddy field beside Mae Ku creek
D6.2	458620	1840230	Paddy field beside Mae Ku creek
D7	458840	1840190	Paddy field
D8	459220	1840250	Paddy field
D9	459420	1840250	Paddy field
D10	459670	1840250	Paddy field
D11	460000	1840260	Paddy field
E1	457420	1840000	Paddy field
E2	457670	1840000	Paddy field
E3	457910	1840040	Paddy field
E5	458420	1840030	Paddy field
E6	458670	1840000	Paddy field
E7	458820	1840000	Paddy field
E8	459170	1840000	Paddy field
E9	459420	1840000	Paddy field
E10	459670	1840000	Paddy field
E11	460000	1840000	Paddy field
F1	457400	1839750	Paddy field
F2	457670	1839770	Paddy field
F3	457920	1839750	Paddy field
F5	458400	1839750	near pond
F6	458670	1839750	Paddy field
F7	458920	1839750	Paddy field
F8	459170	1839750	Paddy field
F9	459420	1839750	Paddy field
F10	459670	1839750	Paddy field
F11	460000	1839750	Paddy field
G2	457710	1839500	Paddy field
G4	458180	1839420	Paddy field
G5	458440	1839500	Corn field
G6	458670	1839500	Paddy field
G7	458920	1839500	Paddy field
G8	459170	1839500	Paddy field

Appendix A

Table I: Sampling Locations (Cont')

Sample ID	position		Note
	X	Y	
G9	459420	1839500	Paddy field
G10	459670	1839500	Paddy field
G11	460000	1839500	Paddy field
H1	457420	1839250	Paddy field
H4	458170	1839250	Paddy field
H5	458450	1839250	Paddy field
H6	458670	1839250	Paddy field
H7	458920	1839250	Paddy field
H8	459170	1839250	Paddy field
H9	459420	1839250	Paddy field
H10	459670	1839250	Paddy field
H11	460000	1839250	Paddy field
I1	457420	1839000	Paddy field
I2	457690	1839000	Paddy field
I3	457920	1839020	Paddy field
I4	458180	1839070	Paddy field
I5	458450	1839000	Paddy field
I6	458760	1839000	Paddy field
I7	458920	1839000	Paddy field
I8	459170	1839000	Paddy field
I9	459430	1839000	Paddy field
I10	459670	1839000	Paddy field
I11	460000	1839000	Paddy field
J1	457420	1838750	Paddy field
J5	458420	1838750	Paddy field
J6	458670	1838750	Paddy field
J7	458920	1838750	Paddy field
J8	459170	1838750	Paddy field
J9	459420	1838750	Paddy field
J10	459670	1838750	Paddy field
J11	460000	1838750	Paddy field

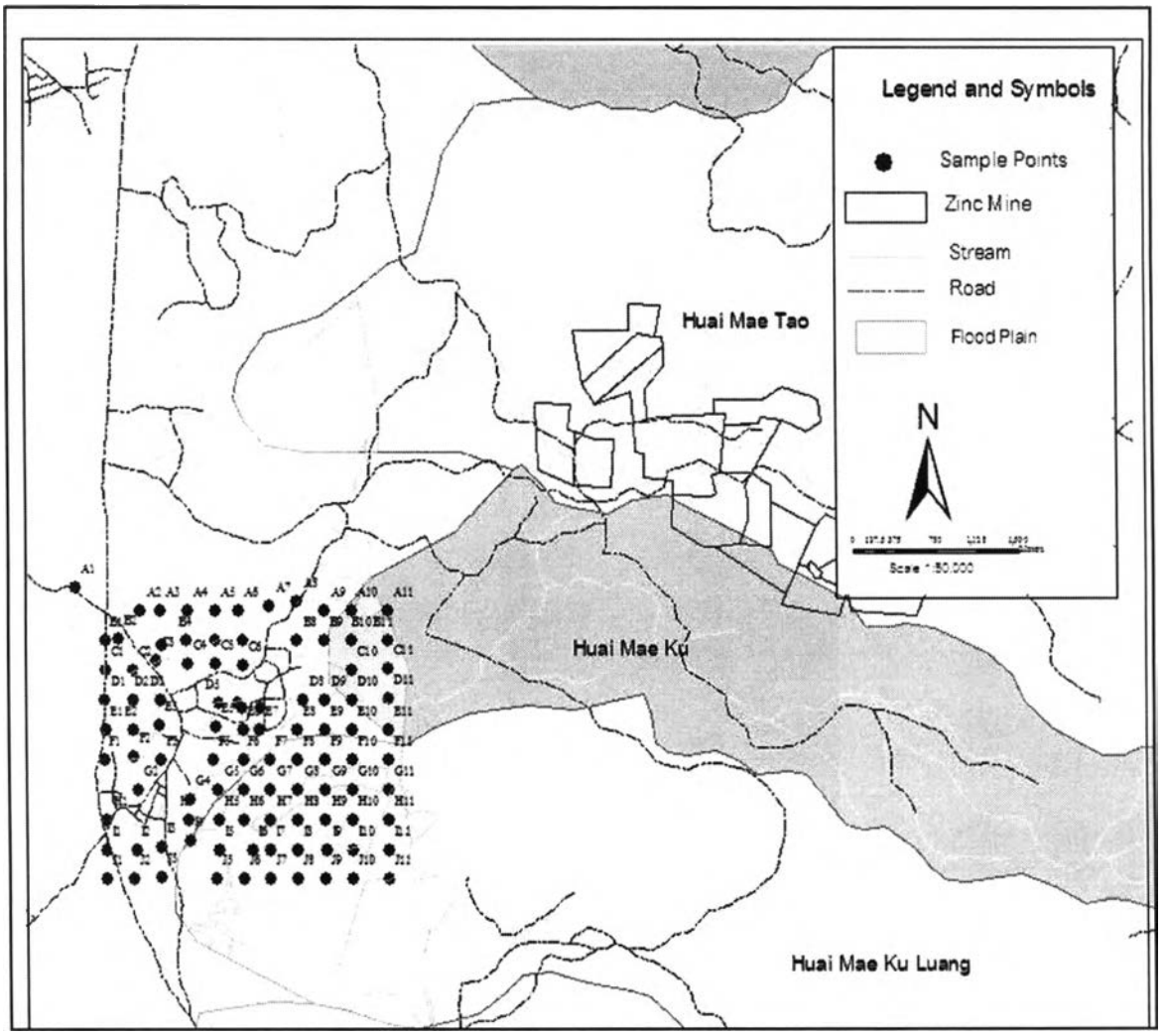

Figure I Sampling Stations

Appendix A

Table II: The results of cadmium and zinc in soil samples in the Mae Ku area.

Sample ID	Concentration (mg/kg)			
	Total Cd	Total Zn	BCR1 Cd	BCR1 Zn
A1	1.41	151.62	0.14	16.92
A2	1.86	94.49	0.39	8.63
A3	1.89	67.74	LD	8.69
A4	1.81	82.83	LD	9.14
A5	2.43	118.16	1.43	10.15
A6	1.86	75.26	2.02	11.55
A7	10.02	297.25	3.02	184.61
A8	0.67	77.10	0.07	18.89
A9	1.70	110.91	0.45	29.65
A10	2.20	139.98	0.77	42.07
A11	1.98	138.61	0.45	32.15
B1	3.98	164.27	1.48	36.53
B2	1.39	45.15	0.15	5.36
B3	3.64	158.41	0.91	26.26
B4	3.33	66.73	0.09	3.04
B5	3.15	71.14	0.65	9.49
B6	3.14	93.85	1.23	33.65
B8	3.09	43.97	0.33	7.04
B9	2.89	80.59	0.50	12.37
B10	3.39	98.20	0.49	18.52
B11	2.35	64.42	0.11	5.73
C1	3.85	141.33	1.13	36.40
C2	1.97	107.90	0.28	11.29
C3	3.27	173.02	1.28	57.33
C4	1.65	94.37	0.38	18.51
C5	6.60	290.69	4.01	102.48
C6	2.08	140.24	0.97	34.13
C10	4.28	233.94	1.88	47.26
C11	109.65	2001.35	81.20	867.74
D1	4.34	71.20	0.07	3.15
D2	3.64	102.20	0.70	24.55
D3	3.09	97.15	0.35	18.25
D5	3.94	168.42	0.64	28.15
D6.1	22.32	893.42	11.99	292.11
D6.2	4.91	237.32	1.52	47.30
D7	15.47	541.38	9.37	196.89

Remark: LD = Lower detection limit
Detection limit = 0.01 mg/kg

Table II: The results of cadmium and zinc in soil samples in the Mae Ku area. (Cont')

Sample ID	Concentration (mg/kg)			
	Total Cd	Total Zn	BCR Cd	BCR Zn
D8	5.41	232.07	2.67	84.13
D9	2.73	114.82	0.57	21.38
D10	2.95	112.23	0.61	15.49
D11	5.38	313.20	2.31	68.58
E1	2.21	75.53	0.18	4.30
E2	1.98	64.30	0.21	7.36
E3	1.82	126.13	0.10	16.36
E5	2.43	144.70	0.27	6.81
E6	1.72	97.46	0.14	7.58
E7	1.72	115.66	0.18	10.38
E8	8.19	296.57	5.16	111.40
E9	1.96	141.74	0.27	4.47
E10	1.01	108.46	0.03	2.04
E11	11.89	563.66	8.69	206.29
F1	2.30	303.93	0.76	25.44
F2	1.60	95.94	0.14	17.37
F3	10.96	510.97	6.33	197.78
F5	1.39	111.66	0.19	16.40
F6	0.46	50.50	0.08	15.26
F7	1.22	67.70	0.07	12.62
F8	1.27	122.70	0.17	17.55
F9	1.17	82.58	0.09	15.96
F10	0.79	75.63	0.24	16.33
F11	3.59	228.46	1.52	59.23
G2	1.58	134.36	0.16	14.60
G4	0.59	95.52	0.08	32.37
G5	0.73	83.52	0.08	17.85
G6	0.66	240.80	0.09	15.06
G7	4.81	255.66	2.11	80.33
G8	9.41	417.21	8.13	176.89
G9	1.19	91.48	0.26	17.61
G10	83.65	2093.94	74.14	703.44
G11	11.49	669.63	8.73	237.26
H1	3.06	189.68	0.03	52.84
H4	0.80	67.12	0.05	12.01
H5	1.12	133.40	0.09	8.91
H6	1.28	201.75	0.11	12.53
H7	0.87	99.95	0.07	13.34
H8	2.09	156.56	1.26	34.08

Remark: LD = Lower detection limit
Detection limit = 0.01 mg/kg

Table II: The results of cadmium and zinc in soil samples in the Mae Ku area. (Cont')

Sample ID	Concentration (mg/kg)			
	Total Cd	Total Zn	BCR1 Cd	BCR1 Zn
H9	13.85	849.12	12.14	353.02
H10	1.36	87.94	0.07	11.77
H11	1.77	194.04	0.86	37.43
I1	1.39	74.92	0.03	9.95
I2	1.46	78.66	0.04	16.86
I3	1.16	76.03	0.03	11.80
I4	0.54	55.09	0.04	22.36
I5	1.81	165.14	0.52	23.42
I6	1.16	115.28	0.21	19.42
I7	2.41	212.94	0.84	47.92
I8	1.12	129.09	0.17	25.32
I9	4.51	301.82	2.08	96.37
I10	1.45	148.28	0.18	13.10
I11	0.88	82.61	0.06	17.48
J1	1.53	92.42	0.15	4.13
J2	1.66	82.36	0.13	2.35
J3	1.28	77.35	0.03	2.92
J5	4.23	331.71	1.09	22.26
J6	1.83	206.60	0.45	10.85
J7	2.49	204.81	0.47	8.21
J8	1.56	116.79	0.38	11.76
J9	1.30	67.86	0.13	4.04
J10	1.03	64.25	0.05	2.86
J11	1.25	69.97	0.04	4.16

Remark: LD = Lower detection limit
Detection limit = 0.01 mg/kg

Appendix B

Result of Cadmium and Zinc Concentration in standard soil

Natural Matrix Certified Reference Material
Catalog No : CRM 025-050
Lot No. :JG 025

Meta in soil
Analyses Concentrations

Element	Reference value	S.D.	Confidntial Interval	Prediction Interval
Cd	369	46.3	350-388	271-466
Zn	51.8	8.29	48.8-55.1	34.4-69.2

Sample ID	Weigth (g)	Cd , ICP	Volume	Cd (mg/kg)	Mean	S.D.
STD 1	0.5008	3.0702	50	306.5296	333.9056	26.5807
STD2	0.5016	3.49.61	50	348.4948		
STD3	0.5004	3.63.78	50	363.4892		
STD4	0.5012	3.17.87	5o	317.1089		

Sample ID	Weigth (g)	Zn , ICP	Volume	Zn(mg/kg)	Mean	S.D.
STD1	0.5008	0.51472	50	51.3898	49.3061	1.84708
STD2	0.5016	0.47398	50	47.2468		
STD3	0.5004	0.50.243	50	50.2028		
STD4	0.5012	0.48.501	50	48.3849		

Appendix C

Detailed Procedure for Samples Analysis

1. Sampling

Soil samples were collected by hoe from ground level to depths about 30 cm. And the samples were kept in plastic container.

2. Chemical properties studies:

Microwave Digestion technique & Inductively Coupled Plasma (ICP)

Sample	Parameters	Instruments/techniques	EPA Method
Soil	Cd and Zn	(1)Microwave Digestion technique	Method 3051
		(2) Inductively Coupled Plasma (ICP)	

Apparatus and Materials

1. Microwave Digestion system: Milestone Ethos SEL
2. Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) : Varian vista MPX Axial
3. pH meter
4. Analytical balance 4 digits
5. Drying Oven
6. Shaker
7. Filter paper – 0.45 μm pore diameter membrane filter or equivalent
8. Glasswares and Others

Reagents

Total acid digestion

(1) De-ionized Water

(2) Nitric acid (concentrated), 65 % HNO_3

(3) Nitric acid, 1 % (v/v) HNO_3

BCR Sequential Extraction

(1) Reagents

All reagents should be of analytical grade or better.

(2) Water

Doubly deionised water (Mili-Q water)

(3) Solution A (Acetic acid, 0.11 mol/L)

Add 25 mL of glacial acetic acid to about 0.5 L of distilled water in a 1 L volumetric flask and make up to 1 L with distilled water. Take 250 mL of this solution and diluted to 1 L with distilled water to obtain an acetic acid solution of 0.11 mol/L

Procedure

Total acid digestion procedure

Soil sample preparation

(1) Dry the sample at 104 ± 1 °C for 24 hr.

(2) Analysis of metals in soil sediment sample (EPA Method 3051)

- Weigh 0.5 g of soil sample (dry weight at 104 ± 1 °C, 24 hr.) in a digestion vessel. Add 10 mL of 65% HNO_3 and close the vessel with teflon cover. Heat the sample at 170 ± 5°C for approximately 5.5 minutes and remain at 175-180°C for another 10 minutes to accelerate the leaching process by Microwave digestion system.

- After cooling, the solution is filtered by membrane filter of 0.45 μm pore diameter. The filtered solution is further diluted in 100 mL volumetric flask. The sample is now ready for analysis by ICP.

BCR Sequential Extraction procedure

For each batch of extractions, dry a separate 1 g sample of the soil in an oven (104±1 °C). Perform the extractions by shaking in a mechanical, end-over-end shaker at a speed of 30±10 rpm and a room temperature of 27±2 °C.

In this study, the samples were determined only availability fraction. The BCR sequential extraction procedure in step 1 is the represent of Availability fraction. Therefore, in this study is done only BCR step 1. The detail of BCR step 1 is described below.

Step 1 Add 40 mL of solution A to 1 g soil in a 50 mL centrifuge screw cap tube and extract by shaking for 16 h at room temperature (overnight). Separate the solution is extracted from the solid residue by membrane filter of 0.45 μm pore diameter. Wash the residue by adding 20 mL distilled water in centrifuge screw cap tube, shaking for 15 minutes. Decant the supernatant and discard. The sample is now ready for analysis by ICP.

BIOGHAPHY

Miss Siriluk Janpho was born on April 11, 1974 in Nakhorn Ratchasima province, Thailand. She graduated in Bachelor's degree from Faculty of Public Health, Khon Kaen University in 1996. She has worked as an environmental official at Office of Natural Resources and Environmental Policy and Planning since 1999 to present. She had studied the Master's degree of Science in Environmental Management (Inter-Department), Chulalongkorn University, Thailand on May, 2004 to May, 2006.