Final Report

on

Research on the Distribution of Soil Chemistry and Fe Dynamics in Sanjian Plain for 2008

by

Institute of Applied Ecology,
Chinese Academy of Sciences

1. Main contents and accomplishment of our work this years

In 2008, soil samples were collected different distance from Naoli River, Bielahong River and Nonjiang River, including three land covers, i.e., natural wetland, Common border, and upland field. The sampling was carried out using auger sampler (one pit) and using core sampler (three pits) per each location.

➢ For auger sampler:

Soil samples were collected vertically every 20 cm from surface to a depth of 2 meters (maybe less than 2 meters in several locations). The total number of soil samples was 72.

Some items such as Fe_t (total iron), Fe_d (free iron oxide iron), Fe_p (chelate iron), Fe_o (amorphous iron oxides), the ratio Fe_d/Fe_t (often termed the 'weathering ratio'), the ratio Fe_o/Fe_d (often termed the 'active ratio'), Mn, Al, SiO_2, particle size distribution, TOC (Organic carbon), pH (H_2O), moisture content, absolute specific gravity, hydraulic conductivity were analyzed. Three replicates for each treatment and the three original data, the average and the original of them were showed in the tables.

➢ For core sampler:

The samples were collected vertically from O layer (organic layer), S layer (surface soil) and D layer (deposited layer) for soil chemical analysis. The total number of soil samples was 24.

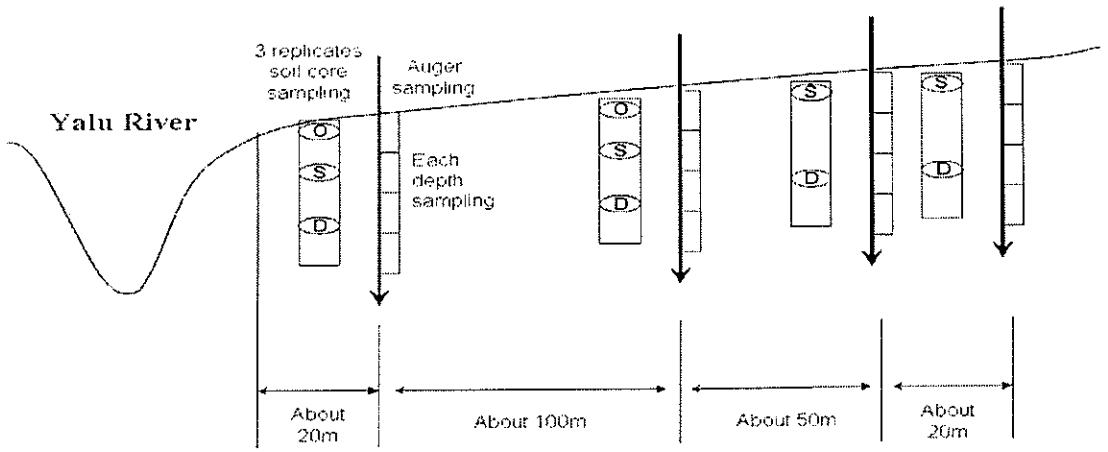
There were three core samples in each soil layer, one for soil bulk density, another one for hydraulic conductivity.

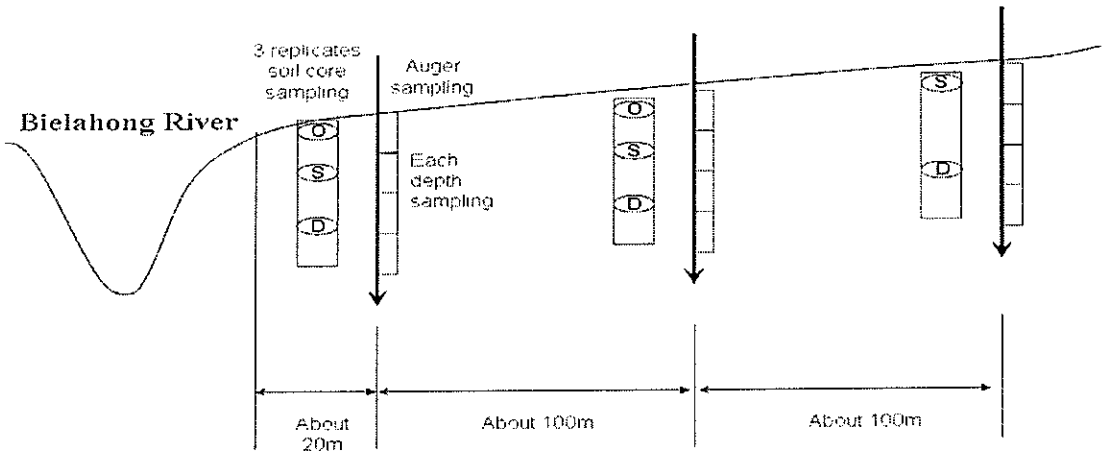
The items such as water soluble Fe^{2+}, water soluble Mn^{2+}, acid soluble Fe^{2+}, acid soluble Mn^{2+} and DOC were determined using the third core sample and three replicates for each treatment. The three original data, the average and the original of them were showed in the tables.

Table.1: Sampling sites in Sanjiang Plain region

No.	Location	latitude and longitude	Land use type	Sampling date
Y-1	Yalu River	134°6.005′E 48°11.677′N	Wetland	Aug. 7, 2008
Y-2		134°6.003′E 48°11.677′N	Wetland	Aug. 7, 2008
Y-3		134°5.968′E 48°11.644′N	Common border	Aug. 7, 2008
Y-4		134°5.930′E 48°11.677′N	Upland (soy bean)	Aug. 7, 2008
B-1	Bielahong River	133°52.996′E 47°32.015′N	Wetland	Aug. 8, 2008
B-2		133°53.045′E 47°32.083′N	Wetland	Aug. 8, 2008
B-3		133°53.045′E 47°32.081′N	upland	Aug. 8, 2008
N-1	Naoli River	133°45.811′E 47°16.987′N	Wetland	Aug. 9, 2008
N-2		133°45.818′E 47°16.977′N	Wetland	Aug. 9, 2008
N-3		133°45.767′E 47°17.020′N	Upland (soy bean)	Aug. 9, 2008

➢ Schematic diagrams for the positions of sampling locations





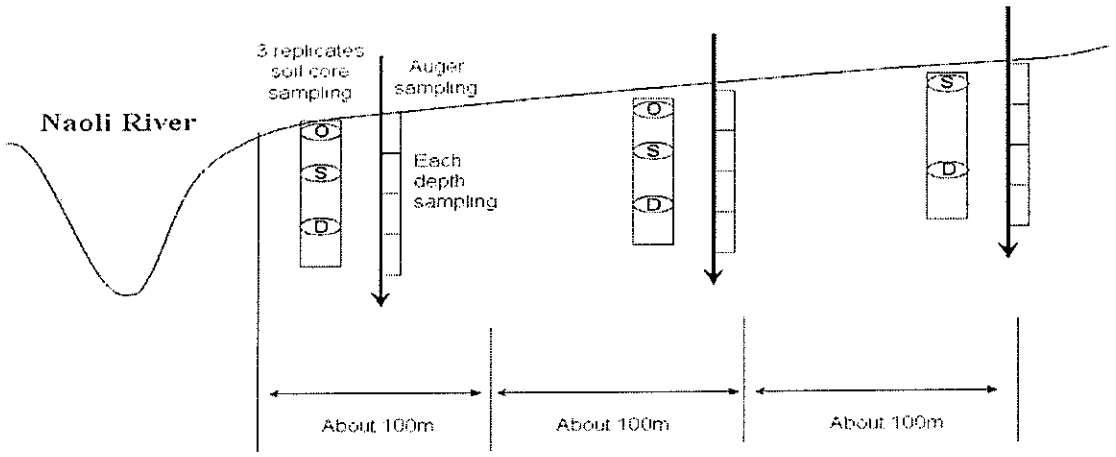


Table.2: Analytical items and methods, and soil treatments (Sample using auger sampler)

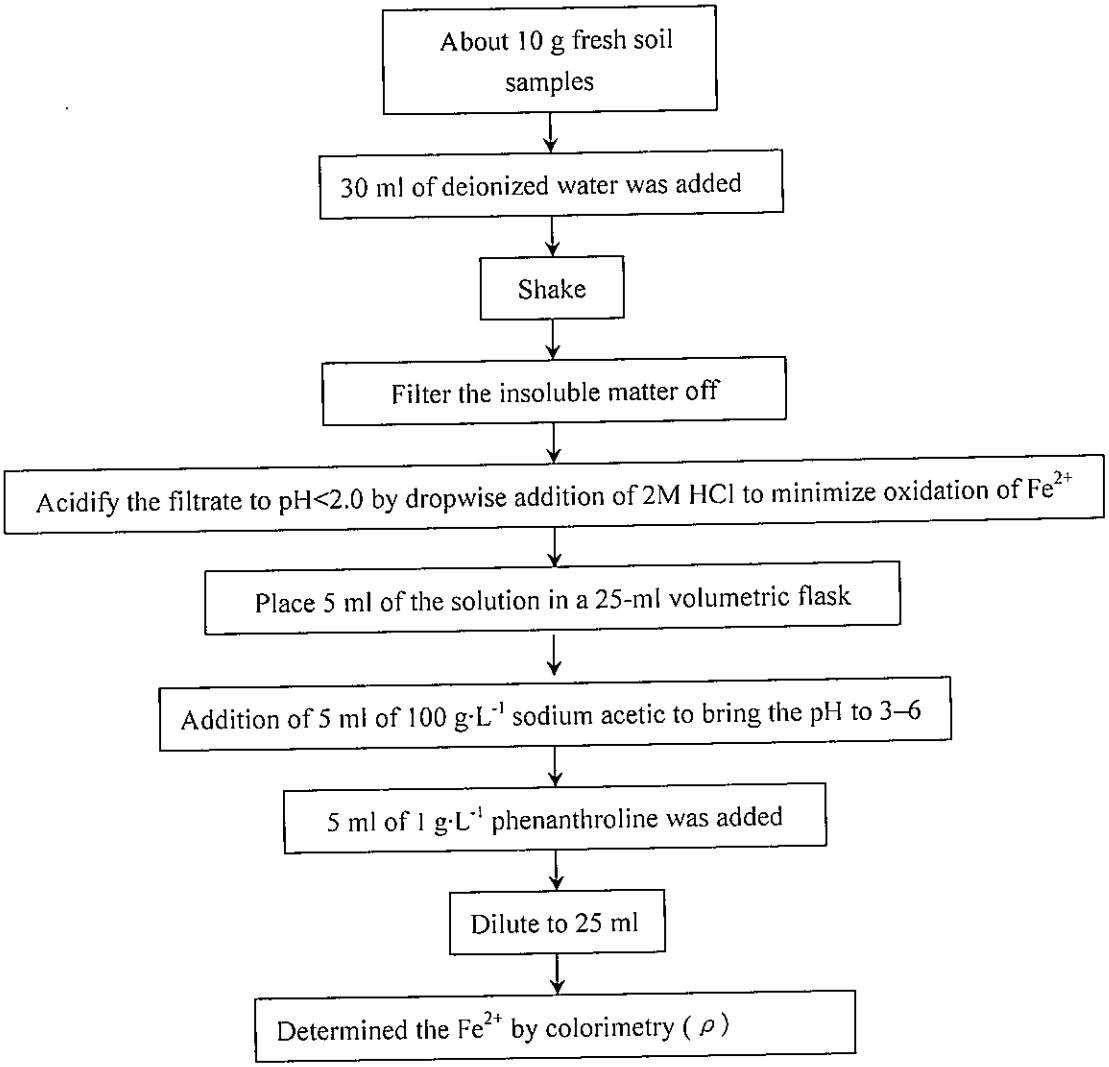
No.	Analytical items	Soil treatment	Analytical method
1	Fe_t (total iron)	Drying, sieving	Sodium carbonate fusion —Flame atomic absorption spectrophotometry
2	Fe_d (free iron oxide iron)	Drying, sieving	Sodium hydrosulfite - Sodium citrate - Sodium bicarbonate extraction method (DCB)
3	Fe_o (amorphous iron oxides)	Drying, sieving	Acid ammonium oxalate extraction method(AAO)
4	Fe_p (chelate iron)	Drying, sieving	Sodium pyrophosphate extraction method
5	Mn	Drying, sieving	Sodium carbonate fusion —Flame atomic absorption spectrophotometry
6	Al	Drying, sieving	Sodium carbonate fusion —Potassium fluoride substitution—EDTA volumetric method
7	SiO_2	Drying, sieving	Sodium carbonate fusion —Mass metrical method
8	particle size distribution	Drying, sieving	Density bottle method
9	TOC (Organic carbon)	Drying, sieving	Determined directly on the TOC autoanalyzer
10	pH (H_2O)	Air-dry, sieving	Potentiometric method
11	Moisture content	Drying	Mass metrical method
12	weathering ratio of iron	Drying, sieving	The ratio Fe_d/Fe_t
13	active ratio of iron	Drying, sieving	The ratio Fe_o/Fe_d
14	absolute specific gravity	Drying, sieving	Mass metrical method

Table.3: Analytical items and methods, and soil treatments (Sample using core sampler)

No.	Analytical items	Soil treatment	Analytical method
1	water soluble Fe^{2+}	Fresh	Phenanthroline colorimetry
2	water soluble Mn^{2+}	Fresh	Potassium periodate colorimetry
3	acid soluble Fe^{2+}	Fresh	Phenanthroline colorimetry
4	acid soluble Mn^{2+}	Fresh	Potassium periodate colorimetry
5	DOC	Fresh	Determined on the DOC autoanalyzer
6	soil bulk density	Drying	Mass metrical method
7	Hydraulic conductivity	Fresh	core cutter method

2. Analytical methods for each item in detail

2.1 Analytical methods for water soluble Fe^{2+}

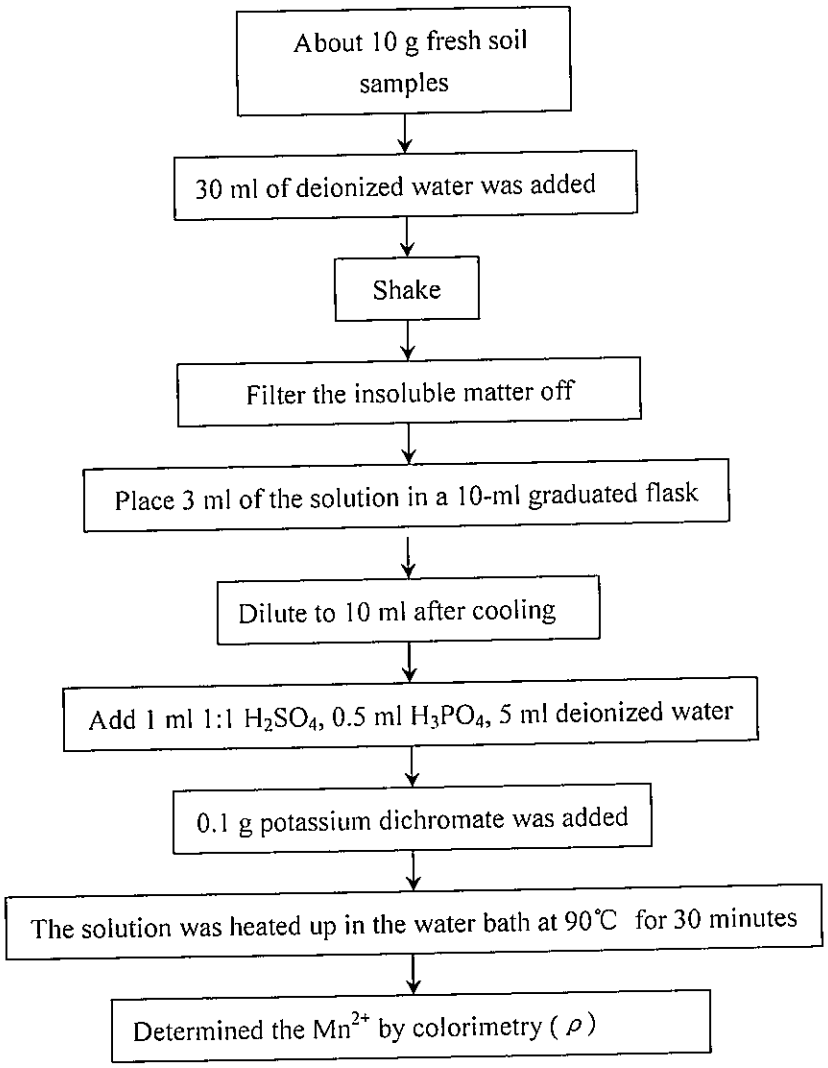


$$\omega(Fe^{2+}) = \frac{\rho \times 25 \times 6}{m}$$

Thereinto: $\omega(Fe^{2+})$: Content of Fe^{2+} in soil, $mg.kg^{-1}$;

m: Mass of oven-drying soil, g.

2.2 Analytical methods for water soluble Mn^{2+}

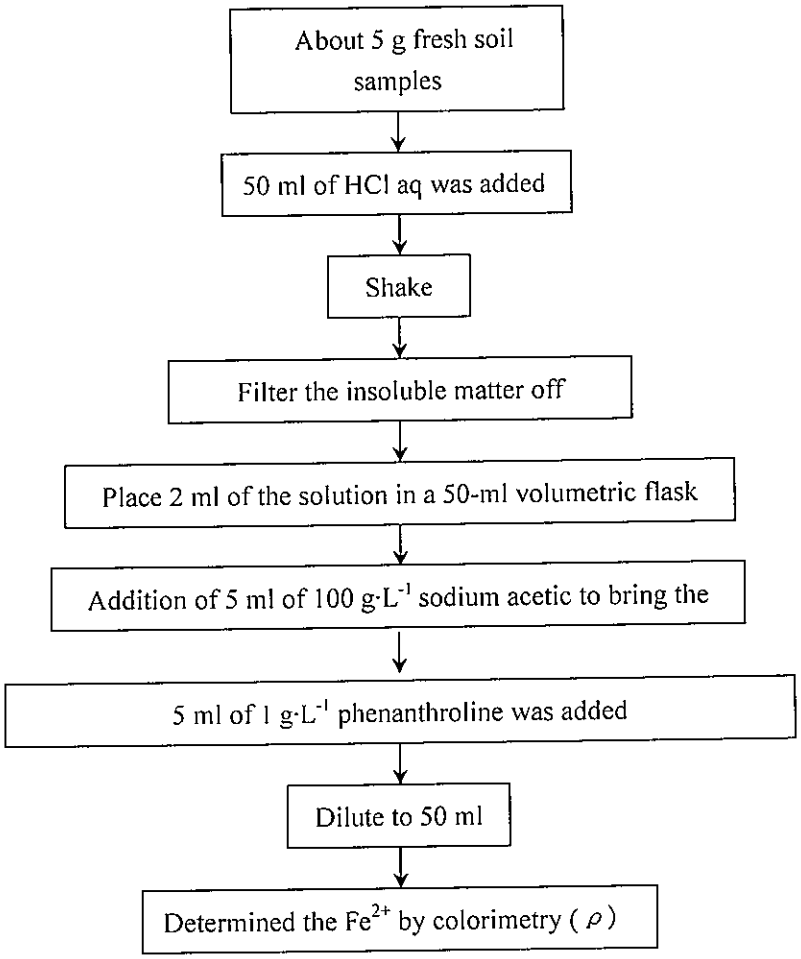


$$\omega(Mn^{2+})=\frac{\rho \times 10 \times 10}{m}$$

Thereinto: $\omega(Mn^{2+})$: Content of Mn^{2+} in soil, $mg.kg^{-1}$;

m: Mass of oven-drying soil, g.

2.3 Analytical methods for acid soluble Fe^{2+}

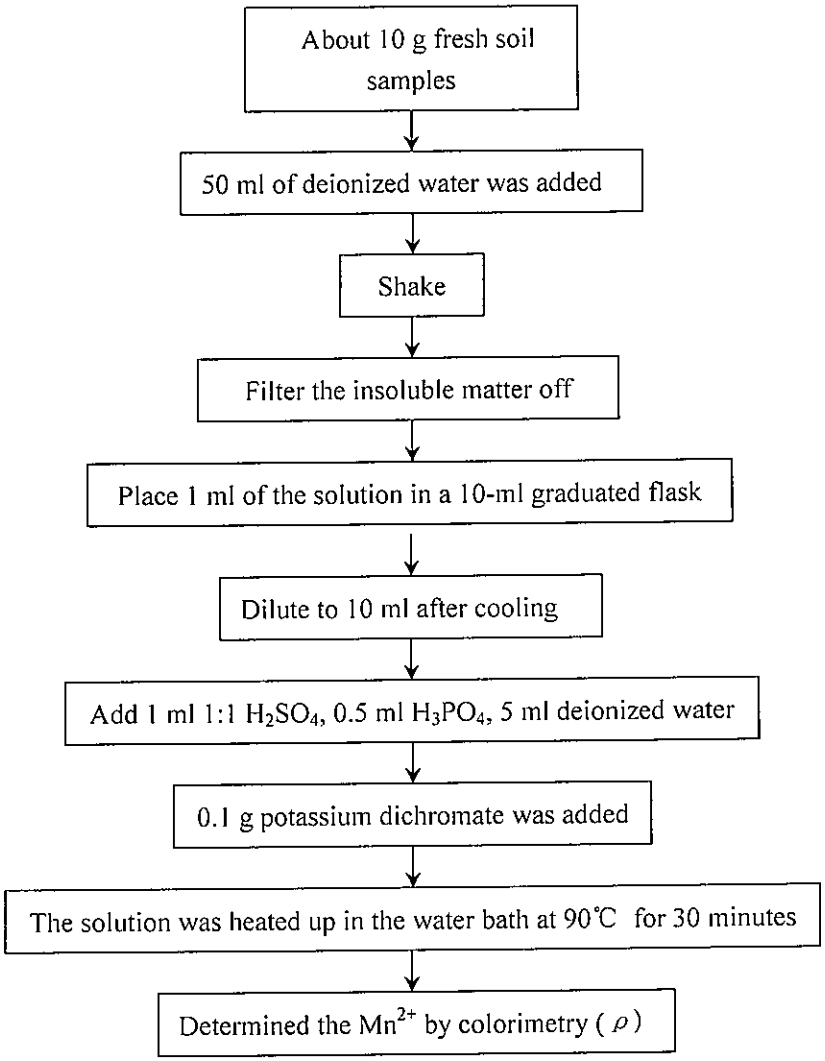


$$\omega(Fe^{2+})=\frac{\rho \times 50 \times 25}{m}$$

Thereinto: $\omega(Fe^{2+})$: Content of Fe^{2+} in soil, $mg.kg^{-1}$;

m: Mass of oven-drying soil, g.

2.4 Analytical methods for acid soluble Mn^{2+}

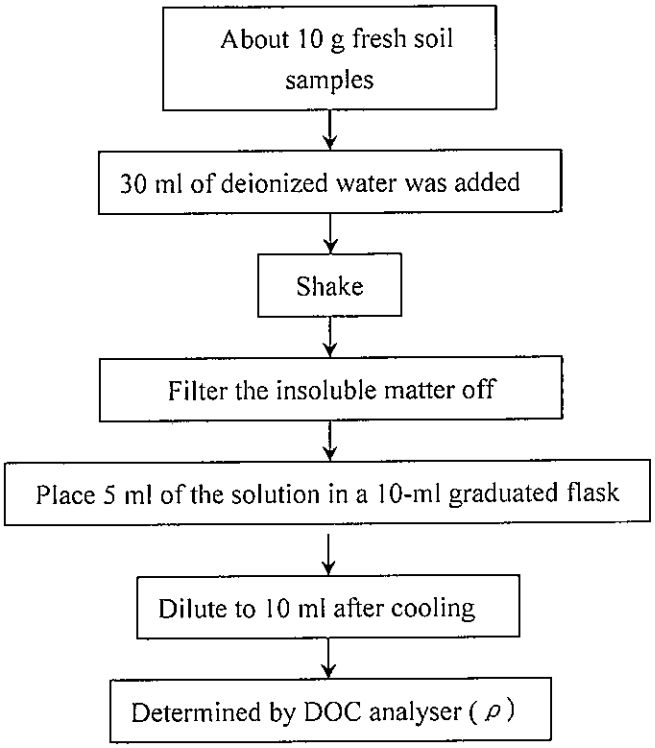


$$\omega(Mn^{2+})=\frac{\rho \times 10 \times 50}{m}$$

Thereinto: $\omega(Mn^{2+})$: Content of Mn^{2+} in soil, $mg.kg^{-1}$;

m: Mass of oven-drying soil, g.

2.5 Analytical methods for DOC



$$\omega(\mathrm{DOC})=\frac{\rho\times 10\times 6}{m}$$

Thereinto: ω (DOC): Content of DOC in soil, $mg.kg^{-1}$;

m: Mass of oven-drying soil, g.

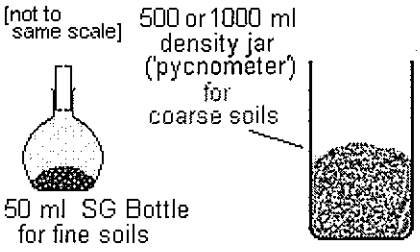
2.6 Analytical methods for absolute specific gravity

Specific gravity (Gs) is a property of the mineral or rock material forming soil grains. It is defined as:

$$G_S = \frac{\text{mass of a soil grain}}{\text{mass of an equal volume of water}}$$

Method of measurement

For fine soils a 50 ml density bottle may be used; for coarse soils a 500 ml or 1000 ml jar.

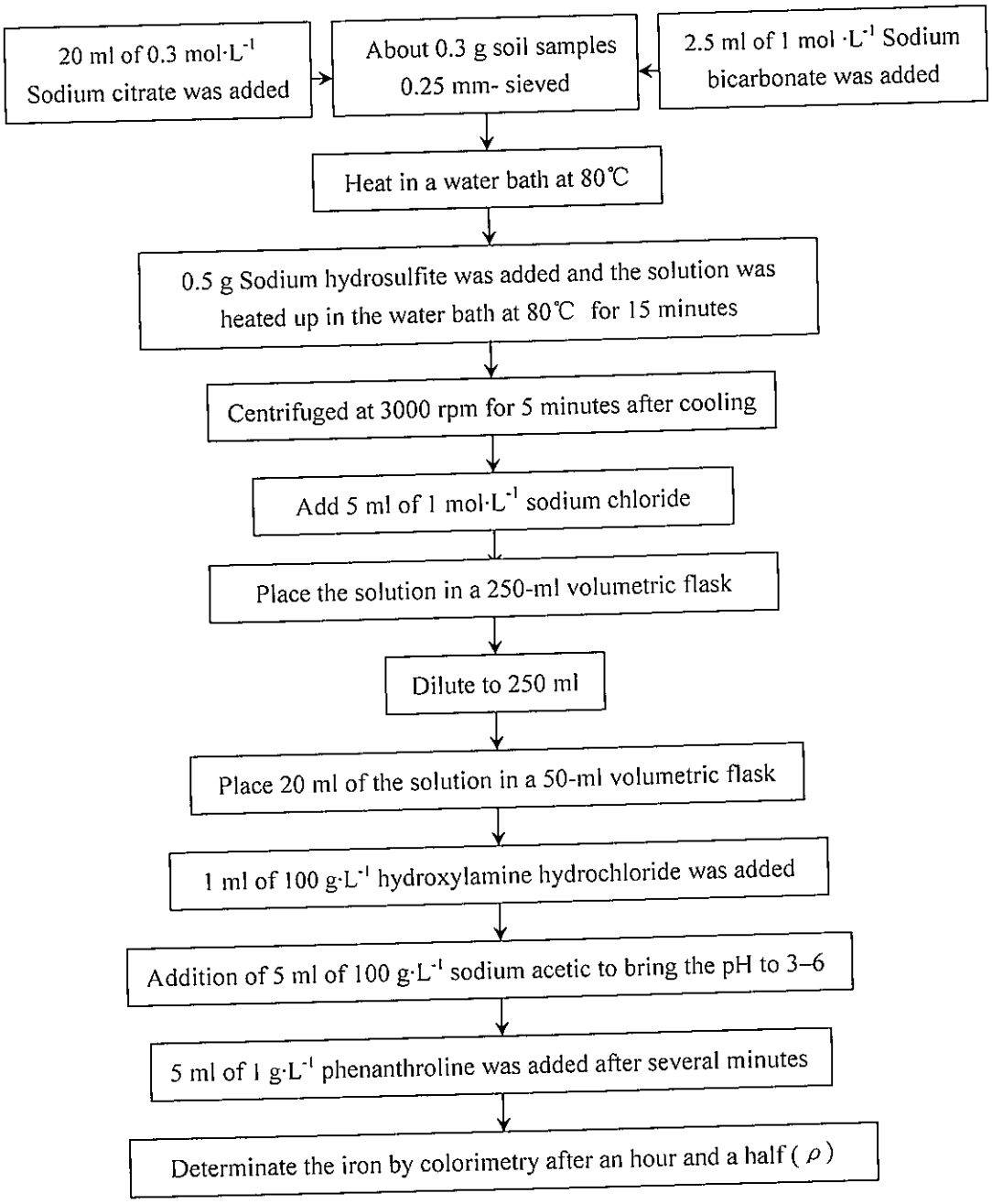


The jar is weighed empty (M_1). A quantity of dry soil is placed in the jar and the jar weighed (M_2). The jar is filled with water, air removed by stirring, and weighed again (M_3). The jar is emptied, cleaned and refilled with water - and weighed again (M_4).

$$G_S = \frac{\text{Mass of soil}}{\text{Mass of water displaced by soil}}$$

$$= \frac{M_2 - M_1}{(M_4 - M_1) - (M_3 - M_2)}$$

2.7 Analytical methods for free iron oxide

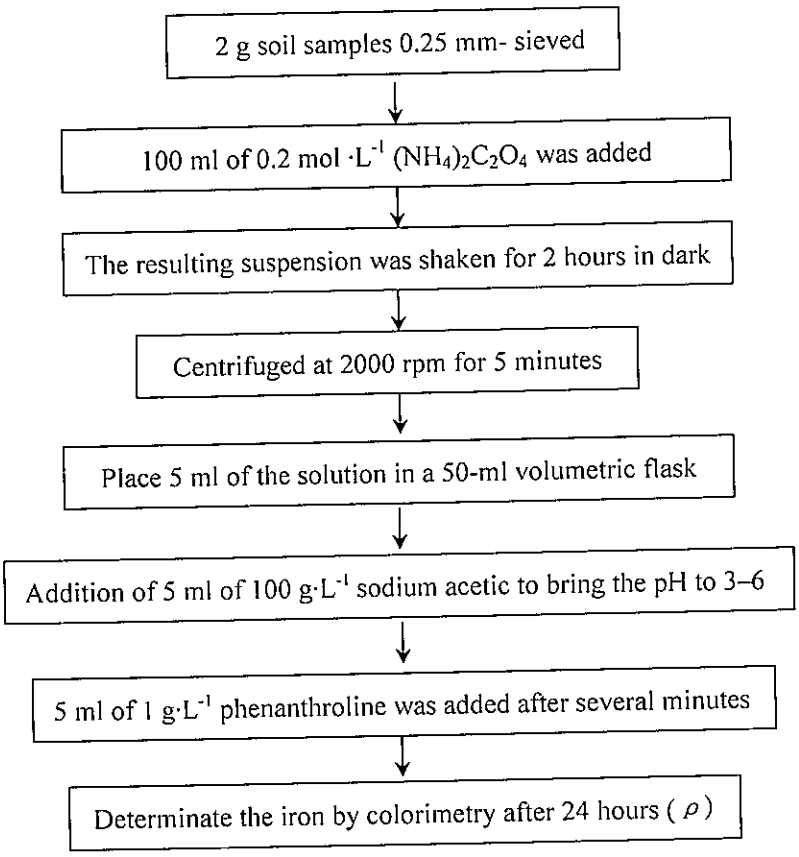


$$\omega(Fe_2O_3)=\frac{\rho \times 50 \times 12.5 \times 1.43}{m}$$

Thereinto: $\omega(Fe_2O_3)$: Content of Fe_2O_3 in soil, $mg.kg^{-1}$;

m: Mass of air-drying soil, g.

2.8 Analytical methods for amorphous iron oxides

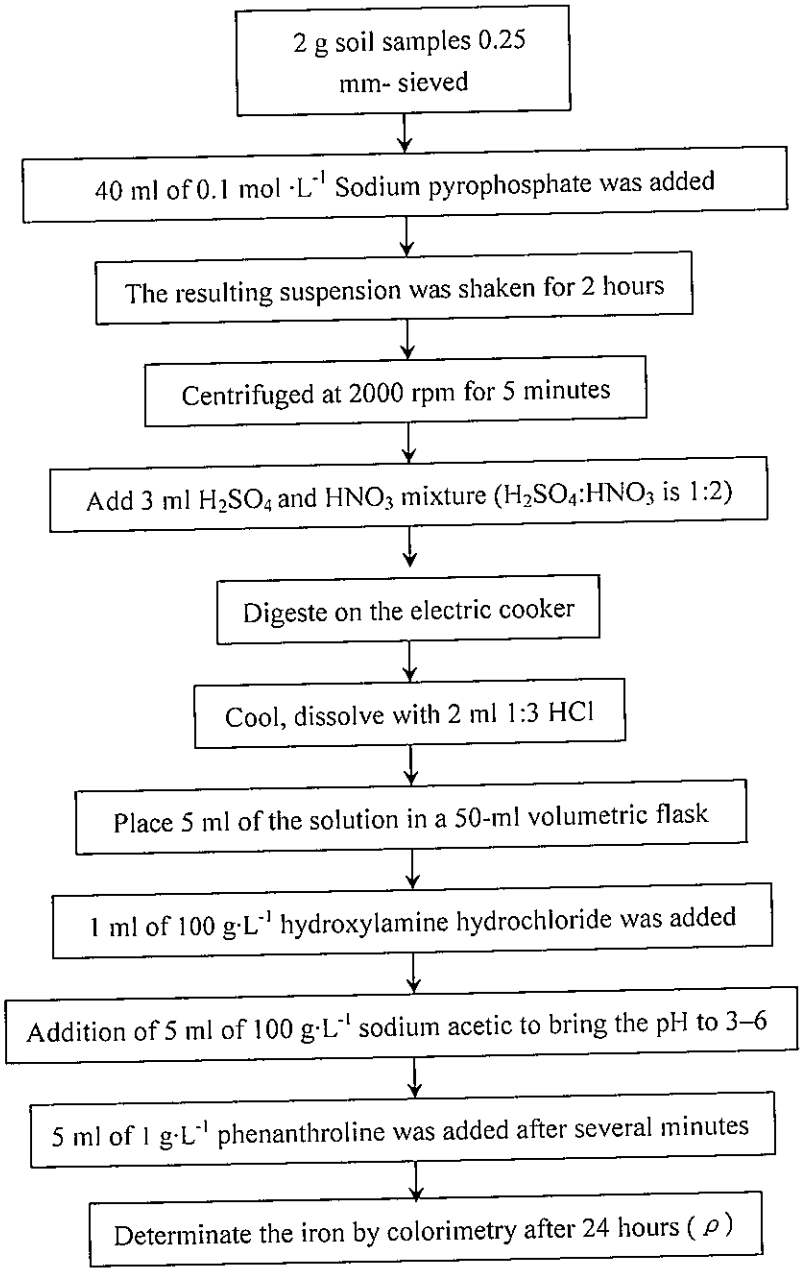


$$\omega(\mathrm{Fe})=\frac{\rho \times 50 \times 10}{m}$$

Thereinto: ω(Fe): Content of amorphous iron oxides in soil, mg.kg^{-1};

m: Mass of air-drying soil, g.

2.9 Analytical methods for ferric chelate

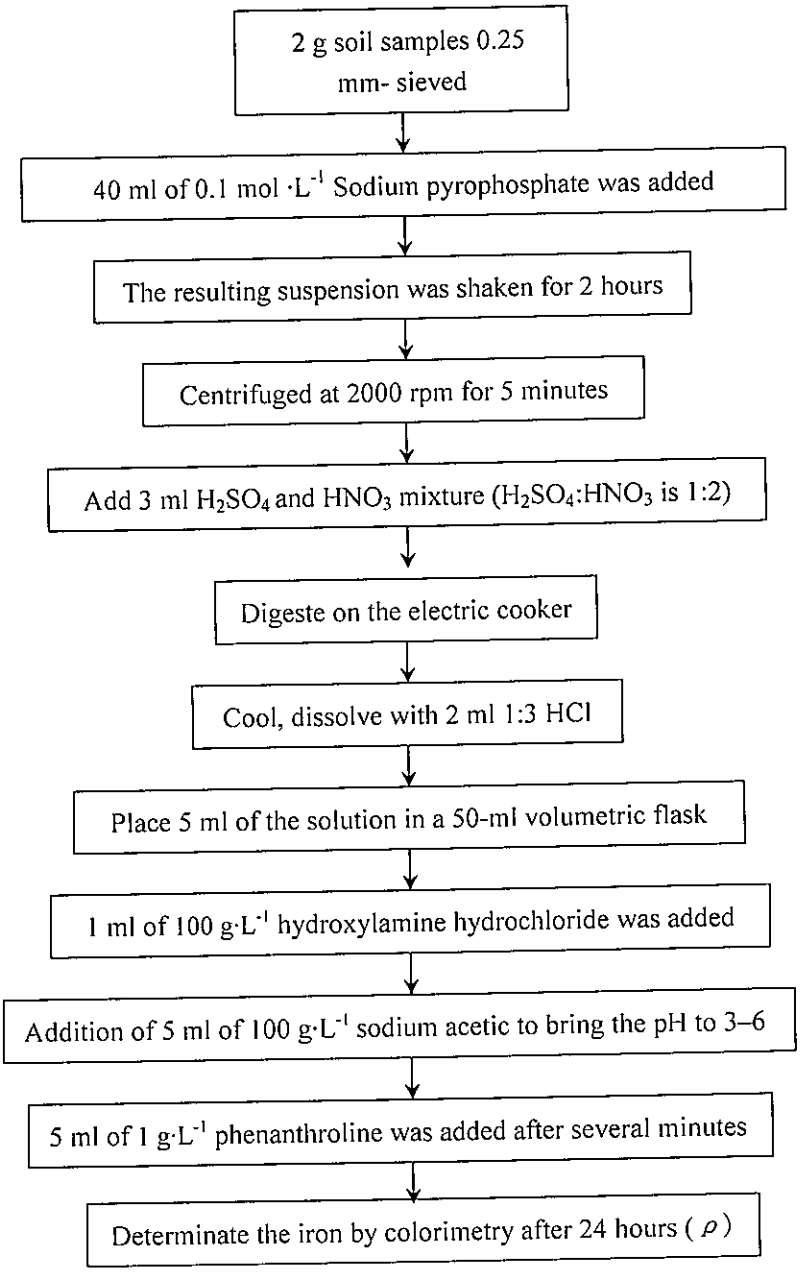


$$\omega(\mathrm{Fe})=\frac{\rho\times 50\times 8}{m}$$

Thereinto: ω(Fe): Content of ferric chelate in soil, $mg.kg^{-1}$;

m: Mass of air-drying soil, g.

2.10 Analytical methods for chelate iron

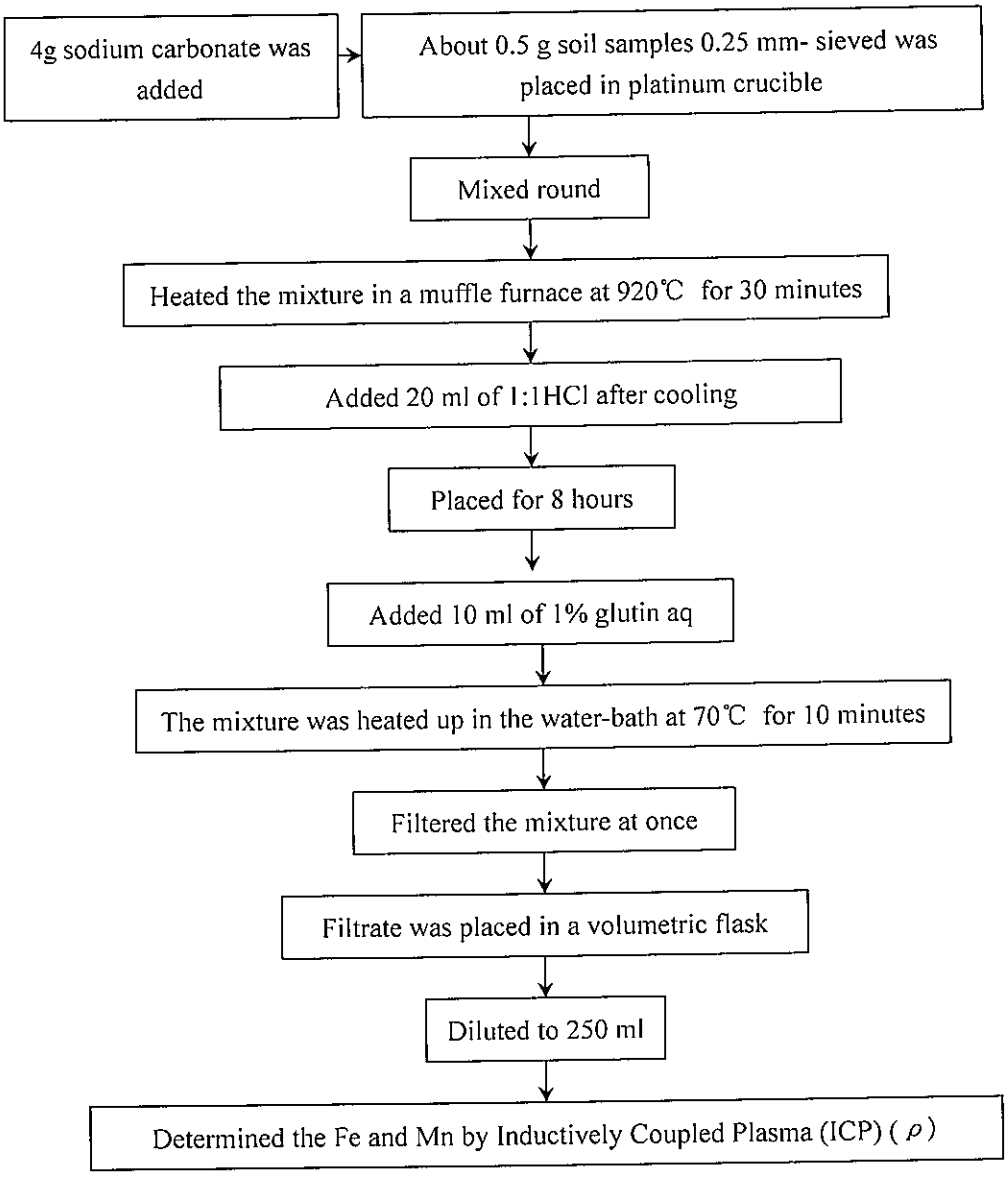


$$\omega\,(\mathrm{Fe}) = \frac{\rho \times 50 \times 8}{m}$$

Thereinto: ω (Fe): Content of ferric chelate in soil, $mg.kg^{-1}$;

m: Mass of air-drying soil, g.

2.11 Analytical methods for Fe_t and Mn

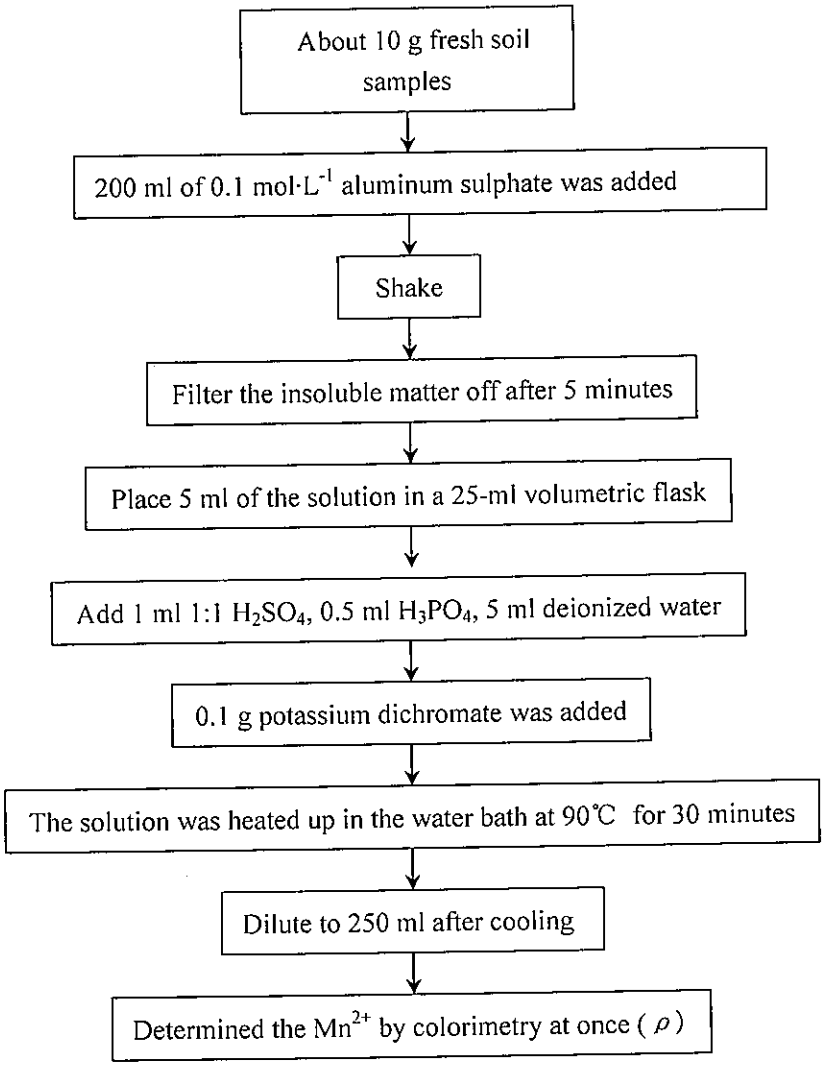


$$\omega(Fe^{2+})=\frac{\rho \times 25 \times 20}{m}$$

Thereinto: $\omega(Fe^{2+})$: Content of Fe^{2+} in soil, $mg.kg^{-1}$;

m: Mass of oven-drying soil, g.

2. 12 Analytical methods for total Mn^{2+}

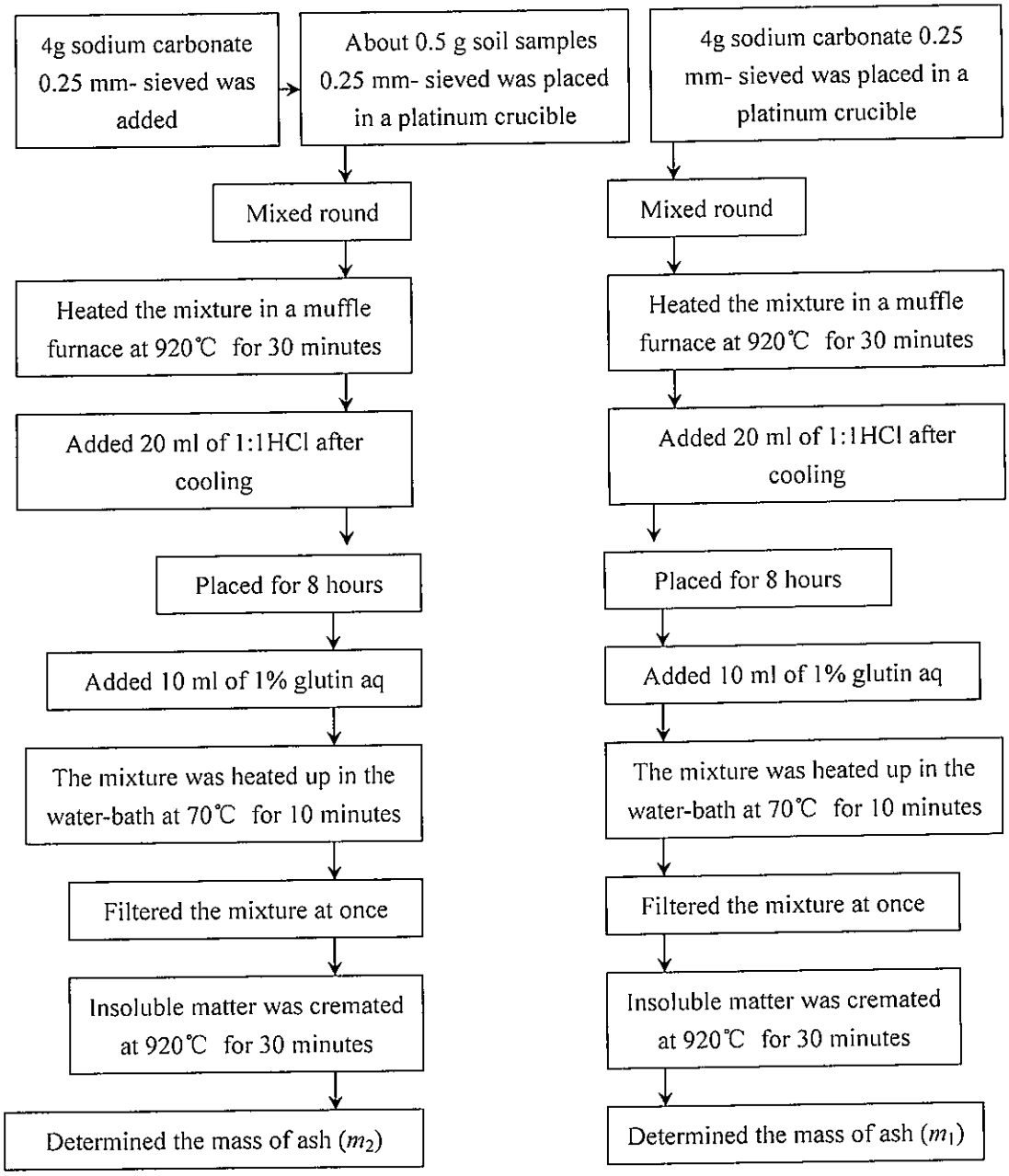


$$\omega(Mn^{2+})=\frac{\rho \times 25 \times 40}{m}$$

Thereinto: $\omega(Mn^{2+})$: Content of Mn^{2+} in soil, $mg.kg^{-1}$;

m: Mass of oven-drying soil, g.

2.13 Analytical methods for SiO_2

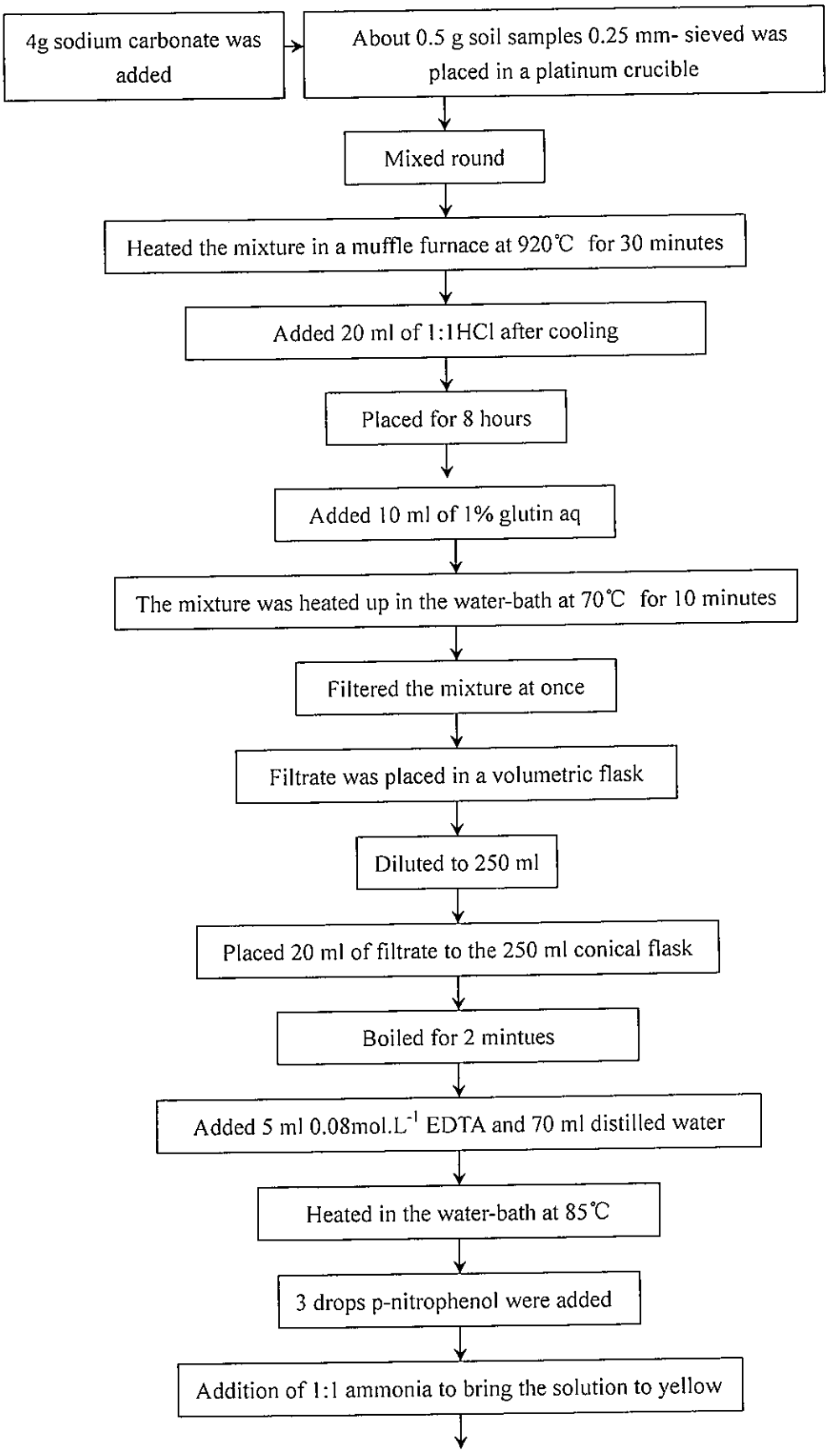


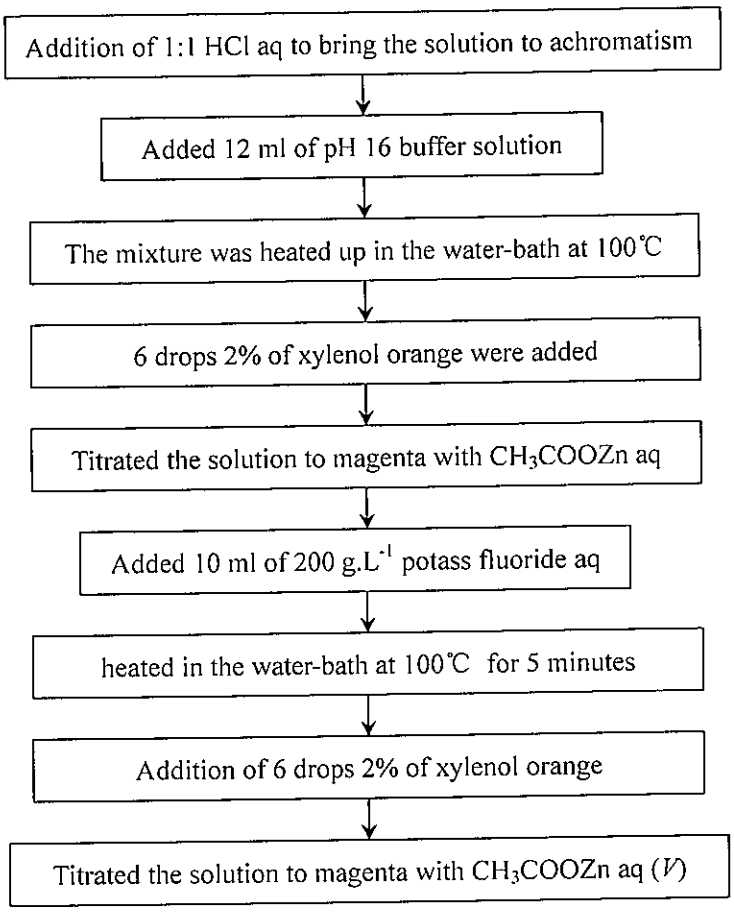
$$\omega(SiO_2)=\frac{m_2-m_1}{m}\times 10$$

Thereinto:$\omega(SiO_2)$: Content of SiO_2 in soil, $g.kg^{-1}$

m: Mass of air-drying soil, g

2.14 Analytical methods for the sum of Al and Ti





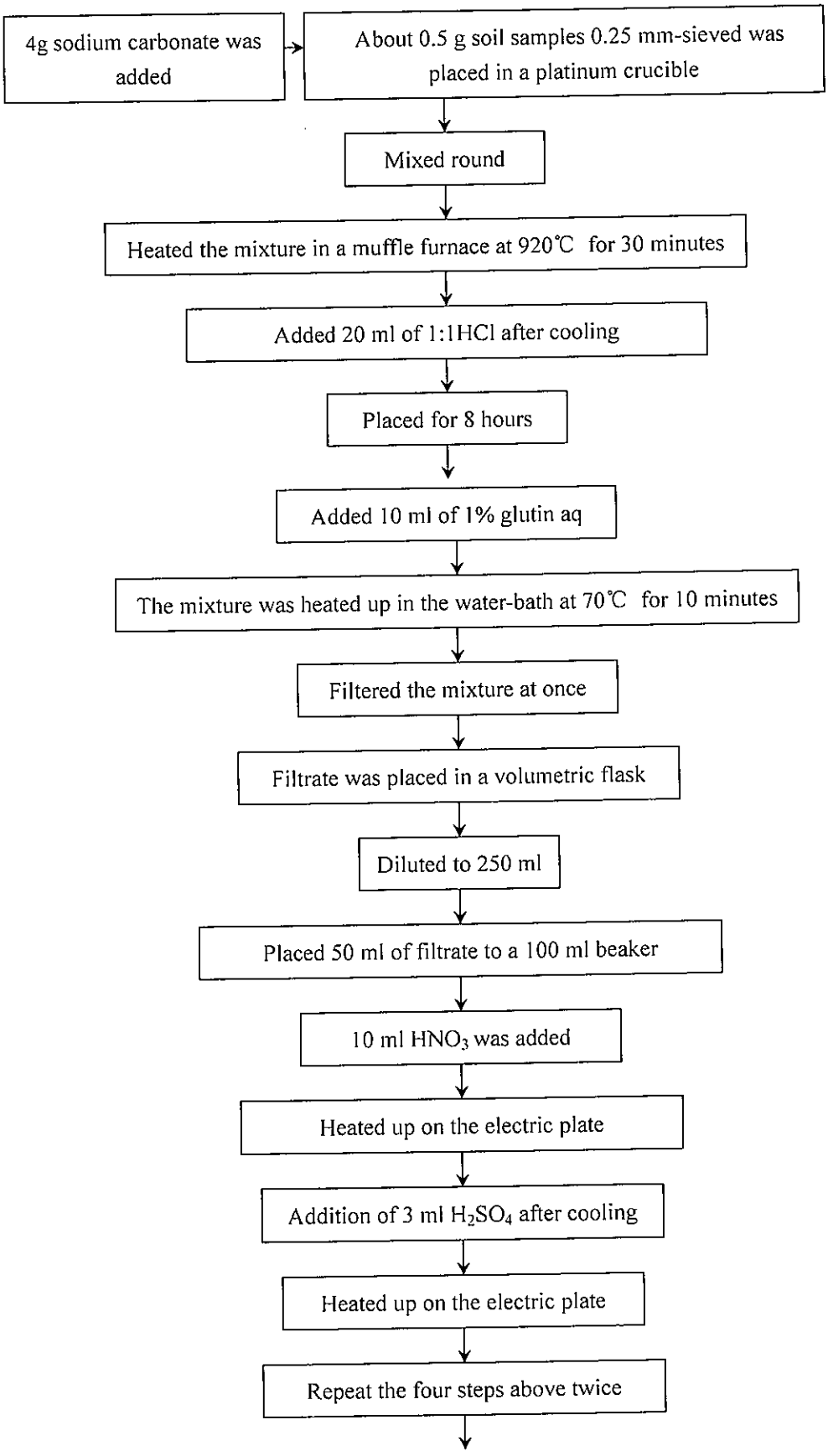
$$\omega(Al_2O_3)=\frac{0.015\times V\times 50.98\times 10^3\times 12.5}{m}\times 100-\omega(TiO_2)\times 0.6381$$

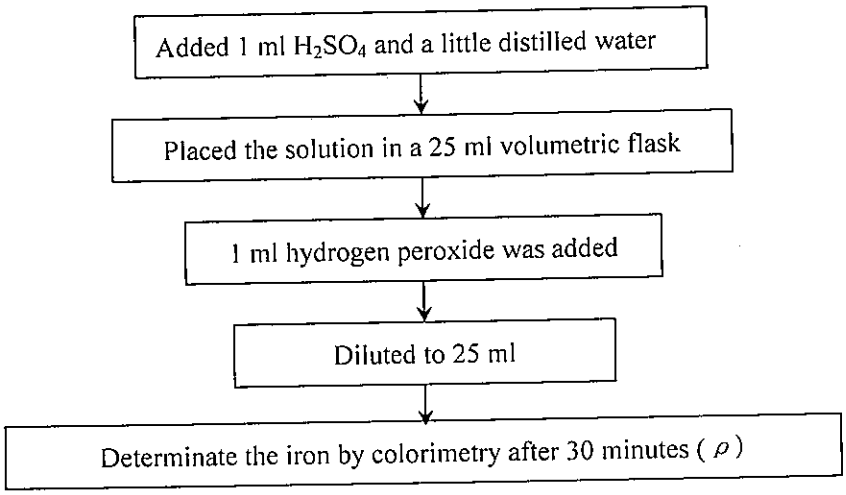
Thereinto: $\omega(Al_2O_3)$: Content of Al_2O_3 in soil, %;

$\omega(TiO_2)$: Content of TiO_2 in soil, %;

m: Mass of air-drying soil, g.

2.15 Analytical methods for Ti



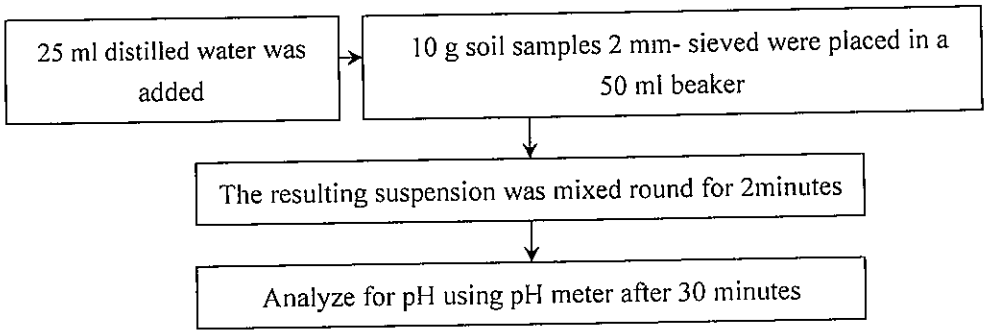


$$\omega(TiO_2)=\frac{\rho \times 25 \times 5}{m \times 10^6} \times 100$$

Thereinto: $\omega(TiO_2)$: Content of SiO_2 in soil, %;

m: Mass of air-drying soil, g.

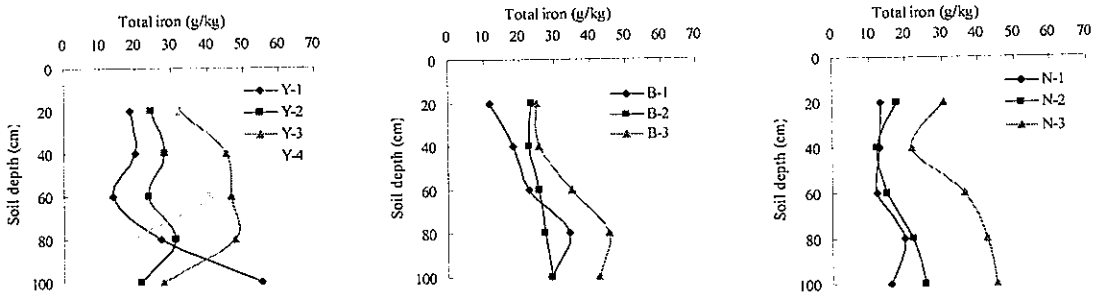
2.16 Analytical methods for pH (H_2O)



3. Results and discussion

1) Vertical distribution of total iron

In all three sample locations, soil total iron in the profiles above 60 cm were decreased in the sequence of upland field > wetland (Figure 1).



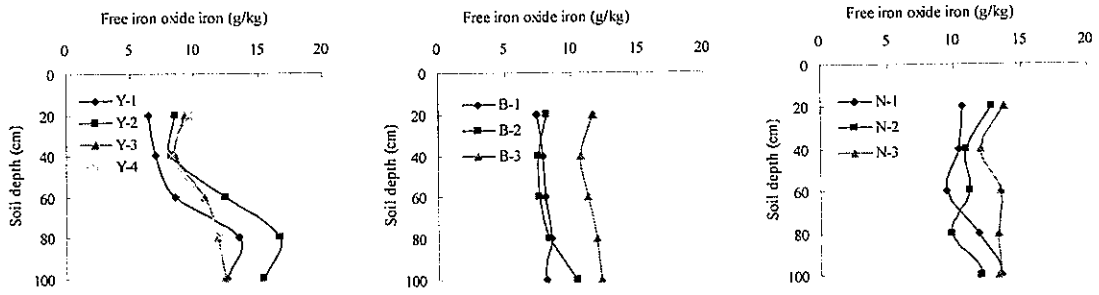
a) Yalu River b) Bielahong River c) Naoli River

Figure 1. Vertical distribution of total iron in soils in three sample locations
Data shown were the means of three replicates

Such a distribution could be explained by gleization which often occurred in flooded soil, and implied that a significant amount of iron was leached out from topsoil. Under cultivation, a redox layer at lower positions occurred due to the artificial disturbances, and the horizons with high accumulation of iron were characterized by highly variable redox conditions. Significant amounts of leached iron from topsoil, which moved vertically within the soil profile, were deposited in subsurface soil where a good aeration occurred, preventing the further loss of iron as a solute.

2) Vertical distribution of free iron oxides

Soil free iron oxides in the profiles above 60 cm were decreased in the sequence of upland field >wetland.



a) Yalu River b) Bielahong River c) Naoli River

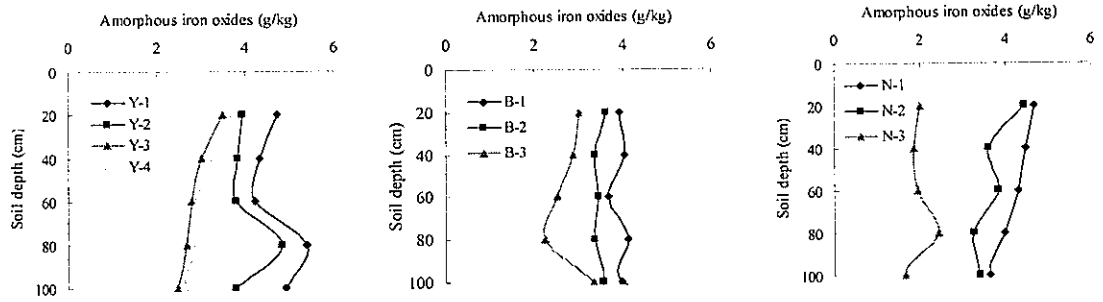
Figure 2. Vertical distribution of free iron oxides in soils in three sample locations Data shown were the means of three replicates

The similar trend between free iron oxides and total iron showed that different total iron concentration undoubtedly contributed to the observed differences in the mean concentrations of free iron oxides in wetland and paddy field. Similar trends were found in other studies, *i.e.*, a parallel trend of free iron oxides and total iron in soil occurred, and free iron oxides preferentially accumulated in well-aerated horizons (Blume and Schwertmann, 1969). The higher free iron oxides in cultivated land revealed that the impact of reclamation might also add to the free iron oxides concentration difference by modifying weathering rate. Weathering is known to be related to soil temperature and moisture content, and is likely to be increased by farming practices. The increased Free iron oxides concentration promoted by increased weathering and erosion rates has been reported in other studies (Collins and Jenkins, 1996).

3) Vertical distribution of amorphous iron oxides and active ratio

Iron oxides can be presented in soils in various forms. The less crystallized the iron oxides, the more readily reduced by microbes. The greater reduction of less crystallized forms of iron oxides might reflect the fact that the less crystalline iron oxide forms were more soluble, and had greater surface area than highly crystalline iron oxide forms (Lovley 1987). Therefore, amorphous iron oxides identified in numerous soil environments was the most reactive iron oxide in soils (Chen and Barak 1982). The spatial distribution of amorphous iron oxides and amorphous iron oxides/free iron oxides reflected a more dynamic aspect of the removal processes of iron oxide associated with podzolization and gleyization than that of total iron and free iron oxides.

The total mass of amorphous iron oxides in the whole profiles tended to be greater in wetland than in cultivated land (Figure 3).

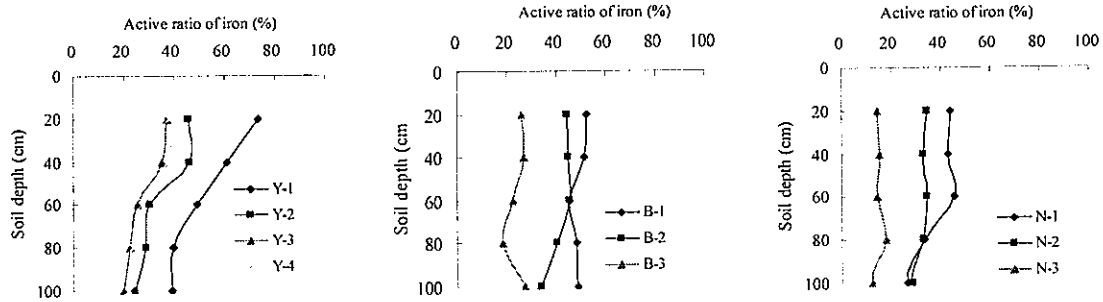


a) Yalu River b) Bielahong River c) Naoli River

Figure 3. Vertical distribution of amorphous iron oxides in soils in three sample locations

Data shown were the means of three replicates

Amorphous iron oxides/free iron oxides (active ratio of iron) is used as a measure of the proportion of amorphous iron in total iron oxides, and characterizes the inhibition of better crystallized forms by organic matter or other components (Blume and Schwertmann, 1969). The active ratio of iron distribution at the sample locations showed that land use change led to a significant decrease of the active ratio of iron along the profile(Figure 4).

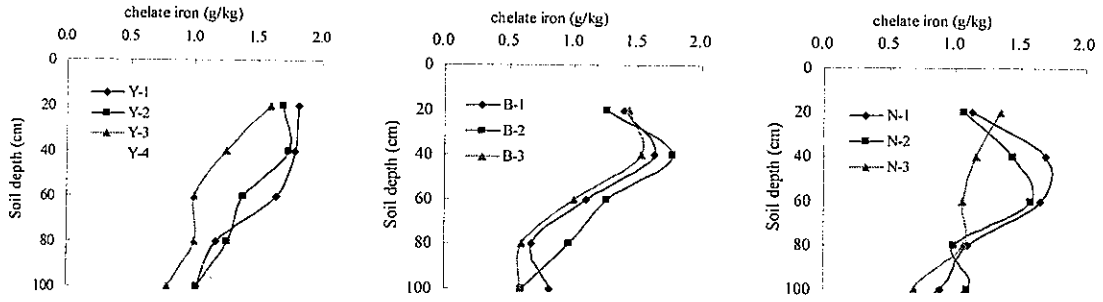


a) Yalu River b) Bielahong River c) Naoli River

Figure 4. Vertical distribution of active ratio of iron in soils in three sample locations

Data shown were the means of three replicates

Comparing with wetland, the total mass of amorphous iron oxides and active ratio of iron in cultivated land were decreased in the whole profile. The results of amorphous iron oxides, free iron oxides and active ratio of iron suggested that reclamation could promote the production of free iron oxides and retarded the



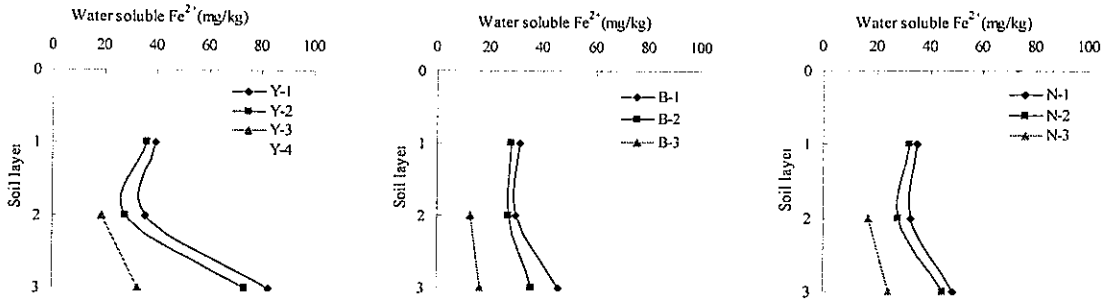
a) Yalu River b) Bielahong River c) Naoli River

Figure 6. Vertical distribution of chelate iron in soils in three sample locations
Data shown were the means of three replicates

The similar trend and remarkable positive relationship between chelate iron and TOC showed that different TOC concentration undoubtedly contributed to the observed differences in the mean concentrations of chelate iron in wetland, upland field and common border. It is thus highly likely that the wetlands having high TOC could act as a prominent source of dissolved Fe, most of which is probably present in organic-bound forms.

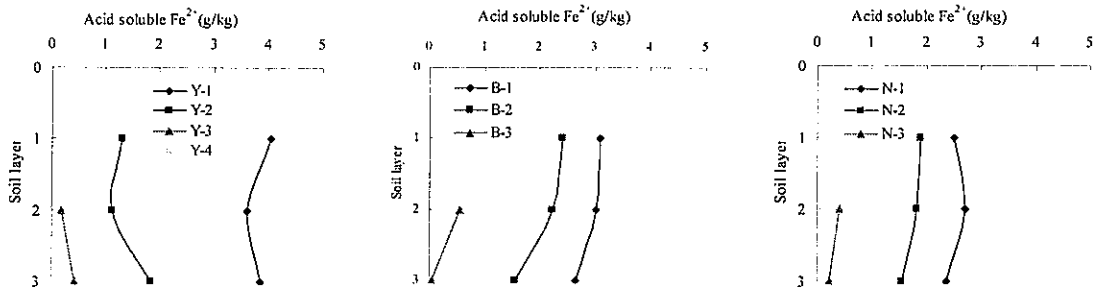
5) Vertical distribution of water soluble Fe^{2+} and acid soluble Fe^{2+}

In all three sample locations, both water soluble Fe^{2+} and acid soluble Fe^{2+} in the wetands were higher than that in upland field and common border (Figure 7 and Figure 8).



a) Yalu River b) Bielahong River c) Naoli River

Figure 7. Vertical distribution of water soluble Fe^{2+} in soils
(1- Organic layer, 2-Surface layer, 3-Deposited layer)
Data shown were the means of three replicates



a) Yalu River b) Bielahong River c) Naoli River

Figure 8. Vertical distribution of acid soluble Fe^{2+} in soils
(1- Organic layer, 2-Surface layer, 3-Deposited layer)
Data shown were the means of three replicates

The concentrations of acid soluble Fe^{2+} were nearly stable in the profiles in all observations, while water soluble Fe^{2+} showed high concentrations in deposited layers which might due to podolization. Furthermore, the concentrations of water soluble Fe^{2+} were remarkably lower than acid soluble Fe^{2+}.

The striking difference between the concentrations of water soluble Fe^{2+} and acid soluble Fe^{2+} suggested that a large amount of iron was present as acid soluble form , probably iron hydroxide. Acid soluble Fe^{2+} was the major form of iron in the soil water of wetland, which probably resulted from oxidation of dissolved iron. The dissolution of iron in soil is mainly caused by organic matter: large quantity of organic matter is produced through incomplete decomposition of litter from wetland plants might contributing to reducing the insoluble ferric iron to soluble ferrous iron.

Appendix Ⅰ: Analytical results for 2005

Table.1: Analytical results for soil bulk density ($g.cm^{-3}$)

No.	depths (cm)	Soil bulk density ($g.cm^{-3}$)
Y-1-O	0-10	0.238
Y-1-S	30-40	0.776
Y-1-D	70-80	0.975
Y-2-O	0-10	0.219
Y-2-S	30-40	0.593
Y-2-D	70-80	0.621
Y-3-S	0-10	0.653
Y-3-D	50-60	1.523
Y-4-S	0-10	1.005
Y-4-D	50-60	1.180
B-1-O	0-10	0.425
B-1-S	30-40	0.314
B-1-D	100-110	1.184
B-2-O	0-10	0.191
B-2-S	90-100	0.279
B-2-D	140-150	1.316
B-3-S	0-10	0.305
B-3-D	90-100	1.347
N-1-O	0-10	0.211
N-1-S	90-100	0.396
N-1-D	170-180	1.294
N-1-O	0-10	0.201
N-2-S	90-100	0.141
N-2-D	170-180	1.427
N-3-S	0-10	0.639
N-3-D	170-180	1.330

Table.2: Analytical results for water soluble Fe^{2+} ($mg.kg^{-1}$) — Yalu River

No.	Water soluble Fe^{2+}	Average	SD
Y-1-O	36.5		
Y-1-O	39.5	39.8	3.5
Y-1-O	43.4		
Y-1-S	33.4		
Y-1-S	37.3	35.9	2.2
Y-1-S	37.2		
Y-1-D	83.0		
Y-1-D	89.0	82.8	6.3
Y-1-D	76.4		
Y-2-O	32.0		
Y-2-O	37.0	35.7	3.2
Y-2-O	38.0		
Y-2-S	26.0		
Y-2-S	29.0	27.7	1.5
Y-2-S	28.0		
Y-2-D	71.2		
Y-2-D	70.0	73.7	5.4
Y-2-D	79.8		
Y-3-S	17.4		
Y-3-S	20.1	19.0	1.4
Y-3-S	19.4		
Y-3-D	32.6		
Y-3-D	35.3	32.9	2.3
Y-3-D	30.7		
Y-4-S	14.3		
Y-4-S	16.3	15.2	1.0
Y-4-S	15.1		
Y-4-D	20.8		
Y-4-D	22.3	22.1	1.3
Y-4-D	23.4		

Table.3: Analytical results for water soluble Fe^{2+} ($mg.kg^{-1}$)—Bielahong River

No.	Water soluble Fe^{2+}	Average	SD
B-1-O	27.7		
B-1-O	35.0	31.1	3.7
B-1-O	30.5		
B-1-S	30.8		
B-1-S	35.7	29.4	7.1
B-1-S	21.6		
B-1-D	45.8		
B-1-D	47.3	45.9	1.3
B-1-D	44.7		
B-2-O	28.1		
B-2-O	27.8	27.9	0.2
B-2-O	27.8		
B-2-S	29.1		
B-2-S	26.5	26.8	2.2
B-2-S	24.8		
B-2-D	34.2		
B-2-D	38.6	35.8	2.4
B-2-D	34.7		
B-3-S	13.4		
B-3-S	12.9	12.9	0.5
B-3-S	12.4		
B-3-D	18.3		
B-3-D	15.0	16.4	1.7
B-3-D	15.8		

Table.4: Analytical results for water soluble Fe^{2+} ($mg.kg^{-1}$)—Naoli River

No.	Water soluble Fe^{2+}	Average	SD
N-1-O	37.0		
N-1-O	36.0	35.3	2.1
N-1-O	33.0		
N-1-S	30.8		
N-1-S	34.6	32.9	2.0
N-1-S	33.3		
N-1-D	45.3		
N-1-D	49.5	49.5	4.2
N-1-D	53.6		
N-2-O	31.0		
N-2-O	30.0	32.0	2.6
N-2-O	35.0		
N-2-S	29.2		
N-2-S	27.6	28.0	1.0
N-2-S	27.3		
N-2-D	46.0		
N-2-D	43.2	45.1	1.6
N-2-D	46.0		
N-3-S	18.1		
N-3-S	15.9	17.0	1.1
N-3-S	17.1		
N-3-D	28.7		
N-3-D	20.2	23.8	4.4
N-3-D	22.5		

Table.5: Analytical results for water soluble Mn^{2+} ($mg.kg^{-1}$) -- Yalu River

No.	Water soluble Mn^{2+}	Average	SD
Y-1-O	2.420		
Y-1-O	2.283	2.386	0.091
Y-1-O	2.456		
Y-1-S	2.514		
Y-1-S	2.697	2.498	0.207
Y-1-S	2.283		
Y-1-D	3.480		
Y-1-D	3.207	3.128	0.398
Y-1-D	2.696		
Y-2-O	1.949		
Y-2-O	2.112	2.078	0.116
Y-2-O	2.173		
Y-2-S	2.384		
Y-2-S	2.335	2.256	0.180
Y-2-S	2.050		
Y-2-D	2.531		
Y-2-D	2.854	2.701	0.162
Y-2-D	2.719		
Y-3-S	1.182		
Y-3-S	1.235	1.220	0.033
Y-3-S	1.243		
Y-3-D	1.431		
Y-3-D	1.162	1.210	0.202
Y-3-D	1.035		
Y-4-S	1.192		
Y-4-S	1.307	1.164	0.159
Y-4-S	0.994		
Y-4-D	0.571		
Y-4-D	0.542	0.588	0.056
Y-4-D	0.651		

Table.6: Analytical results for water soluble Mn^{2+} ($mg.kg^{-1}$)—Bielahong River

No.	Water soluble Mn^{2+}	Average	SD
B-1-O	2.280		
B-1-O	2.477	2.368	0.100
B-1-O	2.346		
B-1-S	1.916		
B-1-S	2.467	2.182	0.276
B-1-S	2.164		
B-1-D	3.532		
B-1-D	3.580	3.490	0.117
B-1-D	3.358		
B-2-O	2.368		
B-2-O	2.177	2.221	0.130
B-2-O	2.120		
B-2-S	1.782		
B-2-S	2.204	1.965	0.216
B-2-S	1.910		
B-2-D	3.678		
B-2-D	2.869	3.120	0.484
B-2-D	2.812		
B-3-S	0.322		
B-3-S	0.280	0.297	0.022
B-3-S	0.289		
B-3-D	0.433		
B-3-D	0.609	0.526	0.088
B-3-D	0.535		

Table.7: Analytical results for water soluble Mn^{2+} ($mg.kg^{-1}$)—Naoli River

No.	Water soluble Fe^{2+}	Average	SD
N-1-O	2.500		
N-1-O	2.300	2.267	0.252
N-1-O	2.000		
N-1-S	1.348		
N-1-S	1.922	1.684	0.299
N-1-S	1.781		
N-1-D	3.108		
N-1-D	3.100	3.057	0.082
N-1-D	2.963		
N-2-O	1.725		
N-2-O	2.102	1.901	0.190
N-2-O	1.875		
N-2-S	1.473		
N-2-S	1.394	1.479	0.089
N-2-S	1.571		
N-2-D	2.205		
N-2-D	2.327	2.194	0.138
N-2-D	2.052		
N-3-S	0.719		
N-3-S	0.711	0.703	0.021
N-3-S	0.679		
N-3-D	0.688		
N-3-D	0.545	0.611	0.072
N-3-D	0.599		

Table.8: Analytical results for acid soluble Fe^{2+} ($g.kg^{-1}$) — Yalu River

No.	Acid soluble Fe^{2+}	Average	SD
Y-1-O	4.38		
Y-1-O	3.75	4.05	0.31
Y-1-O	4.02		
Y-1-S	3.48		
Y-1-S	3.85	3.62	0.21
Y-1-S	3.52		
Y-1-D	3.81		
Y-1-D	4.03	3.88	0.14
Y-1-D	3.78		
Y-2-O	1.33		
Y-2-O	1.27	1.30	0.03
Y-2-O	1.31		
Y-2-S	1.08		
Y-2-S	1.10	1.11	0.04
Y-2-S	1.15		
Y-2-D	1.76		
Y-2-D	1.83	1.85	0.10
Y-2-D	1.95		
Y-3-S	0.16		
Y-3-S	0.20	0.17	0.02
Y-3-S	0.16		
Y-3-D	0.40		
Y-3-D	0.42	0.42	0.02
Y-3-D	0.45		
Y-4-S	0.03		
Y-4-S	0.03	0.04	0.01
Y-4-S	0.05		
Y-4-D	0.04		
Y-4-D	0.04	0.04	0.01
Y-4-D	0.05		

Table.9: Analytical results for acid soluble Fe^{2+} ($g.kg^{-1}$)—Bielahong River

No.	Acid soluble Fe^{2+}	Average	SD
B-1-O	3.12		
B-1-O	3.11	3.10	0.03
B-1-O	3.06		
B-1-S	2.87		
B-1-S	3.07	3.03	0.10
B-1-S	2.94		
B-1-D	2.60		
B-1-D	2.67	2.67	0.07
B-1-D	2.74		
B-2-O	2.52		
B-2-O	2.37	2.49	0.11
B-2-O	2.59		
B-2-S	2.26		
B-2-S	2.32	2.24	0.08
B-2-S	2.15		
B-2-D	1.55		
B-2-D	1.58	1.55	0.03
B-2-D	1.53		
B-3-S	0.55		
B-3-S	0.55	0.54	0.02
B-3-S	0.52		
B-3-D	0.04		
B-3-D	0.05	0.05	0.01
B-3-D	0.05		

Table.10: Analytical results for acid soluble Fe^{2+} ($g.kg^{-1}$)—Naoli River

No.	Acid soluble Fe^{2+}	Average	SD
N-1-O	2.62		
N-1-O	2.57	2.47	0.22
N-1-O	2.21		
N-1-S	2.90		
N-1-S	2.48	2.78	0.26
N-1-S	2.95		
N-1-D	2.42		
N-1-D	2.50	2.44	0.06
N-1-D	2.39		
N-2-O	1.87		
N-2-O	1.72	1.87	0.15
N-2-O	2.01		
N-2-S	2.06		
N-2-S	1.55	1.83	0.26
N-2-S	1.89		
N-2-D	1.52		
N-2-D	1.41	1.55	0.15
N-2-D	1.71		
N-3-S	0.42		
N-3-S	0.31	0.40	0.08
N-3-S	0.47		
N-3-D	0.21		
N-3-D	0.20	0.20	0.01
N-3-D	0.19		

Table.11: Analytical results for acid soluble Mn^{2+} ($g.kg^{-1}$) — Yalu River

No.	Acid soluble Mn^{2+}	Average	SD
Y-1-O	0.165		
Y-1-O	0.197	0.182	0.016
Y-1-O	0.184		
Y-1-S	1.372		
Y-1-S	1.434	1.376	0.056
Y-1-S	1.322		
Y-1-D	1.519		
Y-1-D	1.352	1.441	0.084
Y-1-D	1.451		
Y-2-O	0.314		
Y-2-O	0.249	0.277	0.033
Y-2-O	0.268		
Y-2-S	0.535		
Y-2-S	0.504	0.506	0.028
Y-2-S	0.480		
Y-2-D	0.828		
Y-2-D	0.829	0.816	0.022
Y-2-D	0.791		
Y-3-S	0.066		
Y-3-S	0.070	0.063	0.008
Y-3-S	0.054		
Y-3-D	0.080		
Y-3-D	0.079	0.082	0.005
Y-3-D	0.088		
Y-4-S	0.009		
Y-4-S	0.012	0.010	0.003
Y-4-S	0.007		
Y-4-D	0.010		
Y-4-D	0.017	0.014	0.004
Y-4-D	0.016		

Table.12: Analytical results for acid soluble Mn^{2+} ($g.kg^{-1}$)—Bielahong River

No.	Acid soluble Mn^{2+}	Average	SD
B-1-O	0.199		
B-1-O	0.194	0.189	0.014
B-1-O	0.173		
B-1-S	0.138		
B-1-S	0.146	0.163	0.009
B-1-S	0.128		
B-1-D	0.150		
B-1-D	0.148	0.154	0.009
B-1-D	0.164		
B-2-O	0.145		
B-2-O	0.129	0.140	0.010
B-2-O	0.147		
B-2-S	0.142		
B-2-S	0.159	0.149	0.009
B-2-S	0.145		
B-2-D	0.134		
B-2-D	0.151	0.129	0.025
B-2-D	0.102		
B-3-S	0.100		
B-3-S	0.098	0.092	0.013
B-3-S	0.077		
B-3-D	0.069		
B-3-D	0.092	0.077	0.013
B-3-D	0.070		

Table.13: Analytical results for acid soluble Mn^{2+} ($g.kg^{-1}$)—Naoli River

No.	Acid soluble Mn^{2+}	Average	SD
N-1-O	0.212		
N-1-O	0.251	0.218	0.030
N-1-O	0.191		
N-1-S	0.193		
N-1-S	0.233	0.197	0.034
N-1-S	0.164		
N-1-D	0.146		
N-1-D	0.156	0.160	0.016
N-1-D	0.177		
N-2-O	0.181		
N-2-O	0.220	0.193	0.023
N-2-O	0.179		
N-2-S	0.172		
N-2-S	0.099	0.152	0.047
N-2-S	0.186		
N-2-D	0.142		
N-2-D	0.106	0.123	0.018
N-2-D	0.121		
N-3-S	0.085		
N-3-S	0.061	0.067	0.015
N-3-S	0.056		
N-3-D	0.081		
N-3-D	0.064	0.069	0.010
N-3-D	0.063		

Table.14: Analytical results for DOC ($g.kg^{-1}$) — Yalu River

No.	DOC	Average	SD
Y-1-O	1.523		
Y-1-O	0.826	1.456	0.598
Y-1-O	2.017		
Y-1-S	0.428		
Y-1-S	0.294	0.360	0.067
Y-1-S	0.359		
Y-1-D	0.186		
Y-1-D	0.327	0.275	0.078
Y-1-D	0.311		
Y-2-O	1.434		
Y-2-O	1.121	1.367	0.220
Y-2-O	1.545		
Y-2-S	0.536		
Y-2-S	0.423	0.441	0.087
Y-2-S	0.365		
Y-2-D	0.156		
Y-2-D	0.229	0.256	0.116
Y-2-D	0.384		
Y-3-S	0.730		
Y-3-S	0.605	0.709	0.095
Y-3-S	0.793		
Y-3-D	0.084		
Y-3-D	0.081	0.083	0.002
Y-3-D	0.083		
Y-4-S	0.139		
Y-4-S	0.176	0.159	0.018
Y-4-S	0.161		
Y-4-D	0.122		
Y-4-D	0.078	0.097	0.023
Y-4-D	0.090		

Table.15: Analytical results for DOC ($g.kg^{-1}$) — Bielahong River

No.	DOC	Average	SD
B-1-O	1.547		
B-1-O	1.786	1.711	0.143
B-1-O	1.801		
B-1-S	0.736		
B-1-S	0.578	0.756	0.189
B-1-S	0.953		
B-1-D	0.212		
B-1-D	0.157	0.199	0.037
B-1-D	0.227		
B-2-O	1.992		
B-2-O	0.838	1.431	0.578
B-2-O	1.463		
B-2-S	0.862		
B-2-S	1.005	1.160	0.399
B-2-S	1.613		
B-2-D	0.167		
B-2-D	0.104	0.135	0.032
B-2-D	0.133		
B-3-S	1.000		
B-3-S	0.979	1.097	0.187
B-3-S	1.313		
B-3-D	0.104		
B-3-D	0.093	0.228	0.224
B-3-D	0.487		

Table.16: Analytical results for DOC ($g.kg^{-1}$)—Naoli River

No.	Water soluble Fe^{2+}	Average	SD
N-1-O	1.810		
N-1-O	1.520	1.647	0.148
N-1-O	1.610		
N-1-S	0.722		
N-1-S	0.952	0.782	0.149
N-1-S	0.673		
N-1-D	0.402		
N-1-D	0.121	0.215	0.162
N-1-D	0.121		
N-2-O	2.220		
N-2-O	2.110	2.227	0.120
N-2-O	2.350		
N-2-S	1.986		
N-2-S	1.349	1.775	0.369
N-2-S	1.989		
N-2-D	0.149		
N-2-D	0.132	0.138	0.010
N-2-D	0.133		
N-3-S	0.141		
N-3-S	0.260	0.195	0.061
N-3-S	0.183		
N-3-D	0.060		
N-3-D	0.162	0.134	0.065
N-3-D	0.180		

Table.17: Analytical results for Hydraulic conductivity—Yalu River

No.	Time (min)	Hydraulic conductivity (mm/s)
Y-1-O	2	6.2
	5	6.6
	10	3.9
	20	2.2
	30	2.1
	40	1.9
	50	1.9
	60	1.9
Y-1-S	2	2.0
	5	0.3
	10	0.5
	20	0.3
	30	0.3
	40	0.3
	50	0.3
Y-1-D	2	2.0
	5	0.7
	10	0.7
	20	0.6
	30	0.5
	40	0.3
	50	0.1
	60	0.6
	70	0.6
	80	0.5
	90	0.5
	100	0.5
	110	0.5
	120	0.5

Table.18: Analytical results for Hydraulic conductivity—Yalu River

No.	Time (min)	Hydraulic conductivity (mm/s)
Y-2-O	2	10.9
	5	7.3
	10	5.4
	20	3.2
	30	3.6
	40	3.6
	50	3.3
	60	3.1
	70	3.1
Y-2-S	2	2.7
	5	1.5
	10	1.5
	20	1.2
	30	1.3
	40	1.3
Y-2-D	2	0.25
	5	0.17
	10	0.20
	20	0.05
	30	0.05
	60	0.05

Table.19: Analytical results for Hydraulic conductivity—Yalu River

No.	Time (min)	Hydraulic conductivity (mm/s)
Y-3-S	2	2.2
	5	1.8
	10	1.0
	20	1.2
	30	1.2
	40	1.2
Y-3-D	2	3.2
	5	4.0
	10	3.2
	20	2.3
	30	2.2
	40	1.7
	50	1.7
	60	1.7

Table.20: Analytical results for Hydraulic conductivity—Yalu River

No.	Time (min)	Hydraulic conductivity (mm/s)
Y-4-S	2	0.75
	5	0.33
	10	0.40
	20	0.05
	30	0.05
	60	0.05
	90	0.05
Y-4-D	2	4.9
	5	4.7
	10	3.8
	20	3.0
	30	2.7
	40	2.4
	50	2.4
	60	2.4
	70	2.2
	80	2.2
	90	1.8
	100	1.8
	110	1.8

Table.21: Analytical results for Hydraulic conductivity—Bielahong River

No.	Time (min)	Hydraulic conductivity (mm/s)
B-1-O	2	5.0
	5	3.6
	10	4.3
	20	3.6
	30	3.3
	40	3.1
	50	3.1
B-1-S	2	1.73
	5	0.33
	10	0.30
	20	0.20
	30	0.15
	60	0.15
B-1-D	2	0.25
	5	0.33
	10	0.20
	20	0.10
	30	0.10
	60	0.03

Table.22: Analytical results for Hydraulic conductivity—Bielahong River

No.	Time (min)	Hydraulic conductivity (mm/s)
B-2-O	2	3.23
	5	2.99
	10	2.79
	20	2.76
	30	2.74
	40	2.24
	50	2.24
B-2-S	2	2.7
	5	0.7
	10	0.4
	20	0.4
	30	0.4
B-2-D	2	0.4
	5	0.2
	10	0.2
	20	0.2
	30	0.2
	40	0.2

Table.23: Analytical results for Hydraulic conductivity—Bielahong River

No.	Time (min)	Hydraulic conductivity (mm/s)
B-3-S	2	4.7
	4	4.7
	9	3.1
	19	4.0
	29	3.7
	39	3.7
	49	3.4
	59	2.6
	69	2.5
	79	2.5
B-3-D	2	2.5
	5	2.0
	10	2.0
	20	1.7
	30	1.6
	40	1.7
	50	1.5
	60	1.5

Table.24: Analytical results for Hydraulic conductivity—Naoli River

No.	Time (min)	Hydraulic conductivity (mm/s)
N-1-O	2	6.2
	5	5.8
	10	2.5
	20	1.7
	30	1.7
	40	1.4
	50	1.4
	60	1.4
N-1-S	2	1.0
	5	0.3
	10	0.2
	20	0.2
	30	0.2
	40	0.2
	50	0.2
N-1-D	2	0.75
	5	0.33
	10	0.20
	20	0.05
	30	0.05
	60	0.02
	90	0.02

Table.25: Analytical results for Hydraulic conductivity—Naoli River

No.	Time (min)	Hydraulic conductivity (mm/s)
N-2-O	2	4.5
	5	2.0
	10	2.0
	20	1.9
	30	1.5
	40	1.5
N-2-S	2	1.0
	5	1.3
	10	1.5
	20	1.4
	30	1.2
	40	1.2
N-2-D	2	0.25
	5	0.17
	10	0.10
	40	0.03
	70	0.03

Table.26: Analytical results for Hydraulic conductivity—Naoli River

No.	Time (min)	Hydraulic conductivity (mm/s)
N-3-S	2	2.0
	5	1.2
	10	1.4
	20	1.0
	30	1.0
	40	1.0
N-3-D	2	1.2
	5	0.3
	10	0.2
	20	0.1
	30	0.1
	60	0.1
	90	0.1

Table.27: Analytical results for moisture content (%)-Yalu River

No.	moisture content	average	SD	No.	moisture content	average	SD
Y-1-1	439.0			Y-2-1	357.8		
Y-1-1	427.1	427.7	11.0	Y-2-1	351.0	347.8	11.9
Y-1-1	417.1			Y-2-1	334.6		
Y-1-2	44.5			Y-2-2	95.6		
Y-1-2	45.3	46.4	2.6	Y-2-2	98.5	97.0	1.5
Y-1-2	49.4			Y-2-2	97.0		
Y-1-3	43.0			Y-2-3	98.9		
Y-1-3	42.9	41.6	2.3	Y-2-3	96.1	97.5	1.4
Y-1-3	38.9			Y-2-3	97.4		
Y-1-4	31.7			Y-2-4	107.8		
Y-1-4	29.4	30.0	1.4	Y-2-4	106.8	110.1	4.8
Y-1-4	29.0			Y-2-4	115.5		
Y-1-5	26.7			Y-2-5	96.0		
Y-1-5	26.4	26.2	0.7	Y-2-5	95.5	97.1	2.3
Y-1-5	25.4			Y-2-5	99.7		

Table.28: Analytical results for moisture content (%)-Yalu River

No.	moisture content	average	SD	No.	moisture content	average	SD
Y-3-1	29.3			Y-4-1	35.2		
Y-3-1	30.3	30.0	0.6	Y-4-1	38.0	37.4	2.0
Y-3-1	30.4			Y-4-1	39.1		
Y-3-2	25.5			Y-4-2	34.4		
Y-3-2	26.5	26.5	1.1	Y-4-2	34.6	34.5	0.1
Y-3-2	27.6			Y-4-2	34.6		
Y-3-3	20.1			Y-4-3	29.9		
Y-3-3	20.4	20.7	0.7	Y-4-3	30.2	29.9	0.3
Y-3-3	21.5			Y-4-3	29.7		
Y-3-4	23.1			Y-4-4	20.6		
Y-3-4	24.7	23.6	0.9	Y-4-4	22.1	21.6	0.9
Y-3-4	23.1			Y-4-4	22.2		
Y-3-5	27.2			Y-4-5	14.9		
		27.2	0.1	Y-4-5	14.8	14.7	0.3
				Y-4-5	14.4		
				Y-4-6	24.1		
				Y-4-6	23.7	23.6	0.5
				Y-4-6	23.1		
				Y-4-7	28.1		
				Y-4-7	27.8	27.6	0.7
				Y-4-7	26.8		
				Y-4-8	12.4		
				Y-4-8	13.0	12.8	0.3
				Y-4-8	12.9		

Table.29: Analytical results for moisture content (%)-Bielahong River

No.	moisture content	average	SD	No.	moisture content	average	SD
B-1-1	249.6			B-2-1	401.3		
B-1-1	239.9	243.1	5.7	B-2-1	405.0	405.1	3.9
B-1-1	239.8			B-2-1	409.1		
B-1-2	150.0			B-2-2	387.0		
B-1-2	158.8	153.6	4.6	B-2-2	398.9	385.8	13.8
B-1-2	152.0			B-2-2	371.4		
B-1-3	80.5			B-2-3	356.5		
B-1-3	82.1	82.6	2.3	B-2-3	352.4	353.7	2.4
B-1-3	85.1			B-2-3	352.3		
B-1-4	53.5			B-2-4	249.2		
B-1-4	55.7	54.7	1.1	B-2-4	219.1	239.1	17.3
B-1-4	55.0			B-2-4	249.0		
B-1-5	34.6			B-2-5	210.8		
B-1-5	35.4	35.0	0.4	B-2-5	216.8	213.3	3.1
B-1-5	35.0			B-2-5	212.3		
B-1-6	38.2			B-2-6	192.9		
B-1-6	37.3	37.2	1.0	B-2-6	189.4	192.5	2.9
B-1-6	36.2			B-2-6	195.1		
				B-2-7	193.5		
				B-2-7	198.8	195.3	3.0
				B-2-7	193.7		
				B-2-8	47.8		
				B-2-8	46.6	47.3	0.7
				B-2-8	47.5		
				B-2-9	46.7		
				B-2-9	47.3	47.5	0.9
				B-2-9	48.4		

Table.30: Analytical results for moisture content (%)-Bielahong River

No.	moisture content	average	SD	No.	moisture content	average	SD
B-3-1	252.0						
B-3-1	235.9	242.9	8.2				
B-3-1	240.8						
B-3-2	239.6						
B-3-2	225.4	239.4	14.0				
B-3-2	253.3						
B-3-3	166.7						
B-3-3	170.1	168.1	1.8				
B-3-3	167.5						
B-3-4	50.1						
B-3-4	49.6	49.8	0.3				
B-3-4	49.8						
B-3-5	34.8						
B-3-5	35.3	35.6	1.0				
B-3-5	36.7						

Table.31: Analytical results for moisture content (%)-Naoli River

No.	moisture content	average	SD	No.	moisture content	average	SD
N-1-1	221.4			N-2-1	269.9		
N-1-1	203.1	211.6	9.2	N-2-1	271.3	272.9	4.1
N-1-1	210.2			N-2-1	277.6		
N-1-2	350.5			N-2-2	485.3		
N-1-2	330.7	340.7	9.9	N-2-2	486.3	486.7	1.5
N-1-2	340.9			N-2-2	488.3		
N-1-3	335.2			N-2-3	453.6		
N-1-3	325.1	327.7	6.6	N-2-3	463.6	462.5	8.5
N-1-3	322.7			N-2-3	470.4		
N-1-4	243.2			N-2-4	231.8		
N-1-4	254.4	251.2	7.0	N-2-4	231.7	231.8	0.1
N-1-4	255.9			N-2-4	231.8		
N-1-5	227.4			N-2-5	225.3		
N-1-5	221.2	225.8	4.1	N-2-5	227.0	228.9	4.9
N-1-5	228.8			N-2-5	234.6		
N-1-6	159.7			N-2-6	228.5		
N-1-6	156.7	158.5	1.6	N-2-6	275.8	264.9	32.3
N-1-6	159.0			N-2-6	290.4		
N-1-7	101.0			N-2-7	90.9		
N-1-7	99.8	98.9	2.7	N-2-7	88.9	91.1	2.4
N-1-7	95.9			N-2-7	93.7		
N-1-8	31.1			N-2-8	33.5		
N-1-8	29.6	30.1	0.9	N-2-8	34.1	34.7	1.7
N-1-8	29.6			N-2-8	36.6		
N-1-9	36.5						
N-1-9	35.5	35.4	1.1				
N-1-9	34.3						
N-1-10	36.2						
N-1-10	37.5	36.9	0.6				
N-1-10	37.0						

Table.32: Analytical results for moisture content (%)-Naoli River

No.	moisture content	average	SD	No.	moisture content	average	SD
N-3-1	35.7						
N-3-1	34.0	35.7	1.7				
N-3-1	37.4						
N-3-2	28.9						
N-3-2	27.8	28.7	0.8				
N-3-2	29.3						
N-3-3	32.0						
N-3-3	30.9	32.2	1.4				
N-3-3	33.7						
N-3-4	35.9						
N-3-4	34.6	35.1	0.7				
N-3-4	34.7						
N-3-5	28.9						
N-3-5	27.4	28.9	1.4				
N-3-5	30.3						
N-3-6	27.3						
N-3-6	28.3	27.8	0.5				
N-3-6	27.8						
N-3-7	50.0						
N-3-7	48.4	48.8	1.1				
N-3-7	47.9						
N-3-8	51.0						
N-3-8	51.9	50.4	1.8				
N-3-8	48.4						
N-3-9	38.3						
N-3-9	36.7	36.6	1.7				
N-3-9	34.8						
N-3-10	36.0						
N-3-10	38.4	37.2	1.2				
N-3-10	37.3						

Table.33: Analytical results for TOC($g.kg^{-1}$)-Yalu River

No.	TOC	average	SD	No.	TOC	average	SD
Y-1-1	120.5			Y-2-1	117.1		
Y-1-1	123.9	122.2	1.7	Y-2-1	115.6	117.2	1.7
Y-1-1	122.2			Y-2-1	118.9		
Y-1-2	23.6			Y-2-2	54.3		
Y-1-2	24.3	24.2	0.7	Y-2-2	56.8	55.2	1.3
Y-1-2	24.8			Y-2-2	54.7		
Y-1-3	24.2			Y-2-3	31.4		
Y-1-3	25.4	24.8	0.6	Y-2-3	32.4	31.9	0.5
Y-1-3	24.9			Y-2-3	32.1		
Y-1-4	9.7			Y-2-4	26.8		
Y-1-4	8.8	9.3	0.4	Y-2-4	26.3	26.2	0.6
Y-1-4	9.4			Y-2-4	25.6		
Y-1-5	8.4			Y-2-5	57.5		
Y-1-5	7.8	8.1	0.3	Y-2-5	59.9	58.4	1.3
Y-1-5	8.1			Y-2-5	57.8		

Table.34: Analytical results for Analytical results for TOC($g.kg^{-1}$)-Yalu River

No.	TOC	average	SD	No.	TOC	average	SD
Y-3-1	40.8			Y-4-1	27.8		
Y-3-1	42.6	41.1	1.3	Y-4-1	27.0	27.4	0.4
Y-3-1	40.0			Y-4-1	27.5		
Y-3-2	8.2			Y-4-2	18.9		
Y-3-2	9.2	9.1	0.9	Y-4-2	18.7	18.7	0.3
Y-3-2	10.0			Y-4-2	18.3		
Y-3-3	6.4			Y-4-3	5.6		
Y-3-3	6.2	6.3	0.1	Y-4-3	5.4	5.5	0.1
Y-3-3	6.3			Y-4-3	5.5		
Y-3-4	1.2			Y-4-4	2.1		
Y-3-4	1.2	1.2	0.0	Y-4-4	2.1	2.1	0.0
Y-3-4	1.2			Y-4-4	2.1		
Y-3-5	1.1			Y-4-5	3.5		
Y-3-5	1.1	1.1	0.0	Y-4-5	3.5	3.5	0.1
Y-3-5	1.1			Y-4-5	3.4		
				Y-4-6	2.9		
				Y-4-6	3.0	3.0	0.0
				Y-4-6	3.0		
				Y-4-7	2.2		
				Y-4-7	2.2	2.2	0.0
				Y-4-7	2.2		
				Y-4-8	1.7		
				Y-4-8	1.7	1.7	0.0
				Y-4-8	1.7		

Table.35: Analytical results for Analytical results for TOC($g.kg^{-1}$)-Bielahong River

No.	TOC	average	SD	No.	TOC	average	SD
B-1-1	145.4			B-2-1	160.0		
B-1-1	149.3	147.5	2.0	B-2-1	161.3	159.5	2.1
B-1-1	147.8			B-2-1	157.2		
B-1-2	161.2			B-2-2	181.3		
B-1-2	162.5	160.7	2.1	B-2-2	185.9	184.0	2.4
B-1-2	158.3			B-2-2	184.8		
B-1-3	118.2			B-2-3	121.0		
B-1-3	116.7	118.3	1.7	B-2-3	122.8	121.0	1.7
B-1-3	120.0			B-2-3	119.4		
B-1-4	36.2			B-2-4	80.8		
B-1-4	35.9	35.7	0.6	B-2-4	80.4	81.4	1.4
B-1-4	35.2			B-2-4	83.0		
B-1-5	7.5			B-2-5	78.6		
B-1-5	7.2	7.4	0.1	B-2-5	81.2	79.6	1.4
B-1-5	7.4			B-2-5	79.0		
B-1-6	7.4			B-2-6	77.8		
B-1-6	7.6	7.5	0.1	B-2-6	79.0	78.1	0.8
B-1-6	7.6			B-2-6	77.5		
				B-2-7	93.9		
				B-2-7	93.1	94.3	1.5
				B-2-7	95.9		
				B-2-8	32.1		
				B-2-8	31.7	31.6	0.5
				B-2-8	31.1		
				B-2-9	30.1		
				B-2-9	29.2	29.7	0.5
				B-2-9	29.8		

Table.36: Analytical results for TOC($g.kg^{-1}$)-Bielahong River

No.	TOC	average	SD	No.	TOC	average	SD
B-3-1	79.0						
B-3-1	80.6	80.2	1.0				
B-3-1	80.9						
B-3-2	112.1						
B-3-2	113.9	112.2	1.6				
B-3-2	110.7						
B-3-3	82.9						
B-3-3	85.6	84.0	1.4				
B-3-3	83.4						
B-3-4	27.9						
B-3-4	27.6	27.5	0.4				
B-3-4	27.1						
B-3-5	16.6						
B-3-5	16.1	16.4	0.3				
B-3-5	16.4						

Table.37: Analytical results for TOC($g.kg^{-1}$)-Naoli River

No.	TOC	average	SD	No.	TOC	average	SD
N-1-1	104.1			N-2-1	148.9		
N-1-1	106.2	105.8	1.6	N-2-1	151.9	151.4	2.3
N-1-1	107.3			N-2-1	153.5		
N-1-2	55.8			N-2-2	64.5		
N-1-2	56.2	55.4	1.1	N-2-2	66.8	65.3	1.3
N-1-2	54.1			N-2-2	64.5		
N-1-3	37.4			N-2-3	51.5		
N-1-3	36.3	36.9	0.6	N-2-3	51.9	52.4	1.3
N-1-3	37.0			N-2-3	53.9		
N-1-4	16.1			N-2-4	18.3		
N-1-4	15.9	15.8	0.2	N-2-4	18.1	18.1	0.3
N-1-4	15.6			N-2-4	17.8		
N-1-5	5.5			N-2-5	20.9		
N-1-5	5.4	5.5	0.1	N-2-5	20.3	20.7	0.3
N-1-5	5.5			N-2-5	20.7		
N-1-6	3.3			N-2-6	19.1		
N-1-6	3.4	3.4	0.1	N-2-6	19.5	19.4	0.3
N-1-6	3.4			N-2-6	19.7		
N-1-7	3.2			N-2-7	18.6		
N-1-7	3.1	3.1	0.0	N-2-7	18.4	18.4	0.3
N-1-7	3.1			N-2-7	18.1		
N-1-8	2.6			N-2-8	7.2		
N-1-8	2.6	2.6	0.0	N-2-8	7.4	7.3	0.1
N-1-8	2.7			N-2-8	7.4		
N-1-9	4.1						
N-1-9	4.1	4.0	0.1				
N-1-9	4.0						
N-1-10	5.1						
N-1-10	4.9	5.0	0.1				
N-1-10	5.0						

Table.38: Analytical results for TOC($g.kg^{-1}$)-Naoli River

No.	TOC	average	SD	No.	TOC	average	SD
N-3-1	70.9						
N-3-1	70.1	69.9	1.1				
N-3-1	68.7						
N-3-2	29.9						
N-3-2	29.0	29.5	0.5				
N-3-2	29.6						
N-3-3	14.1						
N-3-3	14.4	14.4	0.2				
N-3-3	14.6						
N-3-4	10.0						
N-3-4	9.9	9.8	0.2				
N-3-4	9.7						
N-3-5	4.8						
N-3-5	4.7	4.8	0.1				
N-3-5	4.8						
N-3-6	6.0						
N-3-6	6.1	6.1	0.1				
N-3-6	6.2						
N-3-7	5.9						
N-3-7	5.8	5.8	0.1				
N-3-7	5.7						
N-3-8	5.7						
N-3-8	5.5	5.6	0.1				
N-3-8	5.6						
N-3-9	4.5						
N-3-9	4.4	4.4	0.1				
N-3-9	4.3						
N-3-10	5.1						
N-3-10	5.0	5.1	0.1				
N-3-10	5.1						

Table.39: Analytical results for pH -Yalu River

No.	pH	average	SD	No.	pH	average	SD
Y-1-1	5.14			Y-2-1	5.15		
Y-1-1	5.14	5.15	0.02	Y-2-1	5.15	5.16	0.01
Y-1-1	5.17			Y-2-1	5.17		
Y-1-2	5.13			Y-2-2	5.15		
Y-1-2	5.14	5.14	0.01	Y-2-2	5.15	5.15	0.01
Y-1-2	5.14			Y-2-2	5.16		
Y-1-3	5.19			Y-2-3	5.09		
Y-1-3	5.18	5.19	0.02	Y-2-3	5.09	5.10	0.01
Y-1-3	5.21			Y-2-3	5.11		
Y-1-4	5.21			Y-2-4	5.17		
Y-1-4	5.20	5.20	0.01	Y-2-4	5.20	5.18	0.02
Y-1-4	5.20			Y-2-4	5.18		
Y-1-5	5.35			Y-2-5	5.13		
Y-1-5	5.33	5.34	0.01	Y-2-5	5.13	5.13	0.01
Y-1-5	5.34			Y-2-5	5.12		

Table.40: Analytical results for pH -Yalu River

No.	pH	average	SD	No.	pH	average	SD
Y-3-1	5.28			Y-4-1	5.74		
Y-3-1	5.26	5.27	0.01	Y-4-1	5.75	5.75	0.01
Y-3-1	5.27			Y-4-1	5.75		
Y-3-2	5.62			Y-4-2	6.14		
Y-3-2	5.63	5.62	0.01	Y-4-2	6.15	6.15	0.01
Y-3-2	5.62			Y-4-2	6.15		
Y-3-3	5.91			Y-4-3	6.13		
Y-3-3	5.88	5.91	0.03	Y-4-3	6.12	6.12	0.01
Y-3-3	5.93			Y-4-3	6.12		
Y-3-4	6.06			Y-4-4	6.19		
Y-3-4	6.05	6.06	0.01	Y-4-4	6.20	6.20	0.01
Y-3-4	6.06			Y-4-4	6.20		
Y-3-5	6.12			Y-4-5	6.21		
Y-3-5	6.15	6.12	0.03	Y-4-5	6.21	6.21	0.01
Y-3-5	6.09			Y-4-5	6.20		
				Y-4-6	6.35		
				Y-4-6	6.37	6.35	0.02
				Y-4-6	6.34		
				Y-4-7	6.15		
				Y-4-7	6.14	6.15	0.01
				Y-4-7	6.15		
				Y-4-8	6.15		
				Y-4-8	6.15	6.16	0.01
				Y-4-8	6.17		

Table.41: Analytical results for pH -Bielahong River

No.	pH	average	SD	No.	pH	average	SD
B-1-1	5.69			B-2-1	5.77		
B-1-1	5.69	5.68	0.01	B-2-1	5.75	5.77	0.02
B-1-1	5.67			B-2-1	5.78		
B-1-2	5.71			B-2-2	5.78		
B-1-2	5.70	5.72	0.03	B-2-2	5.76	5.78	0.02
B-1-2	5.75			B-2-2	5.80		
B-1-3	5.74			B-2-3	5.93		
B-1-3	5.74	5.74	0.01	B-2-3	5.89	5.92	0.03
B-1-3	5.73			B-2-3	5.95		
B-1-4	5.71			B-2-4	5.78		
B-1-4	5.74	5.71	0.03	B-2-4	5.75	5.77	0.02
B-1-4	5.68			B-2-4	5.77		
B-1-5	5.68			B-2-5	5.71		
B-1-5	5.64	5.65	0.03	B-2-5	5.69	5.71	0.02
B-1-5	5.63			B-2-5	5.72		
B-1-6	5.65			B-2-6	5.83		
B-1-6	5.61	5.63	0.02	B-2-6	5.80	5.82	0.02
B-1-6	5.62			B-2-6	5.82		
				B-2-7	5.69		
				B-2-7	5.67	5.69	0.02
				B-2-7	5.70		
				B-2-8	5.77		
				B-2-8	5.74	5.76	0.02
				B-2-8	5.77		
				B-2-9	5.74		
				B-2-9	5.71	5.72	0.02
				B-2-9	5.72		

Table.42: Analytical results for pH -Bielahong River

No.	pH	average	SD	No.	pH	average	SD
B-3-1	5.86						
B-3-1	5.83	5.85	0.02				
B-3-1	5.85						
B-3-2	5.97						
B-3-2	5.96	5.98	0.03				
B-3-2	6.02						
B-3-3	6.06						
B-3-3	6.10	6.07	0.03				
B-3-3	6.05						
B-3-4	6.06						
B-3-4	6.02	6.04	0.02				
B-3-4	6.05						
B-3-5	5.97						
B-3-5	5.95	5.97	0.03				
B-3-5	6.00						

Table.43: Analytical results for pH -Naoli River

No.	pH	average	SD	No.	pH	average	SD
N-1-1	5.38			N-2-1	5.61		
N-1-1	5.45	5.41	0.04	N-2-1	5.62	5.61	0.01
N-1-1	5.39			N-2-1	5.61		
N-1-2	5.55			N-2-2	5.64		
N-1-2	5.57	5.55	0.02	N-2-2	5.63	5.65	0.02
N-1-2	5.54			N-2-2	5.67		
N-1-3	5.52			N-2-3	5.76		
N-1-3	5.51	5.52	0.01	N-2-3	5.74	5.75	0.01
N-1-3	5.52			N-2-3	5.76		
N-1-4	5.38			N-2-4	6.01		
N-1-4	5.40	5.40	0.02	N-2-4	5.97	5.98	0.02
N-1-4	5.41			N-2-4	5.97		
N-1-5	5.33			N-2-5	6.15		
N-1-5	5.35	5.35	0.02	N-2-5	6.10	6.11	0.03
N-1-5	5.37			N-2-5	6.09		
N-1-6	5.19			N-2-6	6.07		
N-1-6	5.23	5.20	0.03	N-2-6	6.02	6.04	0.03
N-1-6	5.18			N-2-6	6.02		
N-1-7	5.21			N-2-7	6.00		
N-1-7	5.25	5.22	0.03	N-2-7	5.96	5.97	0.02
N-1-7	5.20			N-2-7	5.96		
N-1-8	5.35			N-2-8	5.91		
N-1-8	5.37	5.34	0.03	N-2-8	5.89	5.89	0.02
N-1-8	5.31			N-2-8	5.88		
N-1-9	5.34						
N-1-9	5.36	5.33	0.03				
N-1-9	5.30						
N-1-10	5.92						
N-1-10	5.91	5.92	0.01				
N-1-10	5.93						

Table.44: Analytical results for pH -Naoli River

No.	pH	average	SD	No.	pH	average	SD
N-3-1	5.40						
N-3-1	5.42	5.40	0.02				
N-3-1	5.39						
N-3-2	5.86						
N-3-2	5.85	5.85	0.02				
N-3-2	5.83						
N-3-3	5.86						
N-3-3	5.88	5.86	0.03				
N-3-3	5.83						
N-3-4	6.07						
N-3-4	6.10	6.08	0.02				
N-3-4	6.08						
N-3-5	6.24						
N-3-5	6.23	6.24	0.01				
N-3-5	6.25						
N-3-6	6.43						
N-3-6	6.39	6.42	0.02				
N-3-6	6.43						
N-3-7	6.38						
N-3-7	6.37	6.38	0.01				
N-3-7	6.38						
N-3-8	6.36						
N-3-8	6.38	6.36	0.02				
N-3-8	6.35						
N-3-9	6.41						
N-3-9	6.41	6.41	0.01				
N-3-9	6.42						
N-3-10	6.16						
N-3-10	6.16	6.17	0.01				
N-3-10	6.18						

Table.45: Analytical results for absolute specific gravity ($g.cm^{-3}$)-Yalu River

No.	absolute specific gravity	average	SD	No.	absolute specific gravity	average	SD
Y-1-1	2.170			Y-2-1	2.358		
Y-1-1	2.161	2.167	0.01	Y-2-1	2.381	2.373	0.01
Y-1-1	2.170			Y-2-1	2.378		
Y-1-2	2.500			Y-2-2	2.526		
Y-1-2	2.487	2.489	0.01	Y-2-2	2.571	2.552	0.02
Y-1-2	2.480			Y-2-2	2.560		
Y-1-3	2.537			Y-2-3	2.499		
Y-1-3	2.516	2.517	0.02	Y-2-3	2.540	2.523	0.02
Y-1-3	2.499			Y-2-3	2.530		
Y-1-4	2.582			Y-2-4	2.555		
Y-1-4	2.562	2.578	0.01	Y-2-4	2.604	2.583	0.03
Y-1-4	2.590			Y-2-4	2.591		
Y-1-5	2.501			Y-2-5	2.531		
Y-1-5	2.543	2.526	0.02	Y-2-5	2.577	2.558	0.02
Y-1-5	2.534			Y-2-5	2.566		

Table.46: Analytical results for absolute specific gravity ($g.cm^{-3}$)-Yalu River

No.	absolute specific gravity	average	SD	No.	absolute specific gravity	average	SD
Y-3-1	2.559			Y-4-1	2.318		
Y-3-1	2.608	2.588	0.03	Y-4-1	2.335	2.329	0.01
Y-3-1	2.596			Y-4-1	2.334		
Y-3-2	2.535			Y-4-2	2.687		
Y-3-2	2.581	2.562	0.02	Y-4-2	2.711	2.704	0.01
Y-3-2	2.570			Y-4-2	2.713		
Y-3-3	2.650			Y-4-3	2.410		
Y-3-3	2.648	2.653	0.01	Y-4-3	2.439	2.428	0.02
Y-3-3	2.662			Y-4-3	2.434		
Y-3-4	2.893			Y-4-4	2.615		
Y-3-4	2.903	2.904	0.01	Y-4-4	2.629	2.626	0.01
Y-3-4	2.916			Y-4-4	2.635		
Y-3-5	2.600			Y-4-5	2.726		
Y-3-5	2.612	2.610	0.01	Y-4-5	2.755	2.745	0.02
Y-3-5	2.619			Y-4-5	2.755		
				Y-4-6	2.552		
				Y-4-6	2.600	2.580	0.03
				Y-4-6	2.588		
				Y-4-7	2.513		
				Y-4-7	2.556	2.538	0.02
				Y-4-7	2.546		
				Y-4-8	2.697		
				Y-4-8	2.743	2.715	0.02
				Y-4-8	2.705		

Table.47: Analytical results for absolute specific gravity ($g.cm^{-3}$)-Bielahong River

No.	absolute specific gravity	average	SD	No.	absolute specific gravity	average	SD
B-1-1	2.273			B-2-1	2.275		
B-1-1	2.284	2.281	0.01	B-2-1	2.287	2.283	0.01
B-1-1	2.285			B-2-1	2.288		
B-1-2	2.207			B-2-2	2.490		
B-1-2	2.221	2.221	0.01	B-2-2	2.531	2.514	0.02
B-1-2	2.235			B-2-2	2.521		
B-1-3	2.330			B-2-3	2.476		
B-1-3	2.349	2.342	0.01	B-2-3	2.514	2.499	0.02
B-1-3	2.347			B-2-3	2.506		
B-1-4	2.520			B-2-4	2.676		
B-1-4	2.565	2.546	0.02	B-2-4	2.699	2.692	0.01
B-1-4	2.554			B-2-4	2.701		
B-1-5	2.518			B-2-5	2.759		
B-1-5	2.562	2.544	0.02	B-2-5	2.771	2.770	0.01
B-1-5	2.552			B-2-5	2.780		
B-1-6	2.695			B-2-6	2.537		
B-1-6	2.730	2.712	0.02	B-2-6	2.562	2.554	0.01
B-1-6	2.712			B-2-6	2.561		
				B-2-7	2.553		
				B-2-7	2.560	2.560	0.01
				B-2-7	2.568		
				B-2-8	2.585		
				B-2-8	2.639	2.616	0.03
				B-2-8	2.625		
				B-2-9	2.689		
				B-2-9	2.713	2.706	0.01
				B-2-9	2.715		

Table.48: Analytical results for absolute specific gravity ($g.cm^{-3}$)-Bielahong River

No.	absolute specific gravity	average	SD	No.	absolute specific gravity	average	SD
B-3-1	2.035						
B-3-1	2.013	2.025	0.01				
B-3-1	2.027						
B-3-2	2.185						
B-3-2	2.181	2.186	0.01				
B-3-2	2.193						
B-3-3	2.442						
B-3-3	2.476	2.463	0.02				
B-3-3	2.469						
B-3-4	2.459						
B-3-4	2.495	2.480	0.02				
B-3-4	2.487						
B-3-5	2.524						
B-3-5	2.568	2.550	0.02				
B-3-5	2.558						

Table.49: Analytical results for absolute specific gravity ($g.cm^{-3}$)-Naoli River

No.	absolute specific gravity	average	SD	No.	absolute specific gravity	average	SD
N-1-1	2.484			N-2-1	2.403		
N-1-1	2.523	2.507	0.02	N-2-1	2.431	2.420	0.02
N-1-1	2.515			N-2-1	2.426		
N-1-2	2.573			N-2-2	2.636		
N-1-2	2.581	2.581	0.01	N-2-2	2.696	2.670	0.03
N-1-2	2.589			N-2-2	2.679		
N-1-3	2.358			N-2-3	2.424		
N-1-3	2.380	2.372	0.01	N-2-3	2.455	2.443	0.02
N-1-3	2.377			N-2-3	2.450		
N-1-4	2.301			N-2-4	2.516		
N-1-4	2.316	2.311	0.01	N-2-4	2.560	2.542	0.02
N-1-4	2.316			N-2-4	2.549		
N-1-5	2.460			N-2-5	2.494		
N-1-5	2.496	2.481	0.02	N-2-5	2.535	2.518	0.02
N-1-5	2.488			N-2-5	2.525		
N-1-6	2.485			N-2-6	2.455		
N-1-6	2.525	2.509	0.02	N-2-6	2.491	2.476	0.02
N-1-6	2.516			N-2-6	2.483		
N-1-7	2.526			N-2-7	2.683		
N-1-7	2.550	2.542	0.01	N-2-7	2.749	2.721	0.03
N-1-7	2.550			N-2-7	2.730		
N-1-8	2.799			N-2-8	2.708		
N-1-8	2.838	2.824	0.02	N-2-8	2.778	2.748	0.04
N-1-8	2.835			N-2-8	2.758		
N-1-9	2.852						
N-1-9	2.877	2.870	0.02				
N-1-9	2.882						
N-1-10	2.517						
N-1-10	2.550	2.532	0.02				
N-1-10	2.530						

Table.50: Analytical results for absolute specific gravity ($g.cm^{-3}$)-Naoli River

No.	absolute specific gravity	average	SD	No.	absolute specific gravity	average	SD
N-3-1	2.259						
N-3-1	2.267	2.265	0.01				
N-3-1	2.270						
N-3-2	2.585						
N-3-2	2.638	2.616	0.03				
N-3-2	2.624						
N-3-3	2.588						
N-3-3	2.641	2.619	0.03				
N-3-3	2.627						
N-3-4	2.775						
N-3-4	2.854	2.820	0.04				
N-3-4	2.831						
N-3-5	2.507						
N-3-5	2.550	2.532	0.02				
N-3-5	2.540						
N-3-6	2.643						
N-3-6	2.704	2.678	0.03				
N-3-6	2.688						
N-3-7	2.768						
N-3-7	2.846	2.812	0.04				
N-3-7	2.823						
N-3-8	2.771						
N-3-8	2.850	2.816	0.04				
N-3-8	2.827						
N-3-9	2.770						
N-3-9	2.848	2.814	0.04				
N-3-9	2.825						
N-3-10	2.627						
N-3-10	2.685	2.660	0.03				
N-3-10	2.669						

Table.51: Analytical results for particle size distribution -Yalu River

No.	Percent clay	average	SD	Percent silt	average	SD	Percent sand	average	SD
Y-1-1	29.2			23.5			47.3		
Y-1-1	28.7	29.2	0.43	23.4	23.7	0.36	45.9	46.8	0.79
Y-1-1	29.6			24.1			47.3		
Y-1-2	7.2			24.0			68.8		
Y-1-2	7.3	7.3	0.14	23.8	24.1	0.37	66.4	67.9	1.30
Y-1-2	7.5			24.5			68.4		
Y-1-3	9.2			11.0			79.8		
Y-1-3	9.2	9.3	0.12	11.5	11.4	0.40	76.8	78.6	1.57
Y-1-3	9.4			11.8			79.1		
Y-1-4	7.2			7.0			85.8		
Y-1-4	7.3	7.3	0.14	7.1	7.2	0.18	82.5	84.5	1.71
Y-1-4	7.5			7.4			85.0		
Y-1-5	6.2			7.0			86.8		
Y-1-5	6.4	6.4	0.16	7.1	7.2	0.18	83.5	85.4	1.74
Y-1-5	6.5			7.4			86.0		

Table.52: Analytical results for particle size distribution - Yalu River

No.	Percent clay	average	SD	Percent silt	average	SD	Percent sand	average	SD
Y-2-1	28.0			37.5			34.5		
Y-2-1	27.6	28.0	0.41	36.1	36.9	0.72	33.8	34.4	0.52
Y-2-1	28.4			37.2			34.8		
Y-2-2	11.2			48.9			39.9		
Y-2-2	11.6	11.6	0.34	47.0	48.1	1.01	38.9	39.6	0.63
Y-2-2	11.9			48.4			40.1		
Y-2-3	11.3			49.4			39.3		
Y-2-3	11.2	11.3	0.12	48.0	48.9	0.84	38.3	39.0	0.62
Y-2-3	11.5			49.4			39.5		
Y-2-4	22.5			38.5			39.0		
Y-2-4	22.4	22.7	0.36	37.5	38.2	0.60	38.1	38.8	0.61
Y-2-4	23.1			38.7			39.2		
Y-2-5	11.9			54.3			33.8		
Y-2-5	12.3	12.2	0.39	52.6	53.7	0.95	33.1	33.7	0.51
Y-2-5	12.6			54.2			34.1		

Table.53: Analytical results for particle size distribution -Yalu River

No.	Percent clay	average	SD	Percent silt	average	SD	Percent sand	average	SD
Y-3-1	16.2			63.9			19.9		
Y-3-1	16.4	16.5	0.35	61.7	63.1	1.18	19.9	20.1	0.35
Y-3-1	16.9			63.6			20.5		
Y-3-2	8.2			65.9			25.9		
Y-3-2	8.8	8.7	0.44	63.6	65.1	1.23	25.6	25.9	0.39
Y-3-2	9.0			65.6			26.3		
Y-3-3	13.2			53.0			33.8		
Y-3-3	13.5	13.6	0.37	51.3	52.4	0.92	33.1	33.7	0.51
Y-3-3	13.9			52.9			34.1		
Y-3-4	6.2			52.0			41.8		
Y-3-4	6.9	6.7	0.47	50.4	51.4	0.90	40.7	41.5	0.67
Y-3-4	7.1			51.9			42.0		
Y-3-5	4.2			47.0			48.8		
Y-3-5	5.0	4.8	0.50	45.6	46.5	0.78	47.4	48.3	0.83
Y-3-5	5.1			47.0			48.8		

Table.54: Analytical results for particle size distribution -Yalu River

No.	Percent clay	average	SD	Percent silt	average	SD	Percent sand	average	SD
Y-4-1	31.2			53.0			15.8		
Y-4-1	30.6	31.1	0.46	51.3	52.4	0.92	16.0	16.1	0.35
Y-4-1	31.5			52.9			16.5		
Y-4-2	40.2			46.0			13.8		
Y-4-2	39.2	39.9	0.64	44.7	45.6	0.76	14.1	14.2	0.37
Y-4-2	40.3			46.0			14.6		
Y-4-3	36.2			54.0			9.8		
Y-4-3	35.4	36.0	0.55	52.3	53.4	0.95	10.3	10.3	0.41
Y-4-3	36.4			53.9			10.6		
Y-4-4	13.2			60.9			25.9		
Y-4-4	13.5	13.5	0.37	58.9	60.2	1.11	25.6	25.9	0.39
Y-4-4	13.9			60.7			26.3		
Y-4-5	9.2			52.0			38.8		
Y-4-5	9.7	9.7	0.42	50.4	51.4	0.90	37.9	38.6	0.61
Y-4-5	10.0			51.9			39.0		
Y-4-6	5.2			67.0			27.8		
Y-4-6	5.9	5.8	0.49	64.6	66.1	1.25	27.4	27.8	0.41
Y-4-6	6.1			66.6			28.2		
Y-4-7	7.2			71.9			20.9		
Y-4-7	7.8	7.7	0.45	69.3	70.8	1.37	20.9	21.1	0.35
Y-4-7	8.1			71.4			21.5		
Y-4-8	3.2			19.0			77.8		
Y-4-8	4.0	3.8	0.52	19.0	19.2	0.35	74.9	76.7	1.52
Y-4-8	4.2			19.6			77.2		

Table.55: Analytical results for particle size distribution -Bielahong River

No.	Percent clay	average	SD	Percent silt	average	SD	Percent sand	average	SD
B-1-1	15.7			59.1			25.2		
B-1-1	16.0	16.0	0.35	57.1	58.3	1.06	24.9	25.3	0.38
B-1-1	16.4			58.8			25.7		
B-1-2	9.2			60.0			30.8		
B-1-2	9.7	9.7	0.42	58.0	59.2	1.09	30.3	30.8	0.46
B-1-2	10.0			59.7			31.2		
B-1-3	20.2			55.9			23.9		
B-1-3	20.2	20.4	0.35	54.1	55.3	0.99	23.7	24.0	0.37
B-1-3	20.8			55.8			24.4		
B-1-4	28.2			53.9			17.9		
B-1-4	27.8	28.2	0.42	52.2	53.3	0.94	18.0	18.1	0.35
B-1-4	28.6			53.8			18.5		
B-1-5	8.2			81.9			9.9		
B-1-5	8.8	8.7	0.44	78.8	80.6	1.62	10.4	10.4	0.41
B-1-5	9.0			81.2			10.7		
B-1-6	13.2			77.0			9.8		
B-1-6	13.5	13.6	0.37	74.1	75.8	1.50	10.3	10.3	0.41
B-1-6	13.9			76.3			10.7		

Table.56: Analytical results for particle size distribution -Bielahong River

No.	Percent clay	average	SD	Percent silt	average	SD	Percent sand	average	SD
B-2-1	19.7			45.1			35.2		
B-2-1	19.8	20.0	0.35	43.8	44.7	0.74	34.4	35.0	0.54
B-2-1	20.4			45.1			35.5		
B-2-2	12.2			53.0			34.8		
B-2-2	12.6	12.6	0.38	51.3	52.4	0.92	34.1	34.7	0.53
B-2-2	13.0			52.9			35.1		
B-2-3	21.2			45.9			32.9		
B-2-3	21.1	21.4	0.35	44.6	45.5	0.76	32.2	32.8	0.49
B-2-3	21.8			46.0			33.2		
B-2-4	14.2			44.9			40.9		
B-2-4	14.5	14.5	0.36	43.7	44.6	0.74	39.8	40.6	0.65
B-2-4	14.9			45.0			41.0		
B-2-5	4.3			50.3			45.4		
B-2-5	5.1	4.9	0.50	48.8	49.8	0.86	44.1	45.0	0.75
B-2-5	5.2			50.3			45.4		
B-2-6	7.2			39.0			53.8		
B-2-6	7.8	7.7	0.45	38.0	38.7	0.61	52.1	53.2	0.94
B-2-6	8.1			39.2			53.7		
B-2-7	8.2			45.0			46.8		
B-2-7	8.8	8.7	0.44	43.7	44.6	0.74	45.5	46.4	0.78
B-2-7	9.0			45.0			46.9		
B-2-8	16.2			63.9			19.9		
B-2-8	16.4	16.5	0.35	61.7	63.0	1.18	19.9	20.1	0.35
B-2-8	16.9			63.5			20.5		
B-2-9	30.2			53.9			15.9		
B-2-9	29.7	30.1	0.45	52.2	53.3	0.94	16.1	16.2	0.35
B-2-9	30.5			53.8			16.6		

Table.57: Analytical results for particle size distribution -Bielahong River

No.	Percent clay	average	SD	Percent silt	average	SD	Percent sand	average	SD
B-3-1	15.2			58.0			26.9		
B-3-1	15.4	15.5	0.36	56.1	57.2	1.04	26.5	26.9	0.40
B-3-1	15.9			57.7			27.3		
B-3-2	19.2			66.0			14.8		
B-3-2	19.2	19.4	0.35	63.7	65.1	1.23	15.1	15.1	0.36
B-3-2	19.8			65.6			15.5		
B-3-3	10.2			57.9			31.9		
B-3-3	10.7	10.6	0.41	56.0	57.2	1.04	31.3	31.8	0.48
B-3-3	11.0			57.7			32.2		
B-3-4	25.2			58.9			15.9		
B-3-4	24.9	25.2	0.38	57.0	58.2	1.06	16.1	16.2	0.35
B-3-4	25.7			58.7			16.6		
B-3-5	30.2			54.0			15.9		
B-3-5	29.7	30.1	0.45	52.3	53.3	0.94	16.1	16.2	0.35
B-3-5	30.6			53.8			16.6		

Table.58: Analytical results for particle size distribution -Naoli River

No.	Percent clay	average	SD	Percent silt	average	SD	Percent sand	average	SD
N-1-1	20.2			65.9			13.9		
N-1-1	20.2	20.4	0.35	63.6	65.0	1.23	14.2	14.3	0.37
N-1-1	20.8			65.5			14.7		
N-1-2	28.2			58.0			13.9		
N-1-2	27.8	28.2	0.42	56.1	57.3	1.04	14.2	14.2	0.37
N-1-2	28.6			57.7			14.6		
N-1-3	34.2			31.0			34.8		
N-1-3	33.5	34.1	0.52	30.4	30.9	0.46	34.1	34.7	0.53
N-1-3	34.5			31.4			35.1		
N-1-4	22.2			67.9			9.9		
N-1-4	22.1	22.3	0.36	65.5	67.0	1.28	10.4	10.3	0.41
N-1-4	22.7			67.5			10.7		
N-1-5	16.2			68.9			14.9		
N-1-5	16.4	16.5	0.35	66.5	67.9	1.30	15.2	15.2	0.36
N-1-5	16.9			68.5			15.6		
N-1-6	15.2			74.0			10.9		
N-1-6	15.4	15.5	0.36	71.3	72.9	1.42	11.3	11.3	0.40
N-1-6	15.9			73.4			11.7		
N-1-7	15.2			70.0			14.8		
N-1-7	15.4	15.5	0.36	67.5	69.0	1.33	15.1	15.1	0.36
N-1-7	15.9			69.5			15.5		
N-1-8	16.2			62.9			20.9		
N-1-8	16.4	16.5	0.35	60.8	62.1	1.16	20.9	21.1	0.35
N-1-8	16.9			62.6			21.5		
N-1-9	22.2			59.0			18.8		
N-1-9	22.1	22.3	0.36	57.0	58.2	1.06	18.9	19.1	0.35
N-1-9	22.7			58.7			19.5		
N-1-10	34.2			55.9			9.9		
N-1-10	33.5	34.0	0.52	54.1	55.3	0.99	10.4	10.3	0.41
N-1-10	34.5			55.8			10.7		

Table.59: Analytical results for particle size distribution -Naoli River

No.	Percent clay	average	SD	Percent silt	average	SD	Percent sand	average	SD
N-2-1	35.5			29.6			34.9		
N-2-1	34.7	35.3	0.54	29.1	29.6	0.44	34.2	34.8	0.53
N-2-1	35.8			30.0			35.2		
N-2-2	35.3			24.5			40.2		
N-2-2	34.5	35.1	0.54	24.3	24.6	0.37	39.2	39.9	0.64
N-2-2	35.6			25.0			40.4		
N-2-3	28.9			28.0			43.0		
N-2-3	28.5	28.9	0.43	27.6	28.0	0.41	41.9	42.7	0.70
N-2-3	29.4			28.4			43.1		
N-2-4	12.2			42.9			44.9		
N-2-4	12.6	12.6	0.38	41.8	42.6	0.70	43.6	44.5	0.74
N-2-4	13.0			43.0			44.9		
N-2-5	14.2			38.0			47.8		
N-2-5	14.5	14.5	0.36	37.1	37.8	0.59	46.4	47.3	0.80
N-2-5	14.9			38.2			47.8		
N-2-6	16.2			35.0			48.8		
N-2-6	16.4	16.5	0.35	34.3	34.8	0.53	47.4	48.3	0.83
N-2-6	16.9			35.3			48.8		
N-2-7	28.1			55.9			16.0		
N-2-7	27.7	28.2	0.42	54.1	55.2	0.99	16.2	16.2	0.35
N-2-7	28.6			55.7			16.6		
N-2-8	13.2			42.9			43.9		
N-2-8	13.5	13.5	0.37	41.8	42.6	0.70	42.7	43.5	0.72
N-2-8	13.9			43.1			44.0		

Table.60: Analytical results for absolute specific gravity ($g.cm^{-3}$)-Naoli River

No.	Percent clay	average	SD	Percent silt	average	SD	Percent sand	average	SD
N-3-1	13.2			58.0			28.9		
N-3-1	13.5	13.6	0.37	56.1	57.2	1.04	28.4	28.8	0.43
N-3-1	13.9			57.7			29.3		
N-3-2	18.2			66.0			15.8		
N-3-2	18.3	18.4	0.35	63.7	65.1	1.23	16.0	16.1	0.35
N-3-2	18.8			65.6			16.5		
N-3-3	19.2			66.9			13.9		
N-3-3	19.2	19.4	0.35	64.6	66.0	1.25	14.2	14.2	0.37
N-3-3	19.8			66.5			14.6		
N-3-4	21.2			66.9			11.9		
N-3-4	21.1	21.3	0.35	64.5	66.0	1.25	12.3	12.3	0.39
N-3-4	21.7			66.5			12.7		
N-3-5	17.2			70.9			11.9		
N-3-5	17.3	17.4	0.35	68.4	69.9	1.35	12.3	12.3	0.39
N-3-5	17.8			70.4			12.7		
N-3-6	16.2			67.0			16.8		
N-3-6	16.4	16.5	0.35	64.6	66.1	1.25	17.0	17.1	0.35
N-3-6	16.9			66.6			17.5		
N-3-7	34.2			52.0			13.8		
N-3-7	33.5	34.1	0.52	50.4	51.4	0.90	14.1	14.2	0.37
N-3-7	34.5			51.9			14.6		
N-3-8	38.1			47.9			13.9		
N-3-8	37.2	37.9	0.59	46.5	47.5	0.81	14.2	14.3	0.37
N-3-8	38.3			47.9			14.7		
N-3-9	25.2			60.9			13.9		
N-3-9	24.9	25.2	0.38	58.9	60.1	1.11	14.2	14.3	0.37
N-3-9	25.6			60.6			14.7		
N-3-10	25.2			64.0			10.8		
N-3-10	24.9	25.3	0.38	61.8	63.2	1.18	11.3	11.2	0.40
N-3-10	25.7			63.7			11.6		

Table.61: Analytical results for total Fe ($g.kg^{-1}$)-Yalu River

No.	total Fe	average	SD	No.	total Fe	average	SD
Y-1-1	18.6			Y-2-1	23.3		
Y-1-1	18.9	18.7	0.2	Y-2-1	24.9	24.2	0.8
Y-1-1	18.5			Y-2-1	24.2		
Y-1-2	19.3			Y-2-2	26.9		
Y-1-2	20.6	19.9	0.7	Y-2-2	28.8	28.0	1.0
Y-1-2	19.9			Y-2-2	28.2		
Y-1-3	13.8			Y-2-3	22.9		
Y-1-3	14.7	14.1	0.5	Y-2-3	24.5	23.8	0.8
Y-1-3	13.9			Y-2-3	23.8		
Y-1-4	26.1			Y-2-4	29.6		
Y-1-4	27.9	27.1	0.9	Y-2-4	31.7	30.8	1.1
Y-1-4	27.2			Y-2-4	31.1		
Y-1-5	51.8			Y-2-5	21.0		
Y-1-5	55.5	54.2	2.0	Y-2-5	22.4	21.7	0.7
Y-1-5	55.2			Y-2-5	21.7		

Table.62: Analytical results for total Fe ($g.kg^{-1}$)-Yalu River

No.	total Fe	average	SD	No.	total Fe	average	SD
Y-3-1	30.8			Y-4-1	30.3		
Y-3-1	32.9	32.0	1.1	Y-4-1	32.5	31.6	1.1
Y-3-1	32.3			Y-4-1	31.9		
Y-3-2	42.8			Y-4-2	29.6		
Y-3-2	45.8	44.7	1.6	Y-4-2	31.7	30.8	1.1
Y-3-2	45.5			Y-4-2	31.1		
Y-3-3	44.1			Y-4-3	38.5		
Y-3-3	47.1	46.0	1.7	Y-4-3	41.2	40.2	1.4
Y-3-3	46.8			Y-4-3	40.8		
Y-3-4	45.0	47.0	1.7	Y-4-4	19.4		
Y-3-4	48.2			Y-4-4	20.8	20.1	0.7
Y-3-4	47.9			Y-4-4	20.0		
Y-3-5	26.6	27.6	0.9	Y-4-5	17.8		
Y-3-5	28.5			Y-4-5	19.1	18.4	0.6
Y-3-5	27.8			Y-4-5	18.3		
				Y-4-6	23.2		
				Y-4-6	24.8	24.0	0.8
				Y-4-6	24.1		
				Y-4-7	24.2		
				Y-4-7	25.9	25.2	0.9
				Y-4-7	25.3		
				Y-4-8	29.7		
				Y-4-8	31.8	30.9	1.1
				Y-4-8	31.2		

Table.63: Analytical results for total Fe ($g.kg^{-1}$)-Bielahong River

No.	total Fe	average	SD	No.	total Fe	average	SD
B-1-1	13.3			B-2-1	17.0		
B-1-1	14.2	13.6	0.5	B-2-1	18.2	17.6	0.6
B-1-1	13.3			B-2-1	17.4		
B-1-2	12.9			B-2-2	12.2		
B-1-2	12.4	12.6	0.3	B-2-2	13.0	12.4	0.5
B-1-2	12.5			B-2-2	12.1		
B-1-3	12.3			B-2-3	14.8		
B-1-3	13.1	12.6	0.5	B-2-3	15.8	15.2	0.5
B-1-3	12.3			B-2-3	15.0		
B-1-4	18.9			B-2-4	21.3		
B-1-4	20.2	19.5	0.7	B-2-4	22.8	22.1	0.7
B-1-4	19.5			B-2-4	22.1		
B-1-5	15.5			B-2-5	24.3		
B-1-5	16.5	15.9	0.6	B-2-5	26.0	25.2	0.9
B-1-5	15.7			B-2-5	25.4		
B-1-6	16.2			B-2-6	30.9		
B-1-6	17.4	16.7	0.6	B-2-6	33.0	32.1	1.1
B-1-6	16.6			B-2-6	32.4		
				B-2-7	27.2		
				B-2-7	29.1	28.3	1.0
				B-2-7	28.5		
				B-2-8	27.7		
				B-2-8	29.7	28.8	1.0
				B-2-8	29.1		
				B-2-9	27.3		
				B-2-9	29.2	28.3	1.0
				B-2-9	28.6		

Table.64: Analytical results for total Fe ($g.kg^{-1}$)-Bielahong River

No.	total Fe	average	SD	No.	total Fe	average	SD
B-3-1	29.1						
B-3-1	31.1	30.3	1.0				
B-3-1	30.5						
B-3-2	21.0						
B-3-2	22.4	21.7	0.7				
B-3-2	21.7						
B-3-3	34.4						
B-3-3	36.8	35.8	1.3				
B-3-3	36.3						
B-3-4	39.8						
B-3-4	42.6	41.5	1.5				
B-3-4	42.1						
B-3-5	42.5						
B-3-5	45.5	44.4	1.6				
B-3-5	45.1						

Table.65: Analytical results for total Fe ($g.kg^{-1}$)-Naoli River

No.	total Fe	average	SD	No.	total Fe	average	SD
N-1-1	11.9			N-2-1	22.6		
N-1-1	12.7	12.2	0.5	N-2-1	24.2	23.5	0.8
N-1-1	11.8			N-2-1	23.5		
N-1-2	17.9			N-2-2	21.8		
N-1-2	19.1	18.4	0.6	N-2-2	23.3	22.6	0.8
N-1-2	18.3			N-2-2	22.6		
N-1-3	22.0			N-2-3	24.4		
N-1-3	23.5	22.8	0.8	N-2-3	26.1	25.3	0.9
N-1-3	22.8			N-2-3	25.4		
N-1-4	32.5			N-2-4	25.9		
N-1-4	34.8	33.9	1.2	N-2-4	27.8	26.9	0.9
N-1-4	34.3			N-2-4	27.1		
N-1-5	27.6			N-2-5	27.9		
N-1-5	29.6	28.7	1.0	N-2-5	29.8	29.0	1.0
N-1-5	28.9			N-2-5	29.2		
N-1-6	46.3			N-2-6	28.3		
N-1-6	49.5	48.4	1.8	N-2-6	30.3	29.4	1.0
N-1-6	49.2			N-2-6	29.7		
N-1-7	33.9			N-2-7	33.5		
N-1-7	36.2	35.3	1.2	N-2-7	35.8	34.9	1.2
N-1-7	35.7			N-2-7	35.3		
N-1-8	32.8			N-2-8	33.2		
N-1-8	35.0	34.1	1.2	N-2-8	35.6	34.6	1.2
N-1-8	34.5			N-2-8	35.0		
N-1-9	35.8						
N-1-9	38.3	37.3	1.3				
N-1-9	37.9						
N-1-10	35.5	37.0	1.3				
N-1-10	38.0						
N-1-10	37.5						

Table.66: Analytical results for total Fe ($g.kg^{-1}$)-Naoli River

No.	total Fe	average	SD	No.	total Fe	average	SD
N-3-1	23.9						
N-3-1	25.6	24.8	0.8				
N-3-1	24.9						
N-3-2	24.5						
N-3-2	26.2	25.4	0.9				
N-3-2	25.6						
N-3-3	33.0						
N-3-3	35.3	34.4	1.2				
N-3-3	34.8						
N-3-4	42.7						
N-3-4	45.6	44.5	1.6				
N-3-4	45.3						
N-3-5	40.0						
N-3-5	42.8	41.7	1.5				
N-3-5	42.4						
N-3-6	57.4						
N-3-6	61.5	60.3	2.5				
N-3-6	62.0						
N-3-7	57.8						
N-3-7	61.9	60.7	2.5				
N-3-7	62.4						
N-3-8	45.6						
N-3-8	48.8	47.8	1.9				
N-3-8	48.9						
N-3-9	48.4						
N-3-9	51.8	50.7	2.0				
N-3-9	51.9						
N-3-10	32.9						
N-3-10	35.2	34.4	1.3				
N-3-10	35.1						

Table.67: Analytical results for free iron oxide ($g.kg^{-1}$)-Yalu River

No.	free iron	average	SD	No.	free iron	average	SD
Y-1-1	6.44			Y-2-1	8.62		
Y-1-1	6.21	6.39	0.16	Y-2-1	8.29	8.53	0.22
Y-1-1	6.53			Y-2-1	8.70		
Y-1-2	7.07			Y-2-2	8.30		
Y-1-2	6.81	7.01	0.18	Y-2-2	7.99	8.22	0.21
Y-1-2	7.15			Y-2-2	8.38		
Y-1-3	8.59			Y-2-3	12.49		
Y-1-3	8.26	8.51	0.22	Y-2-3	11.96	12.34	0.33
Y-1-3	8.68			Y-2-3	12.56		
Y-1-4	13.54			Y-2-4	16.69		
Y-1-4	12.96	13.37	0.36	Y-2-4	15.95	16.46	0.44
Y-1-4	13.61			Y-2-4	16.75		
Y-1-5	12.54			Y-2-5	15.42		
Y-1-5	12.02	12.39	0.33	Y-2-5	14.75	15.22	0.41
Y-1-5	12.62			Y-2-5	15.49		

Table.68: Analytical results for free iron oxide ($g.kg^{-1}$)-Yalu River

No.	free iron	average	SD	No.	free iron	average	SD
Y-3-1	9.37			Y-4-1	9.64		
Y-3-1	9.00	9.28	0.24	Y-4-1	9.26	9.54	0.25
Y-3-1	9.45			Y-4-1	9.72		
Y-3-2	8.58			Y-4-2	8.32		
Y-3-2	8.25	8.50	0.22	Y-4-2	8.00	8.24	0.21
Y-3-2	8.66			Y-4-2	8.40		
Y-3-3	10.84			Y-4-3	10.59		
Y-3-3	10.40	10.72	0.28	Y-4-3	10.16	10.48	0.27
Y-3-3	10.92			Y-4-3	10.67		
Y-3-4	11.89			Y-4-4	11.96		
Y-3-4	11.40	11.75	0.31	Y-4-4	11.46	11.82	0.31
Y-3-4	11.97			Y-4-4	12.04		
Y-3-5	12.44			Y-4-5	12.12		
Y-3-5	11.92	12.29	0.32	Y-4-5	11.62	11.98	0.32
Y-3-5	12.51			Y-4-5	12.20		
				Y-4-6	12.35		
				Y-4-6	11.83	12.20	0.32
				Y-4-6	12.42		
				Y-4-7	11.16		
				Y-4-7	10.70	11.03	0.29
				Y-4-7	11.23		
				Y-4-8	7.38		
				Y-4-8	7.11	7.32	0.19
				Y-4-8	7.47		

Table.69: Analytical results for free iron oxide ($g.kg^{-1}$)-Yalu River

No.	free iron	average	SD	No.	free iron	average	SD
B-1-1	7.46			B-2-1	8.17		
B-1-1	7.19	7.40	0.19	B-2-1	7.87	8.10	0.21
B-1-1	7.55			B-2-1	8.26		
B-1-2	7.89			B-2-2	7.50		
B-1-2	7.59	7.82	0.20	B-2-2	7.23	7.44	0.19
B-1-2	7.97			B-2-2	7.59		
B-1-3	8.09			B-2-3	7.58		
B-1-3	7.79	8.02	0.20	B-2-3	7.30	7.52	0.19
B-1-3	8.18			B-2-3	7.67		
B-1-4	8.54			B-2-4	8.33		
B-1-4	8.21	8.46	0.22	B-2-4	8.01	8.25	0.21
B-1-4	8.62			B-2-4	8.41		
B-1-5	8.14			B-2-5	10.42		
B-1-5	7.83	8.06	0.21	B-2-5	9.99	10.30	0.27
B-1-5	8.22			B-2-5	10.49		
B-1-6	10.98			B-2-6	11.88		
B-1-6	10.53	10.86	0.28	B-2-6	11.39	11.74	0.31
B-1-6	11.06			B-2-6	11.96		
				B-2-7	10.86		
				B-2-7	10.41	10.73	0.28
				B-2-7	10.93		
				B-2-8	5.87		
				B-2-8	5.68	5.84	0.15
				B-2-8	5.96		
				B-2-9	6.03		
				B-2-9	5.83	5.99	0.15
				B-2-9	6.12		

Table.70: Analytical results for free iron oxide ($g.kg^{-1}$)-Bielahong River

No.	free iron	average	SD	No.	free iron	average	SD
B-3-1	11.61						
B-3-1	11.13	11.47	0.30				
B-3-1	11.69						
B-3-2	10.72						
B-3-2	10.28	10.60	0.28				
B-3-2	10.79						
B-3-3	11.28						
B-3-3	10.81	11.15	0.29				
B-3-3	11.35						
B-3-4	11.94						
B-3-4	11.45	11.80	0.31				
B-3-4	12.02						
B-3-5	12.25						
B-3-5	11.74	12.11	0.32				
B-3-5	12.33						

Table.71: Analytical results for free iron oxide ($g.kg^{-1}$)-Naoli River

No.	free iron	average	SD	No.	free iron	average	SD
N-1-1	10.62			N-2-1	12.85		
N-1-1	10.19	10.50	0.27	N-2-1	12.31	12.69	0.34
N-1-1	10.70			N-2-1	12.92		
N-1-2	10.36			N-2-2	10.96		
N-1-2	9.94	10.25	0.27	N-2-2	10.51	10.84	0.28
N-1-2	10.44			N-2-2	11.04		
N-1-3	9.43			N-2-3	11.17		
N-1-3	9.06	9.34	0.24	N-2-3	10.71	11.04	0.29
N-1-3	9.52			N-2-3	11.24		
N-1-4	11.83			N-2-4	9.86		
N-1-4	11.34	11.69	0.31	N-2-4	9.47	9.76	0.25
N-1-4	11.90			N-2-4	9.94		
N-1-5	13.52			N-2-5	12.05		
N-1-5	12.95	13.35	0.35	N-2-5	11.54	11.90	0.31
N-1-5	13.59			N-2-5	12.12		
N-1-6	10.70			N-2-6	8.20		
N-1-6	10.26	10.58	0.28	N-2-6	7.89	8.12	0.21
N-1-6	10.78			N-2-6	8.28		
N-1-7	11.04			N-2-7	10.22		
N-1-7	10.58	10.91	0.29	N-2-7	9.81	10.11	0.26
N-1-7	11.11			N-2-7	10.30		
N-1-8	20.16			N-2-8	13.54		
N-1-8	19.25	19.87	0.54	N-2-8	12.96	13.37	0.36
N-1-8	20.21			N-2-8	13.61		
N-1-9	12.79						
N-1-9	12.25	12.64	0.33				
N-1-9	12.86						
N-1-10	22.40						
N-1-10	21.38	22.07	0.60				
N-1-10	22.45						

Table.72: Analytical results for free iron oxide ($g.kg^{-1}$)-Naoli River

No.	free iron	average	SD	No.	free iron	average	SD
N-3-1	13.76						
N-3-1	13.17	13.59	0.36				
N-3-1	13.83						
N-3-2	12.01						
N-3-2	11.51	11.86	0.31				
N-3-2	12.08						
N-3-3	13.49						
N-3-3	12.92	13.32	0.35				
N-3-3	13.56						
N-3-4	13.34						
N-3-4	12.77	13.17	0.35				
N-3-4	13.41						
N-3-5	13.34						
N-3-5	12.77	13.18	0.35				
N-3-5	13.41						
N-3-6	11.05						
N-3-6	10.60	10.92	0.29				
N-3-6	11.13						
N-3-7	11.16						
N-3-7	10.70	11.03	0.29				
N-3-7	11.24						
N-3-8	12.15						
N-3-8	11.64	12.00	0.32				
N-3-8	12.22						
N-3-9	11.56						
N-3-9	11.18	11.49	0.29				
N-3-9	11.74						
N-3-10	11.56						
N-3-10	11.08	11.42	0.30				
N-3-10	11.63						

Table.73: Analytical results for weathering ratio of iron
（The ratio free iron/total iron）（%）

No.	depths (cm)	weathering ratio of iron (%)
Y-1-1	0-20	34.7
Y-1-2	20-40	35.6
Y-1-3	40-60	61.9
Y-1-4	60-80	49.7
Y-1-5	80-100	22.7
Y-2-1	0-20	35.5
Y-2-2	20-40	29.4
Y-2-3	40-60	52.4
Y-2-4	60-80	53.7
Y-2-5	80-100	71.1
Y-3-1	0-20	29.0
Y-3-2	20-40	18.9
Y-3-3	40-60	23.2
Y-3-4	60-80	24.8
Y-3-5	80-100	44.7
Y-4-1	0-20	30.2
Y-4-2	20-40	26.7
Y-4-3	40-60	26.0
Y-4-4	60-80	59.7
Y-4-5	80-100	66.2
Y-4-6	120-140	51.3
Y-4-7	140-160	44.2
Y-4-8	160-180	23.7
B-1-1	0-20	55.9
B-1-2	20-40	61.1
B-1-3	40-60	66.1
B-1-4	60-80	43.9
B-1-5	80-100	51.7
B-1-6	100-120	66.3
B-2-1	0-20	46.9
B-2-2	20-40	61.8
B-2-3	40-60	50.7
B-2-4	60-80	37.7
B-2-5	80-100	41.1
B-2-6	100-120	36.6
B-2-7	120-140	38.1
B-2-8	140-160	20.2
B-2-9	160-180	21.1
B-3-1	0-20	38.0

B-3-2	20-40	49.4
B-3-3	40-60	31.1
B-3-4	60-80	28.3
B-3-5	80-100	27.2
N-1-1	0-20	89.6
N-1-2	20-40	56.5
N-1-3	40-60	41.3
N-1-4	60-80	34.5
N-1-5	80-100	46.7
N-1-6	100-120	21.7
N-1-7	120-140	30.9
N-1-8	140-160	58.4
N-1-9	160-180	33.8
N-1-10	180-200	59.6
N-2-1	0-20	54.6
N-2-2	20-40	48.5
N-2-3	40-60	43.9
N-2-4	60-80	36.4
N-2-5	80-100	41.2
N-2-6	100-120	27.6
N-2-7	120-140	28.9
N-2-8	140-160	38.6
N-3-1	0-20	55.3
N-3-2	20-40	47.0
N-3-3	40-60	38.8
N-3-4	60-80	29.5
N-3-5	80-100	31.5
N-3-6	100-120	17.8
N-3-7	120-140	17.9
N-3-8	140-160	24.8
N-3-9	160-180	22.3
N-3-10	180-200	33.0

Table.74: Analytical results for amorphous iron oxides ($g.kg^{-1}$)-Yalu River

No.	amorphous iron	average	SD	No.	amorphous iron	average	SD
Y-1-1	4.71			Y-2-1	4.01		
Y-1-1	4.97	4.71	0.26	Y-2-1	3.92	3.95	0.05
Y-1-1	4.46			Y-2-1	3.92		
Y-1-2	4.63			Y-2-2	3.81		
Y-1-2	4.44	4.32	0.38	Y-2-2	3.84	3.83	0.02
Y-1-2	3.89			Y-2-2	3.85		
Y-1-3	4.68			Y-2-3	3.76		
Y-1-3	3.76	4.22	0.46	Y-2-3	3.85	3.79	0.05
Y-1-3	4.23			Y-2-3	3.77		
Y-1-4	5.22			Y-2-4	4.89		
Y-1-4	5.26	5.39	0.27	Y-2-4	4.84	4.84	0.06
Y-1-4	5.70			Y-2-4	4.78		
Y-1-5	4.90			Y-2-5	3.86		
Y-1-5	4.95	4.93	0.03	Y-2-5	3.77	3.79	0.07
Y-1-5	4.93			Y-2-5	3.73		

Table.75: Analytical results for amorphous iron oxides ($g.kg^{-1}$)-Yalu River

No.	amorphous iron	average	SD	No.	amorphous iron	average	SD
Y-3-1	3.57			Y-4-1	3.67		
Y-3-1	3.40	3.50	0.09	Y-4-1	3.89	3.69	0.20
Y-3-1	3.54			Y-4-1	3.50		
Y-3-2	3.11			Y-4-2	3.17		
Y-3-2	2.93	3.02	0.09	Y-4-2	3.11	3.17	0.06
Y-3-2	3.03			Y-4-2	3.23		
Y-3-3	2.75			Y-4-3	2.84		
Y-3-3	2.63	2.78	0.17	Y-4-3	2.87	2.94	0.14
Y-3-3	2.96			Y-4-3	3.10		
Y-3-4	2.81			Y-4-4	3.00		
Y-3-4	2.55	2.69	0.13	Y-4-4	2.94	2.88	0.15
Y-3-4	2.70			Y-4-4	2.71		
Y-3-5	2.34			Y-4-5	2.72		
Y-3-5	2.64	2.49	0.15	Y-4-5	2.82	2.69	0.15
Y-3-5	2.49			Y-4-5	2.52		
				Y-4-6	3.48		
				Y-4-6	3.68	3.44	0.27
				Y-4-6	3.15		
				Y-4-7	3.01		
				Y-4-7	2.96	3.13	0.25
				Y-4-7	3.42		
				Y-4-8	3.72		
				Y-4-8	3.29	3.50	0.22
				Y-4-8	3.48		

Table.76: Analytical results for amorphous iron oxides ($g.kg^{-1}$)-Yalu River

No.	amorphous iron	average	SD	No.	amorphous iron	average	SD
B-1-1	3.88			B-2-1	3.70		
B-1-1	4.02	3.93	0.08	B-2-1	3.61	3.62	0.07
B-1-1	3.90			B-2-1	3.56		
B-1-2	3.98			B-2-2	3.45		
B-1-2	3.96	4.04	0.13	B-2-2	3.29	3.38	0.08
B-1-2	4.19			B-2-2	3.40		
B-1-3	3.68			B-2-3	3.39		
B-1-3	3.62	3.68	0.07	B-2-3	3.56	3.45	0.10
B-1-3	3.75			B-2-3	3.39		
B-1-4	4.29			B-2-4	3.42		
B-1-4	4.05	4.12	0.14	B-2-4	3.30	3.38	0.07
B-1-4	4.03			B-2-4	3.42		
B-1-5	4.15			B-2-5	3.55		
B-1-5	4.13	3.98	0.28	B-2-5	3.60	3.56	0.04
B-1-5	3.66			B-2-5	3.52		
B-1-6	6.15			B-2-6	3.17		
B-1-6	5.91	6.11	0.18	B-2-6	2.96	3.10	0.12
B-1-6	6.26			B-2-6	3.16		
				B-2-7	3.61		
				B-2-7	3.48	3.47	0.14
				B-2-7	3.33		
				B-2-8	4.64		
				B-2-8	4.66	4.69	0.07
				B-2-8	4.77		
				B-2-9	2.48		
				B-2-9	2.34	2.40	0.07
				B-2-9	2.39		

Table.77: Analytical results for amorphous iron oxides ($g.kg^{-1}$) -Bielahong River

No.	amorpho us iron	average	SD	No.	amorpho us iron	average	SD
B-3-1	3.41						
B-3-1	2.77	3.01	0.35				
B-3-1	2.86						
B-3-2	2.89						
B-3-2	2.91	2.87	0.05				
B-3-2	2.81						
B-3-3	2.52						
B-3-3	2.56	2.52	0.05				
B-3-3	2.47						
B-3-4	2.02						
B-3-4	2.32	2.23	0.19				
B-3-4	2.36						
B-3-5	3.37						
B-3-5	3.32	3.36	0.03				
B-3-5	3.38						

Table.78: Analytical results for amorphous iron oxides ($g.kg^{-1}$)-Naoli River

No.	amorphous iron	average	SD	No.	amorphous iron	average	SD
N-1-1	4.57			N-2-1	4.39		
N-1-1	4.81	4.65	0.14	N-2-1	4.44	4.42	0.03
N-1-1	4.58			N-2-1	4.43		
N-1-2	4.50			N-2-2	3.58		
N-1-2	4.42	4.47	0.04	N-2-2	3.51	3.61	0.12
N-1-2	4.48			N-2-2	3.74		
N-1-3	4.25			N-2-3	3.70		
N-1-3	4.33	4.28	0.04	N-2-3	3.78	3.83	0.16
N-1-3	4.26			N-2-3	4.00		
N-1-4	4.00			N-2-4	3.21		
N-1-4	3.91	3.98	0.07	N-2-4	3.22	3.24	0.05
N-1-4	4.04			N-2-4	3.30		
N-1-5	3.95			N-2-5	3.27		
N-1-5	3.59	3.62	0.32	N-2-5	3.47	3.41	0.12
N-1-5	3.32			N-2-5	3.49		
N-1-6	4.35			N-2-6	3.58		
N-1-6	4.23	4.32	0.08	N-2-6	3.48	3.53	0.05
N-1-6	4.39			N-2-6	3.53		
N-1-7	4.46			N-2-7	3.58		
N-1-7	4.54	4.52	0.05	N-2-7	3.48	3.53	0.05
N-1-7	4.56			N-2-7	3.53		
N-1-8	3.53			N-2-8	5.46		
N-1-8	3.53	3.52	0.01	N-2-8	5.35	5.41	0.06
N-1-8	3.51			N-2-8	5.41		
N-1-9	5.75						
N-1-9	5.73	5.74	0.01				
N-1-9	5.73						
N-1-10	3.90						
N-1-10	3.90	3.89	0.02				
N-1-10	3.86						

Table.79: Analytical results for amorphous iron oxides ($g.kg^{-1}$)-Naoli River

No.	amorphous iron	average	SD	No.	amorphous iron	average	SD
N-3-1	2.02						
N-3-1	2.04	2.00	0.05				
N-3-1	1.95						
N-3-2	1.89						
N-3-2	1.83	1.86	0.03				
N-3-2	1.87						
N-3-3	1.90						
N-3-3	1.98	1.95	0.04				
N-3-3	1.97						
N-3-4	2.50						
N-3-4	2.33	2.42	0.09				
N-3-4	2.43						
N-3-5	1.75						
N-3-5	1.66	1.65	0.10				
N-3-5	1.55						
N-3-6	3.12						
N-3-6	2.90	2.99	0.12				
N-3-6	2.95						
N-3-7	2.77						
N-3-7	3.13	2.99	0.20				
N-3-7	3.08						
N-3-8	2.97						
N-3-8	3.12	3.43	0.68				
N-3-8	4.21						
N-3-9	3.27						
N-3-9	3.02	3.21	0.16				
N-3-9	3.33						
N-3-10	4.83						
N-3-10	4.99	4.98	0.15				
N-3-10	5.13						

Table.80: Analytical results for active ratio of iron（The ratio amorphous iron/free iron）（%）

No.	depths (cm)	active ratio of iron（%）
Y-1-1	0-20	73.2
Y-1-2	20-40	61.1
Y-1-3	40-60	49.1
Y-1-4	60-80	39.8
Y-1-5	80-100	39.3
Y-2-1	0-20	45.8
Y-2-2	20-40	46.1
Y-2-3	40-60	30.4
Y-2-4	60-80	29.0
Y-2-5	80-100	24.5
Y-3-1	0-20	37.3
Y-3-2	20-40	35.3
Y-3-3	40-60	25.6
Y-3-4	60-80	22.6
Y-3-5	80-100	20.0
Y-4-1	0-20	38.2
Y-4-2	20-40	38.1
Y-4-3	40-60	27.7
Y-4-4	60-80	24.1
Y-4-5	80-100	22.2
Y-4-6	120-140	27.8
Y-4-7	140-160	28.1
Y-4-8	160-180	47.4
B-1-1	0-20	52.7
B-1-2	20-40	51.3
B-1-3	40-60	45.5
B-1-4	60-80	48.3
B-1-5	80-100	48.9
B-1-6	100-120	55.6
B-2-1	0-20	44.3
B-2-2	20-40	45.0
B-2-3	40-60	45.4
B-2-4	60-80	40.6
B-2-5	80-100	34.1
B-2-6	100-120	26.0
B-2-7	120-140	32.0
B-2-8	140-160	79.8
B-2-9	160-180	39.9

B-3-1	0-20	25.9
B-3-2	20-40	26.8
B-3-3	40-60	22.3
B-3-4	60-80	18.7
B-3-5	80-100	27.4
N-1-1	0-20	43.8
N-1-2	20-40	43.1
N-1-3	40-60	45.4
N-1-4	60-80	33.7
N-1-5	80-100	26.7
N-1-6	100-120	40.4
N-1-7	120-140	41.0
N-1-8	140-160	17.5
N-1-9	160-180	44.8
N-1-10	180-200	17.4
N-2-1	0-20	34.4
N-2-2	20-40	32.9
N-2-3	40-60	34.3
N-2-4	60-80	32.9
N-2-5	80-100	28.3
N-2-6	100-120	43.1
N-2-7	120-140	34.5
N-2-8	140-160	39.9
N-3-1	0-20	14.5
N-3-2	20-40	15.5
N-3-3	40-60	14.5
N-3-4	60-80	18.1
N-3-5	80-100	12.4
N-3-6	100-120	27.1
N-3-7	120-140	26.8
N-3-8	140-160	28.2
N-3-9	160-180	27.7
N-3-10	180-200	43.1

Table.81: Analytical results for chelate Fe ($g.kg^{-1}$)-Yalu River

No.	chelate Fe	average	SD	No.	chelate Fe	average	SD
Y-1-1	1.82			Y-2-1	1.73		
Y-1-1	1.79	1.81	0.02	Y-2-1	1.67	1.69	0.03
Y-1-1	1.83			Y-2-1	1.68		
Y-1-2	1.76			Y-2-2	1.71		
Y-1-2	1.74	1.79	0.06	Y-2-2	1.76	1.74	0.03
Y-1-2	1.85			Y-2-2	1.77		
Y-1-3	1.69			Y-2-3	1.39		
Y-1-3	1.59	1.65	0.05	Y-2-3	1.36	1.39	0.02
Y-1-3	1.66			Y-2-3	1.41		
Y-1-4	1.19			Y-2-4	1.21		
Y-1-4	1.17	1.18	0.02	Y-2-4	1.28	1.26	0.04
Y-1-4	1.16			Y-2-4	1.29		
Y-1-5	0.98			Y-2-5	0.98		
Y-1-5	1.06	1.02	0.04	Y-2-5	1.05	1.02	0.04
Y-1-5	1.01			Y-2-5	1.03		

Table.82: Analytical results for chelate Fe ($g.kg^{-1}$)-Yalu River

No.	absolute specific gravity	average	SD	No.	absolute specific gravity	average	SD
Y-3-1	1.50			Y-4-1	1.12		
Y-3-1	1.63	1.60	0.09	Y-4-1	1.16	1.15	0.02
Y-3-1	1.66			Y-4-1	1.16		
Y-3-2	1.23			Y-4-2	1.14		
Y-3-2	1.29	1.25	0.04	Y-4-2	1.09	1.13	0.03
Y-3-2	1.23			Y-4-2	1.14		
Y-3-3	1.02			Y-4-3	0.88		
Y-3-3	0.98	1.00	0.02	Y-4-3	0.82	0.85	0.03
Y-3-3	0.99			Y-4-3	0.86		
Y-3-4	1.03			Y-4-4	0.95		
Y-3-4	0.98	1.00	0.02	Y-4-4	0.94	0.95	0.01
Y-3-4	1.01			Y-4-4	0.96		
Y-3-5	0.78			Y-4-5	1.14		
Y-3-5	0.81	0.79	0.02	Y-4-5	1.20	1.19	0.04
Y-3-5	0.79			Y-4-5	1.23		
				Y-4-6	0.91		
				Y-4-6	0.96	0.94	0.02
				Y-4-6	0.95		
				Y-4-7	0.94		
				Y-4-7	0.88	0.91	0.03
				Y-4-7	0.91		
				Y-4-8	0.47		
				Y-4-8	0.54	0.50	0.04
				Y-4-8	0.49		

Table.83: Analytical results for chelate Fe ($g.kg^{-1}$)-Bielahong River

No.	chelate Fe	average	SD	No.	chelate Fe	average	SD
B-1-1	1.34			B-2-1	1.26		
B-1-1	1.50	1.39	0.09	B-2-1	1.20	1.26	0.06
B-1-1	1.34			B-2-1	1.33		
B-1-2	1.58			B-2-2	1.76		
B-1-2	1.62	1.63	0.06	B-2-2	1.76	1.77	0.02
B-1-2	1.70			B-2-2	1.79		
B-1-3	1.12			B-2-3	1.24		
B-1-3	1.09	1.10	0.02	B-2-3	1.26	1.26	0.03
B-1-3	1.08			B-2-3	1.29		
B-1-4	0.67			B-2-4	0.97		
B-1-4	0.66	0.68	0.02	B-2-4	0.99	0.97	0.02
B-1-4	0.70			B-2-4	0.96		
B-1-5	0.81			B-2-5	0.61		
B-1-5	0.86	0.82	0.04	B-2-5	0.62	0.60	0.03
B-1-5	0.79			B-2-5	0.56		
B-1-6	0.75			B-2-6	0.58		
B-1-6	0.74	0.74	0.01	B-2-6	0.55	0.57	0.02
B-1-6	0.73			B-2-6	0.59		
				B-2-7	2.84		
				B-2-7	3.19	3.10	0.23
				B-2-7	3.27		
				B-2-8	0.63		
				B-2-8	0.60	0.64	0.04
				B-2-8	0.68		
				B-2-9	0.44		
				B-2-9	0.41	0.44	0.02
				B-2-9	0.46		

Table.84: Analytical results for chelate Fe ($g.kg^{-1}$)-Bielahong River

No.	chelate Fe	average	SD	No.	chelate Fe	average	SD
B-3-1	1.39						
B-3-1	1.58	1.43	0.13				
B-3-1	1.33						
B-3-2	1.59						
B-3-2	1.41	1.52	0.10				
B-3-2	1.57						
B-3-3	0.98						
B-3-3	1.04	1.00	0.03				
B-3-3	0.99						
B-3-4	0.61						
B-3-4	0.56	0.59	0.03				
B-3-4	0.61						
B-3-5	0.60						
B-3-5	0.61	0.59	0.02				
B-3-5	0.57						

Table.85: Analytical results for chelate Fe ($g.kg^{-1}$)-Naoli River

No.	chelate Fe	average	SD	No.	chelate Fe	average	SD
N-1-1	1.17			N-2-1	1.07		
N-1-1	1.11	1.13	0.03	N-2-1	1.06	1.07	0.01
N-1-1	1.11			N-2-1	1.08		
N-1-2	1.73			N-2-2	1.39		
N-1-2	1.74	1.69	0.08	N-2-2	1.46	1.44	0.04
N-1-2	1.60			N-2-2	1.46		
N-1-3	1.66			N-2-3	1.61		
N-1-3	1.72	1.65	0.08	N-2-3	1.57	1.58	0.02
N-1-3	1.57			N-2-3	1.56		
N-1-4	1.06			N-2-4	0.98		
N-1-4	1.12	1.09	0.03	N-2-4	1.01	0.99	0.02
N-1-4	1.11			N-2-4	0.99		
N-1-5	0.93			N-2-5	1.09		
N-1-5	0.86	0.89	0.03	N-2-5	1.12	1.10	0.02
N-1-5	0.89			N-2-5	1.08		
N-1-6	0.35			N-2-6	0.39		
N-1-6	0.38	0.37	0.02	N-2-6	0.38	0.38	0.01
N-1-6	0.39			N-2-6	0.37		
N-1-7	0.34			N-2-7	0.74		
N-1-7	0.34	0.35	0.01	N-2-7	0.76	0.76	0.01
N-1-7	0.36			N-2-7	0.77		
N-1-8	0.69			N-2-8	0.53		
N-1-8	0.61	0.66	0.04	N-2-8	0.57	0.55	0.02
N-1-8	0.68			N-2-8	0.56		
N-1-9	5.51						
N-1-9	5.59	5.58	0.06				
N-1-9	5.63						
N-1-10	9.08						
N-1-10	8.88	9.11	0.25				
N-1-10	9.38						

Table.86: Analytical results for chelate Fe ($g.kg^{-1}$)-Naoli River

No.	chelate Fe	average	SD	No.	chelate Fe	average	SD
N-3-1	1.37						
N-3-1	1.32	1.35	0.03				
N-3-1	1.35						
N-3-2	1.17						
N-3-2	1.13	1.16	0.03				
N-3-2	1.18						
N-3-3	1.03						
N-3-3	1.07	1.05	0.02				
N-3-3	1.06						
N-3-4	1.12						
N-3-4	1.06	1.07	0.05				
N-3-4	1.03						
N-3-5	0.71						
N-3-5	0.68	0.70	0.02				
N-3-5	0.70						
N-3-6	0.86						
N-3-6	0.85	0.86	0.01				
N-3-6	0.86						
N-3-7	0.73						
N-3-7	0.68	0.72	0.03				
N-3-7	0.74						
N-3-8	0.43						
N-3-8	0.44	0.43	0.02				
N-3-8	0.41						
N-3-9	0.66						
N-3-9	0.66	0.65	0.01				
N-3-9	0.64						
N-3-10	0.76						
N-3-10	0.69	0.70	0.05				
N-3-10	0.66						

Table.87: Analytical results for Mn($g.kg^{-1}$)-Yalu River

No.	Mn	average	SD	No.	Mn	average	SD
Y-1-1	0.29			Y-2-1	0.42		
Y-1-1	0.28	0.29	0.01	Y-2-1	0.41	0.42	0.01
Y-1-1	0.30			Y-2-1	0.43		
Y-1-2	0.25			Y-2-2	0.26		
Y-1-2	0.27	0.26	0.01	Y-2-2	0.28	0.27	0.01
Y-1-2	0.26			Y-2-2	0.28		
Y-1-3	0.27			Y-2-3	0.26		
Y-1-3	0.25	0.26	0.01	Y-2-3	0.25	0.26	0.01
Y-1-3	0.27			Y-2-3	0.27		
Y-1-4	0.28			Y-2-4	0.54		
Y-1-4	0.26	0.27	0.01	Y-2-4	0.54	0.54	0.01
Y-1-4	0.28			Y-2-4	0.55		
Y-1-5	0.85			Y-2-5	0.50		
Y-1-5	0.86	0.85	0.01	Y-2-5	0.52	0.51	0.01
Y-1-5	0.84			Y-2-5	0.51		

Table.88: Analytical results for Mn($g.kg^{-1}$)-Yalu River

No.	Mn	average	SD	No.	Mn	average	SD
Y-3-1	0.45			Y-4-1	0.55		
Y-3-1	0.44	0.45	0.01	Y-4-1	0.55	0.55	0.01
Y-3-1	0.45			Y-4-1	0.56		
Y-3-2	0.31			Y-4-2	0.52		
Y-3-2	0.33	0.33	0.01	Y-4-2	0.54	0.53	0.01
Y-3-2	0.33			Y-4-2	0.53		
Y-3-3	0.36			Y-4-3	0.69		
Y-3-3	0.35	0.36	0.01	Y-4-3	0.69	0.69	0.01
Y-3-3	0.37			Y-4-3	0.70		
Y-3-4	0.34			Y-4-4	0.40		
Y-3-4	0.32	0.33	0.01	Y-4-4	0.39	0.39	0.01
Y-3-4	0.34			Y-4-4	0.40		
Y-3-5	0.41			Y-4-5	0.45		
Y-3-5	0.43	0.42	0.01	Y-4-5	0.47	0.46	0.01
Y-3-5	0.42			Y-4-5	0.46		
				Y-4-6	0.57		
				Y-4-6	0.57	0.57	0.01
				Y-4-6	0.58		
				Y-4-7	0.42		
				Y-4-7	0.44	0.43	0.01
				Y-4-7	0.43		
				Y-4-8	0.33		
				Y-4-8	0.32	0.33	0.01
				Y-4-8	0.34		

Table.89: Analytical results for Mn(g.kg^{-1})-Bielahong River

No.	Mn	average	SD	No.	Mn	average	SD
B-1-1	0.30			B-2-1	0.32		
B-1-1	0.29	0.30	0.01	B-2-1	0.30	0.31	0.01
B-1-1	0.31			B-2-1	0.32		
B-1-2	0.26			B-2-2	0.27		
B-1-2	0.27	0.26	0.01	B-2-2	0.29	0.28	0.01
B-1-2	0.25			B-2-2	0.28		
B-1-3	0.20			B-2-3	0.29		
B-1-3	0.23	0.22	0.01	B-2-3	0.27	0.28	0.01
B-1-3	0.22			B-2-3	0.29		
B-1-4	0.22			B-2-4	0.26		
B-1-4	0.20	0.22	0.01	B-2-4	0.28	0.27	0.01
B-1-4	0.23			B-2-4	0.28		
B-1-5	0.25			B-2-5	0.25		
B-1-5	0.27	0.26	0.01	B-2-5	0.23	0.24	0.01
B-1-5	0.27			B-2-5	0.25		
B-1-6	0.31			B-2-6	0.24		
B-1-6	0.29	0.30	0.01	B-2-6	0.22	0.23	0.01
B-1-6	0.31			B-2-6	0.24		
				B-2-7	0.22		
				B-2-7	0.24	0.23	0.01
				B-2-7	0.24		
				B-2-8	0.22		
				B-2-8	0.20	0.22	0.01
				B-2-8	0.23		
				B-2-9	0.20		
				B-2-9	0.23	0.22	0.01
				B-2-9	0.22		

Table.90: Analytical results for Mn($g.kg^{-1}$)-Bielahong River

No.	Mn	average	SD	No.	Mn	average	SD
B-3-1	0.36						
B-3-1	0.34	0.35	0.01				
B-3-1	0.36						
B-3-2	0.33						
B-3-2	0.32	0.33	0.01				
B-3-2	0.34						
B-3-3	0.30						
B-3-3	0.32	0.31	0.01				
B-3-3	0.32						
B-3-4	0.28						
B-3-4	0.27	0.28	0.01				
B-3-4	0.29						
B-3-5	0.26						
B-3-5	0.28	0.27	0.01				
B-3-5	0.28						

Table.91: Analytical results for Mn(g.kg^{-1})-Naoli River

No.	Mn	average	SD	No.	Mn	average	SD
N-1-1	0.21			N-2-1	0.30		
N-1-1	0.19	0.21	0.01	N-2-1	0.29	0.30	0.01
N-1-1	0.22			N-2-1	0.31		
N-1-2	0.23			N-2-2	0.28		
N-1-2	0.21	0.22	0.01	N-2-2	0.27	0.28	0.01
N-1-2	0.23			N-2-2	0.29		
N-1-3	0.20			N-2-3	0.24		
N-1-3	0.23	0.22	0.01	N-2-3	0.26	0.25	0.01
N-1-3	0.22			N-2-3	0.26		
N-1-4	0.29			N-2-4	0.25		
N-1-4	0.27	0.28	0.01	N-2-4	0.23	0.25	0.01
N-1-4	0.29			N-2-4	0.26		
N-1-5	0.30			N-2-5	0.24		
N-1-5	0.32	0.31	0.01	N-2-5	0.27	0.26	0.01
N-1-5	0.32			N-2-5	0.26		
N-1-6	0.31			N-2-6	0.25		
N-1-6	0.29	0.31	0.01	N-2-6	0.23	0.25	0.01
N-1-6	0.32			N-2-6	0.26		
N-1-7	0.35			N-2-7	1.23		
N-1-7	0.33	0.34	0.01	N-2-7	1.28	1.26	0.03
N-1-7	0.35			N-2-7	1.25		
N-1-8	0.58			N-2-8	0.22		
N-1-8	0.59	0.58	0.01	N-2-8	0.25	0.24	0.01
N-1-8	0.58			N-2-8	0.24		
N-1-9	1.14						
N-1-9	1.17	1.16	0.02				
N-1-9	1.17						
N-1-10	0.53						
N-1-10	0.54	0.54	0.01				
N-1-10	0.53						

Table.92: Analytical results for Mn($g.kg^{-1}$)-Naoli River

No.	Mn	average	SD	No.	Mn	average	SD
N-3-1	0.34						
N-3-1	0.33	0.34	0.01				
N-3-1	0.35						
N-3-2	0.34						
N-3-2	0.36	0.35	0.01				
N-3-2	0.36						
N-3-3	0.28						
N-3-3	0.26	0.28	0.01				
N-3-3	0.29						
N-3-4	0.25						
N-3-4	0.23	0.25	0.01				
N-3-4	0.25						
N-3-5	0.37						
N-3-5	0.39	0.38	0.01				
N-3-5	0.38						
N-3-6	1.28						
N-3-6	1.31	1.30	0.02				
N-3-6	1.30						
N-3-7	1.46						
N-3-7	1.44	1.44	0.02				
N-3-7	1.41						
N-3-8	1.10						
N-3-8	1.12	1.11	0.01				
N-3-8	1.12						
N-3-9	1.68						
N-3-9	1.73	1.71	0.03				
N-3-9	1.71						
N-3-10	0.57						
N-3-10	0.59	0.58	0.01				
N-3-10	0.57						

Table.93: Analytical results for Al($g.kg^{-1}$)-Yalu River

No.	Al	average	SD	No.	Al	average	SD
Y-1-1	26.8			Y-2-1	40.1		
Y-1-1	27.2	27.2	0.4	Y-2-1	41.2	41.1	0.9
Y-1-1	27.7			Y-2-1	42.0		
Y-1-2	48.6			Y-2-2	51.3		
Y-1-2	50.1	49.9	1.2	Y-2-2	52.9	52.7	1.3
Y-1-2	51.0			Y-2-2	53.9		
Y-1-3	43.0			Y-2-3	53.8		
Y-1-3	44.2	44.1	1.0	Y-2-3	55.5	55.3	1.4
Y-1-3	45.0			Y-2-3	56.5		
Y-1-4	40.6			Y-2-4	64.6		
Y-1-4	41.7	41.6	0.9	Y-2-4	67.0	66.6	1.8
Y-1-4	42.5			Y-2-4	68.2		
Y-1-5	44.9			Y-2-5	48.3		
Y-1-5	46.3	46.1	1.1	Y-2-5	49.8	49.6	1.2
Y-1-5	47.1			Y-2-5	50.7		

Table.94: Analytical results for Al($g.kg^{-1}$)-Yalu River

No.	Al	average	SD	No.	Al	average	SD
Y-3-1	50.7			Y-4-1	59.7		
Y-3-1	52.3	52.0	1.3	Y-4-1	61.8	61.4	1.6
Y-3-1	53.2			Y-4-1	62.8		
Y-3-2	58.4			Y-4-2	54.7		
Y-3-2	60.4	60.1	1.6	Y-4-2	56.5	56.3	1.4
Y-3-2	61.5			Y-4-2	57.5		
Y-3-3	61.2			Y-4-3	66.9		
Y-3-3	63.4	63.0	1.7	Y-4-3	69.3	68.9	1.9
Y-3-3	64.5			Y-4-3	70.6		
Y-3-4	65.8			Y-4-4	46.8		
Y-3-4	68.2	67.8	1.8	Y-4-4	48.2	48.0	1.1
Y-3-4	69.4			Y-4-4	49.1		
Y-3-5	54.5			Y-4-5	38.4		
Y-3-5	56.4	56.1	1.4	Y-4-5	39.4	39.3	0.8
Y-3-5	57.4			Y-4-5	40.1		
				Y-4-6	43.6		
				Y-4-6	44.8	44.7	1.0
				Y-4-6	45.6		
				Y-4-7	49.5		
				Y-4-7	51.1	50.9	1.2
				Y-4-7	52.0		
				Y-4-8	63.5		
				Y-4-8	65.8	65.4	1.8
				Y-4-8	67.0		

Table.95: Analytical results for Al($g.kg^{-1}$)-Yalu River

No.	Al	average	SD	No.	Al	average	SD
B-1-1	32.7			B-2-1	34.4		
B-1-1	33.3	33.3	0.6	B-2-1	35.1	35.1	0.7
B-1-1	34.0			B-2-1	35.8		
B-1-2	26.3			B-2-2	31.4		
B-1-2	26.2	26.4	0.3	B-2-2	32.0	32.0	0.6
B-1-2	26.7			B-2-2	32.6		
B-1-3	36.0			B-2-3	38.3		
B-1-3	36.8	36.8	0.8	B-2-3	39.2	39.2	0.8
B-1-3	37.5			B-2-3	40.0		
B-1-4	36.8			B-2-4	53.6		
B-1-4	37.7	37.6	0.8	B-2-4	55.4	55.1	1.4
B-1-4	38.3			B-2-4	56.4		
B-1-5	55.7			B-2-5	59.0		
B-1-5	57.6	57.3	1.5	B-2-5	61.0	60.7	1.6
B-1-5	58.6			B-2-5	62.1		
B-1-6	55.3			B-2-6	60.7		
B-1-6	57.1	56.8	1.5	B-2-6	62.9	62.5	1.7
B-1-6	58.1			B-2-6	64.0		
				B-2-7	58.8		
				B-2-7	60.9	60.5	1.6
				B-2-7	61.9		
				B-2-8	63.0		
				B-2-8	65.3	64.9	1.7
				B-2-8	66.4		
				B-2-9	64.5		
				B-2-9	66.8	66.5	1.8
				B-2-9	68.0		

Table.96: Analytical results for Al($g.kg^{-1}$)-Bielahong River

No.	Al	average	SD	No.	Al	average	SD
B-3-1	43.0						
B-3-1	44.3	44.1	1.0				
B-3-1	45.1						
B-3-2	41.8						
B-3-2	42.9	42.8	1.0				
B-3-2	43.7						
B-3-3	59.0						
B-3-3	61.1	60.8	1.6				
B-3-3	62.2						
B-3-4	72.6						
B-3-4	75.4	74.9	2.1				
B-3-4	76.7						
B-3-5	74.7						
B-3-5	77.5	77.0	2.2				
B-3-5	78.9						

Table.97: Analytical results for Al($g.kg^{-1}$)-Naoli River

No.	Al	average	SD	No.	Al	average	SD
N-1-1	35.4			N-2-1	49.0		
N-1-1	36.2	36.2	0.7	N-2-1	50.5	50.3	1.2
N-1-1	36.9			N-2-1	51.4		
N-1-2	39.4			N-2-2	44.7		
N-1-2	40.4	40.3	0.9	N-2-2	46.0	45.9	1.1
N-1-2	41.1			N-2-2	46.9		
N-1-3	44.0			N-2-3	43.9		
N-1-3	45.3	45.1	1.0	N-2-3	45.2	45.0	1.0
N-1-3	46.1			N-2-3	46.0		
N-1-4	42.0			N-2-4	49.1		
N-1-4	43.2	43.1	1.0	N-2-4	50.6	50.4	1.2
N-1-4	44.0			N-2-4	51.5		
N-1-5	48.2			N-2-5	49.4		
N-1-5	49.7	49.5	1.2	N-2-5	51.0	50.8	1.2
N-1-5	50.6			N-2-5	51.9		
N-1-6	61.4			N-2-6	51.8		
N-1-6	63.6	63.2	1.7	N-2-6	53.5	53.2	1.3
N-1-6	64.7			N-2-6	54.4		
N-1-7	45.7			N-2-7	64.8		
N-1-7	47.1	46.9	1.1	N-2-7	67.2	66.8	1.8
N-1-7	47.9			N-2-7	68.4		
N-1-8	45.3			N-2-8	83.5		
N-1-8	46.6	46.4	1.1	N-2-8	86.9	86.3	2.5
N-1-8	47.4			N-2-8	88.4		
N-1-9	34.7						
N-1-9	35.5	35.5	0.7				
N-1-9	36.2						
N-1-10	42.7						
N-1-10	43.9	43.8	1.0				
N-1-10	44.7						

Table.98: Analytical results for Al($g.kg^{-1}$)-Naoli River

No.	Al	average	SD	No.	Al	average	SD
N-3-1	48.7						
N-3-1	50.2	50.0	1.2				
N-3-1	51.1						
N-3-2	49.1						
N-3-2	50.6	50.4	1.2				
N-3-2	51.5						
N-3-3	62.8						
N-3-3	65.1	64.7	1.7				
N-3-3	66.2						
N-3-4	73.8						
N-3-4	76.7	76.2	2.1				
N-3-4	78.0						
N-3-5	66.4						
N-3-5	68.9	68.5	1.9				
N-3-5	70.1						
N-3-6	40.6						
N-3-6	41.7	41.6	0.9				
N-3-6	42.5						
N-3-7	41.7						
N-3-7	42.9	42.8	1.0				
N-3-7	43.7						
N-3-8	52.8						
N-3-8	54.6	54.3	1.4				
N-3-8	55.5						
N-3-9	61.7						
N-3-9	63.9	63.5	1.7				
N-3-9	65.0						
N-3-10	53.4						
N-3-10	55.1	54.9	1.4				
N-3-10	56.1						

Table.99: Analytical results for $SiO_2(g.kg^{-1})$-Yalu River

No.	SiO_2	average	SD	No.	SiO_2	average	SD
Y-1-1	266.3			Y-2-1	490.9		
Y-1-1	261.9	262.4	3.6	Y-2-1	476.6	479.1	10.8
Y-1-1	259.1			Y-2-1	469.8		
Y-1-2	685.3			Y-2-2	522.5		
Y-1-2	712.8	698.9	13.8	Y-2-2	545.1	532.8	11.5
Y-1-2	698.5			Y-2-2	530.9		
Y-1-3	775.0			Y-2-3	561.7		
Y-1-3	760.7	760.5	14.7	Y-2-3	547.4	549.2	11.7
Y-1-3	745.6			Y-2-3	538.6		
Y-1-4	689.7			Y-2-4	664.1		
Y-1-4	675.4	675.9	13.5	Y-2-4	649.8	650.6	13.1
Y-1-4	662.8			Y-2-4	638.0		
Y-1-5	771.3			Y-2-5	576.3		
Y-1-5	801.4	786.6	15.1	Y-2-5	600.6	587.8	12.2
Y-1-5	787.1			Y-2-5	586.3		

Table.100: Analytical results for $SiO_2(g.kg^{-1})$-Yalu River

No.	SiO_2	average	SD	No.	SiO_2	average	SD
Y-3-1	721.8			Y-4-1	626.4		
Y-3-1	707.5	707.8	13.9	Y-4-1	612.1	613.3	12.6
Y-3-1	694.0			Y-4-1	601.4		
Y-3-2	714.0			Y-4-2	682.3		
Y-3-2	742.4	728.2	14.2	Y-4-2	709.8	695.9	13.7
Y-3-2	728.1			Y-4-2	695.5		
Y-3-3	703.5			Y-4-3	716.1		
Y-3-3	689.2	689.7	13.6	Y-4-3	701.8	702.1	13.8
Y-3-3	676.3			Y-4-3	688.4		
Y-3-4	586.2			Y-4-4	709.1		
Y-3-4	571.9	573.5	12.0	Y-4-4	694.8	695.2	13.7
Y-3-4	562.3			Y-4-4	681.6		
Y-3-5	570.3			Y-4-5	709.6		
Y-3-5	594.5	581.7	12.1	Y-4-5	737.9	723.7	14.1
Y-3-5	580.2			Y-4-5	723.6		
				Y-4-6	779.1		
				Y-4-6	764.7	764.5	14.7
				Y-4-6	749.6		
				Y-4-7	481.3		
				Y-4-7	502.8	490.9	10.9
				Y-4-7	488.5		
				Y-4-8	612.4		
				Y-4-8	598.1	599.5	12.4
				Y-4-8	587.8		

Table.101: Analytical results for SiO_2($g.kg^{-1}$)-Bielahong River

No.	SiO_2	average	SD	No.	SiO_2	average	SD
B-1-1	535.3			B-2-1	325.8		
B-1-1	521.0	523.1	11.3	B-2-1	318.5	320.2	5.0
B-1-1	512.9			B-2-1	316.3		
B-1-2	664.5			B-2-2	318.5		
B-1-2	659.6	664.4	4.8	B-2-2	318.5	318.3	0.3
B-1-2	669.1			B-2-2	318.0		
B-1-3	670.6			B-2-3	317.4		
B-1-3	697.7	683.9	13.6	B-2-3	434.2	393.4	65.9
B-1-3	683.4			B-2-3	428.6		
B-1-4	472.1			B-2-4	384.0		
B-1-4	457.8	460.5	10.5	B-2-4	402.5	391.6	9.7
B-1-4	451.5			B-2-4	388.3		
B-1-5	678.3			B-2-5	407.2		
B-1-5	705.7	691.8	13.7	B-2-5	392.9	396.2	9.8
B-1-5	691.4			B-2-5	388.5		
B-1-6	776.5			B-2-6	428.9		
B-1-6	762.2	761.9	14.7	B-2-6	414.6	417.7	10.0
B-1-6	747.1			B-2-6	409.6		
				B-2-7	621.5		
				B-2-7	621.8	621.8	0.4
				B-2-7	622.2		
				B-2-8	615.4		
				B-2-8	601.1	602.4	12.4
				B-2-8	590.7		
				B-2-9	602.4		
				B-2-9	627.5	614.4	12.6
				B-2-9	613.2		

Table.102: Analytical results for $SiO_2(g.kg^{-1})$-Bielahong River

No.	SiO_2	average	SD	No.	SiO_2	average	SD
B-3-1	304.1						
B-3-1	296.9	298.7	4.7				
B-3-1	295.2						
B-3-2	284.2						
B-3-2	276.9	279.0	4.5				
B-3-2	275.9						
B-3-3	473.5						
B-3-3	494.7	482.9	10.8				
B-3-3	480.4						
B-3-4	641.4						
B-3-4	627.1	628.1	12.8				
B-3-4	615.9						
B-3-5	612.4						
B-3-5	637.8	624.6	12.7				
B-3-5	623.5						

Table.103: Analytical results for $SiO_2(g.kg^{-1})$-Naoli River

No.	SiO_2	average	SD	No.	SiO_2	average	SD
N-1-1	502.7			N-2-1	231.7		
N-1-1	488.4	490.8	10.9	N-2-1	224.5	227.0	4.0
N-1-1	481.2			N-2-1	224.9		
N-1-2	512.1			N-2-2	179.3		
N-1-2	497.8	500.1	11.0	N-2-2	172.1	175.2	3.7
N-1-2	490.4			N-2-2	174.1		
N-1-3	479.9			N-2-3	244.0		
N-1-3	501.3	489.5	10.9	N-2-3	251.3	246.4	4.2
N-1-3	487.1			N-2-3	244.0		
N-1-4	603.2			N-2-4	241.7		
N-1-4	588.9	590.3	12.2	N-2-4	234.4	236.9	4.1
N-1-4	578.8			N-2-4	234.6		
N-1-5	590.7			N-2-5	196.3		
N-1-5	615.4	602.4	12.4	N-2-5	202.2	197.8	3.8
N-1-5	601.1			N-2-5	195.0		
N-1-6	775.9			N-2-6	183.2		
N-1-6	761.6	761.3	14.7	N-2-6	175.9	179.0	3.8
N-1-6	746.5			N-2-6	177.8		
N-1-7	577.5			N-2-7	389.6		
N-1-7	563.2	564.9	11.9	N-2-7	375.4	378.8	9.6
N-1-7	553.9			N-2-7	371.5		
N-1-8	591.0			N-2-8	608.6		
N-1-8	615.7	602.7	12.4	N-2-8	633.9	620.7	12.7
N-1-8	601.4			N-2-8	619.6		
N-1-9	517.8						
N-1-9	503.5	505.7	11.1				
N-1-9	495.9						
N-1-10	565.9						
N-1-10	589.8	577.1	12.1				
N-1-10	575.6						

Table.104: Analytical results for SiO_2($g.kg^{-1}$)-Naoli River

No.	SiO_2	average	SD	No.	SiO_2	average	SD
N-3-1	580.9						
N-3-1	566.6	568.2	11.9				
N-3-1	557.1						
N-3-2	614.5						
N-3-2	639.9	626.7	12.7				
N-3-2	625.6						
N-3-3	661.9						
N-3-3	647.6	648.4	13.1				
N-3-3	635.8						
N-3-4	866.3						
N-3-4	852.0	850.9	16.0				
N-3-4	834.3						
N-3-5	648.9	661.8	13.2				
N-3-5	675.4						
N-3-5	661.1						
N-3-6	438.9						
N-3-6	424.7	427.6	10.1				
N-3-6	419.4						
N-3-7	418.7						
N-3-7	438.3	427.0	10.1				
N-3-7	424.0						
N-3-8	521.4						
N-3-8	507.1	509.3	11.2				
N-3-8	499.4						
N-3-9	647.6						
N-3-9	633.3	634.3	12.9				
N-3-9	622.0						
N-3-10	555.5						
N-3-10	579.2	566.5	11.9				
N-3-10	564.9						

Executor

Chen Xin

Institute of Applied Ecology,

Chinese Academy of Sciences

P. O. Box 417

Shenyang 110016, CHINA

Phone: +86-24-83970318; Fax: +86-24-83970300