Supplementary materials

Table S1: Comparative Analysis of Trace Metal Flux Assessment Studies

Study	Site location	Weather conditions	Data source and Coverage period	Elements Studied	Methodology	
					Assessment of trace metals load	Assessment of sediment contamination
[73]	Wanshan watershed China	Sub-tropical humid	Primary data: Concentration of mercury in soil samples from a field campaign and from several studies carried out between 2003 and 2009. Secondary data: + Monthly rainfall data (from 2000 to 2010) +Thematic mapper (TM) (September 2009 and March 2010) + 10,000 scale digital elevation models	Mercury (Hg)	RUSLE and soil Hg concentration	No assessment of sediment contamination
[18]	The High Moulouya watershed Morrocco	Semi-arid	Primary data: + Concentrations of trace elements in water, soil, sediment and plants (Sampling campaign, December 2014)	Arsenic (As), Cadmium (Cd), Lead (Pb), Copper (Cu) and Zinc (Zn)	no assessment of trace metal flows in the river	+ Comparison with established thresholds + Evaluation of sediment contamination by indices (Geo-accumulation, Potential ecological risk and sediment quality guidelines + Statistical analysis
[11]	Beiluo River watershed China	moderate continental monsoon	Primary data: + Concentrations of elements by soil types, obtained from the Chinese soil database. Secondary data: + Daily rainfall data (from 2009 to 2018) + Map of soil types, Digital Elevation Model (DEM), and Vegetation Index (from the year 2018)	+Particulate nitrogen (PN) +Particulate phosphorus (PP)	RUSLE and soil PN/PP concentration	No assessment of sediment contamination
[42]	Ranau watershed Malaysia	equatorial mountain	Primary data: + Concentrations of trace elements in soil, paddy soil and rice grains (Sampling campaign, April 2019) + Concentrations of elements in soil (no details provided) Secondary data: + Average annual rainfall (no details provided) + Map of Vegetation Index extracted from Landsat 8 images (2020)	Cobalt (Co), Chromium (Cr), Nickel (Ni), Lead (Pb), Copper (Cu), Zinc (Zn)	RUSLE and soil trace element concentrations	Comparison with established thresholds and Pearson correlation between soil erosion and trace metal concentrations

			+ Digital Elevation Model from the ASTER Satellite (30-meter resolution)			
This study	The High Moulouya watershed Morrocco	Semi-arid	Primary data: + Concentration of trace elements in sediment (Sampling campaign, March 2022) + Granulometry of soil particles (March 2022) + Trace metal concentrations in soil (provided by the study of [27] Secondary data: + Monthly rainfall data (from 1997 to 2019) + Map of Vegetation Index extracted from Landsat 8 images (2019) + Digital Elevation Model from the ASTER Satellite (30-meter resolution) + Map of soil composition collected from the International Soil Reference and Information Centre (ISRIC) database (2021)	Cadmium (Cd), Lead (Pb), Copper (Cu) and Zinc (Zn	RUSLE and soil trace element concentrations	+ Comparison with established thresholds + Evaluation of sediment contamination by indices (Geo-accumulation, Pollutant load index and sediment quality guidelines + Statistical analysis

Table S2: Geo-accumulation index classification

Igeo class	sediment quality	Igeo index
6	extremely contaminated	Igeo ≥ 5
5	Strongly to extremely contaminated	4 ≤ Igeo < 5
4	strongly contaminated	3 ≤ *I*geo < 4
3	Moderately to strongly contaminated	2 ≤ *I*geo < 3
2	moderately contaminated	1 ≤ Igeo < 2
1	un-contaminated to moderately contaminated	0 ≤ *Igeo* < 1
0	un-contaminates	*Igeo* < 0

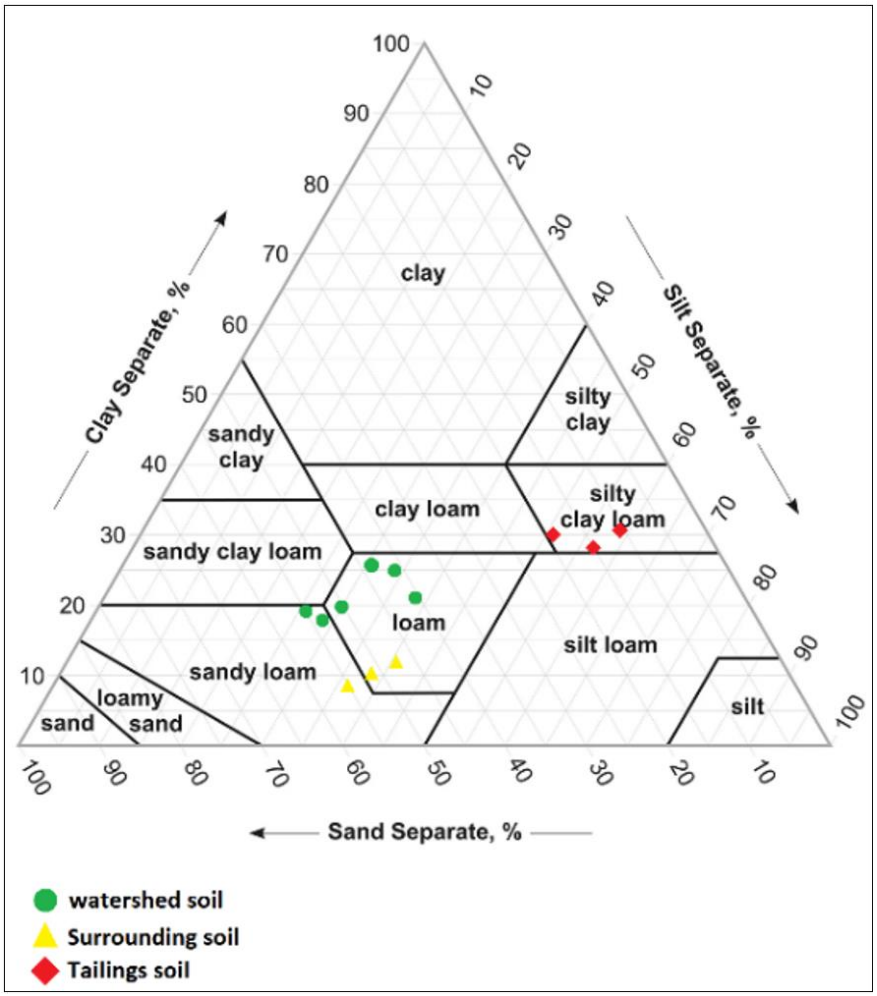

Figure S3: Texture triangle for the mine tailings, surrounding soil, and Upper Moulouya watershed

Table S4: Soil erosion and Lead migration flux under various land use types

Land use	Steppe	Cropland	Urban	Bare land	Forest
Area (ha)	53100	11400	60	44100	13000
Average Pb loading rate (g/ha/yr)	55,33	23,37	820,9	222	1,91
Annual soil erosion by land use (%)	52	4.5	0.5	21	22

Table S5: Variation of physicochemical parameters, pH, EC and CaCO3% in the sediments

	Minimum	Maximum	Median	Mean	SD
pH	8,12	9,3	8,5	8,61	0,42
CaCO3 (%)	19,96	36,5	34.1	32,4	5,04
EC (µs/cm)	156	853	417	468	245

SD: Standard deviation.

Table S6: Average traces metals concentrations in the tree mine tailings at Zaida abandoned mine (mg/kg)

	Cd	Cu	Pb	Zn
Mean concentration in tailings (mg/kg)	2,6	63	4822,9	112,7

Table S7: Comparison of Sampling Points Relative to PEC and TEC Values

	Cd	Cu	Pb	Zn
TEC (mg/kg)	0,99	31,6	35,8	121
PEC (mg/kg)	4,98	149	128	459
≤TEC (%)	0	90	40	90
TEC ~ PEC (%)	100	10	40	10
>PEC (%)	0	0	20	0

Table S8: Shapiro-Wilk test for physicochemical parameters, chemical elements, and trace metals

	P-value	W statistic	Distribution
pH	0.4014	0.9234	Normal
Caco3%	0.01313	0.7864	Non-normal
EC	0.4658	0.9296	Normal
Cd	0.1781	0.8913	Normal
Cu	0.8045	0.9569	Normal
Pb	0.05218	0.8434	Normal
Zn	0.2993	0.9115	Normal
Fe	0.676	0.9469	Normal
Mn	0.201	0.8959	Normal
Na	0.2174	0.899	Normal
K	0.6356	0.9438	Normal
Mg	0.7715	0.9543	Normal
Al	0.6993	0.9487	Normal
Ca	0.4962	0.9323	Normal