![frontiers]

Supplementary Material: A gardener's influence on urban soil quality

1 SUPPLEMENTARY TABLES AND FIGURES

1.1 Figures

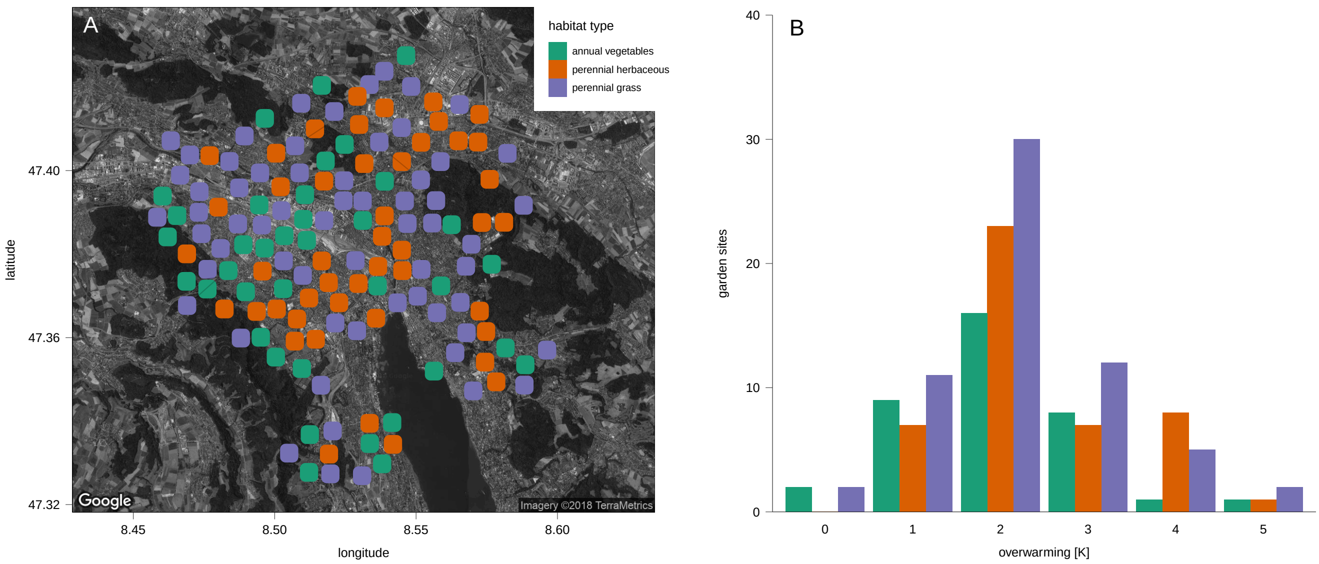

Figure S1: Urban gardens habitat types analysed in the city of Zurich (85 urban gardens x 2 sampling sites per garden). Colours correspond to the garden habitat types. Right: Density map of the urbanization gradient according to the three garden habitat types. The urbanization gradient is represented in this study by a regional climate model with local deviation of mean night temperatures near surface from 0 to + 6 K (Parlow et al., 2010).

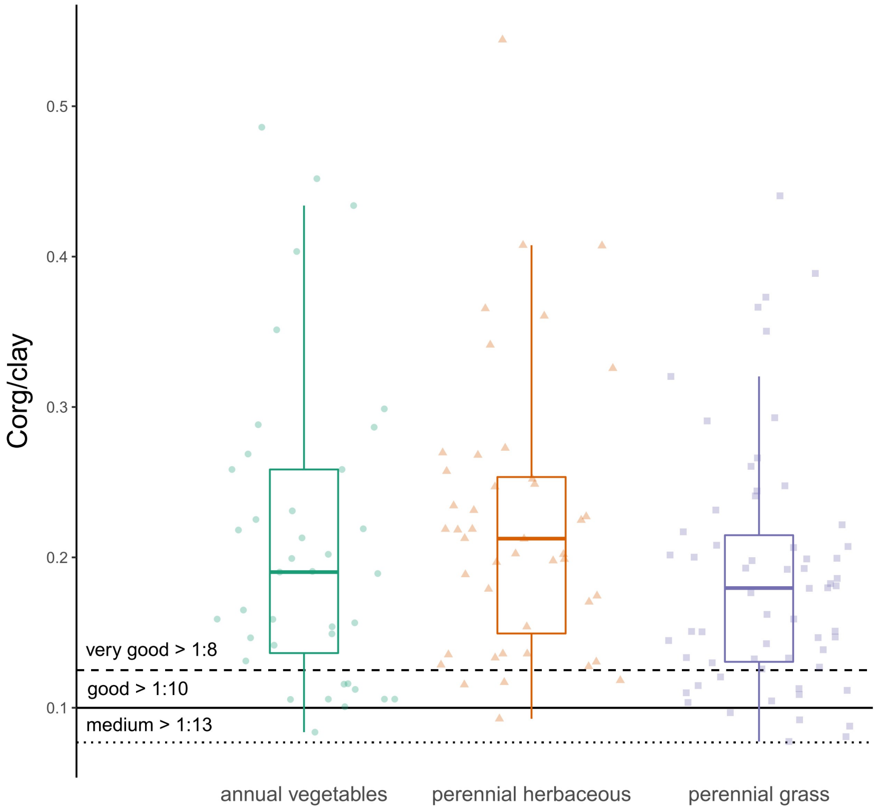

Figure S2: Structural soil quality defined as the ratio of C_{org}/clay of urban gardens of Zurich. Colours correspond to the main garden habitat types (annual vegetables N=39, perennial herbaceous N=44 and perennial grass N=62). Threshold values as defined by Johannes et al. (2017).

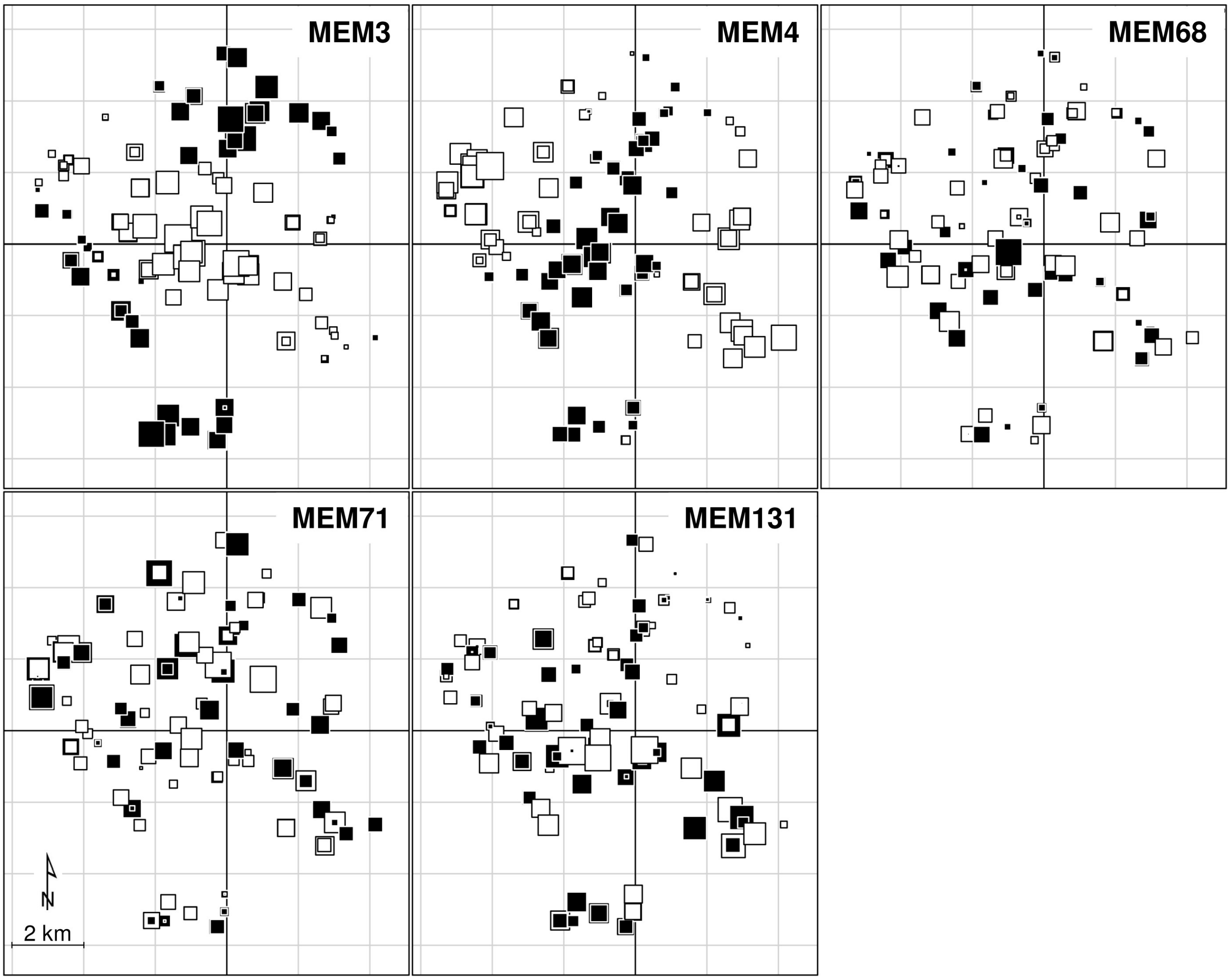

Figure S3: Moran eigenvector maps (MEM) illustrating spatial correlation and similarity of soil quality measurements (SQM). Increasing size of the symbols correspond to increasing positive values in black and increasing negative values in white, of the eigenvector (Hawkins et al., 2007).

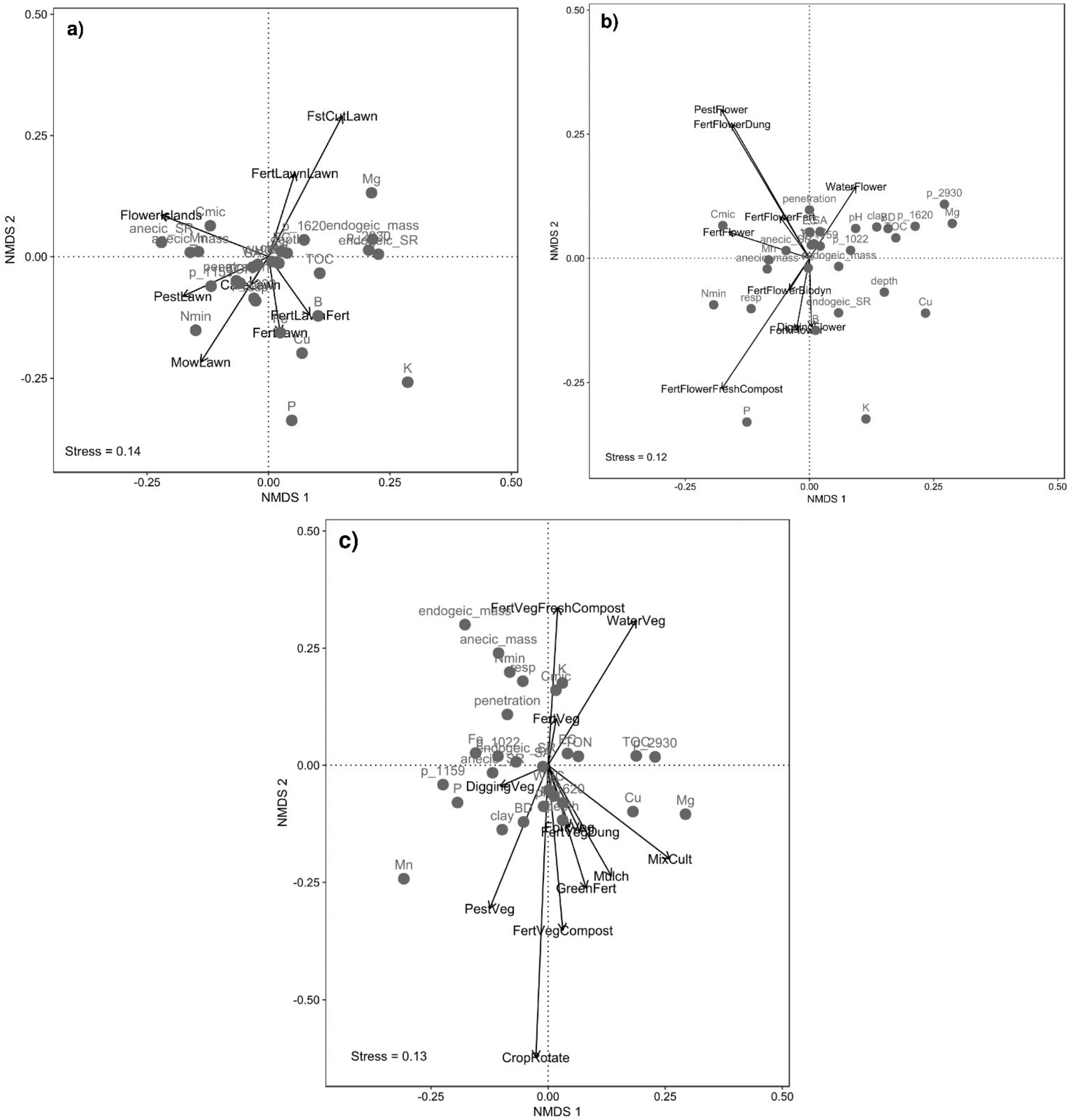

Figure S4: NMDS ordination of soil quality measurements with fitted garden management variables (NMDS habitat). Total data set was divided into sites consisting of a) lawn (N=62), b) herbaceous (N=46) and c) vegetables (N=37).

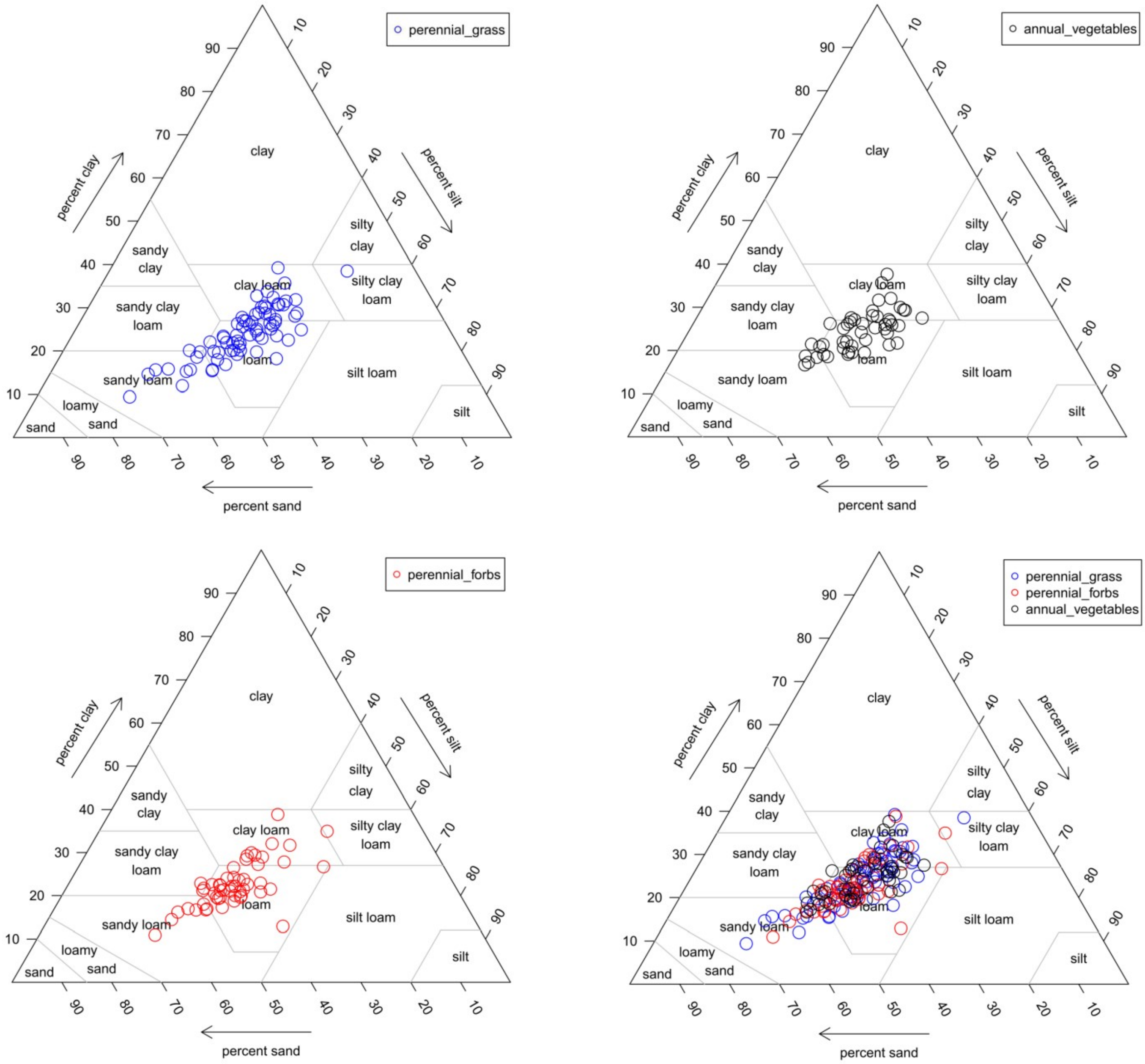

Figure S5: Soil texture according to USDA classification. Perennial grass N=71, Perennial herbaceous N=52, Annual vegetables N=47.

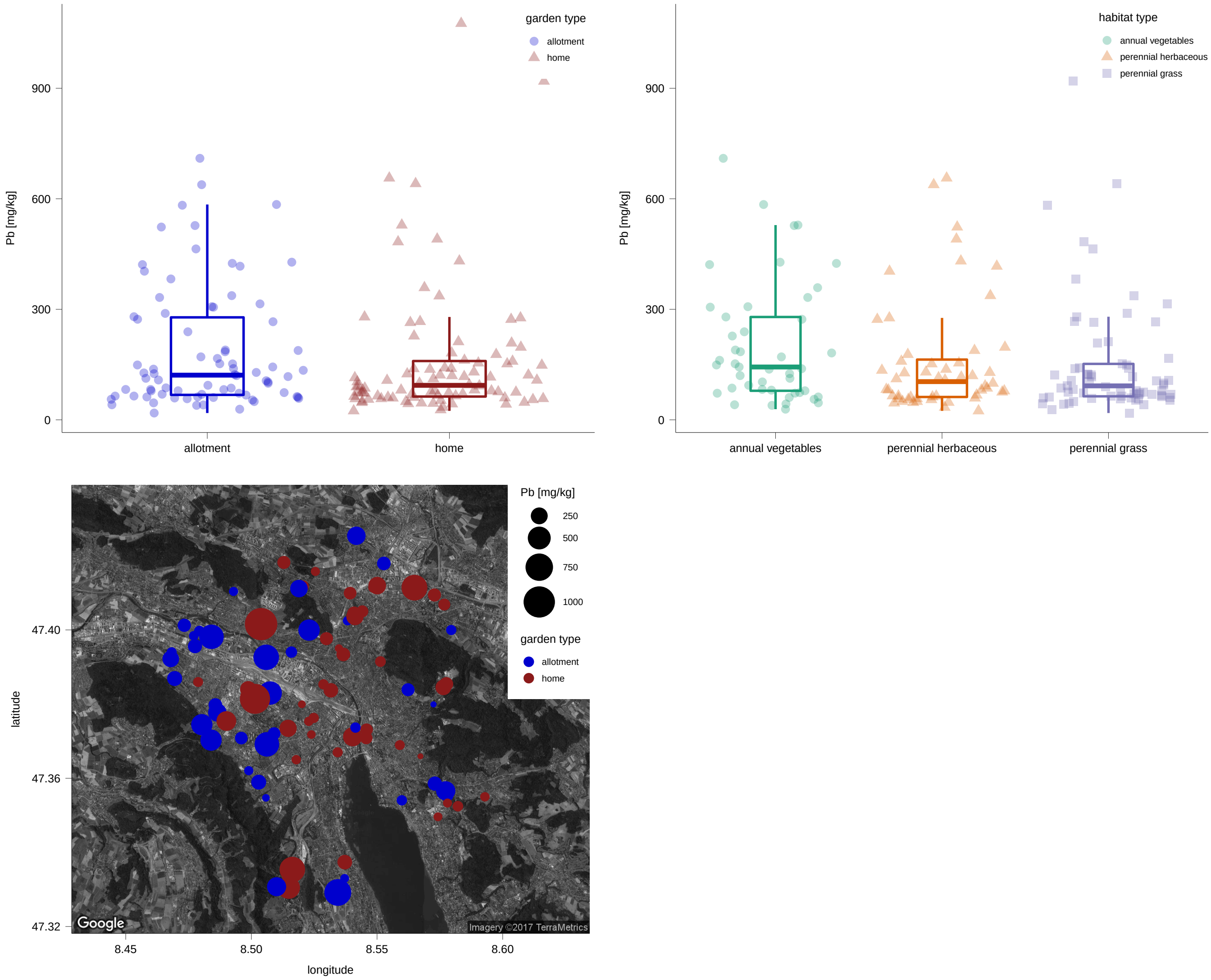

Figure S6: Distribution of Pb concentrations [mg/kg] measured with XRF technique. Boxplots on the left show concentrations per garden type and on the right per urban garden habitat type. Garden types: allotment N = 40, home = 44. Habitat types: perennial grass N = 70, perennial herbaceous N = 52, annual vegetables N = 46.

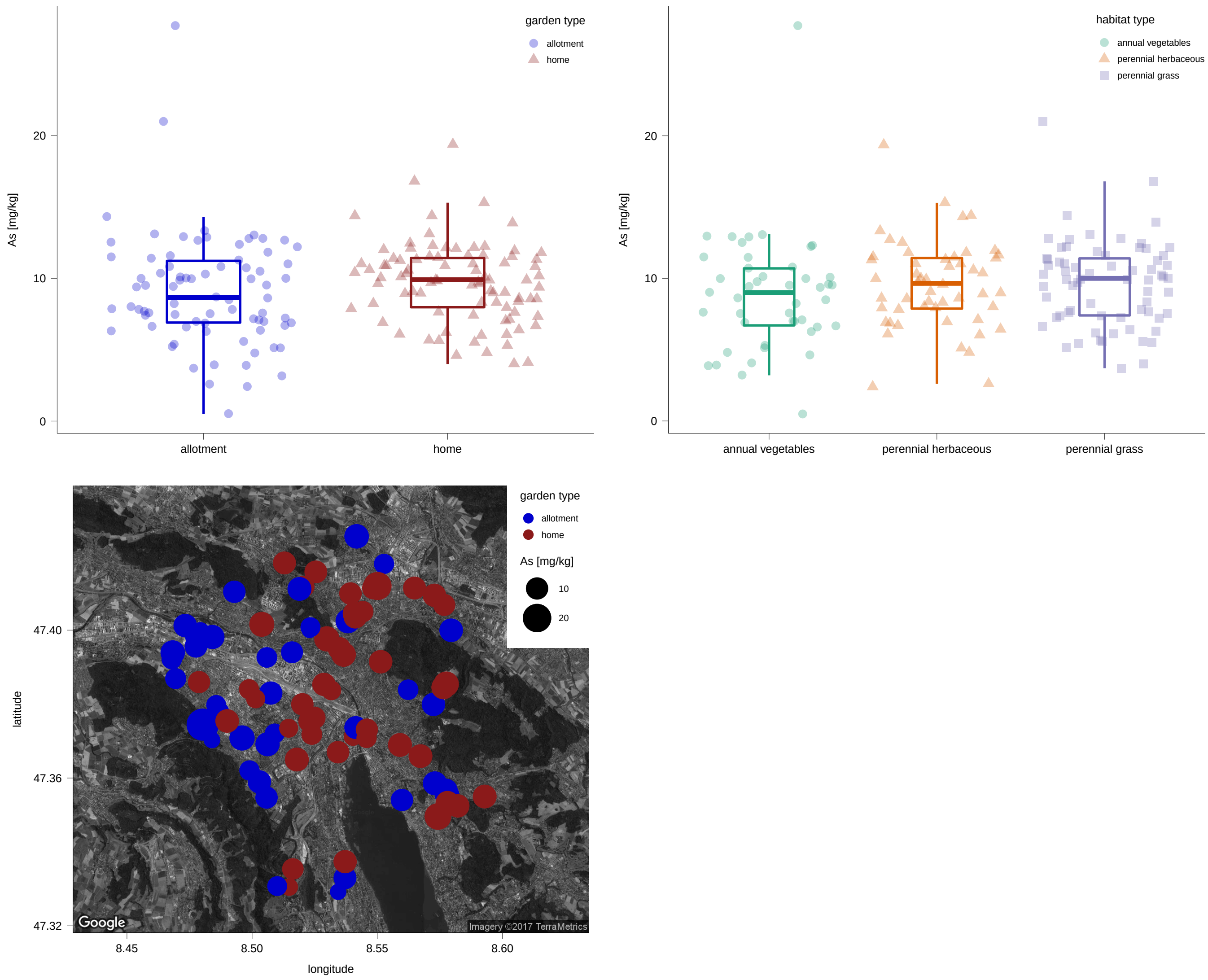

Figure S7: Distribution of As concentrations [mg/kg] measured with XRF technique. Boxplots on the left show concentrations per garden type and on the right per urban garden habitat type. Garden types: allotment N = 40, home = 44. Habitat types: perennial grass N = 70, perennial herbaceous N = 52, annual vegetables N = 46.

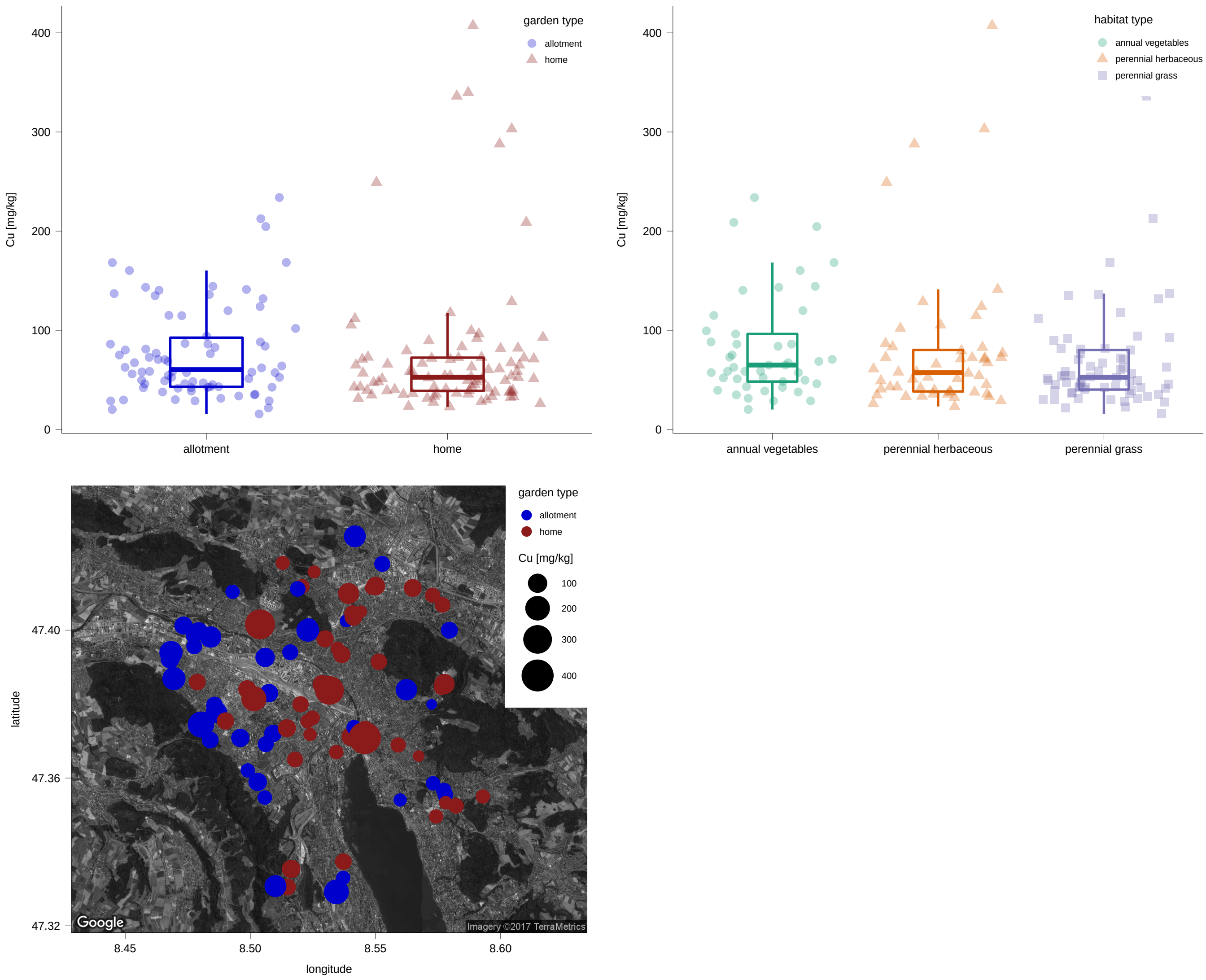

Figure S8: Distribution of Cu concentrations [mg/kg] measured with XRF technique. Boxplots on the left show concentrations per garden type and on the right per urban garden habitat type. Garden types: allotment N = 40, home = 44. Habitat types: perennial grass N = 70, perennial herbaceous N = 52, annual vegetables N = 46.

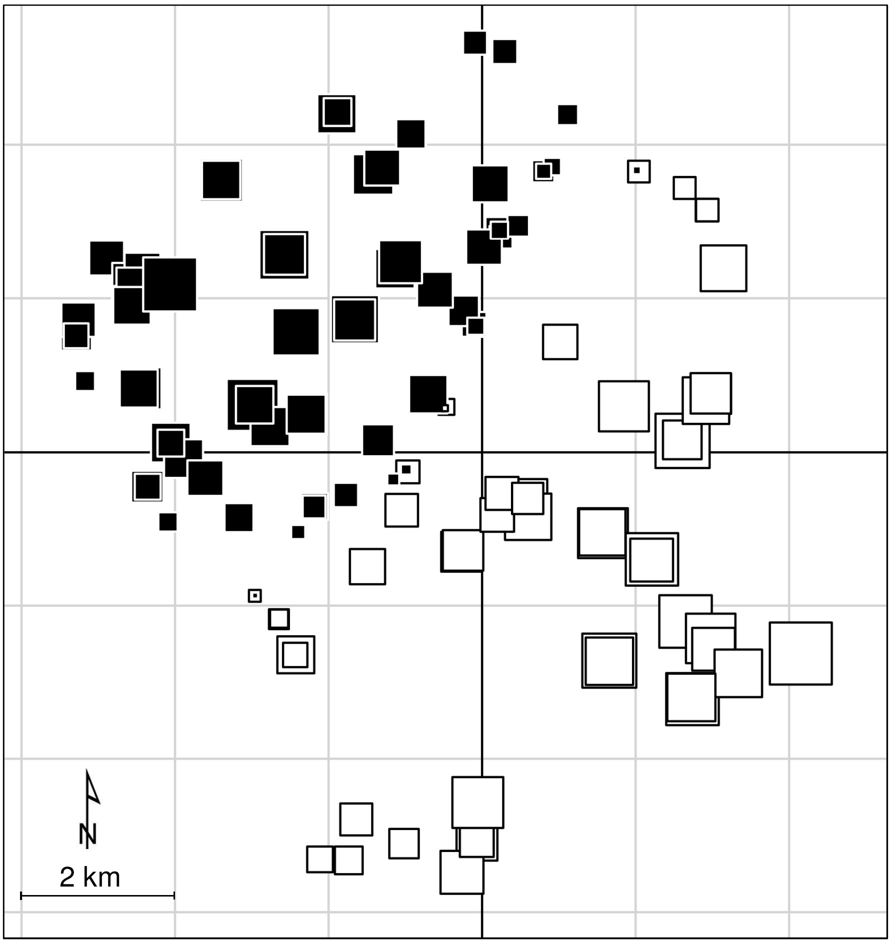

Figure S9: Moran eigenvector map (MEM) 2, which was a significant variable in the PERMANOVA with heavy metals as response variables (S5). Increasing size of the symbols correspond to increasing positive values in black and increasing negative values in white, of the eigenvector (Hawkins et al., 2007).

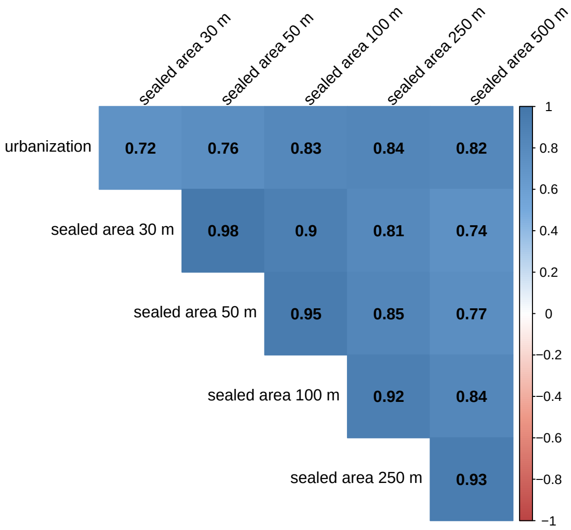

Figure S10: Pearson correlation matrix of sealed area around each garden (N = 85) and the variable 'overwarming', which stands for the urbanisation density in this study. 'Overwarming' is a measure of the local deviation of average night temperatures near surface in the city of Zurich. It is derived from a regional climate model by Parlow et al. (2010) and consists of six categories from 0 to + 6 K.

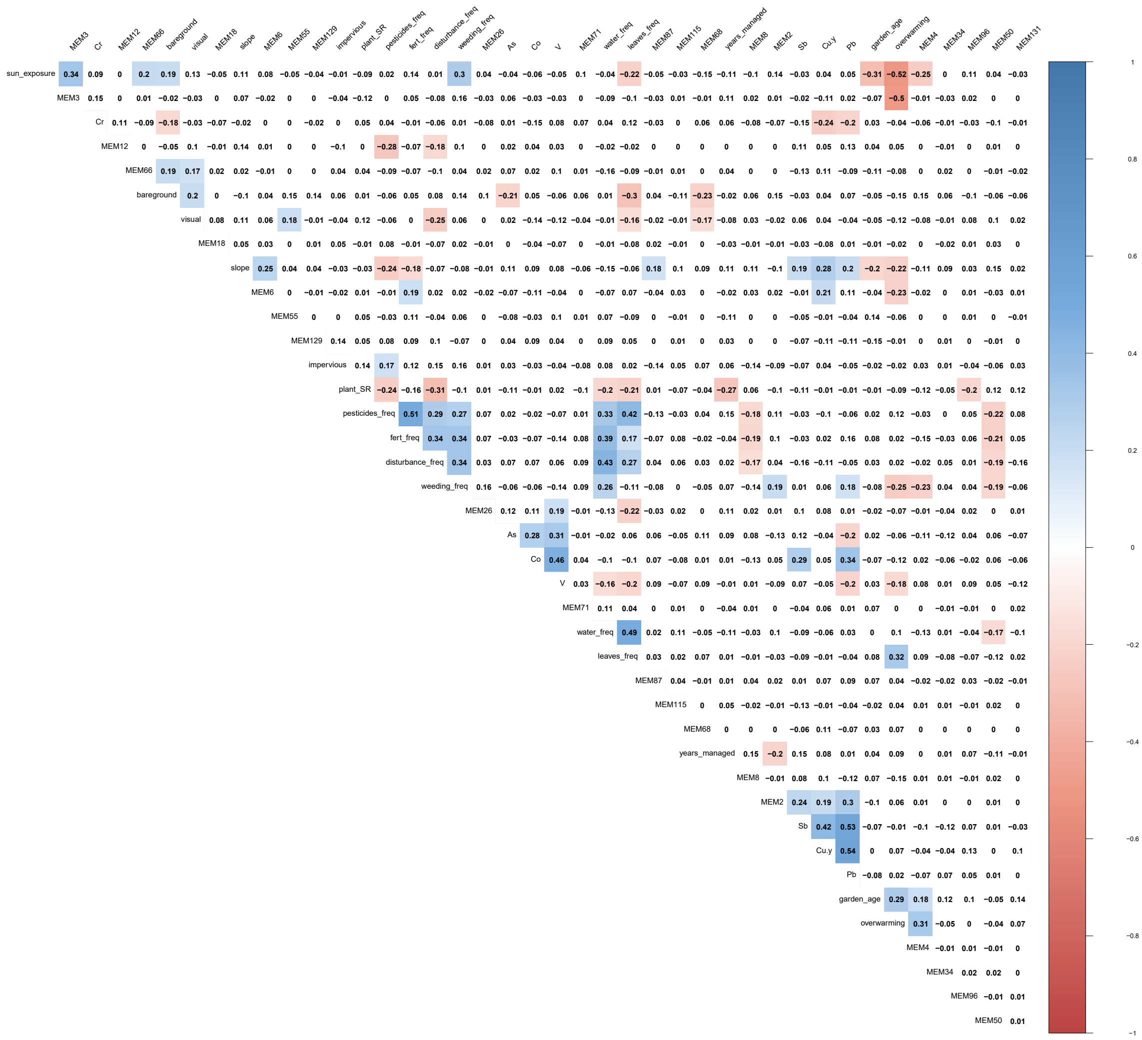

Figure S11: Pearson correlation matrix of all variables after variables selection approach, used for assessing its impact on the soil quality ordination. Variance inflation factor (VIF) < 3.9.

Table S1. Goodness of fit statistic of soil quality measurements on NMDS ordination. Calculated with 10000 permutations. Values are ordered according to the pseudo squared correlation coefficient R^2 and printed in bold type if $p \leq 0.05$.

	R^2	P-value
Mg	0.63	< **0.001**
P	0.49	< **0.001**
C_{mic}	0.42	< **0.001**
Fe	0.37	< **0.001**
p_1159	0.32	< **0.001**
K	0.31	< **0.001**
pH	0.26	< **0.001**
p_2930	0.21	< **0.001**
SA	0.19	< **0.001**
B	0.19	< **0.001**
penetration	0.17	< **0.001**
Mn	0.16	< **0.001**
BD	0.13	< **0.001**
resp	0.11	< **0.001**
N_{min}	0.11	< **0.001**
C_{org}	0.10	< **0.001**
p_1620	0.10	< **0.001**
p_1022	0.09	< **0.001**
Cu	0.07	**0.01**
endogeic_SR	0.07	**0.01**
EC	0.06	**0.02**
anecic_M	0.05	**0.03**
depth	0.04	**0.05**
endogeic_M	0.04	**0.05**
WHC	0.03	0.16
anecic_SR	0.02	0.21
TON	0.01	0.64
clay	0.00	0.88

1.2 Tables

Table S2. Permutational multivariate analysis of variance (PERMANOVA) analysis on Euclidean distance matrix of soil quality measurements as response matrix and selected management and garden characteristic variables as predictors, calculated with 10000 permutations.

	Df	F Model	R^2	P	
Management					
visual	1	0.6	0.01	0.67	
pesticides	1	0.9	0.01	0.45	
pesticides_freq	1	6.4	0.03	< 0.001	***
compost	1	6	0.03	< 0.001	***
fert_freq	1	2.4	0.01	0.05	*
water	1	0.3	0.01	0.88	
water_freq	1	0.8	0.01	0.53	
disturbance	1	2.2	0.01	0.07	
disturbance_freq	1	1	0.01	0.4	
weeding_freq	1	0.9	0.01	0.45	
leaves_freq	1	2.2	0.01	0.07	
Garden characteristics					
overwarming	1	10.4	0.04	< 0.001	***
habitat	2	10.3	0.09	< 0.001	***
garden_type	1	7.6	0.03	< 0.001	***
slope	1	5.3	0.02	< 0.001	**
soil_texture	4	1.1	0.02	0.31	
bare soil	1	2.7	0.01	0.04	*
impervious	1	0.6	0.01	0.66	
plant_SR	1	1.5	0.01	0.21	
sun_exposure	1	1.5	0.01	0.2	
garden_age	1	1.4	0.01	0.23	
years_managed	1	1.7	0.01	0.14	
aspect	2	4.5	0.04	< 0.001	***
former_landuse	3	1.8	0.02	0.05	
history	2	3.2	0.03	< 0.001	**
Heavy metals					
Pb	1	1.7	0.01	0.14	
V	1	0.6	0.01	0.65	
Sb	1	0.9	0.01	0.44	
As	1	7.5	0.03	< 0.001	***
Co	1	1.4	0.01	0.22	
Cu	1	3	0.01	0.02	*
Spatial structure					
MEM2	1	1.2	0.01	0.29	
MEM3	1	2.4	0.01	0.06	
MEM4	1	3.1	0.01	0.02	*
MEM6	1	1	0.01	0.37	
MEM8	1	0.4	0.01	0.85	
MEM12	1	1.9	0.01	0.11	
MEM18	1	0.5	0.01	0.72	
MEM26	1	2	0.01	0.09	
MEM34	1	0.8	0.01	0.49	
MEM50	1	1.1	0.01	0.32	
MEM55	1	1.2	0.01	0.3	
MEM66	1	1.1	0.01	0.37	
MEM68	1	3.2	0.01	0.02	*
MEM71	1	3.2	0.01	0.02	*
MEM87	1	2	0.01	0.09	
MEM96	1	1.3	0.01	0.26	
MEM115	1	1.3	0.01	0.26	
MEM129	1	2.3	0.01	0.06	
MEM131	1	3.6	0.02	0.01	*
Residuals	86		0.36		

Table S3. Pearson correlation coefficients of selected garden management questions and soil quality measurements.

	Perennial herbaceous		**Annual vegetables**		**Perennial lawn**	
	FertFlowerFreshCompost		CropRotate		FstCutLawn	
	r	P	r	P	r	P
Physical						
clay	0.05	0.76	0.25	0.13	0.06	0.63
WHC	0.04	0.78	-0.07	0.68	-0.23	0.07
BD	-0.03	0.87	0.28	0.09	**0.28**	**0.03**
penetration	-0.2	0.2	**-0.65**	$<$**0.001**	0	1
depth	0.18	0.25	0.02	0.9	-0.17	0.19
SA	0.07	0.64	-0.32	0.05	-0.19	0.14
Chemical						
pH	-0.19	0.22	-0.05	0.78	0.02	0.87
EC	0.03	0.83	-0.31	0.06	-0.21	0.1
P	**0.31**	**0.04**	0.13	0.45	**-0.26**	**0.04**
K	0.22	0.16	-0.28	0.08	-0.13	0.33
Mg	-0.1	0.52	0.11	0.53	0.12	0.37
Fe	0	0.99	-0.24	0.14	**-0.29**	**0.02**
Cu	-0.17	0.28	**-0.39**	**0.02**	-0.03	0.83
Mn	0.29	0.06	0.29	0.08	-0.22	0.09
B	0.09	0.54	0.11	0.49	-0.21	0.1
Biological						
resp	0.09	0.58	**-0.46**	**0.01**	-0.07	0.57
C_{mic}	0.24	0.11	**-0.45**	**0.01**	-0.13	0.3
N_{min}	0.13	0.39	-0.17	0.31	-0.15	0.26
anecic_SR	0.08	0.61	0.16	0.35	0.02	0.88
anecic_M	**0.36**	**0.02**	-0.01	0.97	-0.1	0.46
endogeic_SR	-0.02	0.91	-0.08	0.65	-0.06	0.63
endogeic_M	-0.13	0.39	-0.24	0.15	0.02	0.88
SOM						
C_{org}	-0.07	0.64	-0.2	0.23	-0.01	0.94
TON	0.1	0.54	0.02	0.92	-0.21	0.11
p_1159	0.1	0.5	-0.1	0.56	-0.21	0.1
p_1620	-0.12	0.45	-0.31	0.06	0.19	0.13
p_1022	-0.03	0.84	**-0.36**	**0.03**	-0.06	0.62
p_2930	-0.21	0.17	**-0.42**	**0.01**	0.14	0.29

Table S4. Goodness of fit statistic of garden management questions fitted on a ordination of soil quality measurements (NMDS habitat). Calculated with 10000 permutations. Values are ordered according to the squared correlation coefficient R^2. Data set of N = 170 was divided into sites consisting of a) perennial lawn (N = 62), b) perennial herbaceous (N = 44) and c) annual vegetables (N = 39).

a) Garden habitat perennial lawn		
Garden management question	R^2	P
FstCutLawn	0.11	**0.04**
MowLawn	0.07	0.14
FlowerIslands	0.06	0.18
PestLawn	0.04	0.33
FertLawnLawn	0.03	0.38
FertLawn	0.02	0.48
FertLawnFert	0.02	0.53
CareLawn	0	0.87

b) Garden habitat perennial herbaceous		
Garden management question	R^2	P
PestFlower	0.12	**0.05**
FertFlowerFreshCompost	0.1	0.11
FertFlowerDung	0.1	0.13
WaterFlower	0.03	0.55
FertFlower	0.03	0.55
DiggingFlower	0.02	0.68
ForkFlower	0.02	0.64
FertFlowerFert	0.01	0.8
FertFlowerBiodyn	0.01	0.89

c) Garden habitat annual vegetables		
Garden management question	R^2	P
CropRotate	0.39	<**0.001**
WaterVeg	0.13	0.09
FertVegCompost	0.12	0.09
PestVeg	0.11	0.13
MixCult	0.11	0.13
FertVegFreshCompost	0.11	0.13
GreenFert	0.08	0.25
Mulch	0.07	0.26
ForkVeg	0.02	0.71
FertVegDung	0.02	0.65
FertVeg	0.01	0.83
DiggingVeg	0.01	0.8

Table S5. Permutational multivariate analysis of variance of heavy metals (PERMANOVA HM) as response matrix (Euclidean distance matrix) and selected garden characteristics and management variables see PERMANOVA in table S2. Calculated with 10000 permutations.

	Df	F Model	R^2	P	
Management					
visual	1	0.7	0.01	0.49	
pesticides	1	1.7	0.01	0.18	
pesticides_freq	1	1.4	0.01	0.24	
compost	1	1.8	0.01	0.17	
fert_freq	1	4.5	0.02	0.02	*
water	1	2.4	0.01	0.1	
water_freq	1	0.3	0.01	0.75	
disturbance	1	0.5	0.01	0.58	
disturbance_freq	1	1.4	0.01	0.23	
weeding_freq	1	4.9	0.03	0.02	*
leaves_freq	1	6.5	0.04	0.01	**
Garden characteristics					
overwarming	1	2.3	0.01	0.1	
habitat	2	0.7	0.01	0.59	
garden_type	1	0.6	0.01	0.52	
slope	1	4.4	0.02	0.02	*
soil_texture	4	1.2	0.03	0.29	
bare soil	1	0.4	0.01	0.63	
impervious	1	0.5	0.01	0.59	
plant_SR	1	0.2	0.01	0.78	
sun_exposure	1	0.2	0.01	0.82	
garden_age	1	0.6	0.01	0.51	
years_managed	1	0.3	0.01	0.74	
aspect	2	0.7	0.01	0.58	
former_landuse	3	2.9	0.05	0.02	*
history	2	1.2	0.01	0.29	
Spatial structure					
MEM2	1	10.3	0.06	< 0.001	***
MEM3	1	1.7	0.01	0.18	
MEM4	1	0.3	0.01	0.76	
MEM6	1	0.2	0.01	0.76	
MEM8	1	0.4	0.01	0.64	
MEM12	1	1.5	0.01	0.22	
MEM18	1	0	0.01	0.97	
MEM26	1	1	0.01	0.36	
MEM34	1	4.3	0.02	0.05	
MEM50	1	0.8	0.01	0.43	
MEM55	1	0.4	0.01	0.65	
MEM66	1	2.7	0.02	0.07	
MEM68	1	2.8	0.02	0.07	
MEM71	1	0.4	0.01	0.62	
MEM87	1	0.4	0.01	0.62	
MEM96	1	1.5	0.01	0.22	
MEM115	1	0.2	0.01	0.77	
MEM129	1	3.9	0.02	0.05	
MEM131	1	0.7	0.01	0.5	
Residuals	92		0.51		

Table S6. Descriptive statistics of total heavy metal concentrations in urban garden sites (N = 145). Values are in mg kg^{-1}, measured on XRF device.

a) All garden sites N = 145

	mean	se	min	max	range
Sb	1.9	0.4	0.4	39.1	38.7
As	9.4	0.3	0.5	27.7	27.2
Co	31.6	0.4	18.3	45.4	27.1
Cu	77.3	4.9	15.6	339.7	324.1
Pb	179.1	15.0	18.5	1076.0	1057.5
V	79.4	1.3	44.1	117.9	73.8

b) Perennial lawn N = 62

	mean	se	min	max	range
Sb	1.8	0.6	0.4	39.1	38.7
As	9.6	0.4	3.7	21.0	17.3
Co	31.0	0.6	21.4	43.8	22.4
Cu	72.6	7.8	15.6	339.7	324.1
Pb	175.0	25.7	18.5	1076.0	1057.5
V	79.9	2.0	44.1	117.9	73.8

c) Perennial herbaceous N = 46

	mean	se	min	max	range
Sb	2.5	0.9	0.4	33.0	32.6
As	8.9	0.7	0.5	27.7	27.2
Co	31.3	0.7	21.2	40.6	19.4
Cu	85.0	9.0	20.1	233.9	213.8
Pb	195.5	27.5	28.9	709.8	680.9
V	75.7	2.2	50.6	105.6	55.0

d) Annual vegetables N = 37

	mean	se	min	max	range
Sb	1.6	0.3	0.5	11.9	11.4
As	9.5	0.5	2.4	19.4	17.0
Co	32.6	0.7	18.3	45.4	27.1
Cu	77.4	9.0	23.1	303.1	280.0
Pb	171.5	24.0	24.4	656.3	631.9
V	81.7	2.3	51.9	112.2	60.3

e) Allotment gardens N = 69

	mean	se	min	max	range
Sb	1.6	0.2	0.4	9.8	9.4
As	9.1	0.5	0.5	27.7	27.2
Co	30.8	0.6	21.2	40.6	19.4
Cu	79.2	6.0	15.6	233.9	218.3
Pb	185.0	20.0	18.5	709.8	691.3
V	77.1	1.8	44.1	116.4	72.3

f) Home gardens N = 76

	mean	se	min	max	range
Sb	2.2	0.7	0.4	39.1	38.7
As	9.7	0.3	4.0	19.4	15.4
Co	32.3	0.5	18.3	45.4	27.1
Cu	75.6	7.8	22.7	339.7	317.0
Pb	173.8	22.2	24.4	1076.0	1051.6
V	81.5	1.7	51.9	117.9	66.0

Table S7. a) Pearson correlation of heavy metal (HM) variables and selected indices of soil quality as well as variables from PERMANOVA (S5; p <0.05).Rooibos and green tea values are mean decomposition values measured with the TBI (tea bag index). b) Pearson correlation of heavy metal (HM) variables and earthwors including ecological groups. SR = species richness, M = earthworm biomass, r = pearson correaltion coefficient.

a)	C_{mic}/C_{org}		qCO_2		C_{org}/clay		rooibos_tea		green_tea		fert_freq		MEM2		slope	
	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p
Sb	-0.02	0.81	0.03	0.75	0.00	1.00	0.11	0.20	-0.02	0.83	-0.03	0.75	0.24	**0.01**	0.19	**0.02**
As	-0.10	0.22	0.05	0.54	0.03	0.69	-0.07	0.41	-0.06	0.45	-0.03	0.76	-0.13	0.13	0.11	0.2
Co	-0.02	0.81	0.02	0.77	0.00	0.96	-0.04	0.62	-0.12	0.17	-0.07	0.39	0.05	0.54	0.09	0.27
Cu	-0.01	0.89	0.07	0.40	-0.00	1.00	-0.00	0.96	0.01	0.88	0.02	0.81	0.19	**0.02**	0.28	**0.01**
Pb	0.02	0.79	0.09	0.28	-0.02	0.78	0.02	0.77	-0.05	0.57	0.16	**0.05**	0.30	**0.01**	0.20	**0.02**
V	0.11	0.20	-0.16	0.06	-0.14	0.09	-0.04	0.62	-0.07	0.44	-0.14	0.09	-0.09	0.29	0.08	0.33

b)	earthworms_SR		earthworms_M		endogeic_SR		endogeic_M		anecic_SR		anecic_M		epigeic_SR		epigeic_M	
	r	p	r	p	r	p	r	p	r	p	r	p	r	p	r	p
Sb	-0.05	0.53	-0.04	0.62	-0.04	0.62	0.02	0.81	0.02	0.81	-0.06	0.48	-0.27	0.20	-0.12	0.59
As	0.07	0.41	0.07	0.44	0.07	0.44	0.13	0.12	0.13	0.12	0.02	0.84	-0.11	0.62	0.15	0.48
Co	-0.12	0.14	-0.15	0.08	-0.15	0.08	-0.10	0.23	-0.10	0.23	-0.13	0.11	-0.16	0.45	0.10	0.63
Cu	-0.09	0.30	-0.05	0.56	-0.05	0.56	-0.04	0.62	-0.04	0.62	-0.04	0.67	-0.40	**0.05**	-0.20	0.35
Pb	-0.15	0.08	-0.09	0.30	-0.09	0.30	-0.07	0.38	-0.07	0.38	-0.07	0.41	-0.29	0.18	0.04	0.87
V	0.05	0.51	-0.02	0.81	-0.02	0.81	-0.07	0.43	-0.07	0.43	0.01	0.92	-0.08	0.72	-0.19	0.38

Table S8. Pearson correlation of community composition of earthworms and variables from PERMANOVA (S2; p <0.05).SR = species richness, M = earthworm biomass, r = pearson correaltion coefficient, η^2 = Effect size for categorical variables see Bakeman (2005).

a) Management	pesticides_freq		compost		fert_freq	
	r	p	η^2	p	r	p
anecic_SR	0.12	0.15	0.00	0.58	0.04	0.60
anecic_M	0.01	0.95	0.01	0.38	0.09	0.28
endogeic_SR	0.02	0.82	0.03	**0.04**	0.09	0.28
endogeic_M	0.06	0.44	0.02	0.06	0.14	0.10
epigeic_mass	-0.12	0.58	0.05	0.31	0.13	0.54
epigeic_SR	-0.15	0.47	0.02	0.46	-0.26	0.21
EW_SR	0.08	0.33	0.02	0.10	0.09	0.29
EW_mass	0.03	0.71	0.02	0.14	0.13	0.12

b) Garden	overwarming		habitat		garden_type		slope		bare soil		aspect		history	
characteristics	r	p	η^2	p	η^2	p	r	p	r	p	η^2	p	η^2	p
anecic_SR	-0.05	0.57	0.05	**0.03**	0.01	0.36	-0.06	0.45	0.14	0.09	0.00	0.99	0.00	0.72
anecic_M	-0.05	0.56	0.01	0.55	0.00	0.73	-0.10	0.24	-0.02	0.8	0.01	0.49	0.00	0.77
endogeic_SR	-0.14	0.08	0.06	**0.01**	0.02	0.10	-0.00	0.98	0.18	**0.03**	0.02	0.24	0.03	0.15
endogeic_M	-0.07	0.41	0.12	$<$ **0.001**	0.01	0.19	-0.08	0.34	0.24	$<$ **0.001**	0.00	0.90	0.05	**0.02**
epigeic_mass	-0.12	0.59	0.09	0.39	0.03	0.42	0.24	0.25	-0.27	0.2	0.01	0.68	0.17	0.14
epigeic_SR	0.08	0.70	0.07	0.47	0.00	0.93	0.04	0.84	-0.04	0.84	0.06	0.24	0.02	0.83
EW_SR	-0.10	0.22	0.06	**0.02**	0.02	0.10	-0.05	0.54	0.20	**0.02**	0.01	0.47	0.01	0.39
EW_mass	-0.07	0.44	0.02	0.31	0.00	0.80	-0.11	0.18	0.07	0.38	0.01	0.67	0.02	0.24

c) Spatial	MEM4		MEM68		MEM71		MEM131	
structure	r	p	r	p	r	p	r	p
anecic_SR	0.17	**0.05**	0.09	0.29	0.14	0.11	0.11	0.19
anecic_M	0.03	0.71	0.02	0.85	0.02	0.84	0.07	0.42
endogeic_SR	-0.08	0.36	-0.07	0.38	-0.03	0.69	-0.09	0.27
endogeic_M	0.03	0.75	-0.11	0.19	-0.00	1.00	-0.05	0.59
epigeic_mass	0.07	0.76	0.26	0.22	-0.09	0.67	0.12	0.59
epigeic_SR	0.24	0.25	0.38	0.06	-0.36	0.09	0.23	0.27
EW_SR	0.04	0.63	0.03	0.75	0.02	0.84	0.00	0.95
EW_mass	0.04	0.66	-0.03	0.76	0.01	0.89	0.04	0.65

d) SQ indices	C_{mic}/C_{org}		qCO_2		C_{org}/clay		rooibos_tea		green_tea	
& TBI	r	p	r	p	r	p	r	p	r	p
anecic_SR	0.09	0.27	0.01	0.88	-0.01	0.89	-0.03	0.76	-0.14	0.10
anecic_M	0.13	0.13	-0.01	0.93	-0.04	0.61	0.15	0.08	-0.03	0.71
endogeic_SR	-0.10	0.23	0.22	**0.01**	0.01	0.93	0.10	0.23	-0.03	0.77
endogeic_M	-0.11	0.17	0.25	**0.01**	0.10	0.25	0.11	0.21	-0.05	0.54
epigeic_mass	0.15	0.50	0.09	0.67	0.04	0.84	0.20	0.35	0.17	0.44
epigeic_SR	-0.39	0.06	-0.20	0.34	0.34	0.10	-0.08	0.71	-0.16	0.47
EW_SR	-0.05	0.55	0.17	**0.04**	0.02	0.79	0.09	0.32	-0.09	0.28
EW_mass	0.06	0.49	0.09	0.27	0.00	0.96	0.17	**0.05**	-0.04	0.61

Table S9. Pearson correlation of tea bag index and soil quality indices versus variables from PERMANOVA (S2; p <0.05).SR = species richness, M = earthworm biomass, r = pearson correaltion coefficient, η^2 = Effect size for categorical variables see Bakeman (2005).

a) Management	pesticides_freq		compost		fert_freq	
	r	p	η^2	p	r	p
C_{mic}/C_{org}	0.13	0.12	0.01	0.19	0.08	0.36
qCO_2	0.04	0.59	0.05	<**0.001**	0.09	0.28
C_{org}/clay	0.01	0.94	0.00	0.59	0.13	0.11
rooibos_tea	-0.02	0.85	0.01	0.33	0.16	0.06
green_tea	0.07	0.44	0.00	0.94	0.10	0.24

b) Garden	overwarming		habitat		garden_type		slope		bare soil		aspect		history	
characteristics	r	p	η^2	p	η^2	p	r	p	r	p	η^2	p	η^2	p
C_{mic}/C_{org}	-0.11	0.19	0.16	<**0.001**	0.06	<**0.001**	-0.04	0.67	-0.35	<**0.001**	0.02	0.22	0.00	0.91
qCO_2	0.05	0.59	0.15	<**0.001**	0.07	<**0.001**	-0.05	0.52	0.36	<**0.001**	0.01	0.59	0.05	**0.02**
C_{org}/clay	0.25	<**0.001**	0.04	0.07	0.00	0.85	-0.07	0.39	0.09	0.27	0.03	0.08	0.04	0.07
rooibos_tea	0.11	0.21	0.00	0.88	0.01	0.18	0.04	0.61	-0.07	0.43	0.00	0.89	0.01	0.58
green_tea	0.20	**0.02**	0.05	**0.03**	0.00	0.58	-0.13	0.13	-0.17	**0.05**	0.07	**0.01**	0.04	0.06

c) Spatial	MEM4		MEM68		MEM71		MEM131	
structure	r	p	r	p	r	p	r	p
C_{mic}/C_{org}	-0.12	0.15	0.15	0.07	0.21	0.01	-0.06	0.51
qCO_2	-0.05	0.52	-0.20	**0.01**	-0.03	0.71	0.18	**0.03**
C_{org}/clay	0.17	**0.05**	0.05	0.57	-0.06	0.51	0.21	**0.01**
rooibos_tea	0.06	0.49	-0.08	0.36	-0.08	0.38	0.15	0.09
green_tea	0.03	0.69	-0.02	0.83	-0.03	0.76	-0.01	0.95

d) SQ indices	C_{mic}/C_{org}		qCO_2		C_{org}/clay		rooibos_tea		green_tea	
& TBI	r	p	r	p	r	p	r	p	r	p
C_{mic}/C_{org}	1.00	<**0.001**	-0.42	<**0.001**	-0.50	<**0.001**	-0.03	0.75	0.09	0.29
qCO_2	-0.42	<**0.001**	1.00	<**0.001**	0.24	<**0.001**	0.15	0.07	0.11	0.22
C_{org}/clay	-0.50	<**0.001**	0.24	<**0.001**	1.00	<**0.001**	0.06	0.46	0.12	0.15
rooibos_tea	-0.03	0.75	0.15	0.07	0.06	0.46	1.00	<**0.001**	0.03	0.70
green_tea	0.09	0.29	0.11	0.22	0.12	0.15	0.03	0.70	1.00	<**0.001**

Table S10. Assessment of urban garden management questions. Questions were originally asked in German for the 85 participating gardeners.

PestLawn How often do you use pesticeds, fungicides or herbicides to protect your lawn? Never (1) Less than once per year (2) 1 to 3 times per year (3) 4 to 10 times per year (4) More than 10 times per year (5)	**PestFlower** How often do you use pesticeds, fungicides or herbicides (without slug pellets) to protect your flowers? Never (1) Less than once per year (2) 1 to 3 times per year (3) 4 to 10 times per year (4) More than 10 times per year (5)	**PestVeg** How often do you use pesticeds, fungicides or herbicides (without slug pellets) to protect your vegetables? Never (1) Less than once per year (2) 1 to 3 times per year (3) 4 to 10 times per year (4) More than 10 times per year (5)
FertLawnCompost Do you use compost or plant slurry for your lawn? (0/1)	**FertVegCompost** Do you use compost or plant slurry for your vegetables? (0/1)	**FertVegFreshCompost** Do you use fresh compost (less than 1 year old) or plant slurry for your vegetables? (0/1)
FertLawn How often do you use fertilizers for your lawn? Never (0) 4 to 5 years (1) 2 to 3 years (2) once a year (3) More than once a year (4)	**FertVeg** How often do you use fertilizers for your vegetables? Never (0) 2 to 3 years (1) Once a year (2) 2 to 3 per year (3) More than three per year (4)	**FertFlower** How often do you use fertilizers for your flowers? Never (0) 2 to 3 years (1) Once a year (2) 2 to 3 per year (3) More than three per year (4)
Weeds How often do you remove most of the weeds in your garden? Never (1) Rarely (2) Sometimes (3) Often (4) Very often (5)	**PestTrees** How often do you use insecticides, fungicides or herbicides to protect our trees and shrubs? Never (1) Less than once a year (2) 1 to 3 times per year (3) 4 to 10 times per year (4) More than 10 times per year (5)	**Leaves** How often do you remove most of the leaves in your garden? Never (1) Spring (2) Autumn (3) Every 2 to 3 weeks (4) Weekly in autumn (5)
FertFlowerCompost Do you use compost or plant slurry for your flowers? (0/1)	**FertFlowerFreshCompost** Do you use fresh compost (less than 1 year old) or plant slurry for your flowers? (0/1)	**WeedingHerbicide** Do you use commercial herbicides? (0/1)

WaterLawn
How often do you water your lawn?

Never (1)
When dry (2)
once a week (3)
twice a week (4)
More than twice a week (5)

WaterVeg
How often do you water your vegetable beds?
Never (1)
When dry (2)
once a week (3)
twice a week (4)
More than twice a week (5)

WaterFlower
How often do you water your flower beds?
Never (1)
When dry (2)
once a week (3)
twice a week (4)
More than twice a week (5)

CareLawn
How often do you scarify your lawn (including reseeding)
Never (1)
6 to 10 years (2)
4 to 5 years (3)
2 to 3 years (4)
Annually (5)

DiggingFlower
How often do you till your soil in the flower beds?
Never (1)
3 years or less (2)
Every two years (3)
Once per year (4)
More than once per year (5)

DiggingVeg
How often do you till your soil in the vegetable beds?
Never (1)
3 years or less (2)
Every two years (3)
Once per year (4)
More than once per year (5)

DrySticks
Do you leave withered flowers and sticks during the winter in your garden?
Always (1)
Mostly (2)
Sometimes (3)
Rarely (4)
Never (5)

FstCutLawn
When is the first time point of cutting your lawn?

April (1)
May (2)
Start June (3)
End June (4)
After June (5)

Mulch
Do you use organic material (mulch) to cover your vegetable beds?

Never (1)
Rarely (2)
Sometimes (3)
Mostly (4)
Always (5)

MowLawn
How often do you mow your lawn?
1 to 2 (1)
3 to 4 (2)
5 to 8 (3)
9 to 20 (4)
over 20 (5)

Table S11. Least square means calculation from linear mixed effect models. Fixed effects are garden type (allotment and home), habitat type (annual vegetables, perennial herbaceous, perennial grass) and clustering classification (1-3). Garden identity was set as random factor and significance level alpha = 0.05.

	home			allotment			grass			herbaceous			vegetables			clustering 1			clustering 2			clustering 3		
	lsmean	se		lsmean	se		lsmean	se		lsmean	se		lsmean	se		lsmean	se		lsmean	se		lsmean	se	
Physical																								
clay $[\%]$	23.77	0.78	a	24.20	0.79	a	24.64	0.74	a	23.17	0.79	a	24.16	0.87	a	23.16	0.82	a	24.51	0.84	a	24.28	0.94	a
WHC $[\%]$	0.80	0.02	a	0.83	0.02	a	0.81	0.02	a	0.82	0.02	a	0.81	0.02	a	0.83	0.02	a	0.83	0.02	a	0.78	0.02	a
BD $[gcm^{-3}]$	1.09	0.02	a	1.09	0.02	a	1.02	0.02	a	1.11	0.02	b	1.14	0.02	b	1.05	0.02	a	1.08	0.02	ab	1.14	0.02	b
penetration $[MPa]$	1.50	0.07	b	1.26	0.07	a	1.68	0.07	c	1.40	0.07	b	1.06	0.08	a	1.41	0.07	a	1.43	0.07	a	1.31	0.08	a
depth $[cm]$	42.16	2.72	a	46.89	2.79	a	42.24	2.38	a	42.93	2.51	a	48.41	2.68	a	42.54	2.62	a	44.30	2.68	a	46.75	3.00	a
SA $[\%]$	83.62	1.16	a	81.07	1.17	a	85.11	1.16	b	81.47	1.26	ab	80.47	1.40	a	85.68	1.27	b	84.29	1.32	b	77.07	1.45	a
Chemical																								
pH	7.32	0.03	b	7.21	0.03	a	7.22	0.03	a	7.29	0.03	a	7.28	0.04	a	7.26	0.03	ab	7.17	0.04	a	7.36	0.04	b
EC $[\mu Scm^{-1}]$	189.90	5.19	a	177.45	5.19	a	182.04	5.26	a	184.24	5.73	a	184.74	6.39	a	196.04	5.73	b	182.46	5.96	ab	172.52	6.51	a
P $[mgkg^{-1}]$	183.60	12.09	a	201.54	12.18	a	157.14	11.82	a	177.96	12.76	a	242.61	14.08	b	140.37	12.97	a	267.65	13.43	b	169.68	14.82	a
K $[mgkg^{-1}]$	174.09	14.63	a	174.16	14.49	a	146.65	15.47	a	166.60	16.98	ab	209.12	19.15	b	122.85	16.58	a	230.26	17.37	b	169.26	18.74	a
Mg $[mgkg^{-1}]$	532.93	20.97	a	526.28	21.35	a	511.03	19.34	a	533.24	20.61	a	544.54	22.32	a	472.47	21.34	a	469.17	21.94	a	647.18	24.45	b
Fe $[mgkg^{-1}]$	367.15	13.99	a	372.85	14.26	a	349.15	12.86	a	370.04	13.69	ab	390.81	14.82	b	356.94	14.19	a	423.72	14.58	b	329.34	16.26	a
Cu $[mgkg^{-1}]$	27.02	4.34	a	39.18	4.53	a	29.68	3.32	a	33.91	3.38	ab	35.69	3.45	b	34.29	3.47	ab	37.09	3.50	b	27.91	3.74	a
Mn $[mgkg^{-1}]$	289.60	15.73	a	290.25	16.18	a	297.26	13.58	a	277.52	14.25	a	295.00	15.12	a	307.46	14.89	b	311.17	15.20	b	251.14	16.97	a
B $[mgkg^{-1}]$	1.34	0.09	a	1.52	0.09	a	1.14	0.08	a	1.39	0.09	b	1.76	0.10	c	1.25	0.09	a	1.64	0.10	b	1.40	0.11	ab
Biological																								
basal respiration $[\mu gCO_2 - Cg^{-1}h^{-1}]$	0.25	0.01	a	0.24	0.01	a	0.22	0.01	a	0.24	0.02	ab	0.27	0.02	b	0.24	0.01	a	0.30	0.02	b	0.20	0.02	a
C_{mic} $[mgkg^{-1}]$	807.17	30.81	a	761.94	31.03	a	806.43	30.21	a	778.02	32.64	a	769.21	36.03	a	960.21	33.14	c	780.52	34.32	b	612.93	37.85	a
N_{mic} $[mgkg^{-1}]$	140.66	6.02	a	131.43	6.07	a	141.31	5.84	a	136.74	6.29	a	130.09	6.93	a	172.69	6.42	c	132.60	6.64	b	102.84	7.34	a
N_{min} $[mgkg^{-1}]$	1.65	0.15	a	1.85	0.15	a	1.68	0.15	a	1.82	0.16	a	1.75	0.18	a	1.93	0.17	b	2.02	0.17	b	1.30	0.19	a
anecic_SR $[ind.m^{-2}]$	1.17	0.12	a	1.38	0.12	a	0.97	0.12	a	1.48	0.13	b	1.38	0.15	ab	1.50	0.13	a	1.25	0.13	a	1.08	0.15	a
anecic_M $[gm^{-2}]$	7.81	0.84	a	7.91	0.84	a	7.15	0.88	a	8.72	0.96	a	7.70	1.07	a	8.73	0.94	a	8.22	0.99	a	6.63	1.07	a
endogeic_SR $[ind.m^{-2}]$	1.74	0.17	a	1.89	0.17	a	1.55	0.17	a	1.70	0.18	ab	2.19	0.21	b	1.63	0.18	a	1.90	0.19	a	1.90	0.21	a
endogeic_M $[gm^{-2}]$	3.57	0.38	a	3.49	0.37	a	2.69	0.39	a	2.79	0.43	a	5.10	0.49	b	3.17	0.42	a	4.33	0.44	a	3.10	0.48	a
epigeic_SR $[ind.m^{-2}]$	0.71	0.17	a	0.86	0.17	a	0.72	0.15	a	1.07	0.22	a	0.56	0.19	a	0.56	0.18	a	0.56	0.15	a	1.23	0.25	a
epigeic_M $[gm^{-2}]$	2.57	1.53	a	5.59	1.56	a	4.36	1.44	a	6.45	2.06	a	1.44	1.83	a	3.11	1.70	a	3.66	1.42	a	5.47	2.41	a
earthworm_SR $[ind.m^{-2}]$	3.01	0.23	a	3.37	0.24	a	2.63	0.24	a	3.30	0.26	ab	3.64	0.29	b	3.21	0.26	a	3.27	0.27	a	3.09	0.29	a
earthworm_M $[gm^{-2}]$	126.80	11.45	a	127.38	11.38	a	109.90	11.90	a	128.87	13.01	a	142.50	14.61	a	132.98	12.84	a	139.96	13.41	a	108.32	14.55	a
earthworm_abundance $[gm^{-2}]$	227.23	22.84	a	250.65	22.64	a	199.95	24.12	a	190.58	26.47	a	326.29	29.85	b	221.23	25.88	a	266.64	27.10	a	228.95	29.25	a
SOM																								
C_{org} $[\%]$	4.75	0.23	a	4.85	0.24	a	4.55	0.21	a	4.93	0.23	a	4.92	0.25	a	4.42	0.24	a	4.86	0.24	a	5.13	0.27	a
TON $[\%]$	0.33	0.02	a	0.35	0.02	a	0.32	0.01	a	0.33	0.02	a	0.36	0.02	a	0.34	0.02	a	0.36	0.02	a	0.31	0.02	a
p_1620 $[A.U.cm^{-1}]$	0.34	0.01	a	0.32	0.01	a	0.35	0.01	a	0.34	0.01	a	0.31	0.01	a	0.31	0.01	a	0.31	0.01	a	0.37	0.01	b
p_1022 $[A.U.cm^{-1}]$	1.16	0.05	a	1.24	0.05	a	1.35	0.05	b	1.25	0.06	b	1.00	0.06	a	1.20	0.06	a	1.26	0.06	a	1.14	0.06	a
p_2930 $[A.U.cm^{-1}]$	0.94	0.04	a	0.89	0.04	a	0.90	0.04	a	0.96	0.04	a	0.88	0.05	a	0.82	0.04	a	0.88	0.04	a	1.04	0.05	b
Soil quality indices																								
C_{mic}/C_{org} $[\%]$	1.87	0.09	a	1.72	0.09	a	2.00	0.08	b	1.72	0.09	a	1.67	0.10	a	2.31	0.09	c	1.73	0.09	b	1.35	0.10	a
qCO_2 $[\mu gCO_2 - Cg^{-1}h^{-1}C_{mic}^{-1}h^{-1}]$	0.31	0.01	a	0.33	0.01	a	0.29	0.01	a	0.31	0.01	ab	0.36	0.02	b	0.25	0.01	a	0.39	0.01	c	0.32	0.02	b
C_{org}/clay	0.21	0.01	a	0.21	0.01	a	0.19	0.01	a	0.22	0.01	a	0.22	0.01	a	0.20	0.01	a	0.21	0.01	a	0.23	0.02	a
TBI																								
green tea decomposition	0.59	0.01	a	0.59	0.01	a	0.60	0.01	a	0.58	0.01	a	0.58	0.01	a	0.59	0.01	a	0.58	0.01	a	0.58	0.01	a
rooibos tea decomposition	0.30	0.00	a	0.29	0.00	a	0.30	0.00	a	0.30	0.00	a	0.29	0.01	a	0.29	0.00	a	0.30	0.00	a	0.30	0.01	a
Heavy metals																								
Sb $[mgkg^{-1}]$	2.30	0.61	a	1.52	0.62	a	1.84	0.60	a	1.18	0.65	a	2.70	0.72	a	2.01	0.66	a	2.26	0.68	a	1.45	0.75	a
As $[mgkg^{-1}]$	9.75	0.52	a	9.10	0.54	a	9.84	0.43	a	9.23	0.45	a	9.20	0.47	a	9.21	0.47	a	9.58	0.48	a	9.49	0.53	a
Co $[mgkg^{-1}]$	32.53	0.65	a	30.87	0.65	a	31.30	0.64	a	32.26	0.69	a	31.55	0.77	a	31.04	0.70	a	31.91	0.73	a	32.16	0.80	a
Cu $[mgkg^{-1}]$	79.33	9.22	a	76.84	9.60	a	73.20	7.26	a	76.22	7.44	a	84.83	7.66	a	76.70	7.70	a	78.00	7.79	a	79.56	8.47	a
Pb $[mgkg^{-1}]$	171.94	26.30	a	179.84	26.94	a	173.82	23.40	a	169.34	24.73	a	184.51	26.48	a	175.39	25.77	a	178.21	26.40	a	174.08	29.49	a
V $[mgkg^{-1}]$	81.30	2.20	a	77.37	2.25	a	81.33	1.96	a	79.79	2.07	a	76.89	2.22	a	77.83	2.16	a	80.43	2.21	a	79.76	2.47	a

Table S12. Description of CO_2 flux measurements

Soil respiration was measured after pre-incubating 30 g of soil (dry matter equivalent) for 7 d at 20°C in 100 ml wide-neck DURAN glass bottles (Schott AG, Mainz, Germany). All samples of one series were kept in moist plastic boxes to avoid drying. Bottles were left open to allow soil aeration and only closed during CO_2 flux measurements. Soil moisture was readjusted if necessary by adding H_2O_{demin} until 40-50 % water holding capacity was reached. After re-wetting, we waited 24 hours until CO_2 flux measurements were performed. Bottles were gently vented with ambient air to produce defined initial conditions in the head-space, prior to each measurement. For CO_2 measurement, the bottles were sealed with a lid containing a rubber septum and placed on an auto sampler (MPS 2XL, Gerstel AG, Sursee, Switzerland), equipped with a temperature controlled tray at 20 ± 0.8°C. To avoid partial vacuum, 5 ml of He was injected into the head-space prior to each gas sampling. CO_2 concentrations in the head-space were analysed for by a gas chromatograph (7890A, Agilent Technologies, Santa Clara, CA) equipped with a flame ionization detector (FID). CO_2 calibration curves ($R^2 > 0.99$) were obtained by a threefold analysis of 3 standard gases (300, 2960 and 9000 ppm CO_2) before and after each measurement cycle. CO_2 flux calculations were based on the increase in CO_2 concentration in the head-space over 6 hours. The linearity of the enrichment was tested according to Krause et al. (2017).

Table S13. Description of soil organic matter characterisation

The biochemical composition and quality of soil organic matter (SOM) was characterized by diffuse reflectance Fourier transform mid-infrared spectroscopy (DRIFTS). Mid-infrared spectra of dried and ball milled soil samples were recorded according to Rasche et al. (2013). Each soil sample was analysed in triplicate from wavelengths 3950 to 650 cm-1 using solid, undiluted KBr as background. The obtained spectra were baseline corrected (OPUS version 7.0 Bruker Optik GmbH). Main functional groups of SOM compounds were calculated by peak area integration of particular spectral frequencies according to Rasche et al. (2014) & Demyan et al. (2012).

Table S14. Description of R packages used for various calculations.

Calculation	Description	Function	Package	Reference
Delaunay triangulation	Spatial matrix, representing the connections between the urban gardens	tri2nb	spdep	Bivand and Piras (2015)
MEM model selection	Selection with AICc	test.W	spacemakeR	Dray (2013)
PERMANOVA	Permutational multivariate analysis of variance	adonis	vegan	Oksanen et al. (2016)
Distance matrix selection	Selection of most appropriate distance matrix	rankindex	vegan	Oksanen et al. (2016)
NMDS	Nonmetric multidimensional scaling	metaMDS	vegan	Oksanen et al. (2016)
Cluster numbers	Optimal numbers of clusters	NbClust	NbClust	Charrad et al. (2014)
Fuzzy cluster analysis	Fuzzy cluster analysis	fanny	cluster	Maechler et al. (2017)
Variable fitting	Variable fitting on NMDS ordination	envfit	vegan	Oksanen et al. (2016)
LMEM	Linear mixed effect models	lmer	lme4	Bates et al. (2015)
CV	Coefficient of variation	cv	raster	van Etten (2012)
Least square means	Least square means comparison	cld & lsmeans	lsmeans	Lenth (2016)
Soil texture	Classification according to USDA taxonomy	soiltexture	soiltexture	Moeys (2016)
NMDS plots	Plotting NMDS plots	ggvegan	ggvegan	Simpson (2015)
MEM plots	Plotting MEM plots	s.value	ade4	Dray and Dufour (2007)
Maps	Spatial plots integrating google maps information	get_googlemap	ggmap	Kahle and Wickham (2013)
Plots	All other plots	ggplot2	ggplot2	Wickham (2009)
η^2	Effect size of categorical and numerical variables (η^2) Bakeman (2005)	etasq	heplots	Fox et al. (2007)
Bayesian inference	Bayesian inference posterior distributions with 95 % credible intervals (see Korner-Nievergelt et al. (2015))	sim	arm	Gelman and Su (2016)

REFERENCES

Bakeman, R. (2005). Recommended effect size statistics for repeated measures designs. *Behavior research methods* 37, 379–384

Bates, D., Mächler, M., Bolker, B., and Walker, S. (2015). Fitting Linear Mixed-Effects Models Using {lme4}. *Journal of Statistical Software* 67, 1–48. doi:10.18637/jss.v067.i01

Bivand, R. and Piras, G. (2015). Comparing Implementations of Estimation Methods for Spatial Econometrics. *Journal of Statistical Software* 63, 1–36

Charrad, M. M., Ghazzali, N., Boiteau, V., Niknafs, A., and Charrad, M. M. (2014). {NbClust}: An {R} Package for Determining the Relevant Number of Clusters in a Data Set. *Journal of Statistical Software* 61, 1–36

Demyan, M. S., Rasche, F., Schulz, E., Breulmann, M., Müller, T., and Cadisch, G. (2012). Use of specific peaks obtained by diffuse reflectance Fourier transform mid-infrared spectroscopy to study the composition of organic matter in a Haplic Chernozem. *European Journal of Soil Science* 63, 189–199. doi:10.1111/j.1365-2389.2011.01420.x

Dray, S. (2013). *spacemakeR: Spatial modelling*

Dray, S. and Dufour, A. B. (2007). The ade4 package: implementing the duality diagram for ecologists. *Journal of Statistical Software* 22, 1–20

Fox, J., Friendly, M., and Monette, G. (2007). Visual hypothesis tests in multivariate linear models: The heplots package for R. *DSC 2007: Directions in Statistical Computing*

Gelman, A. and Su, Y.-S. (2016). *arm: Data Analysis Using Regression and Multilevel/Hierarchical Models*

Hawkins, B. A., Diniz-Filho, J. A. F., Mauricio Bini, L., De Marco, P., and Blackburn, T. M. (2007). Red herrings revisited: spatial autocorrelation and parameter estimation in geographical ecology. *Ecography* 30, 375–384

Johannes, A., Matter, A., Schulin, R., Weisskopf, P., Baveye, P. C., and Boivin, P. (2017). Corrigendum to "Optimal organic carbon values for soil structure quality of arable soils. Does clay content matter?" [Geoderma 302 (2017) 14–21]. *Geoderma* 302, 111. doi:10.1016/j.geoderma.2017.05.009

Kahle, D. and Wickham, H. (2013). ggmap: Spatial Visualization with ggplot2. *The R Journal* 5, 144–161

Korner-Nievergelt, F., Roth, T., Von Felten, S., Guélat, J., Almasi, B., and Korner-Nievergelt, P. (2015). *Bayesian data analysis in ecology using linear models with R, BUGS, and Stan* (Academic Press)

Krause, H.-M., Thonar, C., Eschenbach, W., Well, R., Mäder, P., Behrens, S., et al. (2017). Long term farming systems affect soils potential for N 2 O production and reduction processes under denitrifying conditions. *Soil Biology and Biochemistry* 114, 31–41. doi:10.1016/j.soilbio.2017.06.025

Lenth, R. V. (2016). Least-Squares Means: The {R} Package {lsmeans}. *Journal of Statistical Software* 69, 1–33. doi:10.18637/jss.v069.i01

Maechler, M., Rousseeuw, P., Struyf, A., Hubert, M., and Hornik, K. (2017). *cluster: Cluster Analysis Basics and Extensions*

Moeys, J. (2016). *soiltexture: Functions for Soil Texture Plot, Classification and Transformation*

Oksanen, J., Blanchet, F., Kindt, R., Legendre, P., Minchin, P., O'hara, R., et al. (2016). vegan: Community Ecology Package. R package version 2.4-1

Parlow, E., Scherer, D., and Fehrenbach, U. (2010). *Klimaanalyse der Stadt Zürich (KLAZ) - Wissenschaftlicher Bericht*. Tech. rep.

Rasche, F., Marhan, S., Berner, D., Keil, D., Kandeler, E., and Cadisch, G. (2013). midDRIFTS-based partial least square regression analysis allows predicting microbial biomass , enzyme activities and 16S rRNA gene abundance in soils of temperate grasslands. *Soil Biology and Biochemistry* 57, 504–512. doi:10.1016/j.soilbio.2012.09.030

Rasche, F., Musyoki, M. K., Röhl, C., Muema, E. K., Vanlauwe, B., and Cadisch, G. (2014). Lasting influence of biochemically contrasting organic inputs on abundance and community structure of total and proteolytic bacteria in tropical soils. *Soil Biology and Biochemistry* 74, 204–213. doi:10.1016/j.soilbio.2014.03.017

Simpson, G. L. (2015). *ggvegan: 'ggplot2' Plots for the 'vegan' Package*

van Etten, R. J. H. &. J. (2012). *raster: Geographic analysis and modeling with raster data*

Wickham, H. (2009). *ggplot2: Elegant Graphics for Data Analysis* (Springer-Verlag New York)