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Principle Authors: M. K. Shukla and R. Lal

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ABSTRACT

This research project is aimed at assessing the soil organic carbon (SOC) sequestration potential of reclaimed minesoils (RMS). The experimental sites, owned and maintained by the American Electrical Power, are located in Guernsey, Morgan, Noble, and Muskingum Counties of Ohio. These sites, characterized by age chronosequences, were reclaimed with and without topsoil application and are under continuous grass or forest cover. During this quarter, bulk and core soil samples were collected from all 13 experimental sites for 0-15 cm, 15-30 cm, and 30-50 cm depths. In addition, 54 experimental plots (4 x 4 m) were established at three separate locations on reclaimed minesites to assess the influence of compost application on SOC during project period 2. This report presents the results from two sites reclaimed during 1978. The first site is under grass and the other under forest cover. The soil bulk density (ρ_b), SOC, total nitrogen (TN) concentrations and stocks were determined for these two sites on a 20 x 20 m grid. The preliminary analysis showed that the ρ_b ranged from 0.88 Mg m^{-3} to 1.16 Mg m^{-3} for 0-15 cm, 0.91 Mg m^{-3} to 1.32 Mg m^{-3} for 15-30 cm, and 1.37 Mg m^{-3} to 1.93 Mg m^{-3} for 30-50 cm depths in Cumberland tree site, and it's statistical variability was low. The variability in ρ_b was also low in Wilds grass site and ranged from 0.82 Mg m^{-3} to 1.18 Mg m^{-3} for 0-15 cm, 1.04 Mg m^{-3} to 1.37 Mg m^{-3} for 15-30 cm, and 1.18 Mg m^{-3} to 1.83 Mg m^{-3} for 30-50 cm depths. The ρ_b showed strong spatial dependence for 0-15 cm depth only in the Cumberland tree site. The SOC concentrations and stocks were highly variable with CV > 0.36 from all depths in both Wilds grass site and Cumberland tree site. The SOC stocks showed strong spatial dependence for 0-15 cm and 15-30 cm depths and moderate to strong for 20-50 cm depth in the Cumberland tree site. In contrast, in Wilds grass site, ρ_b was weakly and SOC stocks moderately spatially dependent

for all depths. These preliminary results suggest that the management effects are important and indicative of these sources of variability.

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1.0 **Executive Summary**

This research project is aimed at assessing the soil organic carbon (SOC) sequestration potential of reclaimed minesoils (RMS) and is supported by US Department of Energy- National Energy Technology Laboratory. The proposed research focuses on: (1) assessing the sink capacity of RMS to sequester SOC in selective age chronosequences, (2) determining the rate of SOC sequestration, and it's spatial (vertical as well as horizontal) and temporal variation, (3) developing and validating models for SOC sequestration rate, (4) identifying the mechanisms of SOC sequestration in RMS, (5) assessing the potential of different methods of soil reclamation on SOC sequestration rate, soil development, and changes in soil mechanical and water transmission properties, and (6) determining the relation between SOC sequestration rate, and soil quality in relation to soil structure and hydrological properties.

Before 1972, surface mining operations were performed by removing the soil and underlying strata and piling them on a side. After mining operations were complete, the excavated area was planted to trees or grass without grading or reclamation due to the nonexistence of any specific reclamation guidelines. After 1972, Ohio Mineland Reclamation Act (also 1977 SMCRA) made it mandatory to grade the area back to its original topography and reclaim it with topsoil application prior to sowing grass or planting trees. In this project, several experimental sites were identified, which were reclaimed both prior to SMCRA regulation (without topsoil under grass or forest) and after (with topsoil under grass or forest). All these sites, characterized by distinct age chronosequences of reclaimed minesoil, are located in Guernsey, Morgan, Noble, and Muskingum Counties of Ohio, and are maintained and owned by the American Electrical Power.

A total of thirteen reclaimed sites were identified out of which six were under forest, six under grass, and one undisturbed site under grass cover. Three out of six minesites were reclaimed with topsoil application and the remaining three without topsoil application under both cover types. Soil samples on a grid of 20 x 20 m were collected from three sites reclaimed with topsoil (two under continuous grass and one under forest cover) and one unmined site under grass cover. The unmined sites and those reclaimed after 1972 with topsoil application have gentle or regular slope gradients and are easily accessible. The sites reclaimed before 1972 without topsoil application both under grass and forest have steep slopes and therefore soil samples were collected from shoulder, back/ middle and foot slope positions.

Soil samples were collected between 1st April and 15th July, 2004. A total of 360 soil samples from three depths (0-15 cm, 15-30 cm and 30-50 cm depths) were collected from 30 locations in each of the four sites (i.e., Cumberland tree site reclaimed in 1978, switch grass site reclaimed in 1987, Wilds grass site reclaimed in 1978, and undisturbed site). Three core and three bulk soil samples were collected from each slope position and depth from the remaining nine reclaimed sites. The core soil samples were used for the determination of soil bulk density (ρ_b), texture, saturated hydraulic conductivity (Ks), volumes of transport (VTP) and storage (VSP) pores, and available water capacity (AWC). The pH, electrical conductivity (EC), and SOC and total nitrogen (TN) concentrations and stocks will be determined on air dried bulk soil samples <2mm and <0.5 mm, respectively.

This report presents the results of ρ_b, SOC and TN concentrations and stocks from two sites reclaimed in 1978 (Wilds and Cumberland). Both sites were reclaimed with topsoil application but are under grass and tree cover. The statistical variability was assessed by descriptive statistics, and variations in soil properties were expressed by ranking the coefficient of variation (CV) into different classes. The geostatistical variability was assessed by the regionalized variable theory and using *Variowin* and ArcGIS geostatistical Analyst, variograms of each soil property were obtained. Distinct classes of spatial dependence for soil variables were obtained by the ratio of the nugget to the sill value.

The preliminary variability analysis of the data showed that the statistical variability was low in ρ_b (CV < 8%) and high in SOC concentrations and stocks (CV > 36%) for all depths for both Wilds grass and Cumberland tree site. The nugget-total sill ratio obtained by fitting spherical models to the spatial data showed that the ρ_b was strongly spatially dependent (20%) for the 0-15 cm depth only from the Cumberland tree site. The SOC stocks showed strong spatial dependence for 0-15 cm and 15-30 cm depths and moderate to strong for the 0-50 cm depth for the Cumberland tree site. In contrast, in the Wilds grass site, ρ_b was weakly (>88%) and SOC stocks moderately spatially dependent (36% to 42%) for all depths. These preliminary results suggest that the management effects are important and indicative of these sources of variability. The increase in SOC stocks is important to improving the soil and environment quality and soil productivity. Therefore, correct assessment of SOC pools and the knowledge of actual sequestration rates are important.

2.0 Experimental

2.1 Experimental Sites:

The experimental sites consisted of distinct age chronosequence of minesoils reclaimed with and without topsoil application. Prior to the 1972 Ohio Mineland Reclamation Act or the 1977 Surface Mining Control and Reclamation Act (SMCRA) application of topsoil was not mandatory. However, after the 1972 Ohio Mineland Reclamation Act, application of topsoil was made mandatory for reclamation. The experimental sites are owned by American Electric Power (AEP) Co. and are under continuous grass and forest cover. This report includes the analysis of soil data from two sites: (i) reclaimed with topsoil application and under continuous grass cover, and (ii) reclaimed with topsoil application and under forest cover. Both sites were reclaimed in 1978 in conformity with the Ohio Mineland Reclamation Act of 1972 (Fig. 1). Trees were planted at the Cumberland tree site during1982.

As per the objectives for project period 2 (10/01/04 to 09/30/05), 54 experimental plots (each 4 x 4 m) were established at three locations within the same study area. These plots are located at the sites reclaimed in 1978 and 1994 with topsoil application, and are under continuous grass cover.

2.2 Collection of Soil Sample

The core and bulk soil samples were collected from a 20 x 20 m grid size for 0-15 cm, 15-30 cm, and 30-50 cm depths. Altogether 90 cores and 90 bulk soils samples were collected from three depths from each of the site. Core samples were obtained using 6 cm long and 6 cm diameter stainless steel cylinders.

2.3 **Analysis of Soil Samples**

2.3.1 **Soil Bulk Density**

All soil cores collected in the field were brought to the lab and trimmed at both ends, and bulk density (ρ_b) was measured according to the method described by Blake and Hartge (1986), as the ratio of dry weight to the total volume.

2.3.2**. Soil Organic Carbon Concentrations and Stocks**

The air-dried soil from each depth was ground separately to pass through 0.25 mm sieve. About 1 g of the soil was used for the determination of total carbon (TC) and total nitrogen (TN) concentrations by the dry combustion method (Elementar, GmbH, Hanau, Germany). The TC was assumed to be the SOC because there were no carbonates. The SOC and TN stocks on hectare basis were calculated as the product of SOC or TN concentration, ρ_b and the specific depth of soil layer.

2.4. **Statistical Analysis**

Descriptive statistics including mean, standard deviation, CV, maximum, minimum, skewness, and kurtosis were obtained for each measured soil variable using the Statistical Analysis System (SAS Institute, 1989). All measured soil physical and chemical property data were checked for normality. Using *Variowin* (Pannatier, 1996) and ArcGIS geostatistical Analyst (ESRI, 2004), variograms of each soil physical property and cross-variograms were obtained. The spherical models were fitted to the variograms (Fig 2):

$$\gamma(h) = C_0 + C_1\left[\frac{3h}{2a} - \frac{h^3}{2a^3}\right] \qquad for\ h \le a$$
$$= C_0 + C_1 \qquad for\ h \ge a \qquad (1)$$

where C_0 is nugget, h is lag distance and a is range of spatial dependence to reach the sill (C_0 + C_1).

Variations in soil properties were expressed by ranking the CV into different classes: least (<15%), moderate (15 to 35%) and most (>35%) (Wilding, 1985; Shukla et al., 2004). Distinct classes of spatial dependence for soil variables were obtained by the ratio of the nugget to the total sill value (NSR). The variable was considered strongly spatially dependent when the NSR was $\le$ 25%, moderately spatially dependent for 25% < NSR < 75% and weakly spatially dependent for the NSR of $\ge$ 75% (Cambardella et al., 1994).

3.0 **Results and Discussion**

3.1 **The Variability of Soil Properties**

Tables 1 to 3 list the descriptive statistics of the original data from Cumberland tree site including mean, median, coefficient of variation, skewness, kurtosis, maximum and minimum values for 0-15 cm, 15-30 cm and 30-50 cm depths, respectively. Despite some skewness in the data for ρ_b, TN, and SOC concentrations and stocks, the mean and median values for all these parameters were similar and median was either equal to or smaller than the mean for most of the parameters and data was normally distributed (Tables 1 to 3). The standard error of the mean as well as range (minimum-maximum) increased with depth for all the measured parameters. The variability was low in ρ_b (7% to 8%) and high in SOC concentrations and stocks (44% to 70%)

for all the depths (CV < 8%). However, variability in TN concentrations and stocks was high (>35%) for 0-15 cm, and moderate (21% to 28%) for 15-30 and 30-50 cm depths.

For Cumberland tree site, the mean ρ_b ranged from 0.88 Mg m^{-3} to 1.16 Mg m^{-3} for 0-15 cm, 0.91 Mg m^{-3} to 1.32 Mg m^{-3} for 15-30 cm, and 1.37 Mg m^{-3} to 1.93 Mg m^{-3} for 30-50 cm depths. The SOC concentration was 23.7±10.4 g kg^{-1} for 0-15 cm, 17.5±2.2 g kg^{-1} for 15-30 cm, and 17.3±10.0 g kg^{-1} for 30-50 cm depths. The SOC stocks were 35.9±16.6 Mg ha^{-1} for 0-15 cm, 31.9±22.3 Mg ha^{-1} for 15-30 cm, and 44.8±26.8 Mg ha^{-1} for 30-50 cm depths. The mean ρ_b increased with depth and SOC stocks were higher for the 30-50 cm than for 0-15 and 15-30 cm depths. However, TN concentrations and stocks decreased with depth. This higher SOC stocks for 30-50 cm than other two depths could be due to the presence of coal particles in the deeper soil layers. The coal carbon determination will be taken up during the fourth quarter.

Tables 4 to 6 present the descriptive statistics for the original data for the Wilds grass site. The median values were again close to mean values and except for the ρ_b, median values were smaller than the mean. The standard error of the mean as well as range increased with depth for all the measured parameters. The variability was low in ρ_b (6 to 7%) and high in SOC concentration, TN and SOC stocks (>36%) for all depths. However, variability in TN concentration ranged from moderate for 0-15 cm and 15-30 cm depths (32% and 31%, respectively) to high (44%) for the remaining depth (>44%).

For the Wilds grass site, the mean ρ_b was 0.98±0.07 Mg m^{-3} for 0-15 cm, 1.24±0.07 Mg m^{-3} for 15-30 cm, 1.72±0.11 Mg m^{-3} for 30-50 cm depths. The SOC concentration was 15.35±6.63 g kg^{-}

^{1} for 0-15 cm, 8.77±8.83 g kg^{-1} for 15-30 cm, and 13.85±10.70 g kg^{-1} for 30-50 cm depths. The SOC stocks were 22.6±8.2 Mg ha^{-1} for 0-15 cm, 16.3±16.2 Mg ha^{-1} for 15-30 cm, and 35.6±27.5 Mg ha^{-1} for 30-50 cm depths. The mean ρ_b increased with depth. However, SOC and TN concentrations and stocks were higher from 0-15 cm depths than the remaining two depths. The higher SOC concentrations and stocks for 30-50 cm than 15-30 cm depth suggest possible contamination with coal.

3.2 **Spatial Variability In Soil Properties**

The measured soil properties showed differences in their spatial pattern in Cumberland tree site. The spatial dependence showed an isotropic behavior, which can be due to the low variability in soil management treatments and soil forming factors for the study area. Several different models were fitted to the variogram and the spherical model (Eq. 1) was the best with least sum of squares (Fig. 2). There was no anisotropy evident in the directional semivariograms for any soil property. Therefore, isotropic models were fitted using *Variowin*. All variogram models of ρ_b, TN and SOC concentrations and stocks showed a positive nugget effect, which may be explained as the sampling error, random and inherent variability, or shorter-range variability of soil properties than the chosen grid size of 20 x 20 m. The relative size of nugget effect among different soil properties is described by expressing the nugget variance as a percentage of total semivariance or total sill (Trangmar et al., 1985).

For Cumberland tree site, the nugget-sill ratio (NSR) of 20% showed strong spatial dependence for the ρ_b in 0-15 cm depth, and moderate (75% and 47%) for 15-30 cm and 30-50 cm depths, respectively (Table 7). The spatial dependence for TN concentrations and pools was moderate for all depths and ranged from 43% for 0-15 cm to 69% for 30-50 cm and 74% for 0-15 cm to 61% for 30-50 cm, respectively. The SOC concentration showed moderate variability (42% to 61% for 0-15 cm and 30-50 cm depths, respectively). However, SOC stocks showed strong spatial dependence for all three depths with nugget-sill ratios of 17% for 0-15 cm, 24% for 15-30 cm, and 17% for 30-50 cm depths. The moderate spatially dependent soil properties can be a function of intrinsic variations in soil texture and mineralogy. The extrinsic variations due to topography, and root distribution may control the strong variations in SOC stocks and moderate variation in SOC and TN concentrations.

For the Wilds grass site, the nugget-sill ratio exhibited weak spatial correlation (>88%) for ρ_b at all depths. However, SOC and TN concentrations and stocks were characterized by moderate variability for all three depths (Table 8). The Wild grass site is a well maintained and has a very gentle slope with dense grass cover. The moderate variability in SOC and TN concentrations and stocks may probably be due to the small variations in soil texture.

4.0 **Conclusion**

The preliminary results of descriptive statistics show that all the data were normally distributed. The statistical variability was low in soil bulk density and high in SOC concentrations and stocks for all depths for both Wilds grass and Cumberland tree sites. Soil bulk density showed strong spatial dependence for 0-15 cm depth from Cumberland tree site. However, it showed moderate to weak spatial dependence for remaining depths and the other site. The SOC stocks also showed strong spatial dependence for all three depths in Cumberland tree site. In Wilds grass site, SOC stocks were also moderately spatially dependent for all depths. These preliminary results suggest that the management effects are important, and that an explicit recognition of these sources of variability is essential.

5.0 **Tasks to be performed in the next Quarter (July- September 2004)**

1. Infiltration tests on all sites
2. Water stable aggregate analysis
3. Particle size distribution
4. SOC and TN concentrations, and assessment of coal contamination
5. Statistical and geostatistical analysis for data on soil physical and chemical properties

6.0 **References**

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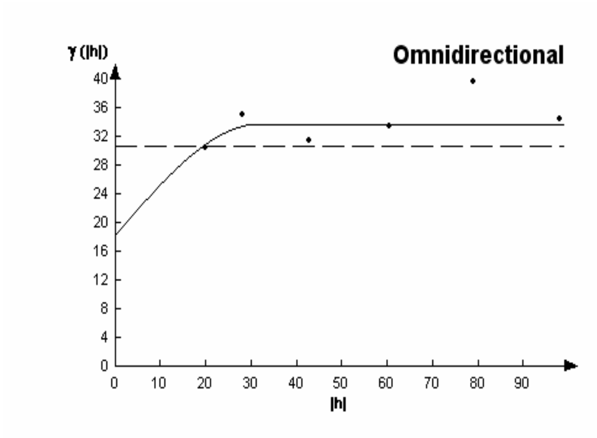
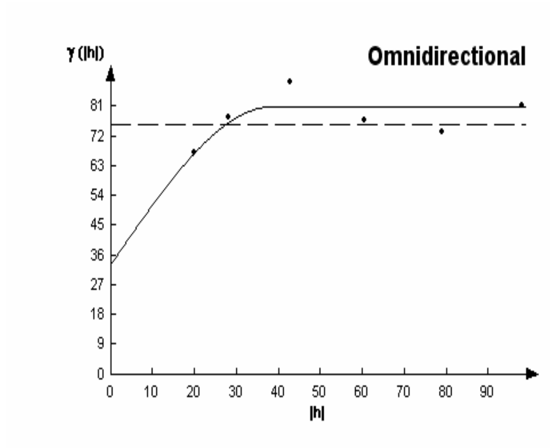
A. Wilds grass site

B. Cumberland tree site

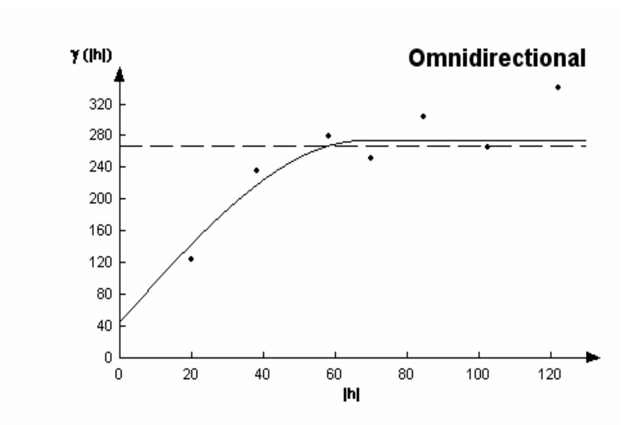
Fig. 1. Experimental sites reclaimed in year 1978: (A) under grass, and (B) under forest cover



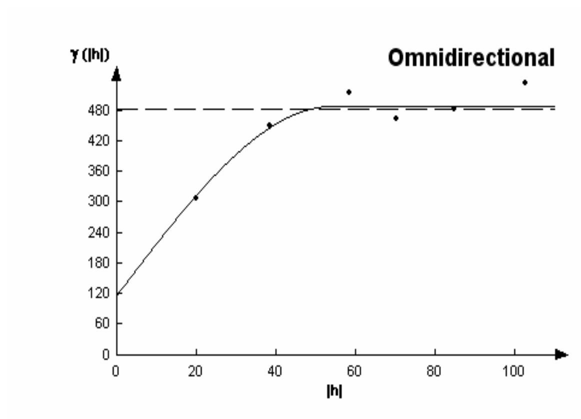
A. SOC stock in 0-15 cm depth



B. SOC stock in 15-30 cm depth



C. SOC stock in 0-15 cm depth



D. SOC stock in 15-30 cm depth

Fig. 2. Sample variograms for soil organic carbon (SOC) stocks for the Wilds grass site for: (A) 0-15 cm and (B) 15-30 cm depths, and for the Cumberland tree site for: (C) 0-15 cm and (D) 15-30 cm depths

Table 1. Summary statistics for soil properties for the Cumberland site under forest for 0-15 cm depth. The site was reclaimed in 1978

Property	ρ_b	*TNC*	*TNS*	*SOCC*	*SOCS*
Mean	1.00	1.33	2.00	23.67	35.86
Median	1.01	1.29	1.95	22.45	34.97
Std Error	0.01	0.08	0.13	1.89	3.03
Std Dev	0.07	0.46	0.73	10.36	16.61
CV	0.07	0.35	0.37	0.44	0.46
Kurtosis	0.03	0.87	0.56	-0.11	0.05
Skewness	0.02	0.80	0.72	0.56	0.61
Minimum	0.88	0.59	0.85	6.47	8.69
Maximum	1.16	2.41	3.92	48.95	72.16

Where ρ_b is soil bulk density (Mg m^{-3}), TNC and SOCC is total nitrogen and soil organic carbon concentration (g kg^{-1}), and TNS and SOCS is total nitrogen and soil organic carbon stocks (Mg ha^{-1})

Table 2. Summary statistics for soil properties for the Cumberland site under forest for 15-30 cm depth. The site was reclaimed in 1978

Property	ρ_b	*TNC*	*TNS*	*SOCC*	*SOCS*
Mean	1.20	0.57	1.02	17.47	31.85
Median	1.21	0.57	1.03	15.79	26.62
Std Error	0.02	0.03	0.05	2.15	4.08
Std Dev	0.09	0.16	0.28	11.78	22.32
CV	0.08	0.28	0.27	0.67	0.70
Kurtosis	2.11	-0.21	0.20	-0.05	-0.05
Skewness	-1.08	0.45	0.50	0.75	0.79
Minimum	0.91	0.29	0.50	1.34	2.33
Maximum	1.32	0.95	1.75	43.66	82.56

Table 3. Summary statistics for soil properties for the Cumberland site under forest for 30-50 cm depth. The site was reclaimed in 1978

Property	ρ_b	*TNC*	*TNS*	*SOCC*	*SOCS*
Mean	1.73	0.49	1.26	17.34	44.77
Median	1.77	0.48	1.28	16.70	45.04
Std Error	0.02	0.02	0.05	1.83	4.89
Std Dev	0.13	0.13	0.27	10.02	26.79
CV	0.07	0.26	0.21	0.58	0.60
Kurtosis	1.09	4.45	0.58	3.24	6.84
Skewness	-1.15	1.64	0.53	1.22	1.84
Minimum	1.37	0.32	0.83	1.08	2.90
Maximum	1.93	0.95	1.95	51.12	148.17

Table 4. Summary statistics for soil properties for the Wilds site under grass for 0-15 cm depth. The site was reclaimed in 1978

Property	ρ_b	*TNC*	*TNS*	*SOCC*	*SOCS*
Mean	0.98	1.43	3.67	15.35	22.63
Median	0.01	0.09	0.44	1.03	1.49
Std Error	0.98	1.35	2.89	14.61	21.94
Std Dev	0.07	0.47	2.42	5.63	8.14
CV	**0.07**	**0.32**	**0.66**	**0.37**	**0.36**
Kurtosis	2.08	0.53	2.00	1.07	0.46
Skewness	0.42	0.02	1.31	0.42	0.09
Minimum	0.82	0.26	0.07	1.91	2.74
Maximum	1.18	2.50	11.24	29.99	40.27

Table 5. Summary statistics for soil properties for the Wilds site under grass for 15-30 cm depth. The site was reclaimed in 1978

Property	ρ_b	*TNC*	*TNS*	*SOCC*	*SOCS*
Mean	1.24	0.47	0.62	8.77	16.26
Median	0.01	0.03	0.10	1.61	2.96
Std Error	1.24	0.46	0.51	5.67	10.16
Std Dev	0.07	0.15	0.55	8.83	16.23
CV	**0.06**	**0.31**	**0.89**	**1.01**	**1.00**
Kurtosis	0.72	-0.27	5.30	10.05	8.17
Skewness	-0.39	0.33	1.86	2.79	2.55
Minimum	1.04	0.22	0.06	1.78	3.40
Maximum	1.37	0.77	2.68	45.70	81.30

Table 4. Summary statistics for soil properties for the Wilds site under grass for 30-50 cm depth. The site was reclaimed in 1978

Property	ρ_b	*TNC*	*TNS*	*SOCC*	*SOCS*
Mean	1.72	0.41	0.90	13.85	35.57
Median	0.02	0.03	0.16	1.95	5.01
Std Error	1.75	0.37	0.62	10.57	28.07
Std Dev	0.11	0.18	0.89	10.70	27.47
CV	**0.07**	**0.44**	**0.99**	**0.77**	**0.77**
Kurtosis	18.53	6.57	5.41	-1.17	-1.06
Skewness	-3.90	2.35	1.95	0.47	0.51
Minimum	1.18	0.23	0.05	1.31	3.27
Maximum	1.83	1.07	4.20	33.60	89.13

Table 7. The spatial variability of soil properties for the Cumberland site under forest. The site was reclaimed in 1978

Property	Model	SS	Nugget	Range (m)	Partial Sill	NSR (%)
		0-15 cm depth				
ρ_b (Mg m^{-3})	Spherical	0.078	0.001	42.5	0.004	20
TN Concentration (g kg^{-1})	Spherical	0.079	0.09	28.6	0.117	43
TN Stock (Mg ha^{-1})	Spherical	0.109	0.39	36.0	0.138	74
SOC Concentration (g kg^{-1})	Spherical	0.190	52.80	123.0	73.70	42
SOC Stock (Mg ha^{-1})	Spherical	0.018	45.90	67.6	229.50	17
		15-30 cm depth				
ρ_b (Mg m^{-3})	Spherical	0.054	0.006	23.4	0.002	75
TN Concentration (g kg^{-1})	Spherical	0.141	0.014	28.5	0.012	54
TN Stock (Mg ha^{-1})	Spherical	0.142	0.059	32.3	0.022	73
SOC Concentration (g kg^{-1})	Spherical	0.101	0.015	22.5	0.011	58
SOC Stock (Mg ha^{-1})	Spherical	0.003	117	53.9	372.4	24
		30-50 cm depth				
ρ_b (Mg m^{-3})	Spherical	0.081	0.008	23.4	0.009	47
TN Concentration (g kg^{-1})	Spherical	0.575	0.011	19.5	0.005	69
TN Stock (Mg ha^{-1})	Spherical	0.053	0.043	22.1	0.027	61
SOC Concentration (g kg^{-1})	Spherical	0.026	0.0104	24	0.005	68
SOC Stock (Mg ha^{-1})	Spherical	0.011	133	44.2	630	17

Where SS is sum of squares, NSR is nugget-sill ratio (%)

Table 8. The spatial variability of soil properties for the Wilds site under grass. The site was reclaimed in 1978

Property	Model	SS	Nugget	Range (m)	Partial Sill	NSR (%)
		0-15 cm depth				
ρ_b (Mg m^{-3})	Spherical	0.103	0.01	23.4	0.0003	94
TN Concentration (g kg^{-1})	Spherical	0.034	0.15	35.0	0.08	64
TN Stock (Mg ha^{-1})	Spherical	0.010	3.99	32.7	2.05	66
SOC Concentration (g kg^{-1})	Spherical	0.013	18.29	31.7	15.50	54
SOC Stock (Mg ha^{-1})	Spherical	0.023	30.72	28.6	41.60	42
		15-30 cm depth				
ρ_b (Mg m^{-3})	Spherical	0.076	0.01	22.1	0.0007	88
TN Concentration (g kg^{-1})	Spherical	0.018	0.02	77.9	0.01	65
TN Stock (Mg ha^{-1})	Spherical	0.006	0.14	39.6	0.18	44
SOC Concentration (g kg^{-1})	Spherical	0.008	33.44	38.61	47.88	41
SOC Stock (Mg ha^{-1})	Spherical	0.064	166.4	51.8	114.4	59
		30-50 cm depth				
ρ_b (Mg m^{-3})	Spherical	0.158	0.02	23.4	0.001	94
TN Concentration (g kg^{-1})	Spherical	0.097	0.03	49.4	0.01	77
TN Stock (Mg ha^{-1})	Spherical	0.013	0.42	28.5	0.42	50
SOC Concentration (g kg^{-1})	Spherical	0.008	28.8	34.5	86.40	25
SOC Stock (Mg ha^{-1})	Spherical	0.013	270.1	42.0	481.80	36