Assessing of Soil Quality Index by Scoring Function Analysis in Ohio

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INTRODUCTION

Soil quality index (SQI) is a tool for assessing the impact of land use and management practices on soil properties. Soil quality refers to the capacity of soil to provide goods and service for a specific use. Because management practices lead to changes in soil function, there is a need for comprehensive tools and methods to assess and SQI. In this research, our objective is to evaluate the effects of tillage and surface tile drainage on SQI of Crosby Silt Loam in Central Ohio.

MATERIALS AND METHODS

The SQI assessment was carried out using the scoring function analysis framework that has been found to perform well for managements effects (Karlen et al., 2001). Crop productivity was identified as the management goal in the study.

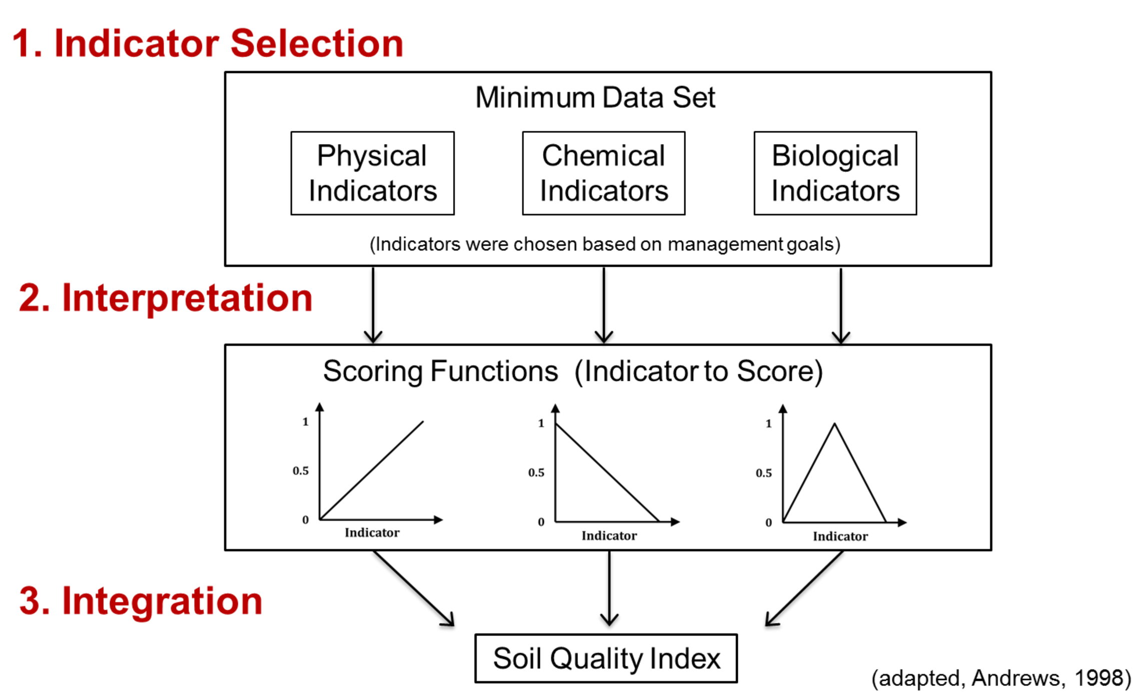

Fig. Conceptual framework for scoring function analysis

Three main steps were followed for the SQI assessment:

1) identification of the minimum data set of indicators,
2) indicator interpretation,
3) integration of the all indicator scores into one overall SQI

Table. Scoring function chart for interpretations soil quality index with source references

Indicator	unit	5	4	3	2	1	Reference
BD	Mg m^{-3}	<1.2	1.2-1.3	1.3-1.4	1.4-1.5	>1.5	
MWD	mm	>2.5	2-2.5	1.0-2.0	0.5-1.0	<0.5	
Texture	-	Loam	Silt loam, Silt, Silty clay loam	Clay loam, sandy loam	Silty clay, Loamy sand	Clay, Sand	Lal (1994)
AWC	$m^3 m^{-3}$	>0.30	0.20-0.30	0.08-0.20	0.02-0.08	<0.02	
MBC	mg-C kg^{-1}	>450	300-450	200-300	100-200	<100	Rice et al. (1996), Andrew et al. (2004),
K_{sat}	cm h^{-1}	>2	0.2-2.0	0.02-0.2	0.002-0.02	<0.002	Lal (1994)
pH	-	6.0-7.0	5.8-6.0 and 7.0-7.4	5.4-5.8 and 7.4-7.8	5.0-5.4 and 7.8-8.2	<5.0 and >8.2	Andrew et al. (2004), Lal (1994)
EC	μS m^{-1}	<300	300-500	500-700	700-1000	>1000	Lal (1994)
SOC	g kg^{-1}	50-100	30-50	,10-30	,5-10	<5	Gregoric et al. (1994), Lal (1994)
Soil T	°C	>14	13-14	12-13	,11-12	<11	Griffith et al (1972), Maurya and Lal (1981)
Soil M	$m^3 m^{-3}$	<0.20	0.20-0.30	0.30-0.35	0.35-0.40	>0.40	Lal (1974)

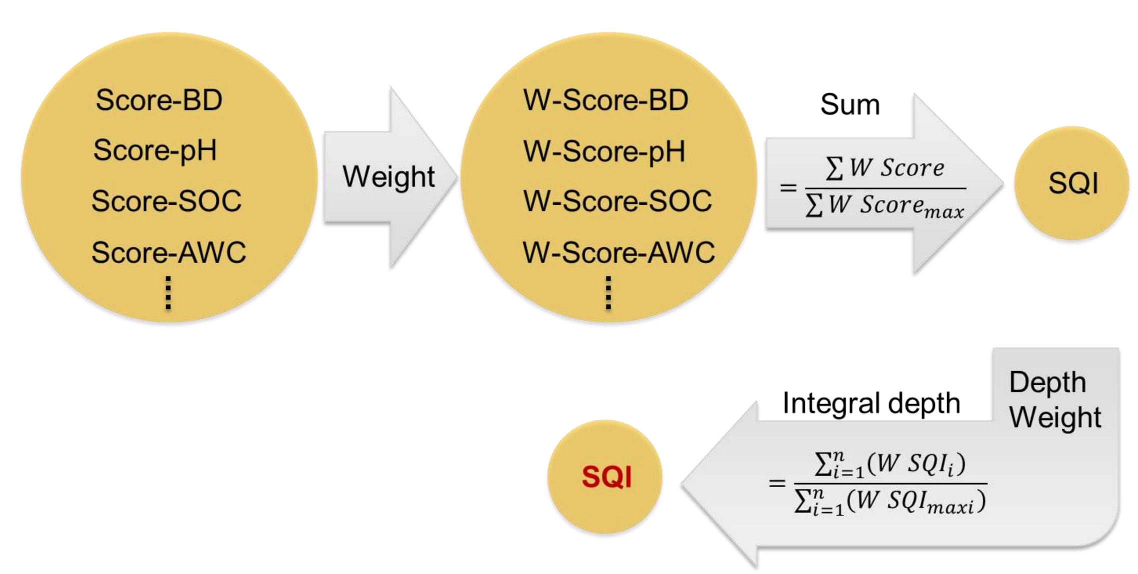

Fig. Conceptual framework for integrating SQI.

Table. 2 Weighting factor for soil function and indicators

Function	Weight	Indicators	R	Weight Index	Depth	NT	CT
Physical	0.33	K_{sat}	0.70	0.16	0-10cm	0.52	0.65
		Soil M	0.57	0.13			
		BD	0.55	0.13			
		AWC	0.51	0.12	10-20cm	0.22	0.17
		Soil T	0.42	0.10			
		Texture	0.15	0.03			
		MWD	0.09	0.02	20-40cm	0.17	0.11
Chemical	0.33	SOC	0.61	0.14			
		EC	0.23	0.05			
		pH	0.06	0.01	40-60cm	0.10	0.06
Biologcal	0.33	MBC	0.41	0.10			
Total	**1.00**			**1.00**		**1.00**	**1.00**

RESULTS AND DISCUSSIONS

- ✓ K_{sat} was the key indicator ($W_{indicator}$ = 0.16; n = 48) for SQI assessment,
- ✓ SOC had the highest weighting index ($W_{indicator}$ = 0.14; n = 48).
- ✓ The SQI were not significantly affected by tillage and subsurface drainage treatment (P = 0.380 and 0.763),
- ✓ The root densities of each depth under different treatments in corn field were employed to determine the weighting factor of depths in this study. Thus, it seems to be an effective way to integrate and evaluate the whole depth.
- ✓ The SQI was significantly correlated with corn yield (R = 0.62, P < 0.05; n = 12),

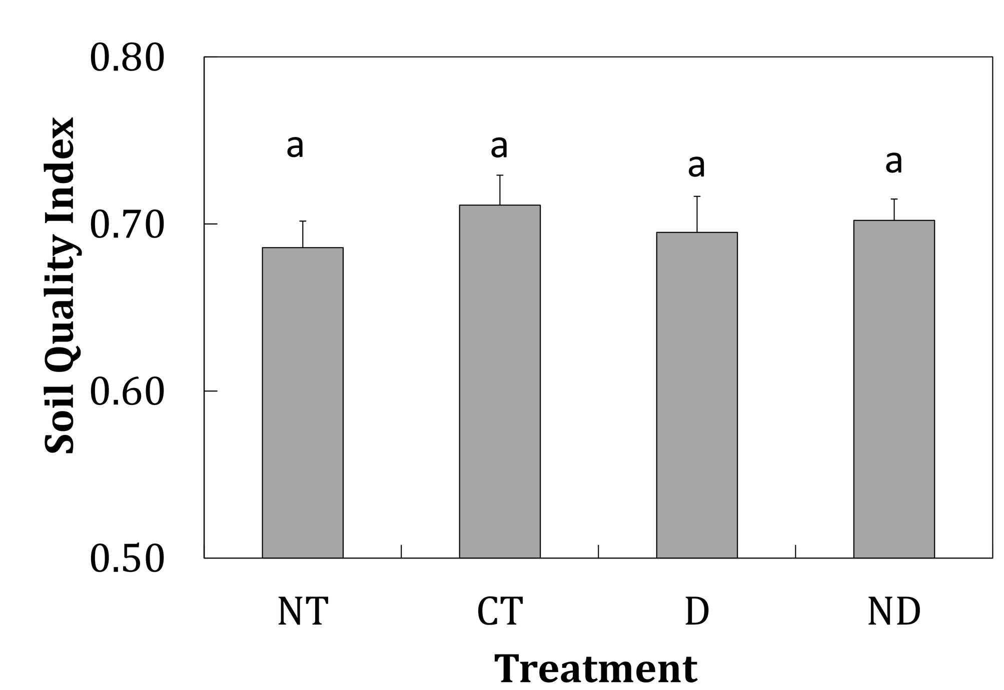

Fig. Effects of no-till and subsurface drainage on the soil quality index

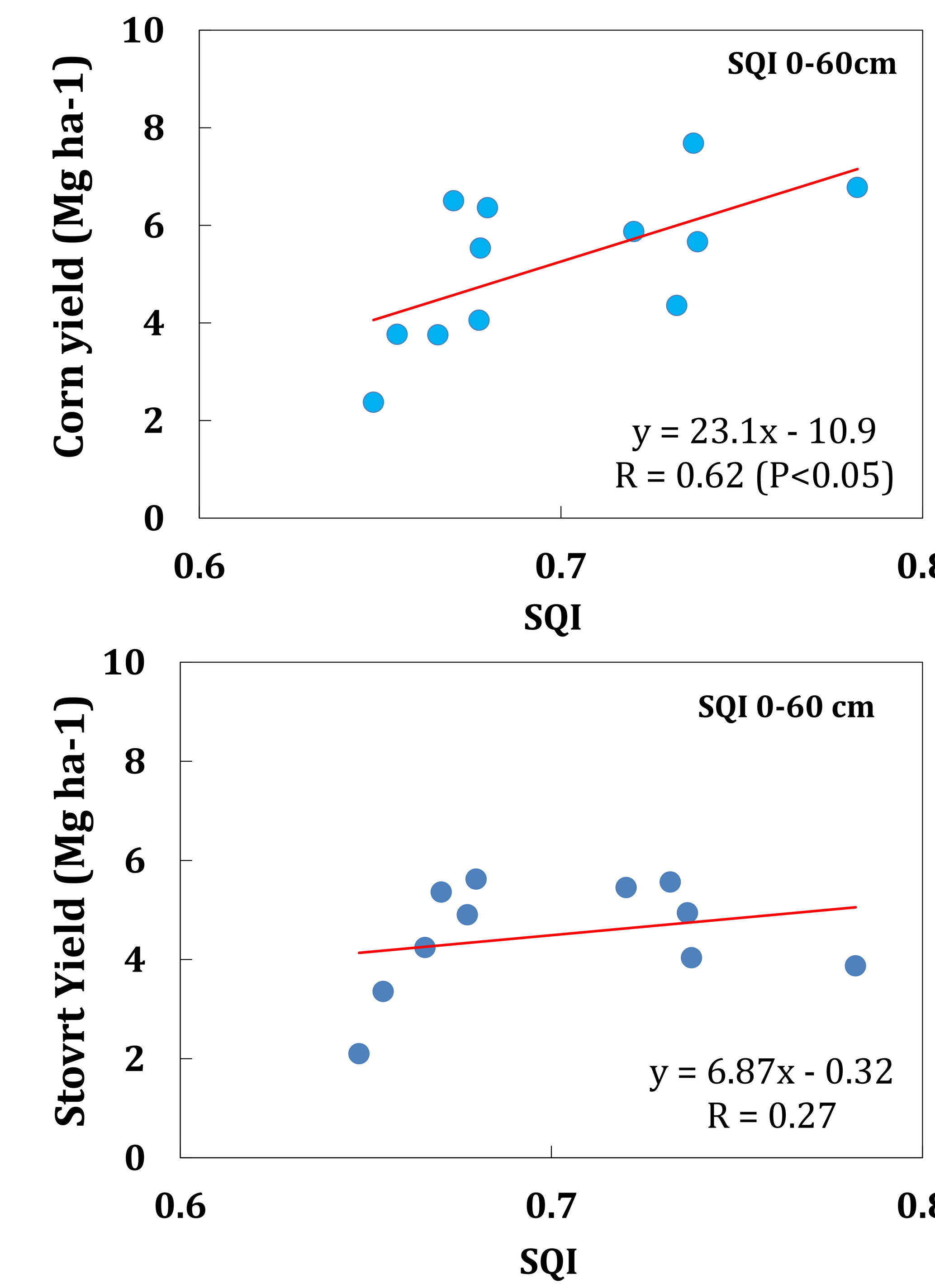

Fig. Relationship between SQI and the corn yield and stover yield (2011)

CONCLUSIONS

This research suggested that the SQI assessment can be an effective and useful tool for assessing the agronomic productivity in central Ohio.

However, we recommend that more long-term studies be conducted to assess the effects of tillage and drainage management on SQI.

BIBLIOGRAPHY

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