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A Farmer-Friendly Tool for Predicting Soil Organic Matter

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Introduction

Removal of crop residue for biofuels and other purposes is becoming a common practice in the Midwest. However, removal of crop residue adversely impacts the stability of soil organic matter (SOM) stock. Management practices like continuous no-till, cover crops, and manure can offset the SOM losses. Therefore, there is a growing interest among farmers, crop consultants, and bio-energy related industry for a tool that can help optimize their management practices and crop residue removal rates, while maintaining a good soil health in the long term.

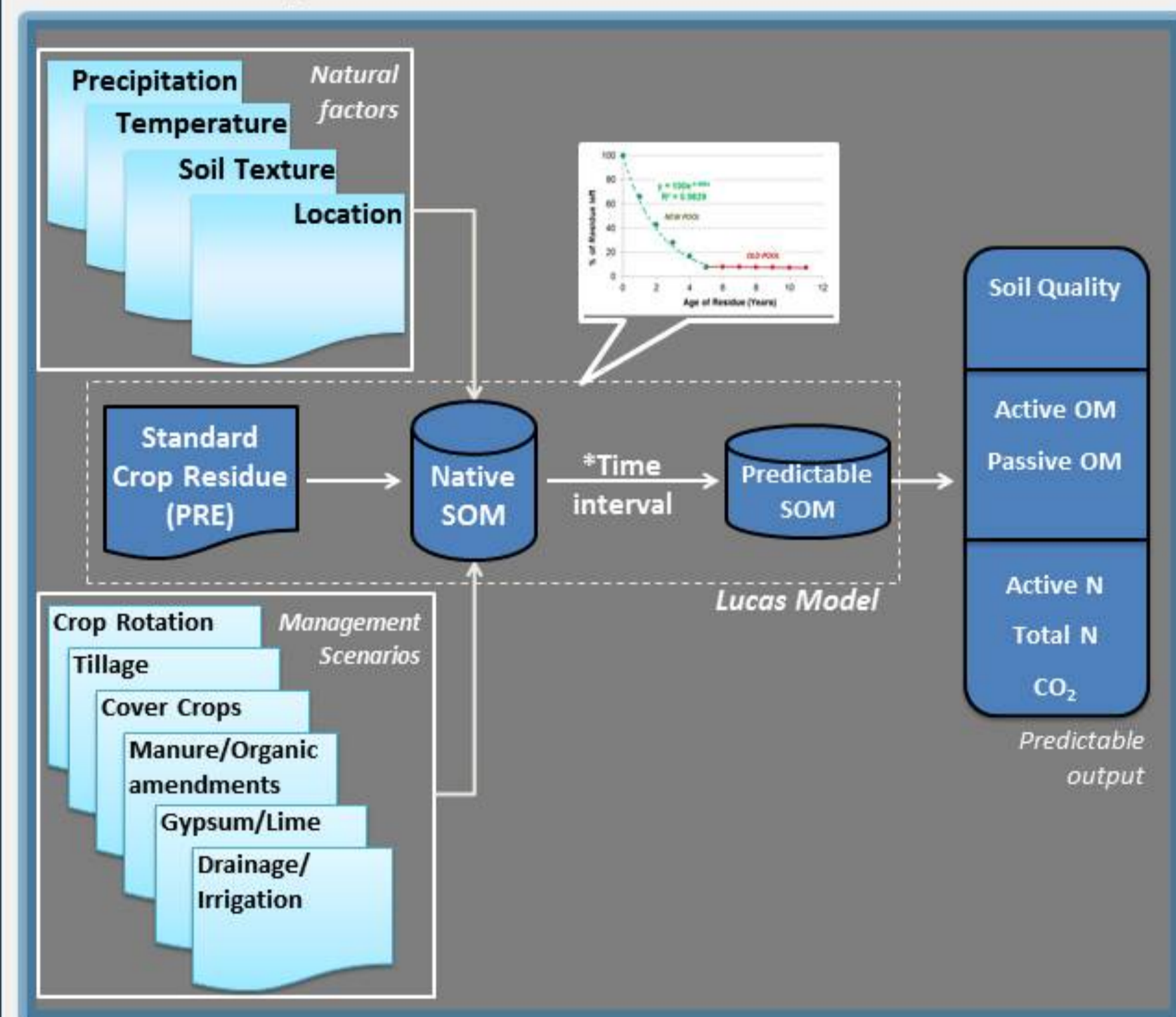A few tools are available to quantify SOM changes when crop residue is removed, e.g.

- Soil conditioning index
- CENTURY
- DAISY
- Comet VR , COMET-FARM™ and more…

Some of these are "User Friendly"…But none are "Farmer-friendly"

Objective

Our goal was to develop a farmer-friendly tool for predicting SOM, nutrients, and overall soil quality.

Conceptual model

The SOM is divided into two pools, viz. active organic matter and passive (old) organic matter. The active pool is assumed to decompose at a faster rate, exponentially with time (years 1 to 5). The passive pool, on the other hand, is expected to have a very slow and constant decomposition rate (linear), which depends on local climate, native vegetation, soil type, and management practices.
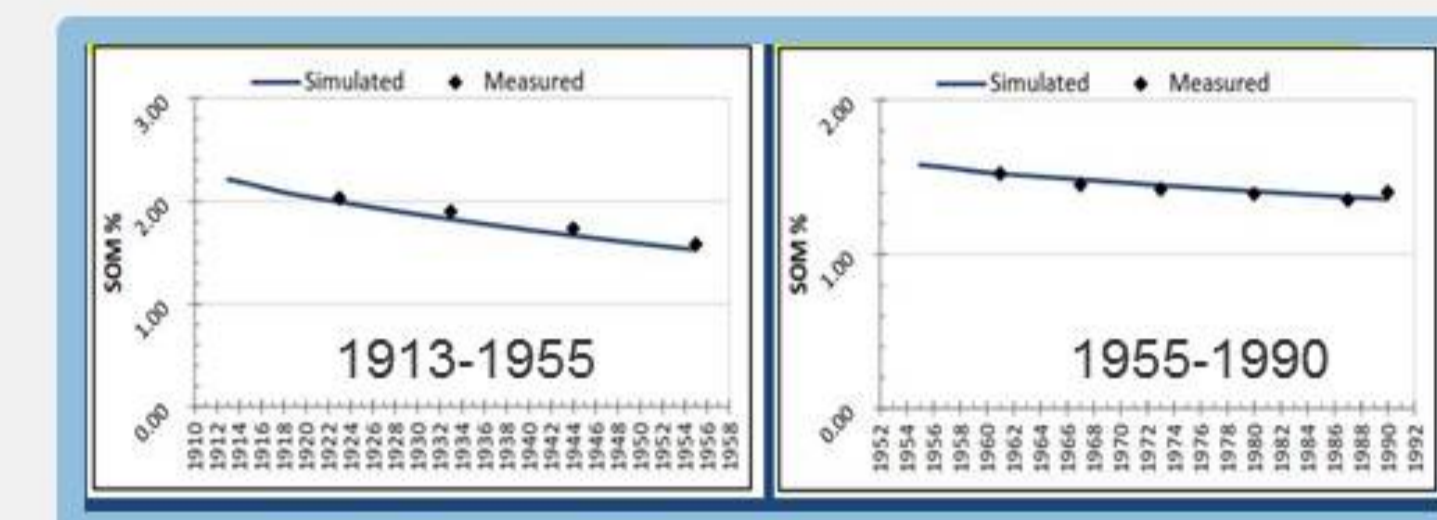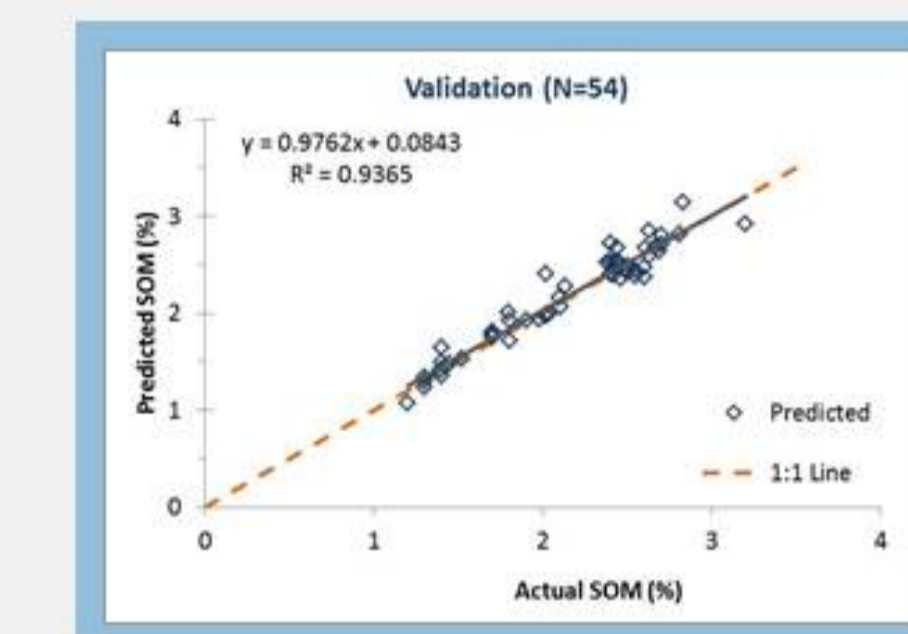
User Guide

Printable Report
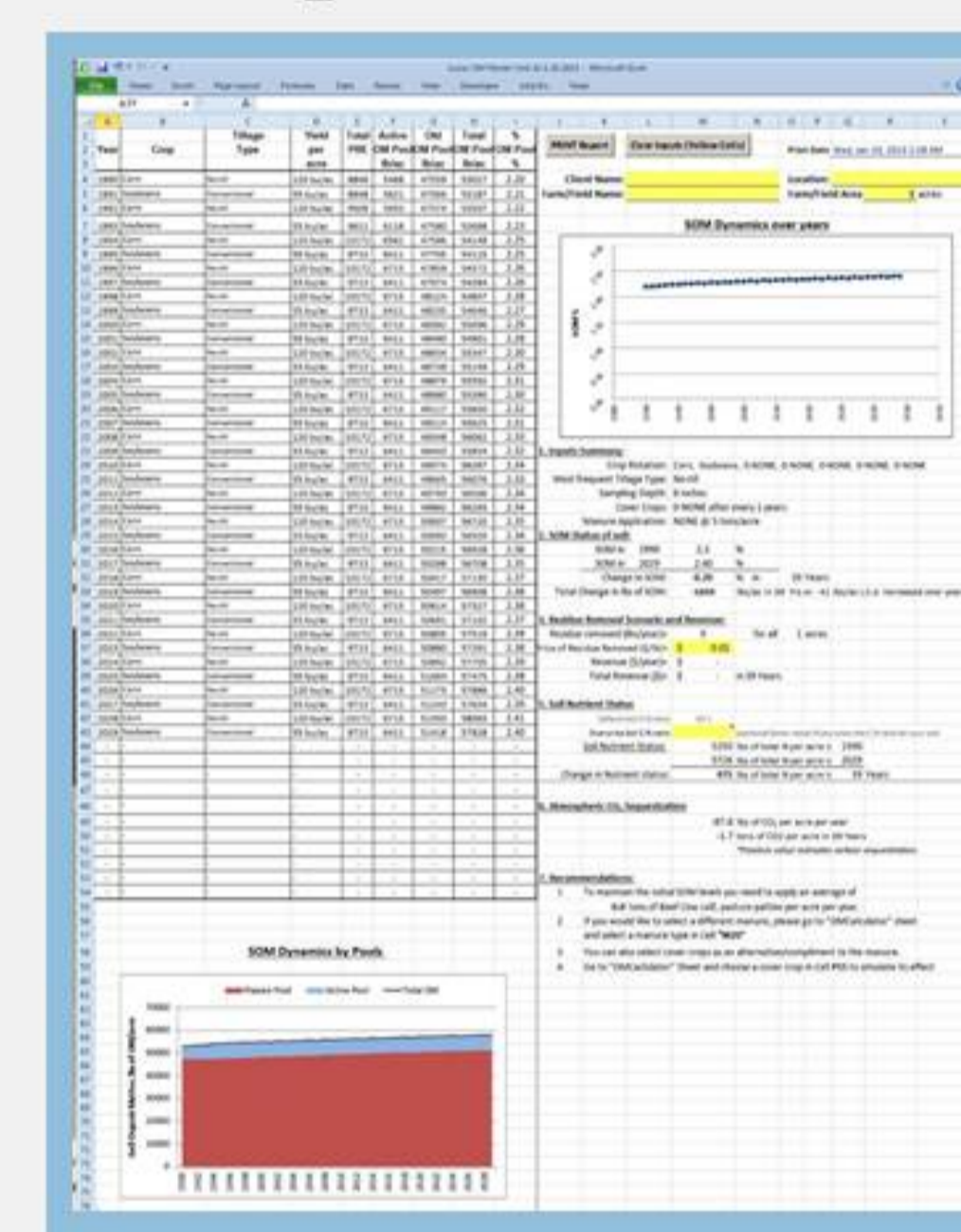
Performance Evaluation

Morrow plots (North C) – Continuous corn

Data from 12 different experiments in Michigan and Illinois

Future work

- Regional validation using a GIS to extend the applicability of calculator over the Midwest
- A web-application and/or a stand-alone program that can further make this calculator easy to use and widely accessible
- Provide a capability to estimate carbon credits
- Further improve accuracy by expanding the options and modules for biomass type and management inputs

Materials and methods

Characteristics of a "Farmer-Friendly" tool:

- ✓ Easy to install, use, maintain
- ✓ Less data intensive
- ✓ Simple and sequential inputs
- ✓ 'How to use' guide
- ✓ Clear and easy to interpret outputs
- ✓ Capable of scenario generation
- ✓ Capable of generating reports

Theoretical Basis:

The calculator is based on a 2-pool exponential decay model initially suggested by Dr. Robert Lucas (Lucas et al., 1978).

NEW POOL / OLD POOL
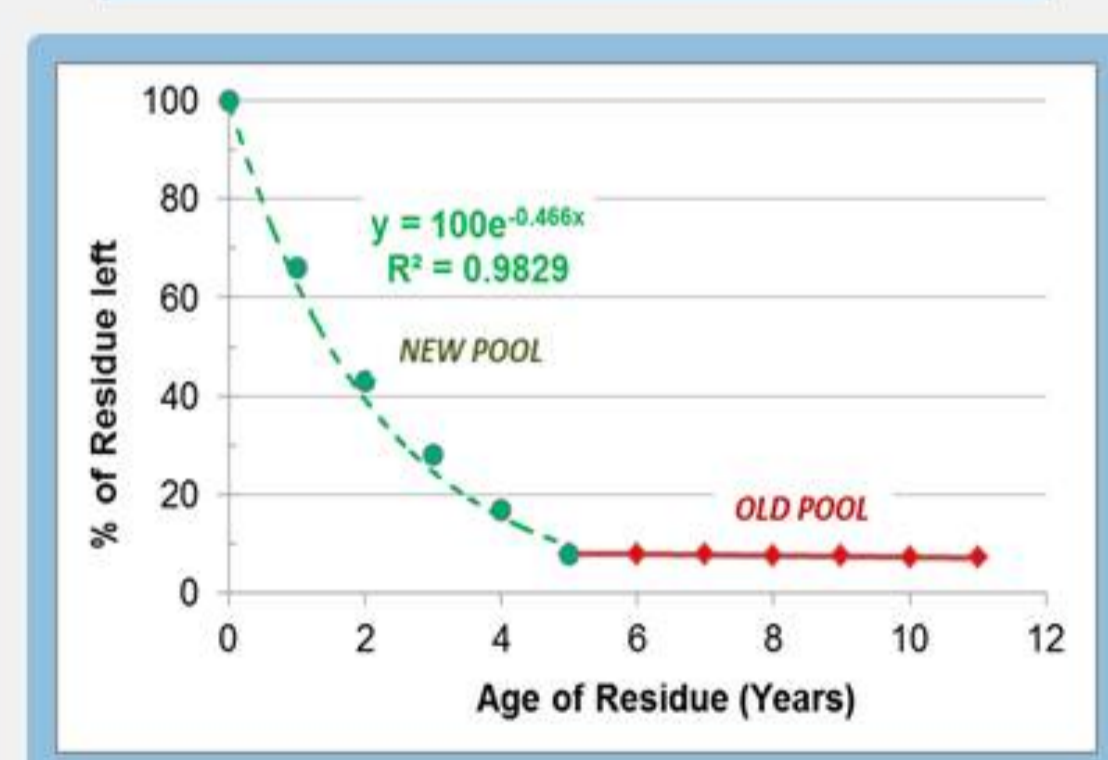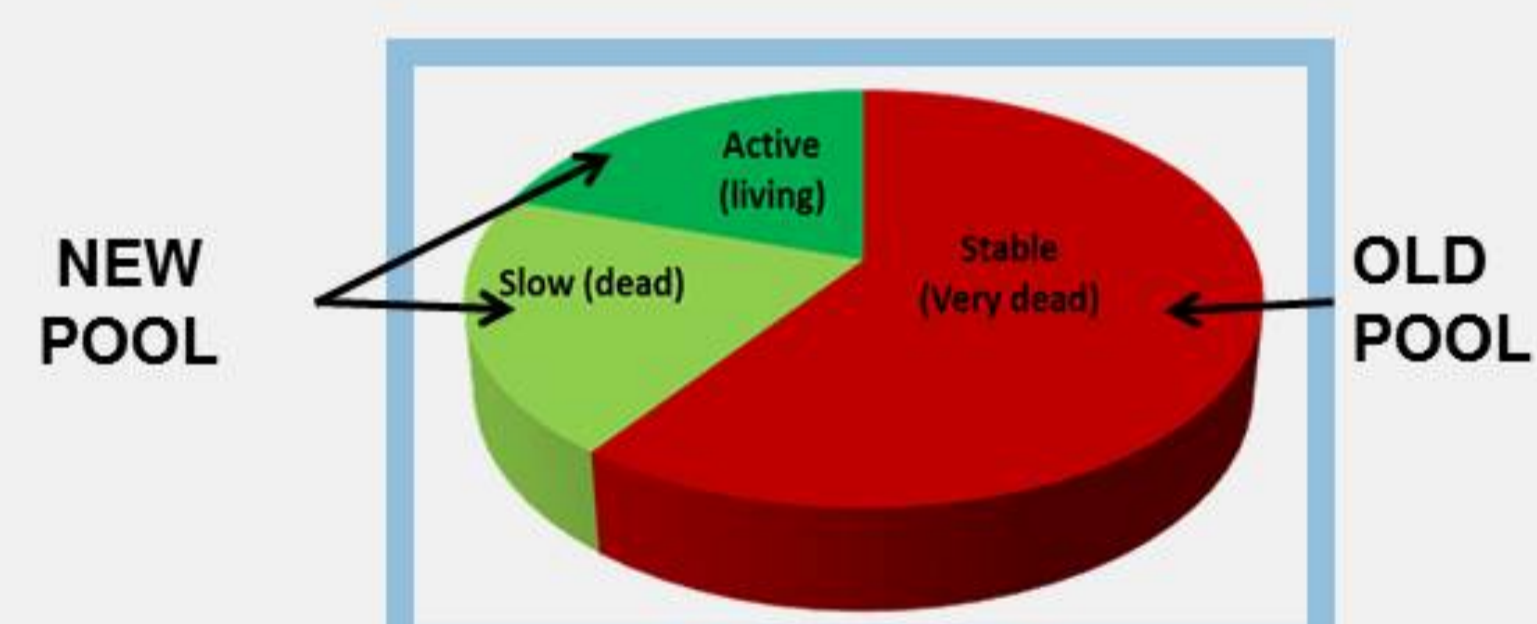
SOM Calculator

The calculator is available as a "Macro Enabled Excel File"

Crop-related inputs
Tillage-related inputs
Manure-related inputs
Soil-related & Management inputs
Residue removal inputs

Extension activities

Date	Place	Event
Dec. 2012	Paw Paw, MI	SWCD farmer meeting
Jan. 2013	Adrian, MI	Center for Excellence annual meeting
Feb. 2013	Allegan, MI	SWCD farmer meeting
May, 2013	Mt. Vernon, Springfield, Sycamore	Three one-day Sustainable Agriculture and Soil Health Workshops in Illinois
Oct. 2013	Clarksville, Gaylord, Owosso	Three one-day Sustainable Agriculture and Soil Health Workshops in Michigan
Nov. 2013	Tampa, FL	Poster and oral presentations at Annual International ASA meeting

Summary and Conclusions

We developed a spreadsheet-based SOM calculator in Microsoft Excel using VBA (Visual Basic for Applications) environment. The calculator is capable of assessing soil health by simulating the dynamics of SOM content in response to residue removal and various management scenarios. The calculator can predict scenarios for up to 50 years with satisfactory accuracy. The ability of the tool to estimate soil C sequestration can provide a tool for calculating C credits in C trading. In addition to farmers, the calculator can also be used by private crop consultants, University Extension Educators, and USDA professionals to help guide farmers.

Some important model components

- CROP YIELD: Yield information for more than 18 crops was collected from the Census of Agriculture for Michigan (USDA, 1998, 2003 & 2007).
- CROP PRE: The crop residue values were obtained from several sources and compiled together to represent average residue amounts. The major sources of these data are RR-358, and the Midwest Cover Crops Council (MCCC) Cover Crop Decision Tool.
- COVER CROPS: The yield and residue data were obtained for main cover crops in Michigan and Ohio. Most of the yield data were obtained from Field studies in Ohio, Census of Agriculture for Michigan (USDA, 1998, 2003 & 2007) and Midwest Cover Crops Council.
- MANURE: The amount of dry-matter from each manure type is converted to PRE based on the laboratory and field analysis results of 18 Livestock manure types.
- TILLAGE: The effect of tillage type is simulated based on data summarized from studies reported worldwide. This module is based on the assumption that the net effect of tillage variations on SOM dynamics can be reflected through changes in crop yield, and hence the crop PRE. Thus, changing from conventional to conservation tillage is associated with certain yield benefits which translate into additional amounts of PRE added to soil.
- TEST SCENARIOS: Users can use "Test Scenarios" button to open a form that allows you to test different scenarios on the existing spreadsheet. After first run of the model, users can modify individual components and evaluate their effect on Soil Organic Matter dynamics.

Acknowledgments

Where to get it?

The SOM calculator is available for download free of cost to the members of the Michigan Corn Growers Association. It is also available to the educators and researchers after due request. Please visit the following link for more details: http://southcenters.osu.edu/soil

Scan this QR code for download