CIGLR Soil Health and Watershed Modeling Summit Summary

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MICHIGAN ENVIRONMENTAL COUNCIL

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- 70+ member organizations

- Statewide environmental policy
  - Agriculture, surface/groundwater quality, solid waste management, energy infrastructure, transportation, healthy food access, environmental justice

Summit Overview

Improving models of nutrient loading and HABs through a watershed-scale approach that emphasizes soil health and upland farming practices

Implications of summit

….. And why did a policy NGO lead this….

- ➔ Nutrient reduction planning (i.e. DAP)
- ➔ Funding priorities
- ➔ Solid waste management
- ➔ Research opportunities
- ➔ Unifying message

Summit-- Defining soil health

- Soil health is a widely accepted albeit general term, officially defined by USDA as “the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans”. Our focus is more on soil function and how changes to the physical, biological, and chemical composition of soil alters its overall function
    - Important soil functions: nutrient cycling, supporting plant growth, carbon sequestration, infiltration/storage, pest/disease suppression

- We could spend endless time figuring out the correct soil health/parameters to include in models. Summit participants decided in the interest of ag sector we should focus on **hydrological flows** off ag fields (infiltration, water holding capacity); **N&P retention**; **Yield stability/resilience**

Soil Health Institute Tier 1 Indicators

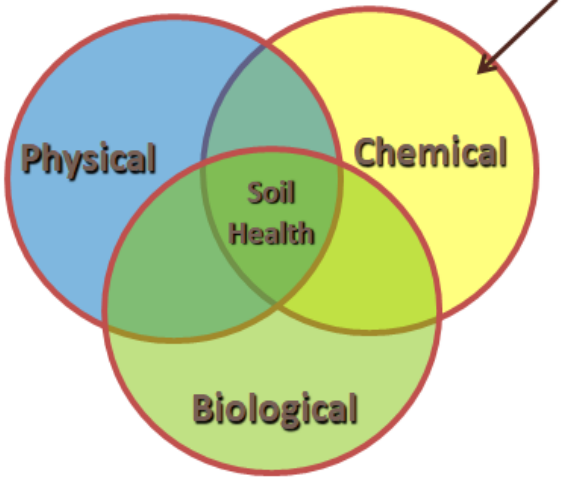
- Nutrients
  - N, P, K, Micronutrients
- Chemical Indicators
  - Base saturation; CEC; Electrical Conductivity; pH

USDA-NRCS

- Physical Indicators
  - Available water holding capacity; bulk density; infiltration rate; erosion rating; penetration resistance; texture; water stable aggregation
- Biological indicators
  - N mineralization; Organic carbon; carbon mineralization

Healthy soil supports function

- Good Tilth (structure)
- Physical support for plants
- Aeration
- Soil water storage and movement
- Resistance to erosion
- Physical root proliferation & organism movement



Focus of Soil Testing and Nutrient Management Planning

- Nutrient storage and release
- Salinity/toxicity prevention
- Energy (C) storage

- OM decomposition/accumulation
- Nutrient transformations & access
- Disease, disease suppression
- Well-supported microbial community, beneficials, producing plant growth promoting compounds
- Immobilization of toxins

Janice Thies- Cornell University

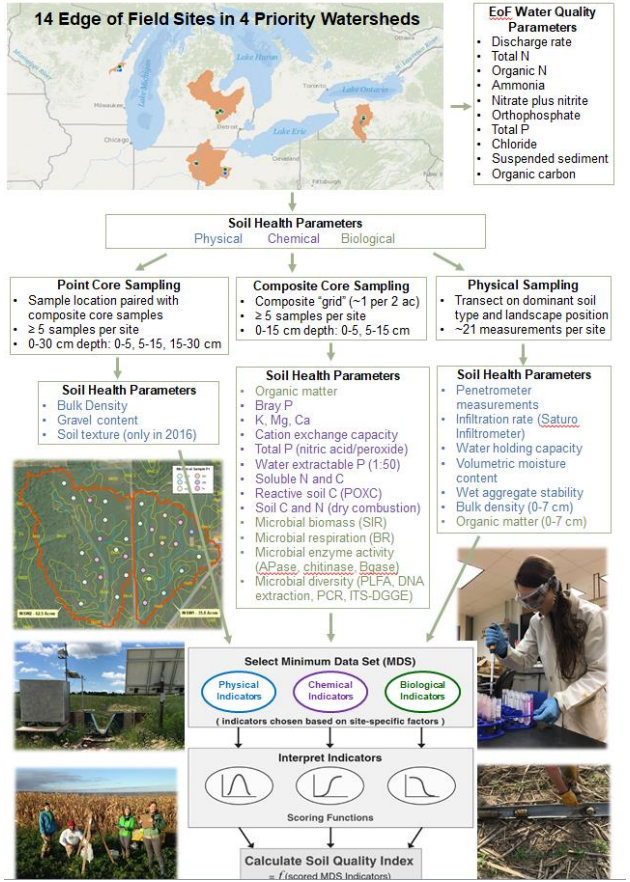
(Cornell) Soil health indicators test indicators

Soil Indicator	Soil Process (Function)
Soil Texture	affects soil analyses and interpretations
Available Water Capacity	plant-available water retention
Surface Hardness	shallow rooting, water intake, air exchange
Subsurface Hardness	deeper rooting, stored water access
Aggregate Stability	aeration, infiltration, shallow rooting, crusting
Organic Matter	energy/C storage, water and nutrient retention
ACE Soil Protein Index	readily-available N for mineralization
Respiration	metabolic activity of the microbial community
Active Carbon	organic material to support biological functions
pH	toxicity, nutrient availability
Phosphorus	P availability, environmental loss potential
Potassium	K availability
Minor Elements (Mg, Fe, Mn, Zn)	micronutrient availability, elemental imbalances

Cornell University

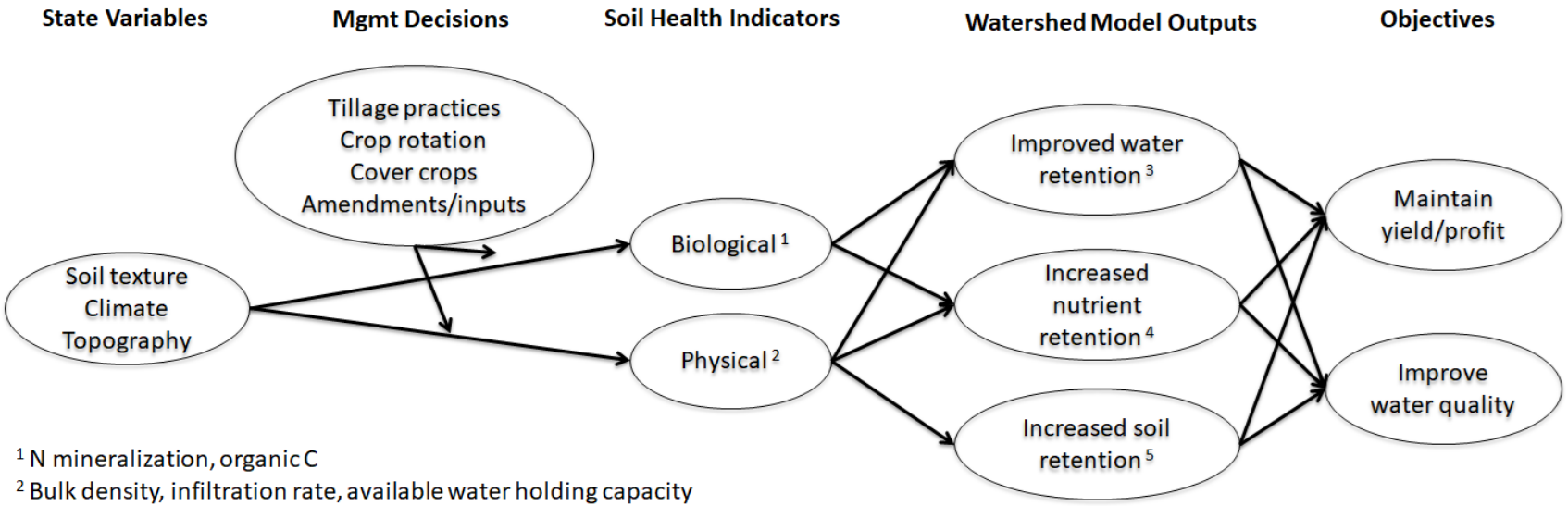
Linking EoF Water Quality to Soil Health

- Create a robust dataset of soil health at EoF and to connect field-scale soil parameters with water quality leave fields
- 14 EoF sites in WI, MI, IN, OH, NY
- Baseline sampling 2016-2017, second round sampling 2018
- Includes nearly all SHI endorsed Tier 1 soil health measurements
- Investigating relationships among microbial properties (biomass), soil structure (bulk density), soil resources (carbon pools), and exported resources (TP/SRP)
- 5 year project



Materials/information from UW-Green Bay

Conceptual design



[1] N mineralization, organic C
[2] Bulk density, infiltration rate, available water holding capacity
[3] Leaching, subsurface flow/drainage, surface flow
[4] N/P pools in soil, N/P export surface/subsurface
[5] Soil loss

Current models and soil health inputs

- Best or most viable model?
  - SWAT, APEX, RUSLE2, NTT, P Index, DAYCENT-WQ, PAWS (process-based adaptive watershed simulator, MiState co-developed)

- SWAT/APEX
  - %OM in each field → SSURGO - could influence infiltration and AWC
  - Ksat in each field → SSURGO - infiltration
  - AWC → SSURGO (or calculated from SSURGO)
  - Hydrologic soil group - incorporates slope and governs C:N
  - Organic N and P
  - Labile P
  - OVN/USLEP- soil erosion from surface roughness

Model limitations, gaps, immediate needs

- Models were developed with a specific goal in mind; are models conducive to including soil health?
- Static vs. dynamic parameters
  - For example, soil aggregate stability will likely change over time from the addition of organic amendments… can models account for this change over time
- Temporal influences of BMPs
- Data
  - What is the correct soil health information we need to be collecting?
  - Need for more EoF projects and a platform to coordinate datasets across projects
  - Data mining from previous efforts… do we already have good baseline data?
- Research question
  - It is generally accepted that improved soil health increases infiltration…. Is it wise to promote additional infiltration via improved soil health on fields with subsurface tiles?

Soil health gaps

- Long term, field-base data from large number of sites with high diversification/alt management strategies
  - Soil health and water quality data… usually only water quality
- Need to leverage existing research programs for data collection; practitioners and researchers need a concrete list of soil parameters
- Clearer direction of nutrient management recommendations that consider soil health and contribution of SOM to plant nutrition
- What drives legume dominance in cover crop mixtures?
- What drives variation in N fixation rates

Next Steps

- Research(ish) paper
  - Defining soil health
  - How our understanding for soil health into models has changed
  - The evolution of models
  - Gaps in modeling – static vs. dynamic variables –
  - Immediate research needs and gaps

- Continuing the conversation and collaboration between researchers, practitioners, and policy implementers