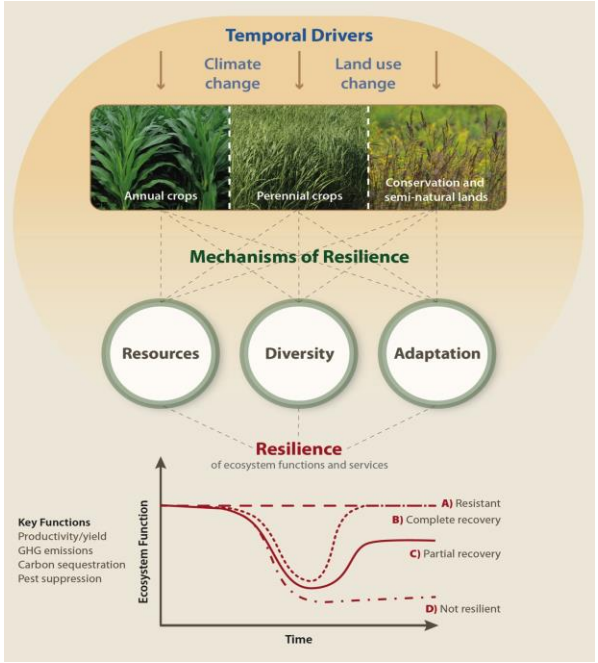
Resources

- Collaborators: Sarah Evans, Sandy Marquart-Pyatt, Phil Robertson, Steve Hamilton, Bruno Basso
- How do Resources facilitate resilience?
- Separate into natural science (soils) and social science (knowledge)



KBS LTER
Kellogg Biological Station
Long-term Ecological Research

NSF

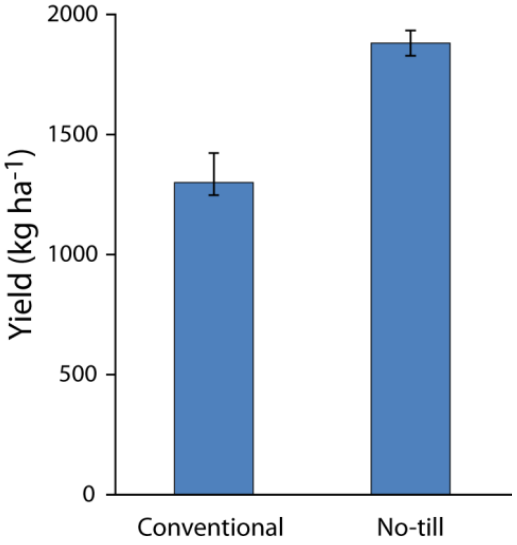
The Problem

- Widespread degradation of soils
- Rainfall is changing (longer dry periods, heavier rain)
- Complex mechanisms lead to resilience

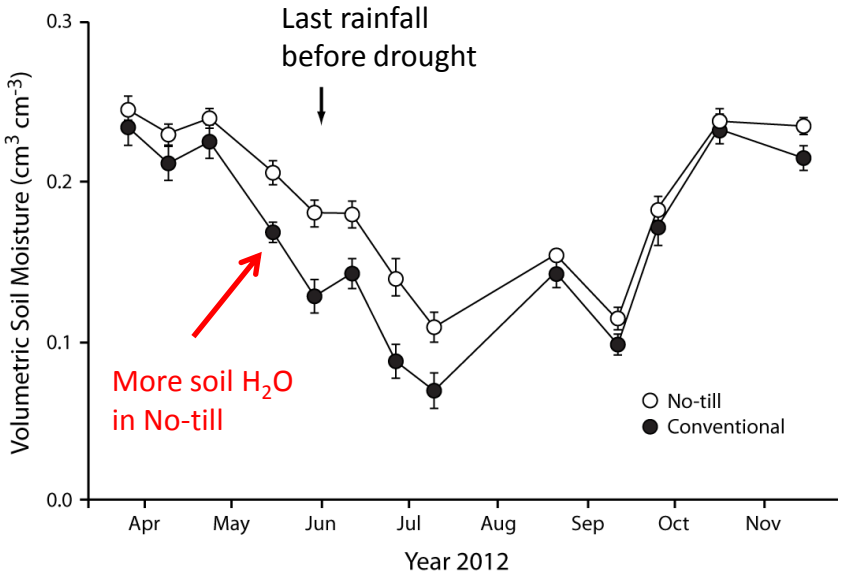
Soils (in particular, organic matter) are key to resilience of agricultural yield and other ecosystem services

Past results: yield reduction under the 2012 drought

Yield (soybean)



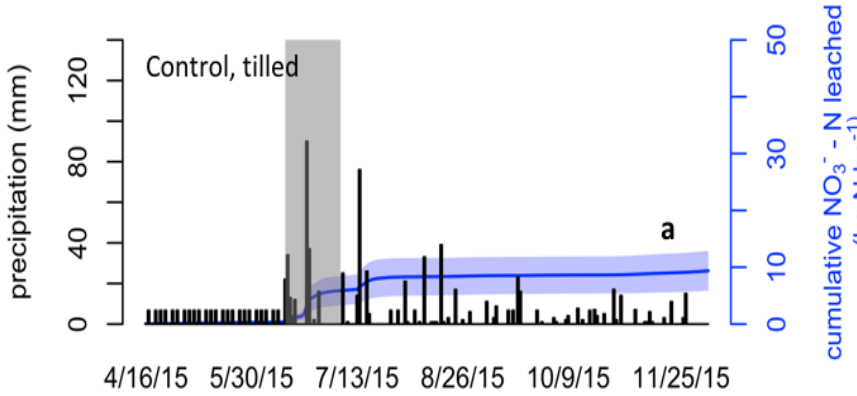
Soil Moisture

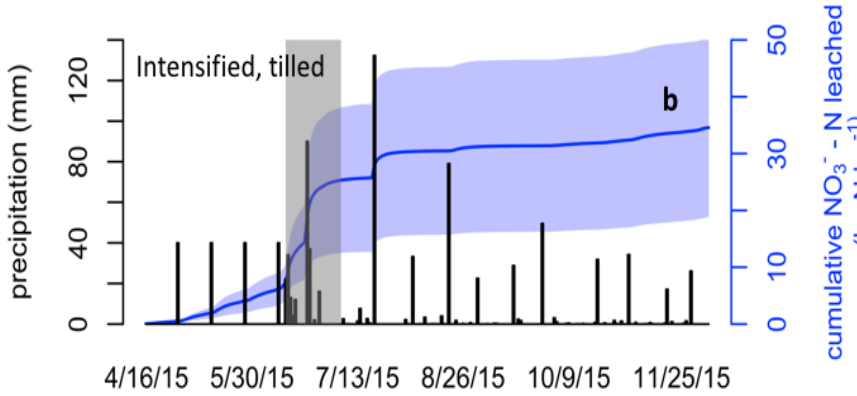


Soils in No-till contain ~20% more C (1 m depth) than those in Conventional!

Robertson et al. 2014, Syswerda et al. 2011

Past results: nitrate leaching under heavier rains





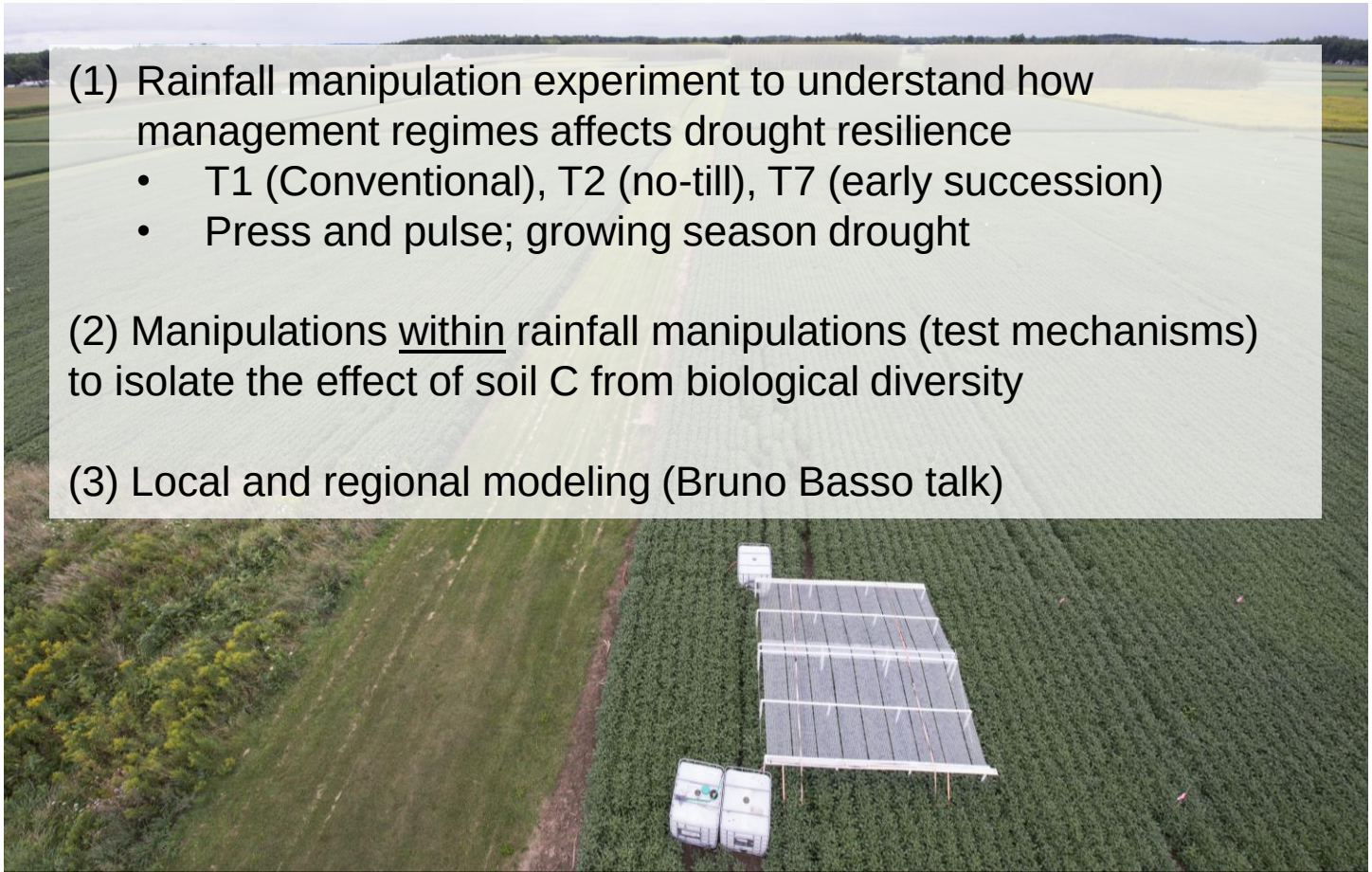
Hess et al., in review.

New Questions

To what extent can soil attributes stabilize ecosystem function?

Hypothesis: Soil C will increase resilience of primary production and reduce nutrient exports and GHG emissions during drought

Approaches

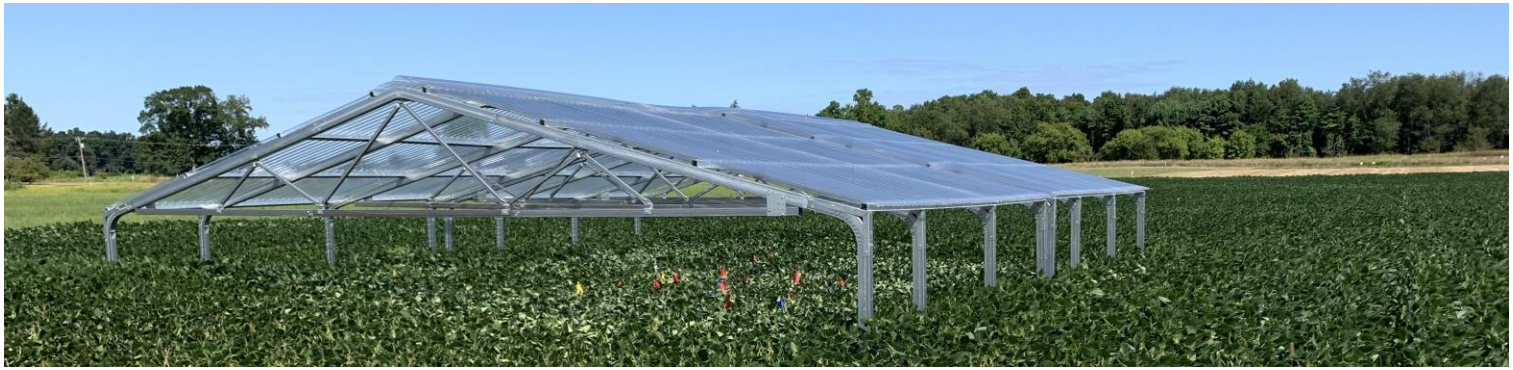


(1) Rainfall manipulation experiment to understand how management regimes affects drought resilience
- T1 (Conventional), T2 (no-till), T7 (early succession)
- Press and pulse; growing season drought

(2) Manipulations <u>within</u> rainfall manipulations (test mechanisms) to isolate the effect of soil C from biological diversity

(3) Local and regional modeling (Bruno Basso talk)

Approaches



+ Carbon	+ Carbon + Microbes
+ Microbes (w/ media)	Control

Preliminary work underway to inform treatments (more on field tour!)

Collaboration opportunities

- Leverage our rainout shelter experiment!
  - Measure other drought or treatment responses
- Cross-site comparisons
  - Role of soil carbon across sites
  - Other drought studies
- Link biological and social:
  - E.g., how does knowledge of soil health alter farmer practices?

Building long-term social data

- Why a panel farmer survey?
- Human decisions & actions are heterogeneous & contextually embedded.

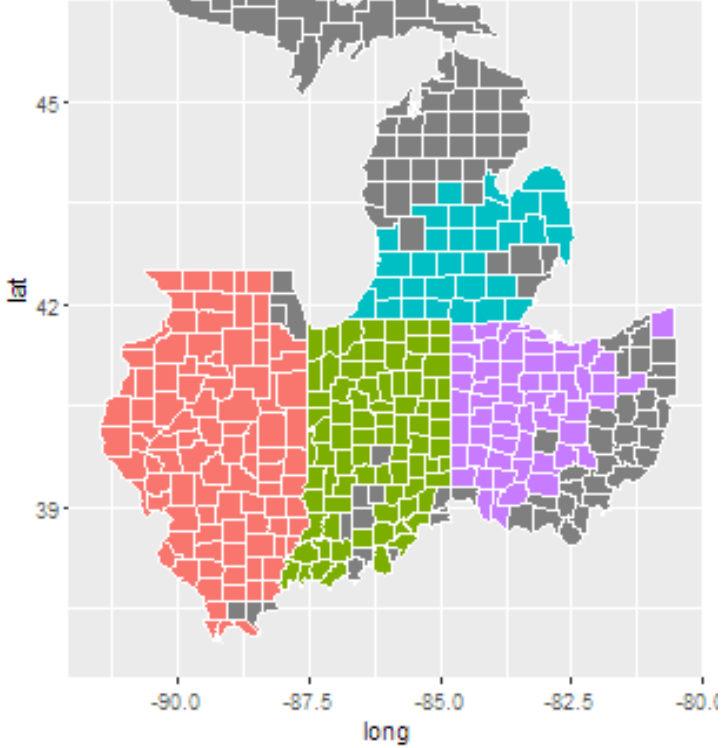
- Farmer decision-making
- Information, knowledge & practice adoption
- Management: crop, nutrient, pest, soil

- Farming Challenges & Farmer Concerns: Resilience

PANEL FARMER SURVEY

- 2017 baseline
- Eastern corn belt
  - Illinois, Indiana, Michigan, Ohio
- Management at the farm level
  & of one field planted to corn in 2016

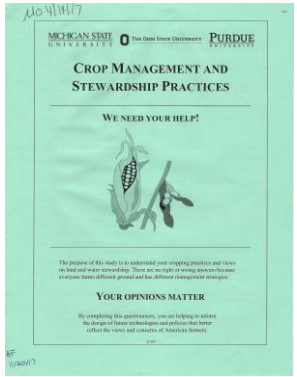
- Initial selection criteria:
- 1) counties with at least 15% of total land planted in corn or soybeans in 2016
- 2) farms planting more than 100 acres of corn or soybeans in 2016



Sampling Design by wave

PANEL FARMER SURVEY

Wave 1 2017



28% response rate

2,295 responses
Average farmer:
· 60.8 years old
· 31.7 years as primary decision-maker (pdm)
Average farm size:
· 498 acres

Wave 2 2018

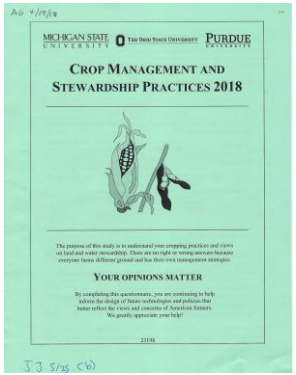
Wave 3 2019

Sampling Design by wave

PANEL FARMER SURVEY

Wave 1 2017

Wave 2 2018


MICHIGAN STATE UNIVERSITY · THE OHIO STATE UNIVERSITY · PURDUE UNIVERSITY

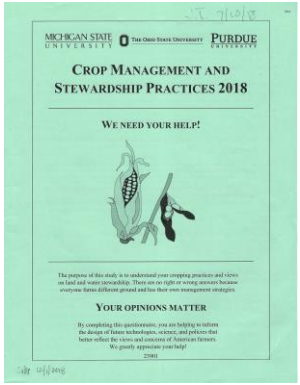
CROP MANAGEMENT AND STEWARDSHIP PRACTICES 2018

YOUR OPINIONS MATTER

65% response rate

1,480 responses

Average farmer:
· 62 years old
· 33 years pdm
Average farm:
<500 acres


MICHIGAN STATE UNIVERSITY · THE OHIO STATE UNIVERSITY · PURDUE UNIVERSITY

CROP MANAGEMENT AND STEWARDSHIP PRACTICES 2018

WE NEED YOUR HELP!

YOUR OPINIONS MATTER

28% response rate

981 responses
Average farmer:
· 61 years old
· 31 years pdm
Average farm:
· 462 acres

Wave 3 2019

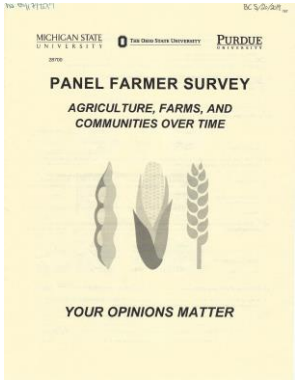
Sampling Design by wave

Wave 1 2017

Wave 2 2018

PANEL FARMER SURVEY

Wave 3 2019



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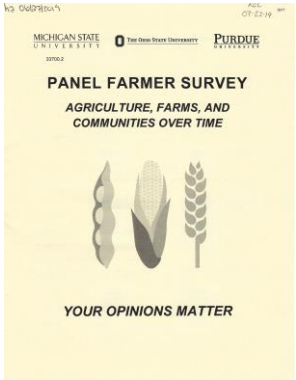
1,402 responses



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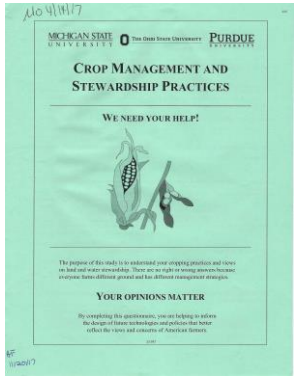
1,080 responses

Sampling Design by wave

PANEL FARMER SURVEY

Wave 1 2017



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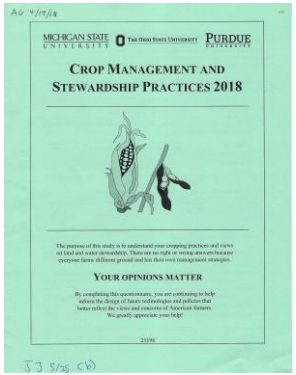

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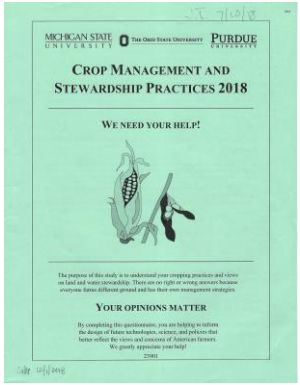

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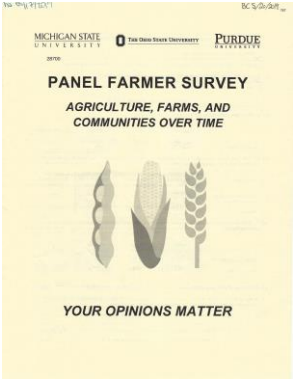

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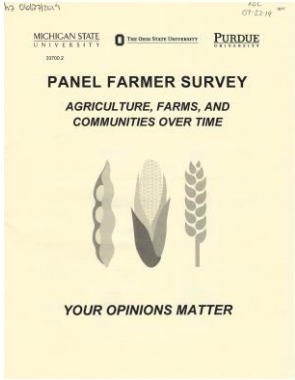


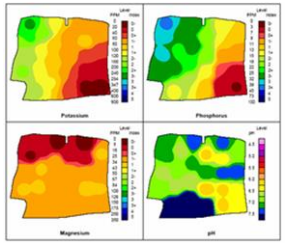
26% response rate

1,080 responses

Early findings & ongoing work

Decision aids

18% PSNT

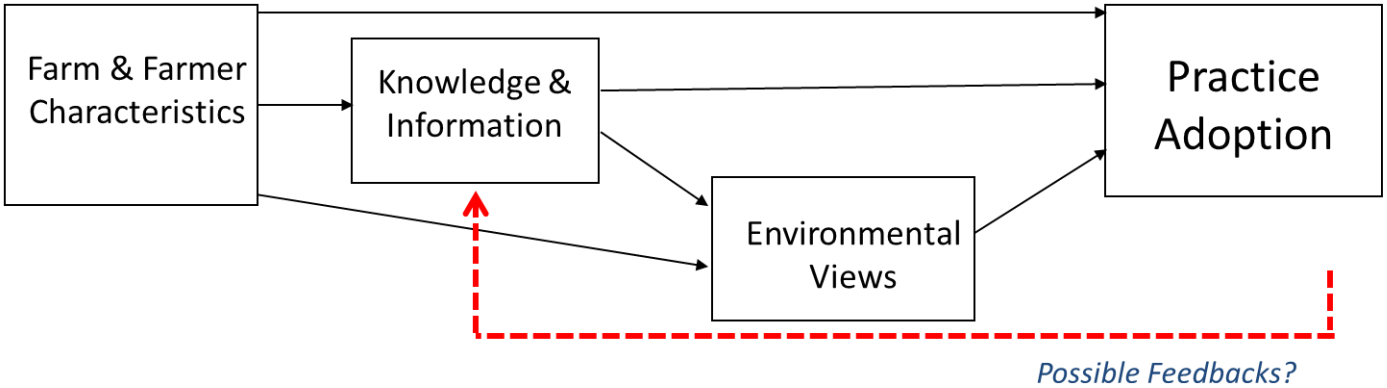


83% yield maps

Precision application

28% vr N

64% vr P or K



Sources: Denny 2019; Marquart-Pyatt et al. in prep

New Questions: Social Resources

What influences farmer decisions to manage lands in ways that improve soil resource stocks?

Hypothesis: Using conservation practices increases farmers' soil resource knowledge, and influences information they access and their likelihood to adopt ecologically-based practices.

Soybeans growing in last year's corn stubble

Rye between harvested corn

For soil health, nutrient and crop management, and extreme weather events:

(1) Which practices are more likely to be adopted, and in what combinations?
(2) Which information and knowledge are more likely to influence adoption, and in what combinations?

- New questions for farmer survey

(3) How does knowledge increase resilience at the farm scale & the regional scale?

What's on the horizon

- Outreach and education: Julie Doll, State partners
- Adaptation
- Crafting social-ecological questions:
  - soil health, climate, drought, flooding, biodiversity, technology
- Monitoring change.
- From understanding to prediction.
- Planning Waves 4-6—ideas welcome!