SOM and Ecosystem services – some thoughts

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SOM and ecosystem services

• Soil chemical/biological
  • Energy and C skeletons for soil biota
  • Nutrient supply – esp. N, P & S
  • Ion exchange/retention

• Soil physical
  • Soil aggregate formation and stabilization
  • Macro-porosity and pore size distribution
    • Infiltration vs runoff (erosion)
    • Water holding capacity

• Biological C sink
We can safely say more SOM is (almost) always better, but

How do we get there?
‘The Soil C dilemma: shall we hoard it or use it?’

Janzen (2006)

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Requires organic matter degradation
Requires o.m. preservation
How to resolve the ‘dilemma’?

**Increase C inputs, while reducing ‘unproductive’ respiratory losses**
Trade-offs and caveats

- Agronomic production goal has been to maximize C off-take (thus reducing C inputs)
  - Breeding in favor of increasing harvest index (HI)
  - Crop residue use for forage and fuel
  - Fertilizer substitution for green manures/rotations

Thus increasing C inputs means either foregoing productivity potential (bad) or finding ‘niches’ to increase C inputs without sacrificing yields.
Trade-offs and caveats

- Sequestration of C requires sequestration of N (and P)
  - ‘universal’ C:N ratios of mineral-associated SOM
    - Consistent with microbial products as the dominant source of stabilized SOM
  - Implies a relatively tightly-constrained demand for N (& P) need to build SOM

This means higher C inputs, alone, are not enough! Greater N(&P) inputs and/or reduced losses are needed to satisfy both plant and SOM stabilization
The good news

- In the context of small-holder/subsistence agriculture, increasing **per ha yields** are broadly consistent with goals of increasing SOM
  - Usually ‘baseline condition’ is low
    - Soils depleted in SOM (far below saturation capacity)
    - Yields low – productivity well below site potential
    - Residues often already removed

- Moderate intensification of crop production (increased nutrient subsidies, improved plant varieties, improved cropping systems) can **both** increase yields **and** C inputs
The good news

- In general, we know the techniques that work (e.g. TSBF, ICRAF, others)
  - Avoided conversion of native ecosystems
  - Set-aside/rehab of degraded croplands & grasslands
  - Increase nutrient inputs to nutrient-deficient cropland/grazing land
  - Appropriate agroforestry systems
  - Tighter nutrient and water cycles – increase NUE & WUE
  - Elimination of ‘non-productive’ fallows
  - Reduced soil physical (tillage) disturbance
Barriers and Challenges

- Promoting SOM improvements share the same constraints as productivity/livelihood improvements (financial, labor, education, training, etc.), but in addition...

- SOM change is slow, many benefits are perceived only after several years
  - Requires long-term commitment and support
  - Requires tangible incentives in the short-term, i.e., positive yield responses, payments for ecosystem services, ??
Barriers and Challenges

- **Assessment** of programmatic success (enhancing SOM) is more challenging (than, e.g., yield improvement)
  - Slow changes, high spatial variability, other measurement issues

- Available modeling & measurement tools (e.g., CBP) can provide reasonable magnitude and direction of change
  - Dependent on capability to collect information on **local-scale** land use and management ‘activity data’, cheaply and efficiently – key priority

- Needs support from **strategic** ground-based measurement and monitoring systems