GREAT LAKES BIOENERGY RESEARCH CENTER

Economic sustainability and ecosystem services valuation

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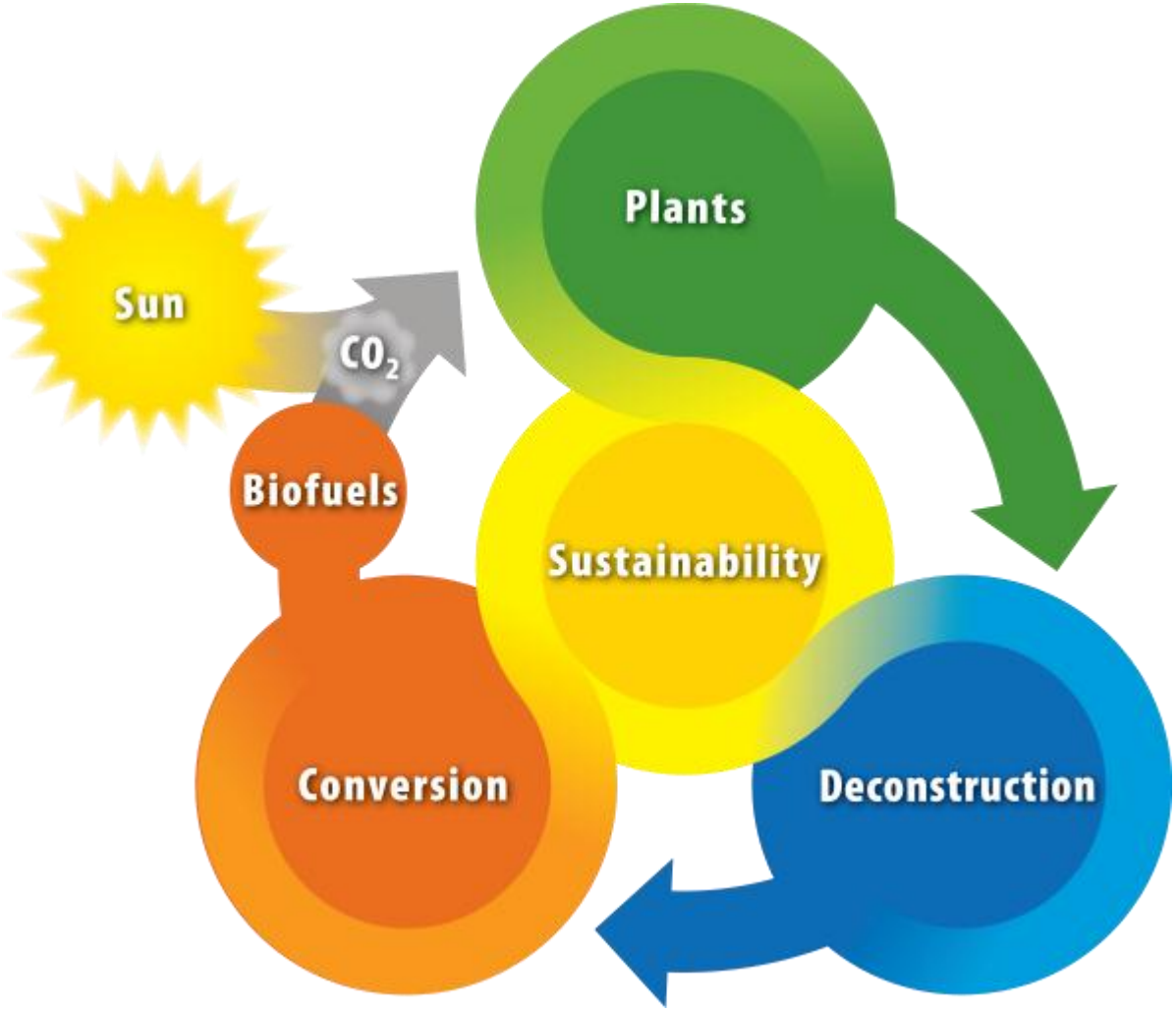
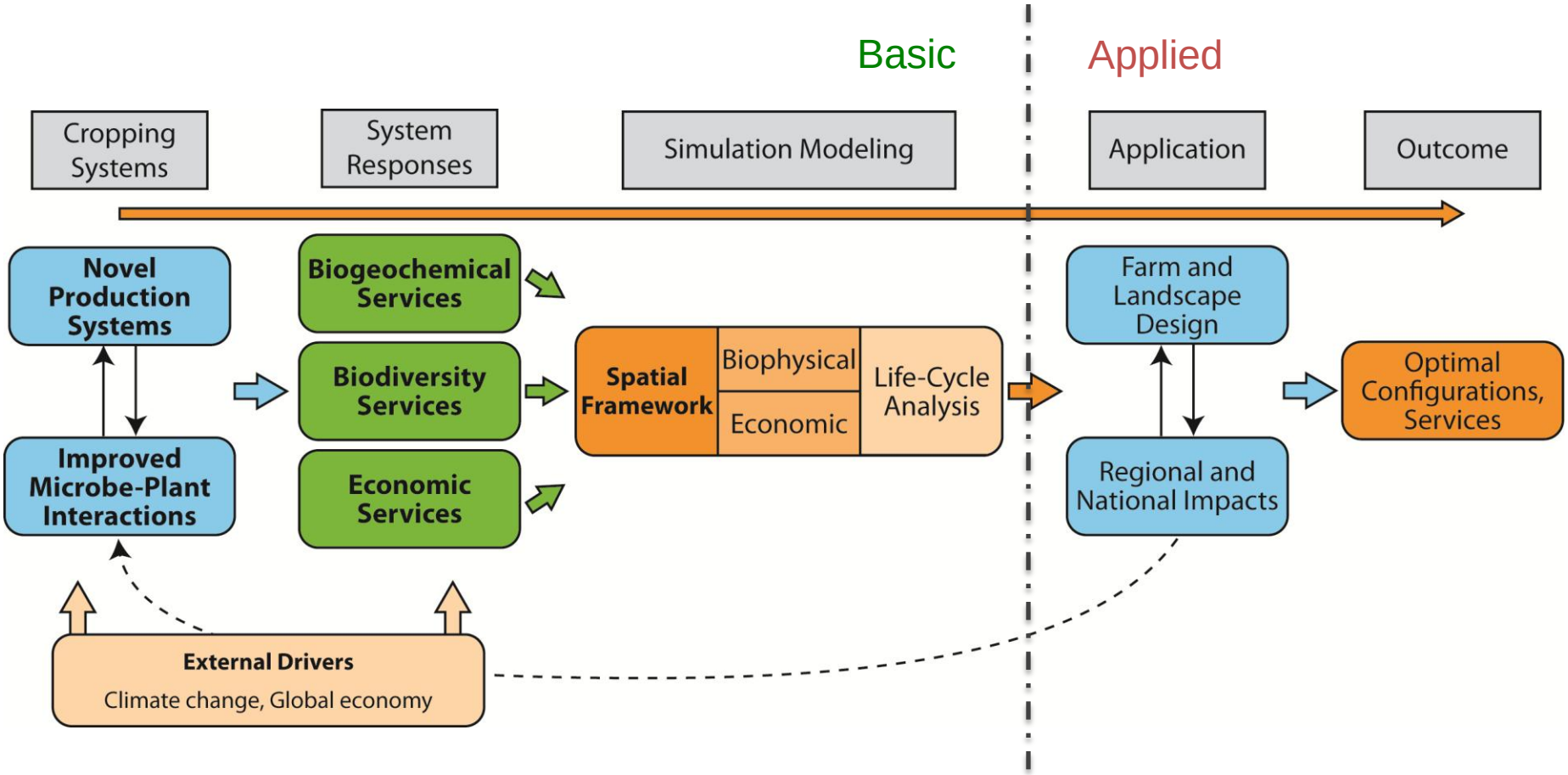
U.S. DEPARTMENT OF ENERGY

DOE Bioenergy Research Centers

GLBRC Research



GLBRC Sustainability Research Roadmap



GLBRC's guidelines for sustainable feedstocks

Productive

- Economically profitable
- Favorable energy return
- Land-conserving

Perennial

- Cost less to maintain
- Emit fewer greenhouse gases
- Less prone to soil erosion and water pollution

Polyculture-tolerant (diverse)

- Pest and disease suppression
- Nitrogen fixation
- Nutrient and carbon retention
- Pollination services to surrounding crops

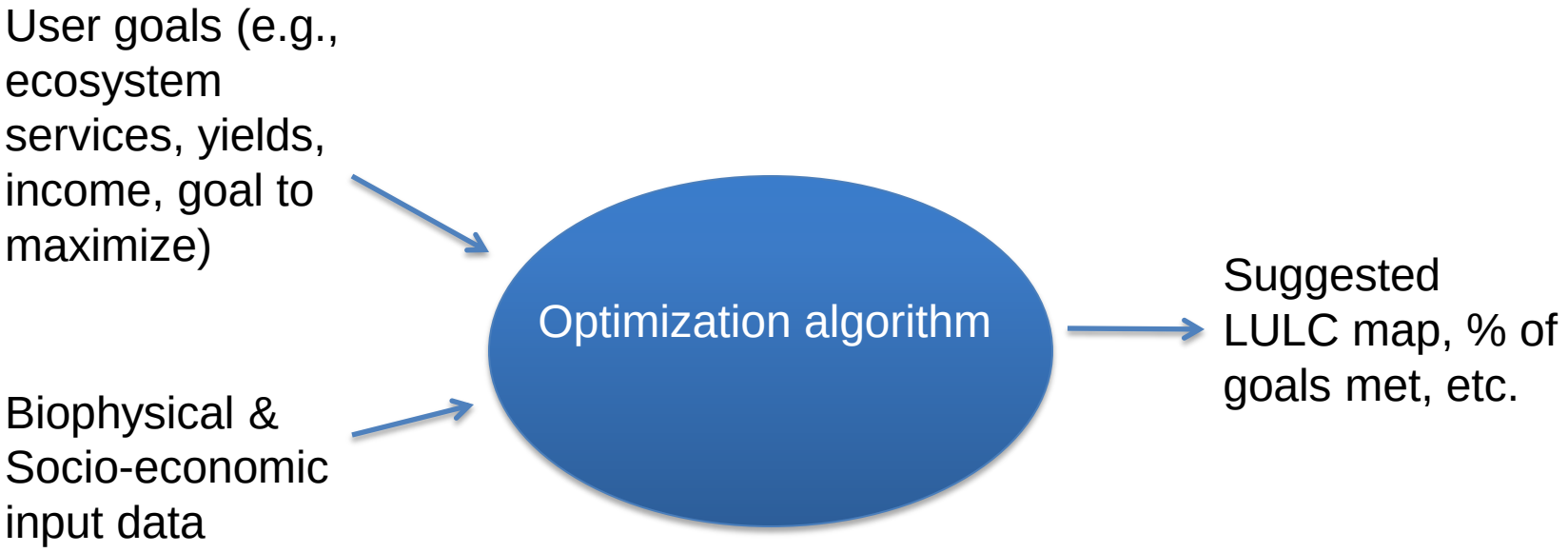
Positioned appropriately

- Configuration of landscapes is key

So, how do we get here?

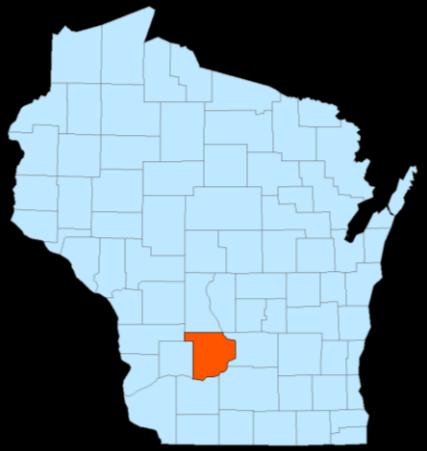
CREDIT: ERIK SANDBERG/BERNSTEIN & ANDRIULLI
From, Robertson et al. 2008 Science

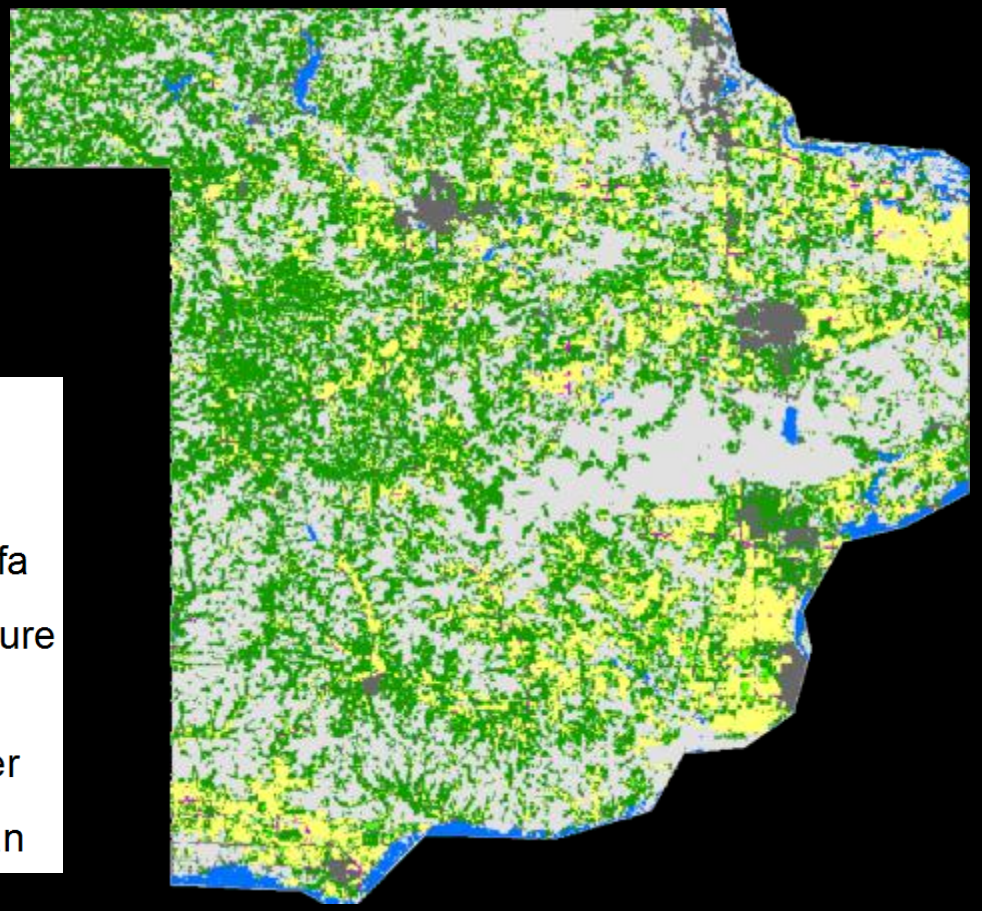
How do we assess multi-dimensional tradeoffs?



Diehl & Jackson, unpublished

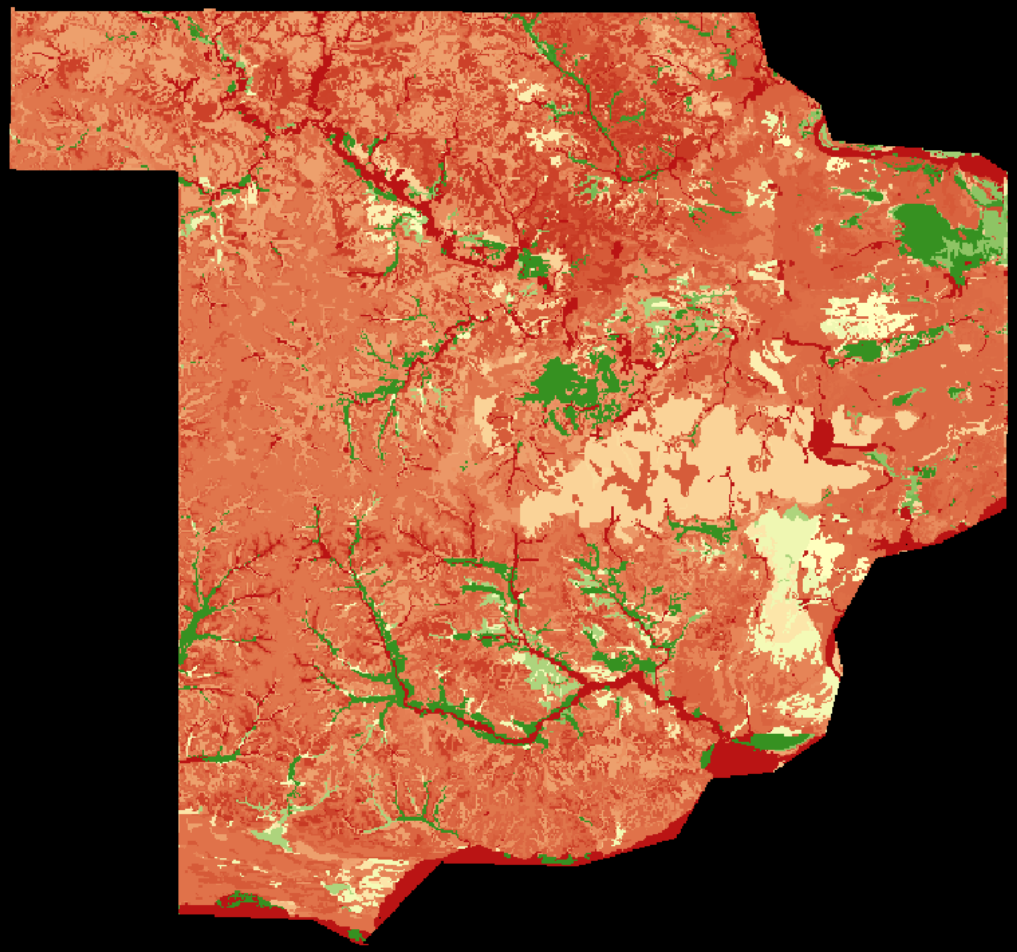
Sauk County, WI



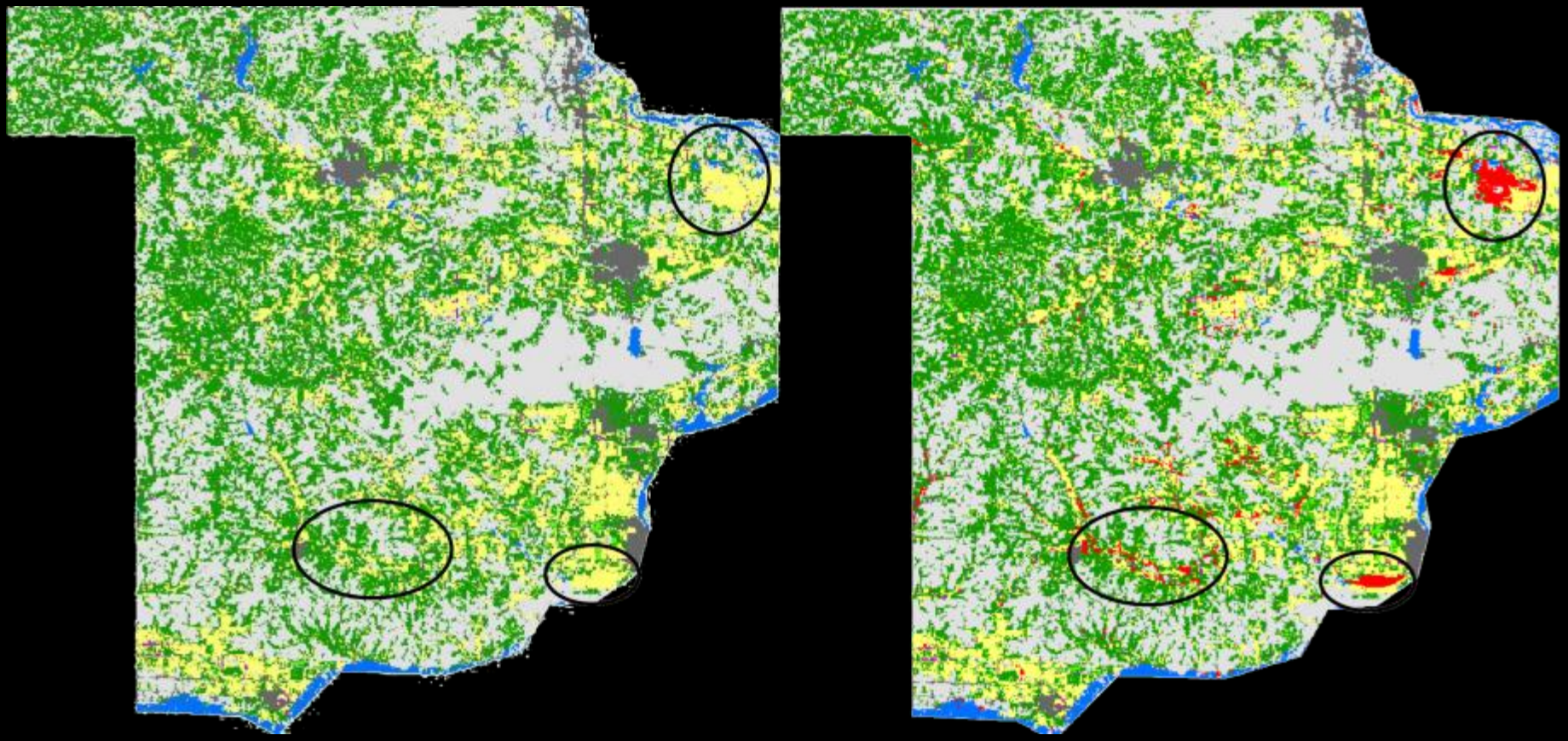


Biophysical and Socio-economic input data

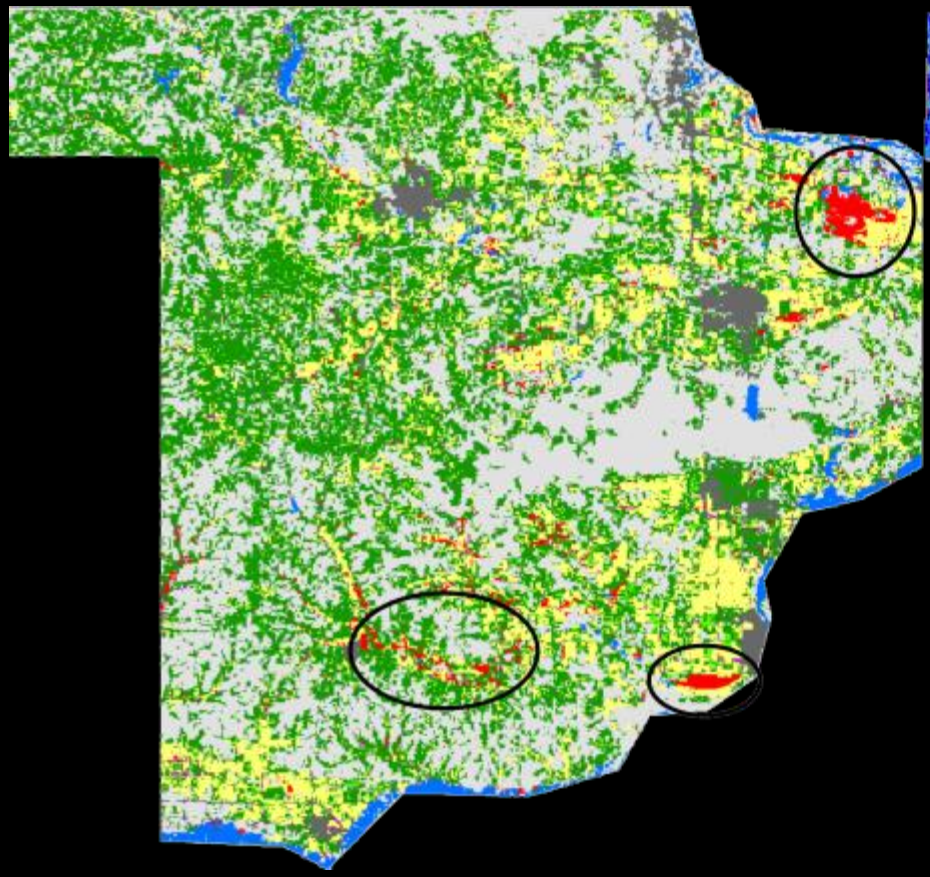
- Soil Retention (USLE)
- 20-year Soil Carbon (SSURGO + IPCC)
- Yield & Net Income (SSURGO + user prices)



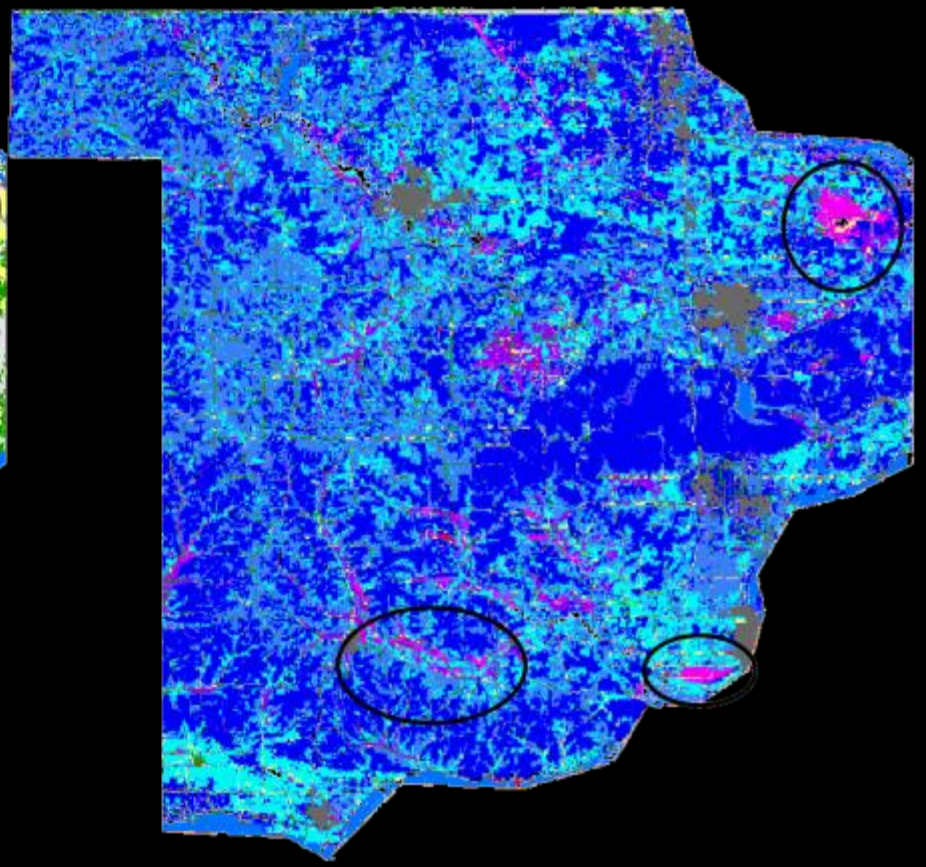
Goal: 30,000 Mg switchgrass, minimize net soil C loss, soil loss, & income loss

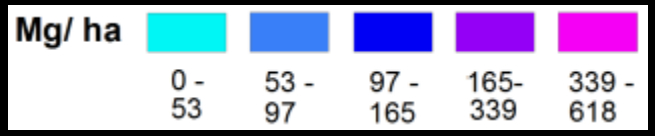


What drives the clustering of switchgrass?



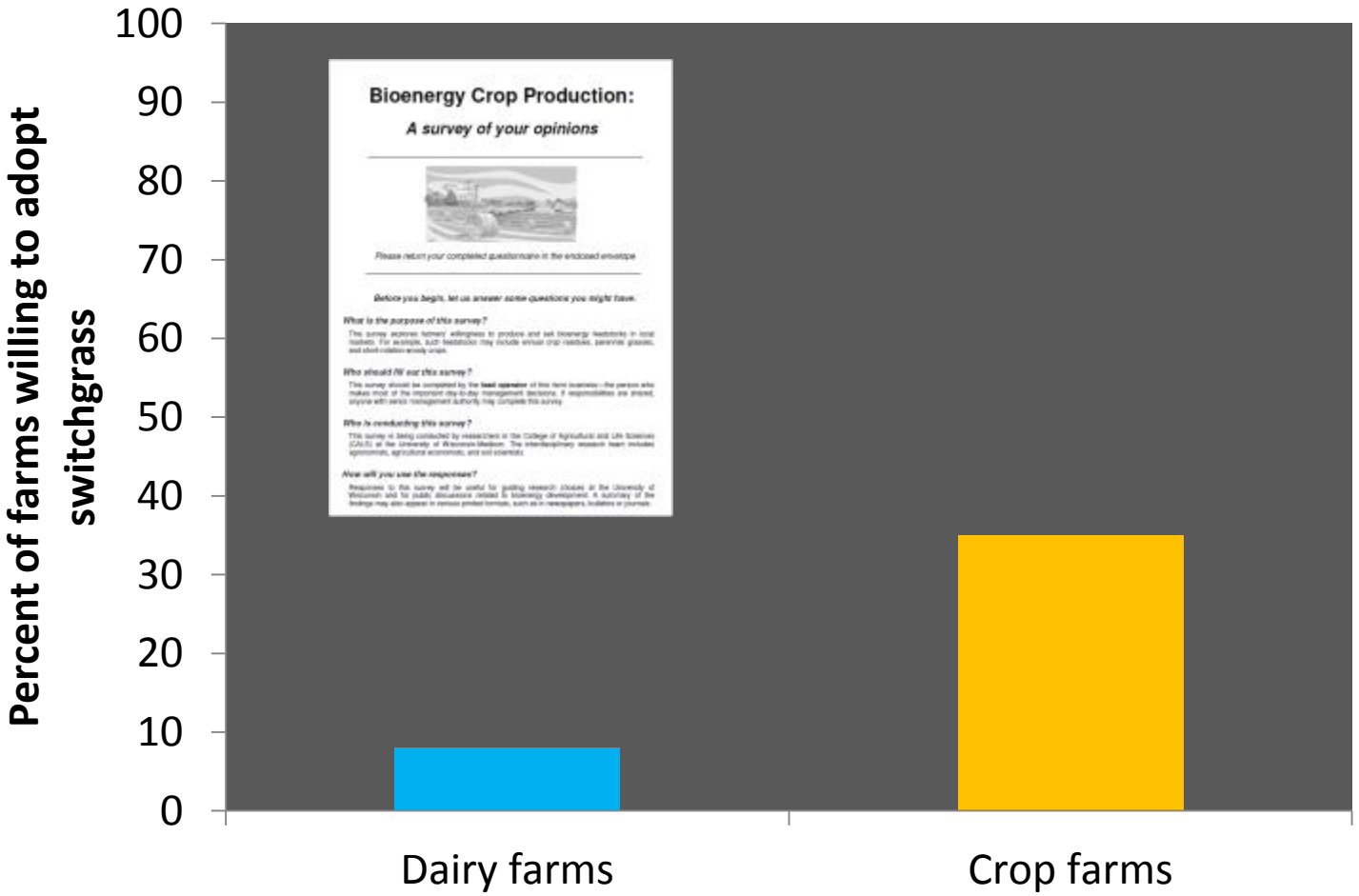
Land cover





Soil carbon

Surveys indicate low willingness to adopt perennial crops

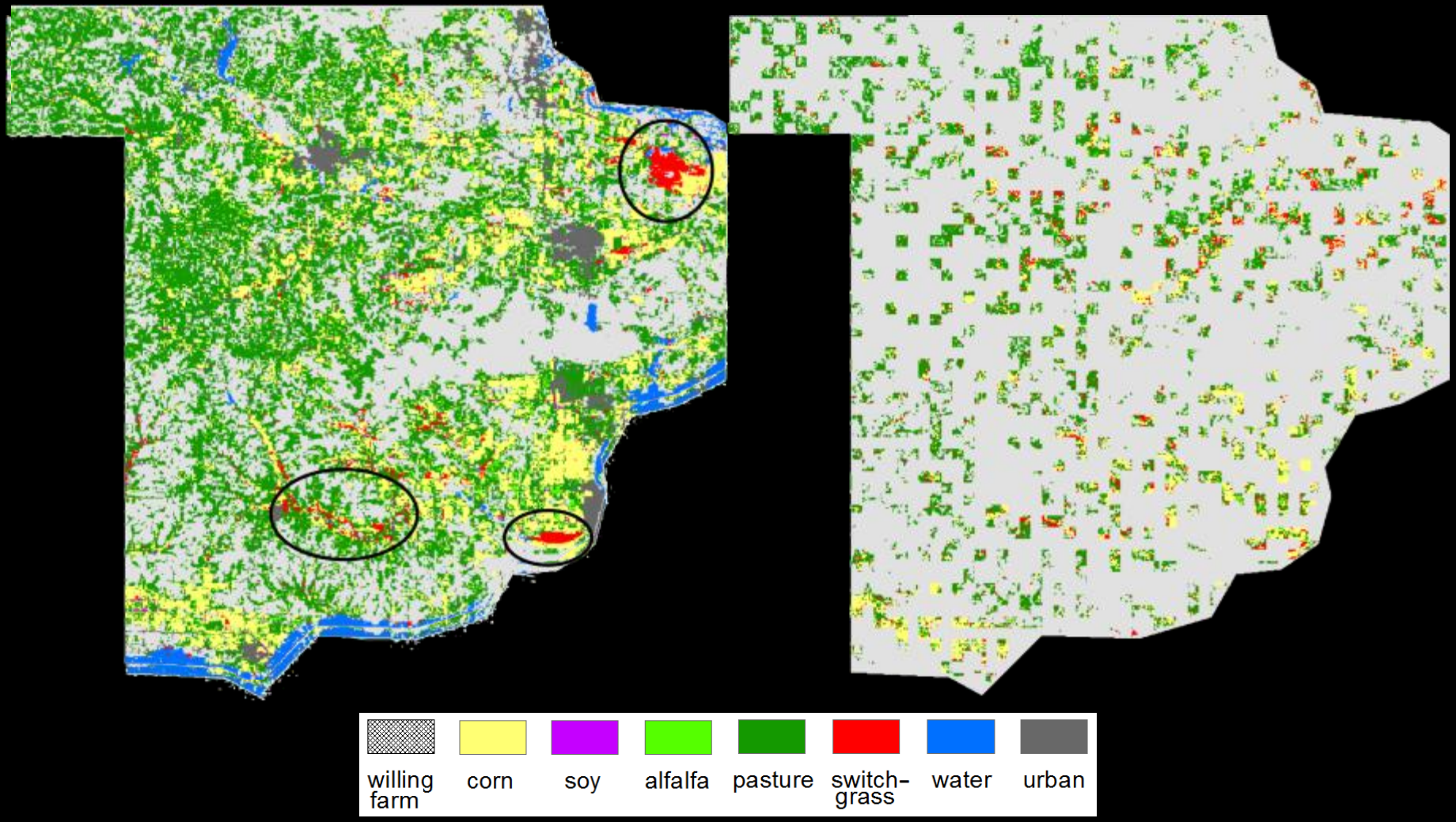


Mooney et al. 2013

GLBRC economic studies paint a bleak picture for perennial cellulosic crops

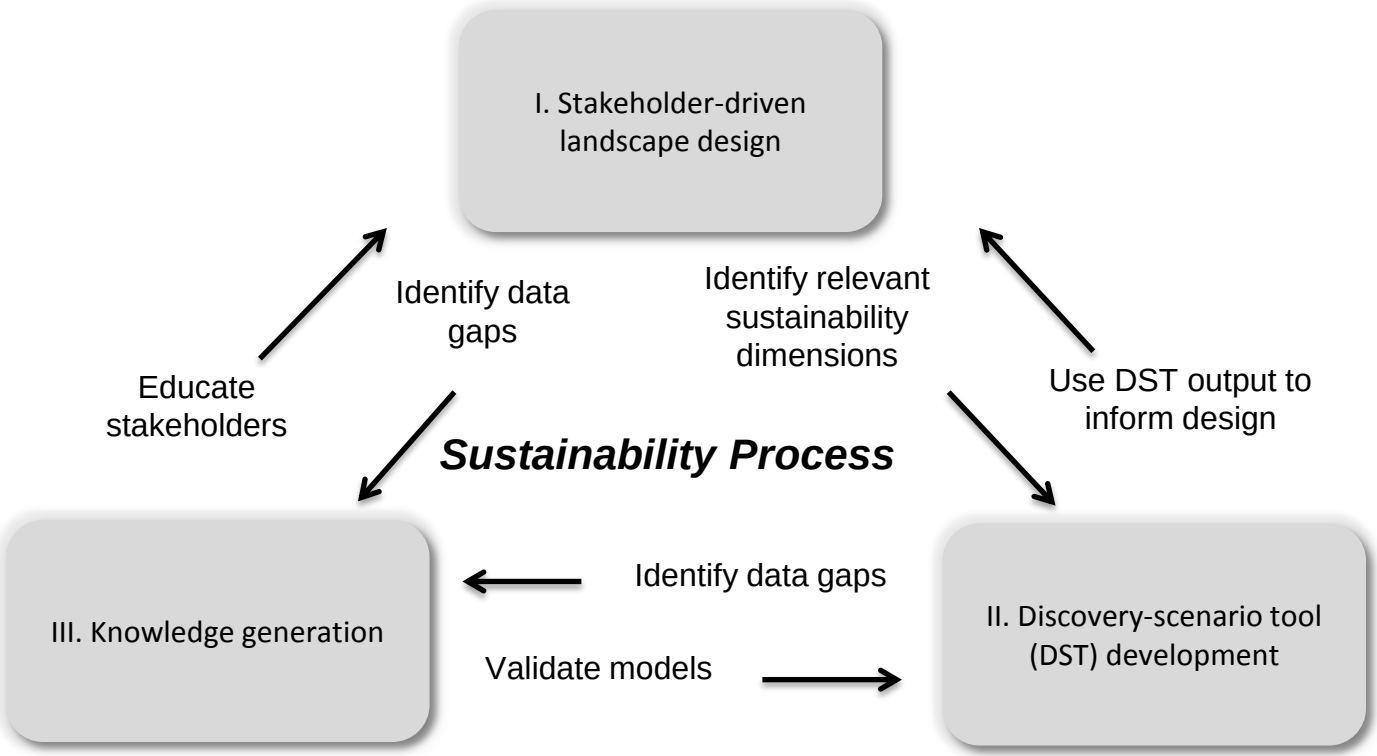
1. Corn already profitable (Jiang and Swinton 2009)
2. Corn more adaptable and opportunistic (James et al. 2010, Song et al. 2011)
3. Bioenergy crops may drive up food prices (Babcock, 2008), favoring planting of food crops (Hayes et al. 2009)

Goal: 30,000 Mg switchgrass, no loss of services + "willingness" constraint



Goal: 30,000 Mg switchgrass, no loss of services + "willingness" constraint

Modeled Service Response	30k Mg	30k Mg + constraint
Switchgrass biomass (Mg /ha)	+10.09	+9.27
Estimated annual income (per ha)	-$5	-$19
Soil Carbon change after 20 years (Mg/ha)	+0.39	+1.78
Soil Retention (Mg/ha)	+0.00	+0.23



Jackson & Gratton, unpublished

Embed the *Sustainability Process* within a place-based deployment scheme to create LandLabs (sensu Jordan et al. 2013)