Soil Health: Economics and Ranch Sustainability

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Soil Health and Ranching

- Forage productivity
- Soil erosion
- Translate into ranch effects
Soil Health and Economics on Rangelands

- No direct research on this topic for rangelands
  - More on croplands

- Likely to be more anecdotal at this point
  - Improved forage production due to factors such as better soil structure, more organic matter, better nutrient cycles, microbial populations

- From an economic standpoint, we would like to know answers such as:
  - If you improve soil structure by X%, the response in forage production is Y%
  - If you change the microbial population, what does that mean in terms of forage quality or quantity?
Greater Sage-Grouse Ranch Model

Show the impacts of changes in forage availability
Simplified Ranch
Ranch Business Model
• Basic premises
  • Cattle somewhere every day
  • Yearlong operation
  • Substitute feeds
Sources of Uncertainty

Wyoming Steer Calf Prices, Adjusted 2012

Precipitation
Results - Base Model

- 590 Cows
- Gross annual returns = $369,939
- Average Net Cash Income = $112,895
- Fixed costs = $40,434
- Negative net annual income occurred 22% of the time
Simulations

- 40 years, 100 runs, random prices, average precipitation
- Representative ranches - Idaho, Nevada, Oregon, Wyoming
- Turn out 1 month late, Take off 1 month early, both
- Reduce permit by 25, 50, 75, 100 %
Seasonal Dependency

- 3/1-4/15: BLM
- 4/16-5/15: Deeded
- 5/16-9/15: State
- 9/16-10/15: Hayland converted to pasture
- 10/16-11/15: Meadow hayland grazed/hayed
- 11/16-12/15: Raised meadow hay fed
- 12/16-2/28: Purchased meadow hay

Purchased alfalfa hay
So what does this mean for soil health?

- NRCS practices aimed at improving conservation use of rangelands
- Practices that potentially increase forage production - prescribed grazing, seeding, overstory removal
- Practices that potentially improve grazing distribution - fencing, water development
- If these simultaneously improve soil health (C transformation, nutrient cycling, soil structure, microbial health), then it is possible to conduct an economic analysis
  - Difficult to tease out causes
  - Even more difficult to tease out which part of soil health
Net Present Value

\[ NPV = \sum_{t=0}^{T} (Sales_t - Cost_t)(1 + r)^{-t} - \text{Initial investment}_0 \]

Where sales is a function of production.

NRCS has spreadsheets that will do these calculations
Needs the biological responses
Caveats

- Improving forage quality or quantity in any given season does not mean it is useful to the yearlong operation
- Have to balance supply of forage with demand for forage
- Our examples with sage-grouse assume a loss of forage and ranch adjusts. The same method can be used to look at forage increases
Caveats

- This only looks at the private benefit from improving forage production.
- What other values does society gain?
- Can we place values on those?
  - What is more wildlife habitat worth?
  - What is the value of less soil erosion?
  - What is the value of a soil microbe?
  - What is the value of society “knowing” rangelands are being properly managed?
Sustainability
Social, Economic, and Ecological
Economic
Social
Ecological
Economic
Still sustainable?
ISEEC Framework

- Biophysical and Social/Economic over time
- Nexus is the Ecosystem Services
- Only things that humans want and need have value
Effects of Soil Health on Sustainability

- In our framework, soil is one of the basic biophysical components.
- Improving soil health leads to a variety of effects on the ecosystem, including forage production.

Ecological

Social

Economic
Effects of Soil Health on Sustainability

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- To the extent that society wants more red meat, there is a derived demand for forage (an ecosystem service)
Effects of Soil Health on Sustainability

- In our framework, soil is one of the basic biophysical components.
- Improving soil health leads to a variety of effects on the ecosystem, including forage production.
- To the extent that society wants more red meat, there is a derived demand for forage (an ecosystem service).
- If a rancher can produce that red meat at a profit, they will supply that to society.