

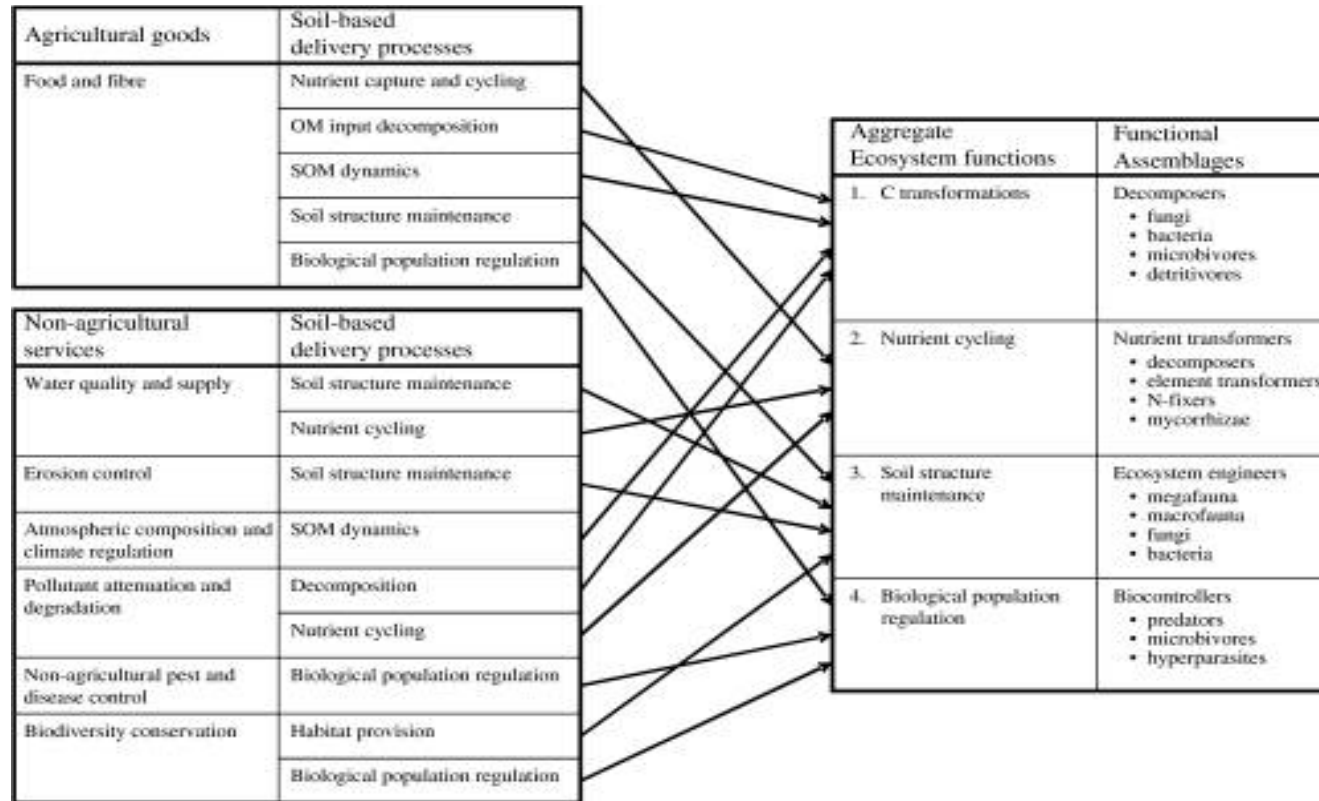
Soil Health: Economics and Ranch Sustainability

John Tanaka | University of Wyoming Agricultural Experiment Station,
Sustainable Rangelands Roundtable



UNIVERSITY OF WYOMING





Kibblewhite, M.G., K. Ritz, M.J. Swift. 2008. Soil health in agricultural systems. *Philosophical Transactions of the Royal Society B: Biological Sciences* 363(1492): 685-701.

Soil Health and Ranching

- ▶ Forage productivity
- ▶ Soil erosion
- ▶ Translate into ranch effects



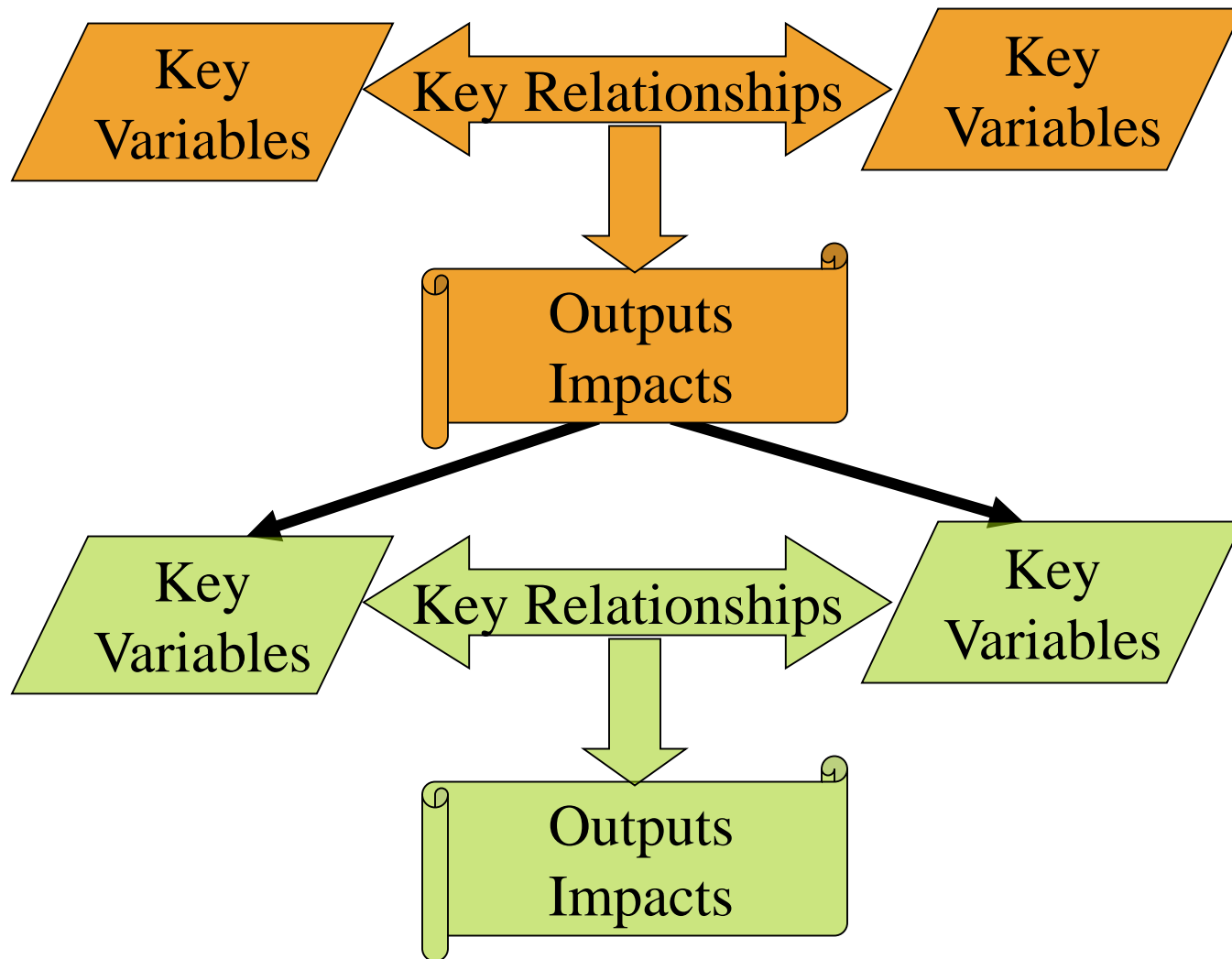
Soil Health and Economics on Rangelands

- ▶ 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

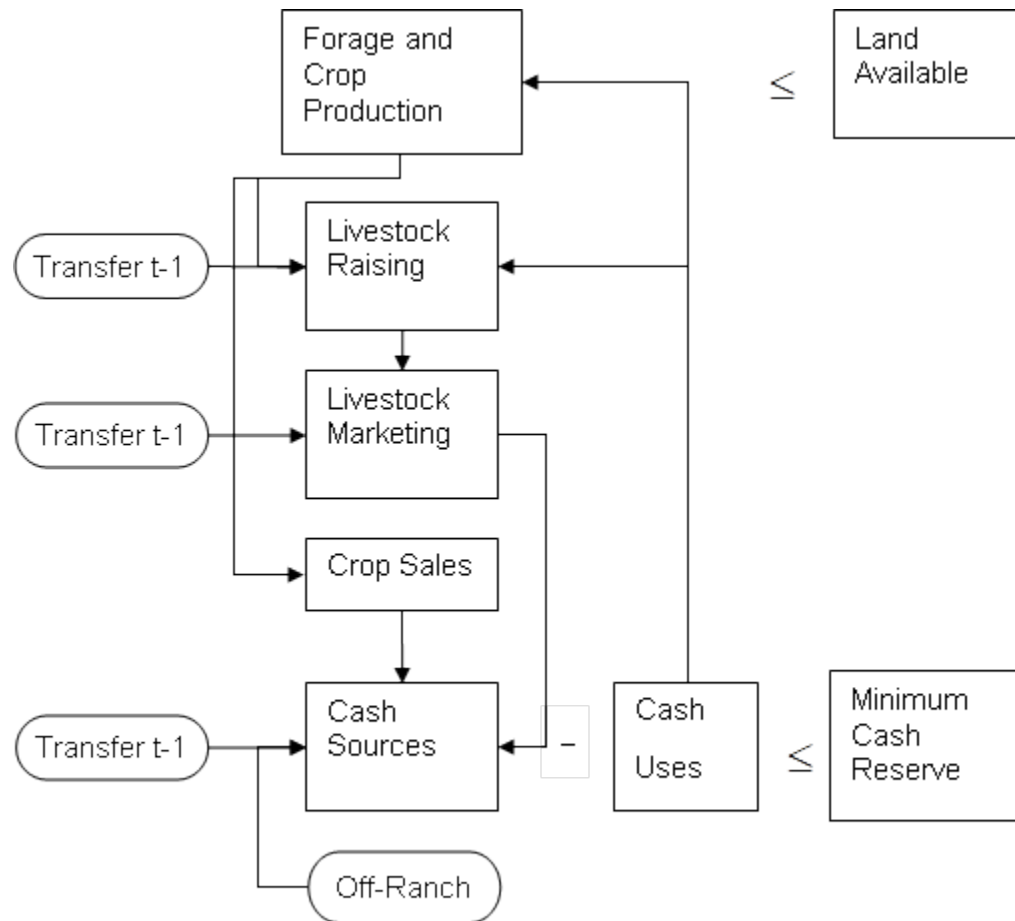
Show the impacts of changes in forage availability

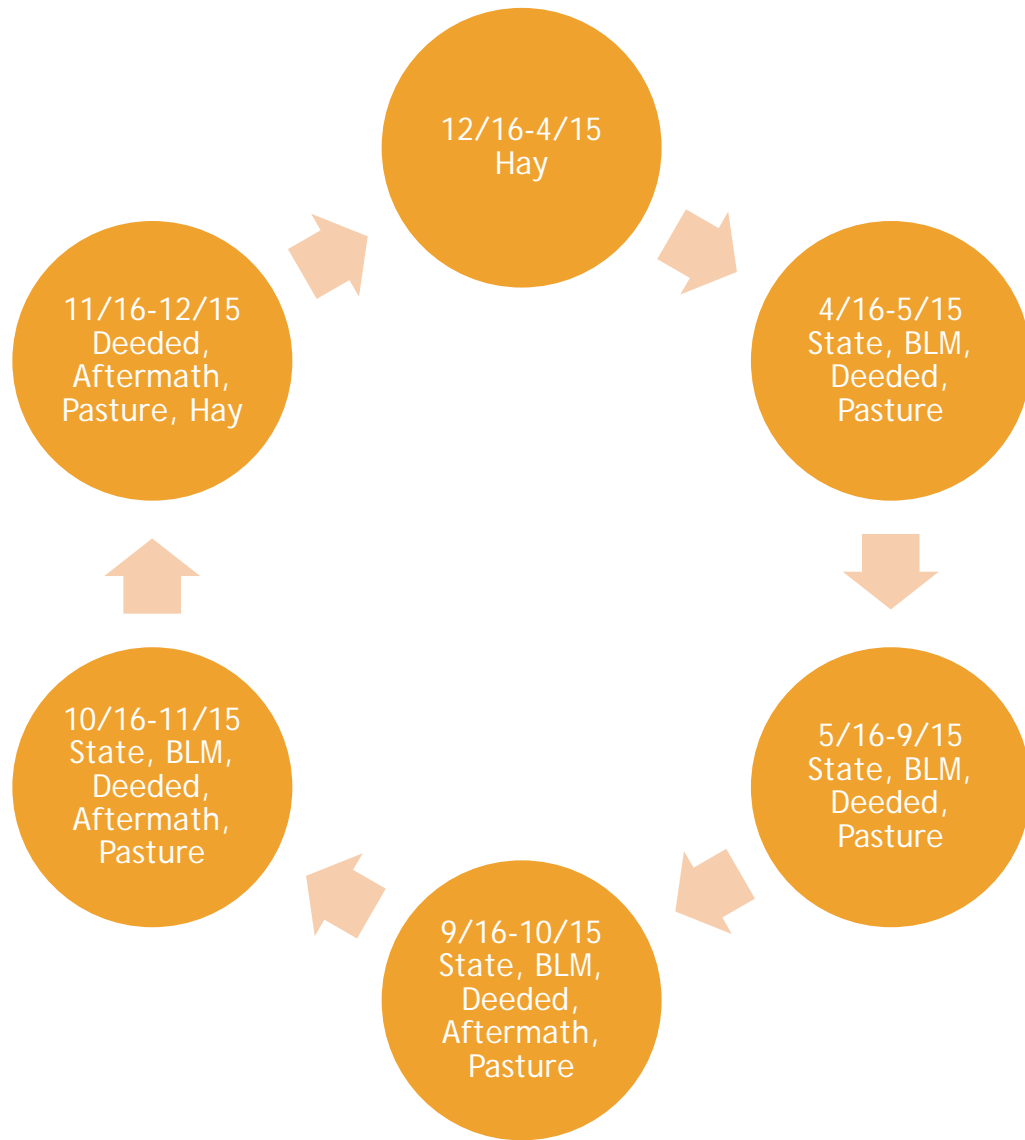
Simplified Ranch



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Y
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2

Ranch Business Model

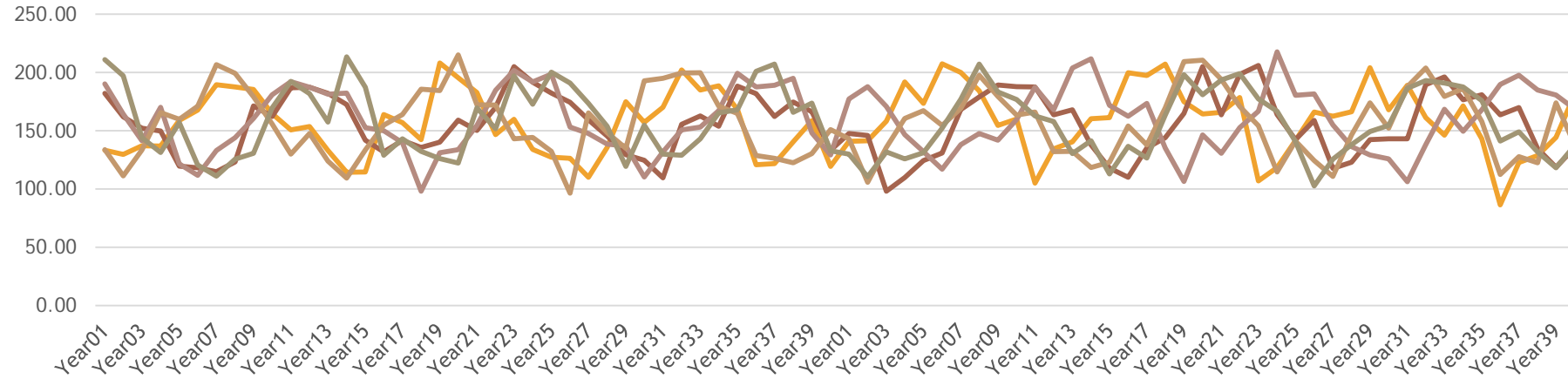




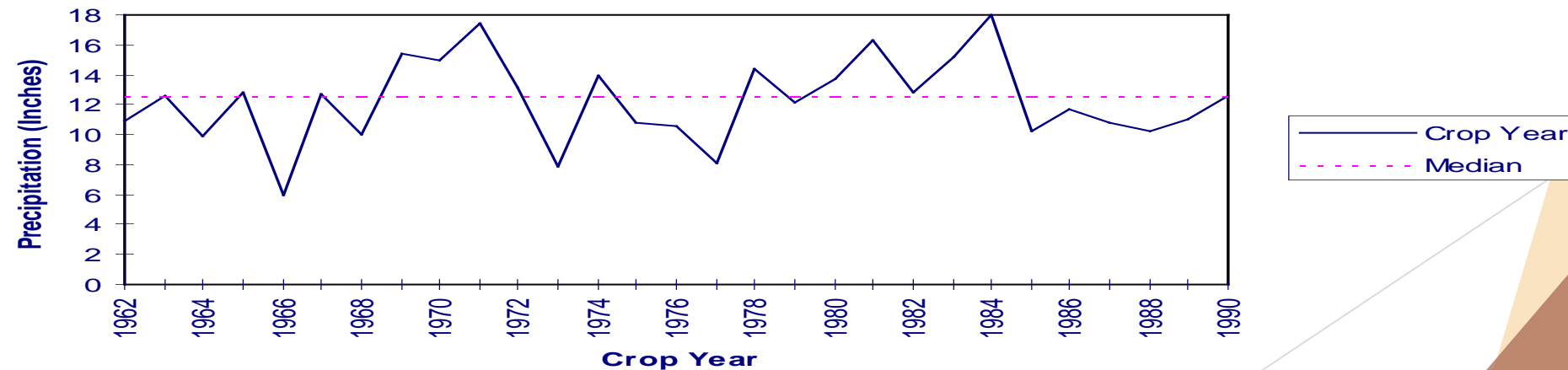
- Basic premises
 - Cattle somewhere every day
 - Yearlong operation
 - Substitute feeds

Sources of Uncertainty

Wyoming Steer Calf Prices, Adjusted 2012



Precipitation



Results – Base Model

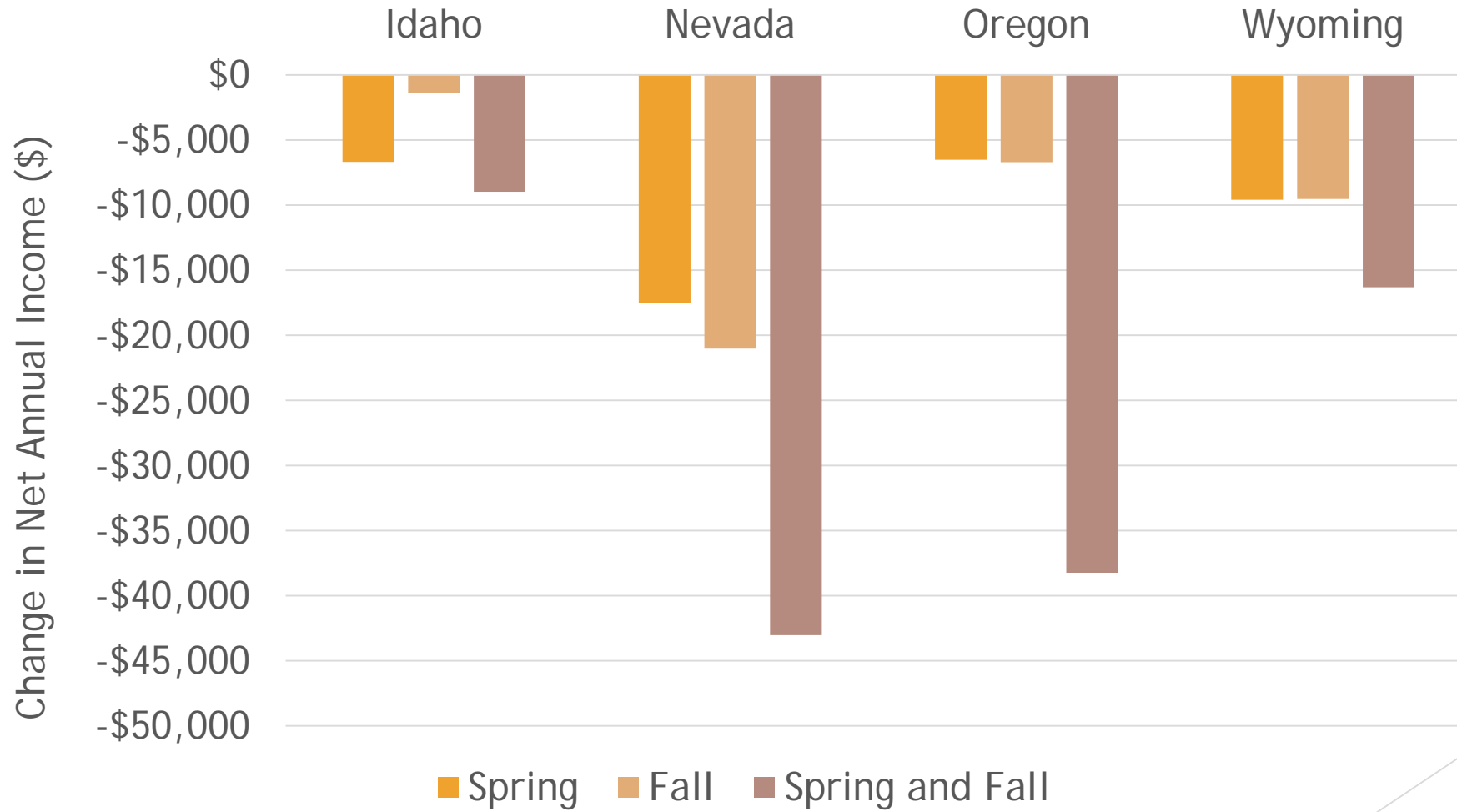
- ▶ 590 Cows
- ▶ Gross annual returns = \$369,939
- ▶ Average Net Cash Income = \$112,895
- ▶ Fixed costs = \$40,434
- ▶ Negative net annual income occurred 22% of the time



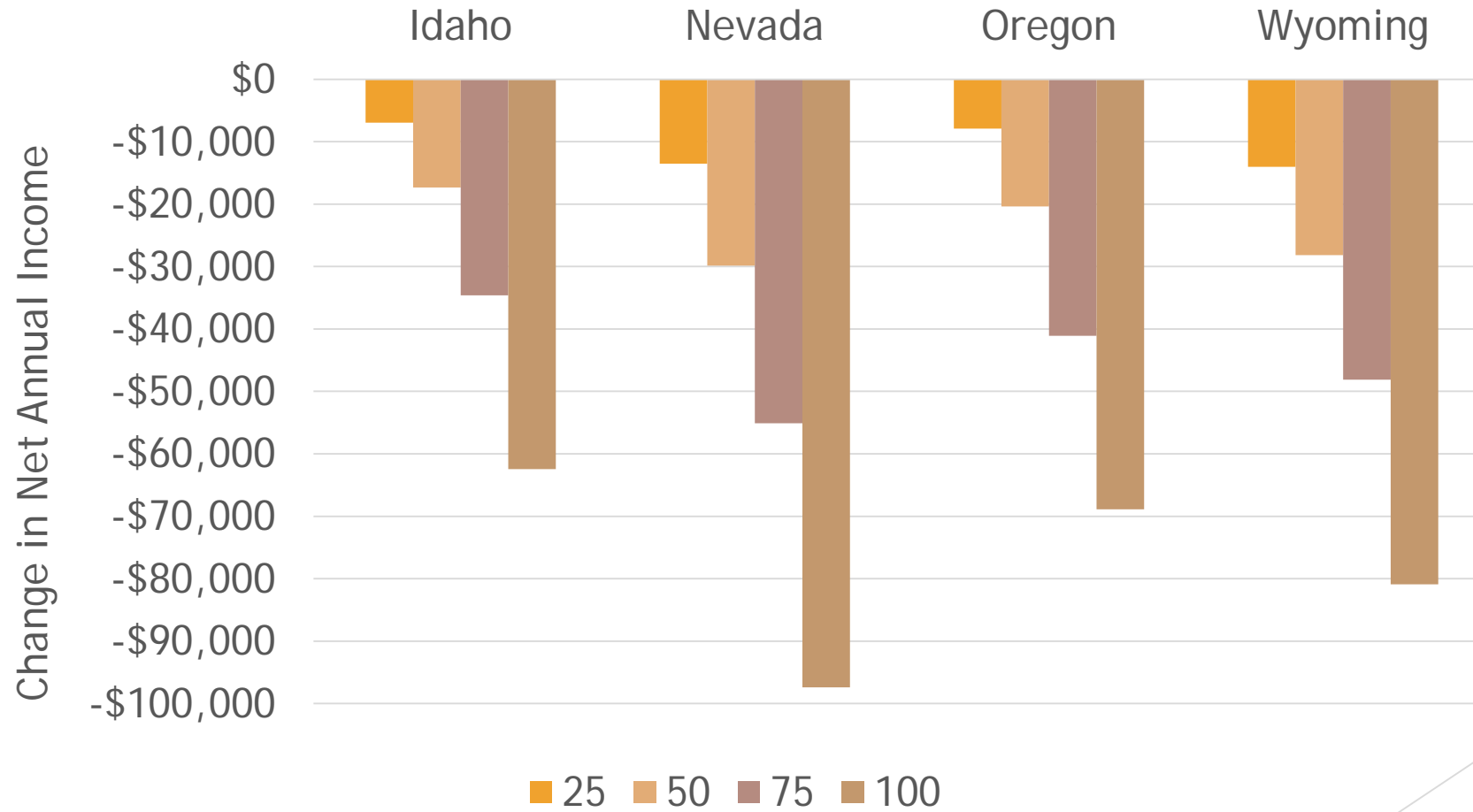
Simulations

- ▶ 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 %

Loss of BLM Season of Use



Percent Reduction in BLM Permit



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

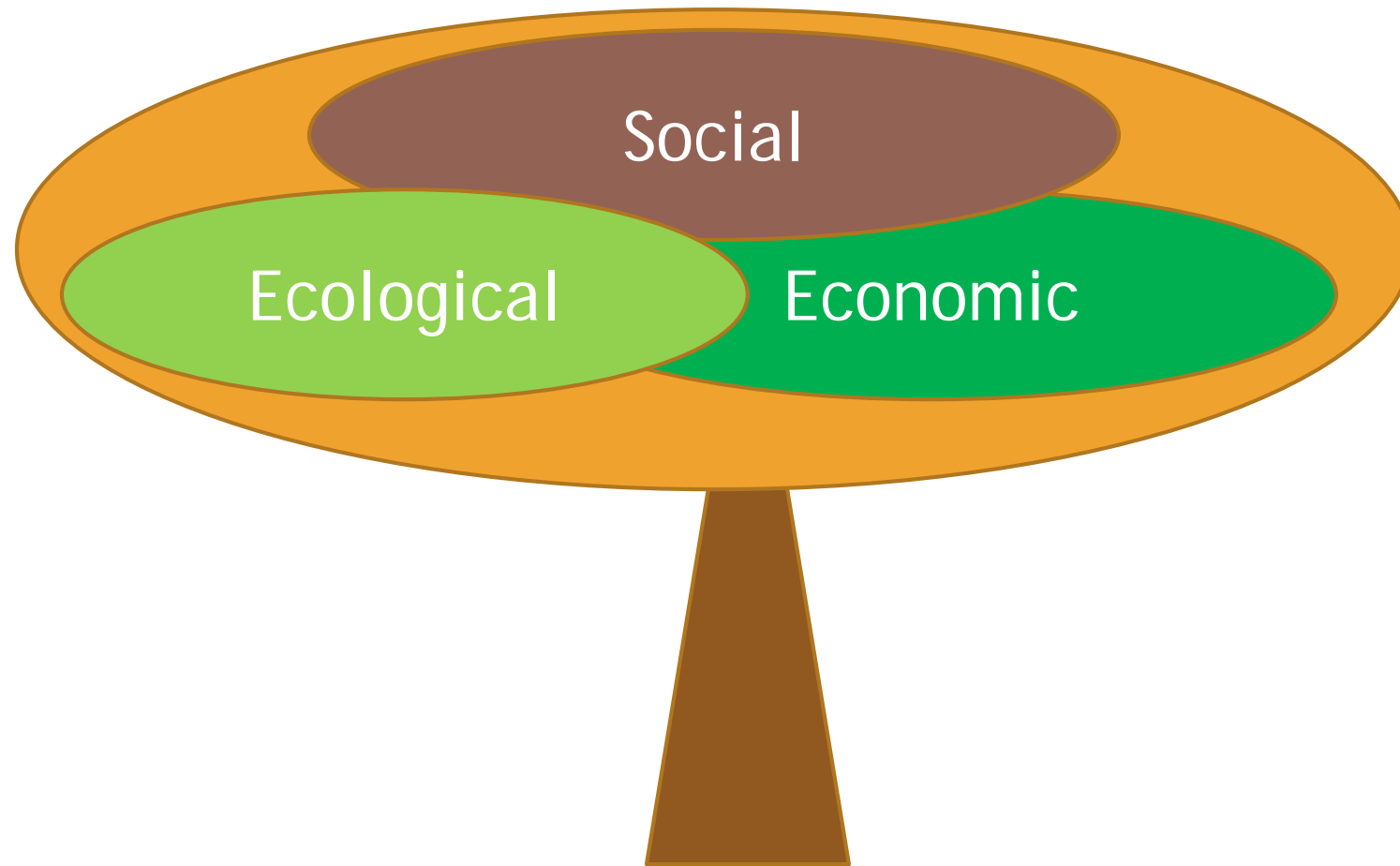
- ▶ This only looks at the private benefit from improving forage production.
- ▶ What other values does society gain?
- ▶ Can we place values on those?
 - ▶ What is more wildlife habitat worth?
 - ▶ What is the value of less soil erosion?
 - ▶ What is the value of a soil microbe?
 - ▶ What is the value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

Sustainability

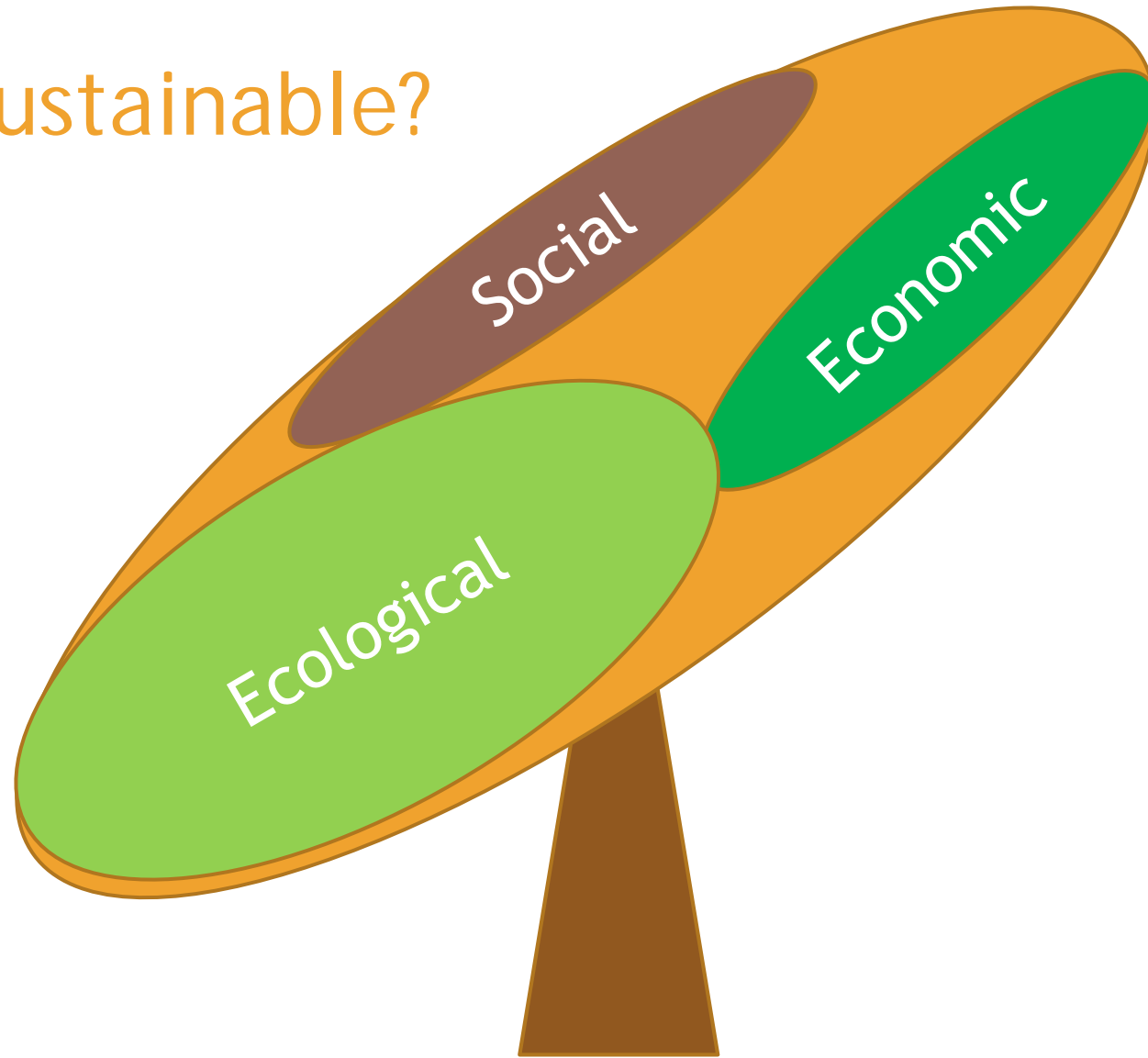
Social, Economic, and Ecological



Balance

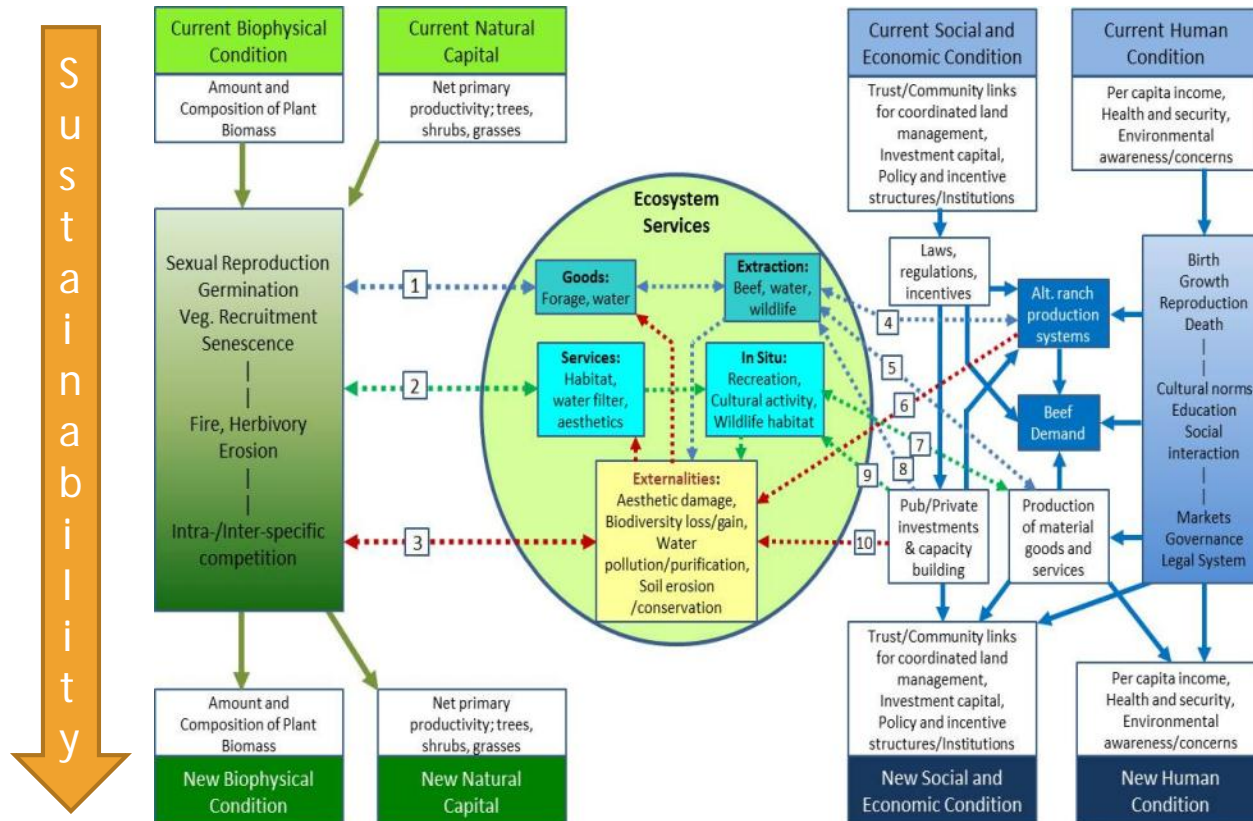


Still sustainable?



ISEEC Framework

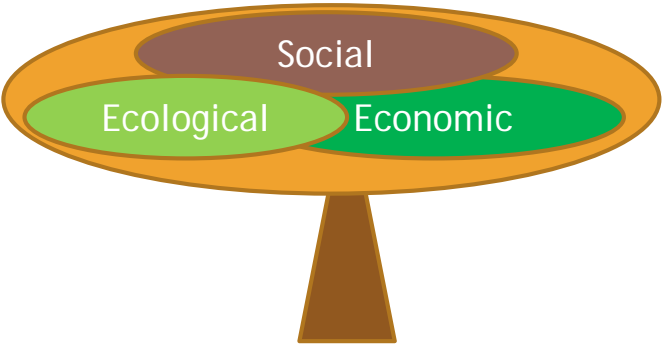
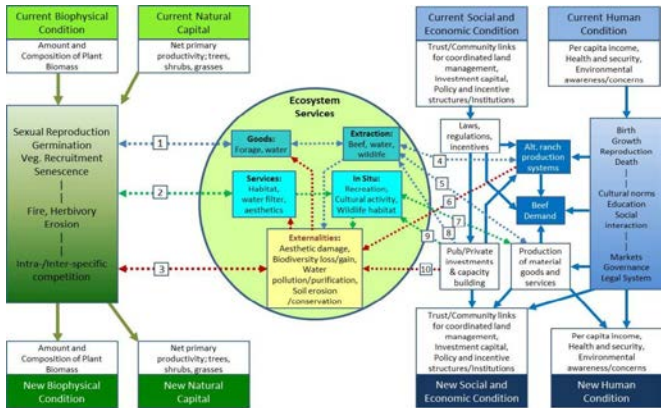
- ▶ Biophysical and Social/Economic over time
- ▶ Nexus is the Ecosystem Services
- ▶ Only things that humans want and need have value



Effects of Soil Health on Sustainability

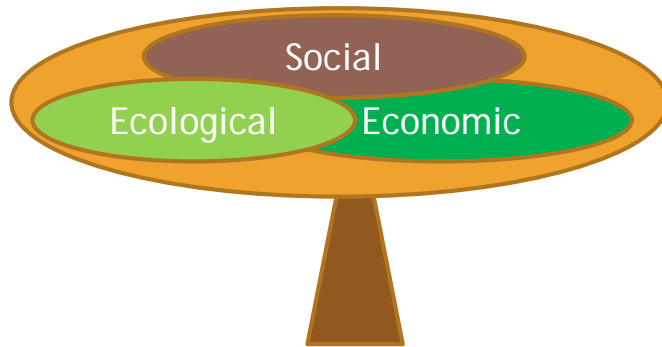
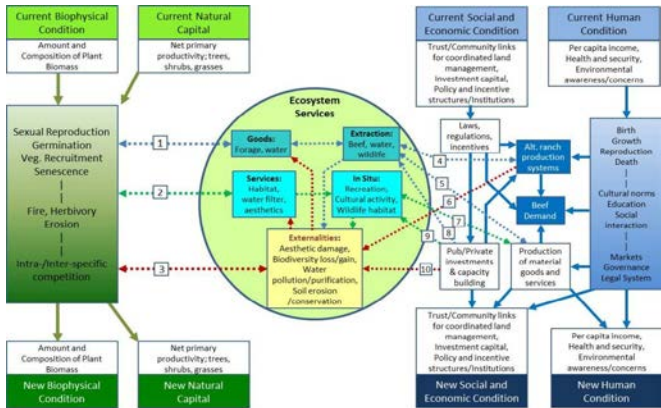
- ▶ In our framework, soil is one of the basic biophysical components
- ▶ Improving soil health leads to a variety of effects on the ecosystem, including forage production

Ecological



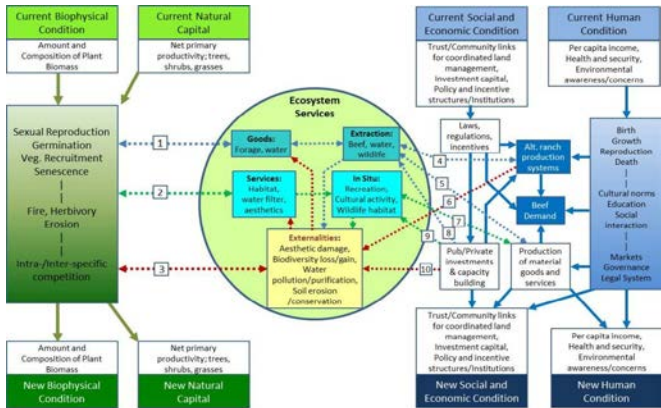
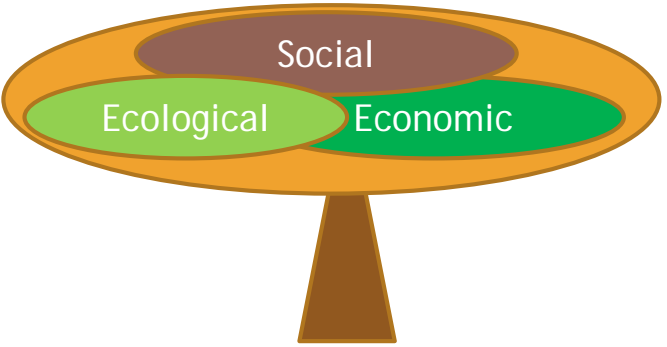
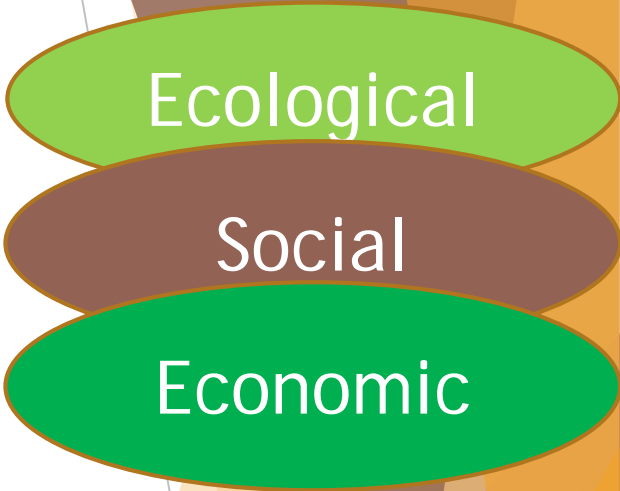
Effects of Soil Health on Sustainability

- ▶ 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)



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



Questions?

