Stakeholder-driven scenarios of land system changes and their impacts on ecosystem services

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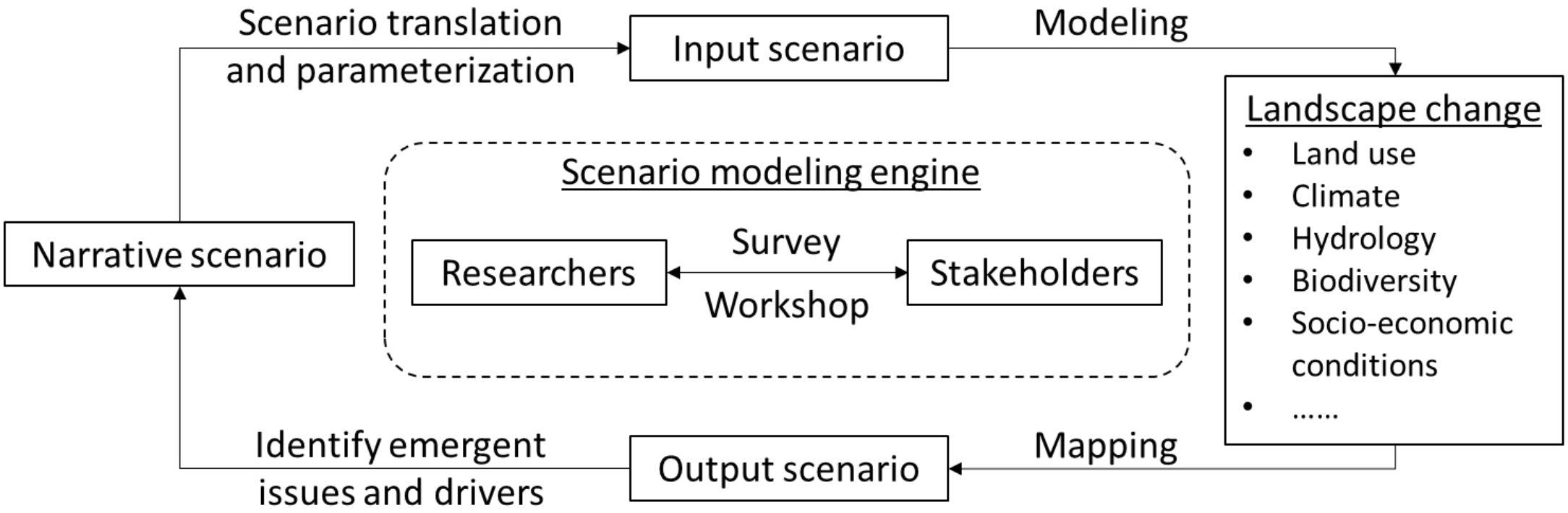
GEM3
Genes by Environment
Modeling · Mechanisms · Mapping

IMCI
Institute for Modeling
Collaboration and Innovation

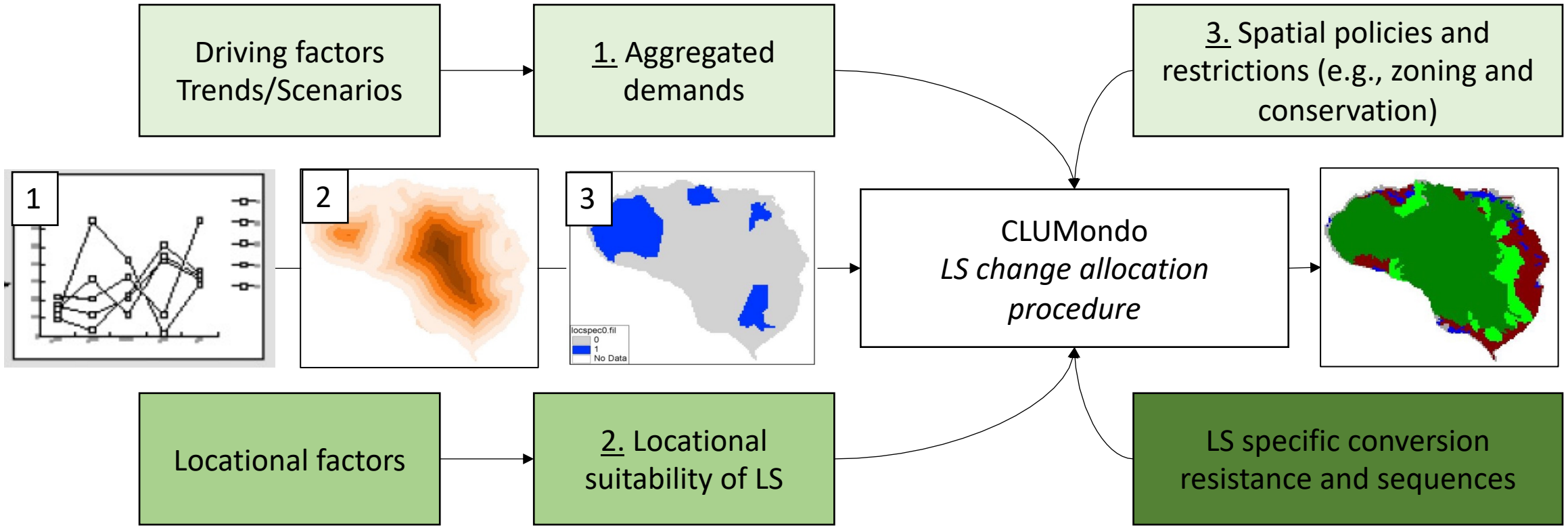
Introduction

- Land systems (LS) are related to human use of land and impact the socio-ecological systems (SES) and sustainability.
- Scenarios are used to address the uncertainties in modeling future development of land systems and communicate the implications.
- Participatory planning of scenarios with the stakeholders incorporates the local knowledge and enhance the legitimacy of the scenarios.
- In this study, we evaluate how stakeholder participation changes both the scenario construction and the analysis/assessment.

Framework


Scenario translation
and parameterization
Input scenario
Modeling
Landscape change
• Land use
• Climate
• Hydrology
• Biodiversity
• Socio-economic conditions
• ……
Scenario modeling engine
Survey
Researchers
Stakeholders
Workshop
Narrative scenario
Identify emergent
issues and drivers
Output scenario
Mapping

Method


Driving factors
Trends/Scenarios
1. Aggregated demands
3. Spatial policies and restrictions (e.g., zoning and conservation)
1
2
3
locspec0.fil
0
1
No Data
CLUMondo
LS change allocation procedure
Locational factors
2. Locational suitability of LS
LS specific conversion resistance and sequences

Results: scenario narratives

SCENARIO THEMES

1) Recreation and Population Growth

2) Socio-economic Change

Conservation

Recreation

Ecological conservation (EC)	Managed recreation (MR)
Business-as-usual (BAU)	Destroying Boise's playground (DBP)

Destroying Resources in Owyhee County

Scenario Narrative:

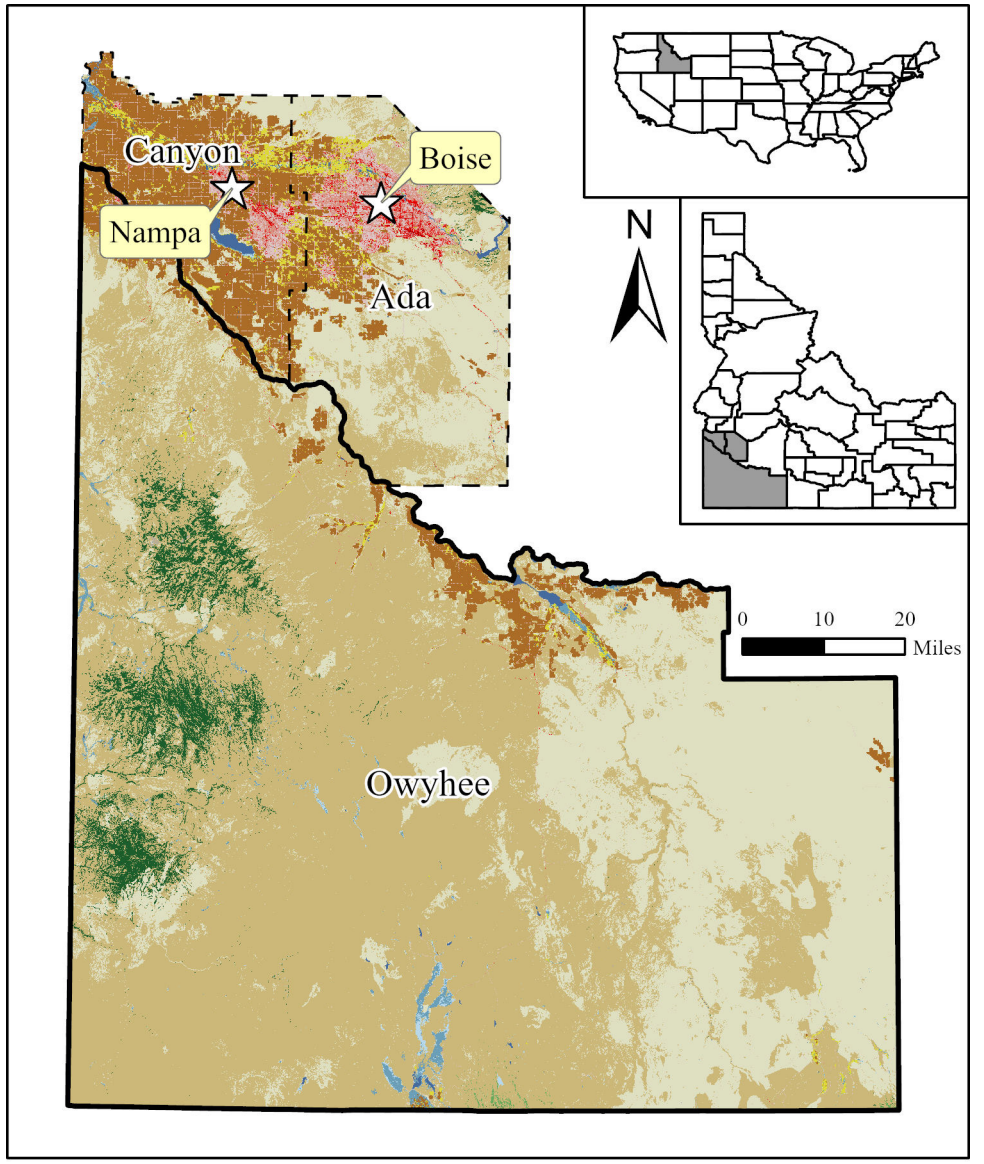
As Treasure Valley has experienced excessive population growth, the needs and interests for various types of recreation have also been on an incline. Swaths of recreators have inundated surrounding regions of Treasure Valley including the Owyhee region. By 2030, campsites are beyond capacity, impromptu ATV trails have become a problem, and other various other year-round recreational uses have caused various impacts including: increased soil erosion, conflicts with rangeland managers. Riparian areas in close proximity to trails are impacted with ecological issues. Noxious weeds spread due to excessive trail usage and areas which used to thrive with natives plant materials, now have become conduits for invasives, including cheatgrass. With excessive heat and decreased precipitation events, fire has also become a problem within the Owyhees.

Ecological Conservation Scenario

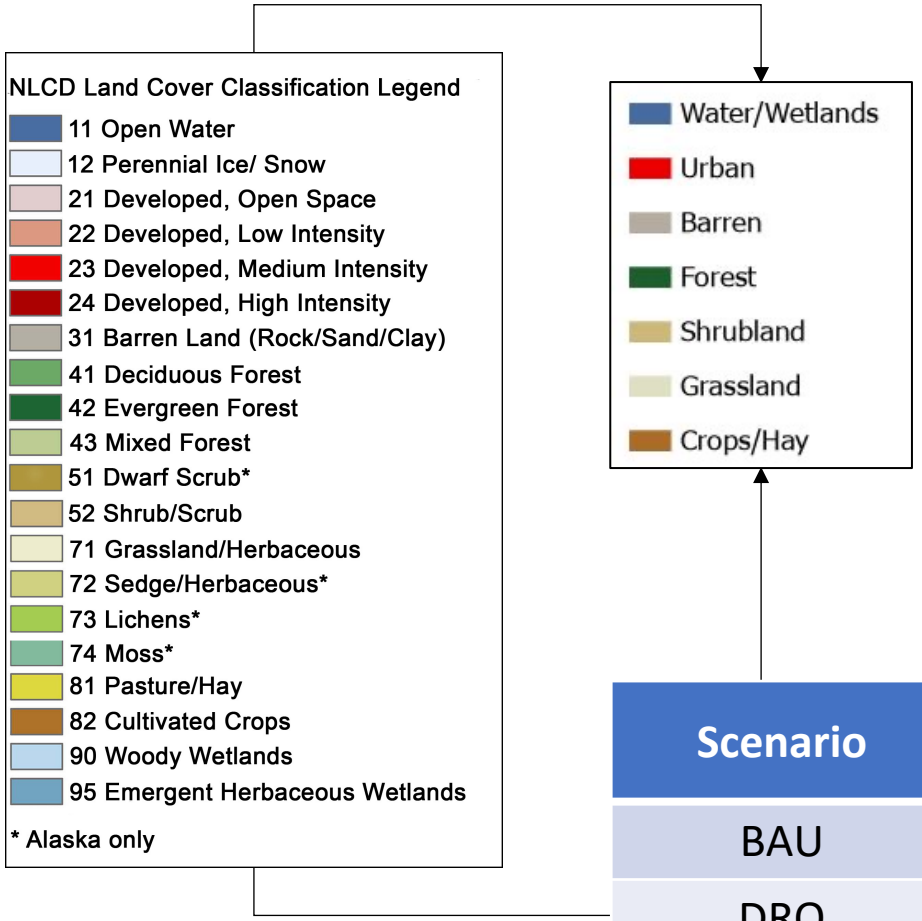
As increased heat and wildfire events continue within the Owyhee region, so have efforts to control invasive species impacting the area. The Bureau of Land Management in conjunction with County Commissioners have devised methods to incrementally reduce the amount of invasive species affecting the area. Efforts such as the Cheatgrass Challenge and the Soda Fire Restoration have aided in a tremendous shift of proactive management of invasive species. Similarly, due to incremental restoration practices, habitat availability has also increased procuring rich and viable habitats for the following species: *salmon, big sagebrush, redband trout, mule deer, pronghorn, greater sage-grouse.* Sagebrush and riparian areas now thrive with biodiversity. Due to these impacts, the local economy has begun to thrive as recreationists not only visit the area but aid in stewardship to support restoration and protection of habitat.

Managed Recreation Scenario

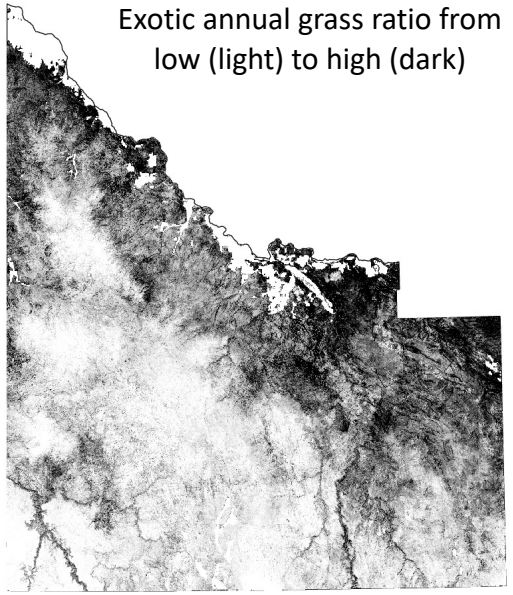
With droves of recreators from Treasure Valley and other neighboring communities, the Owyhee region has seen an uptick in use on private and public land. The Owyhees' local communities are seen as 'gateways' providing services for local communities, thus providing a revenue stream supporting infrastructure. In an effort to control increased recreation, regulations and improved infrastructure have been managed through the planning of designated areas of use to prevent trespassing. Along with population growth and increases in infrastructure, fire risk has also become an issue, in particular, along highways and roadways. Outreach and education efforts continue to inform visitors of fire and invasive risk. Strict regulations for motorized and non-motorized vehicle use are also enforced to control spread of wildfire and detrimental issues on habitat and private land uses.



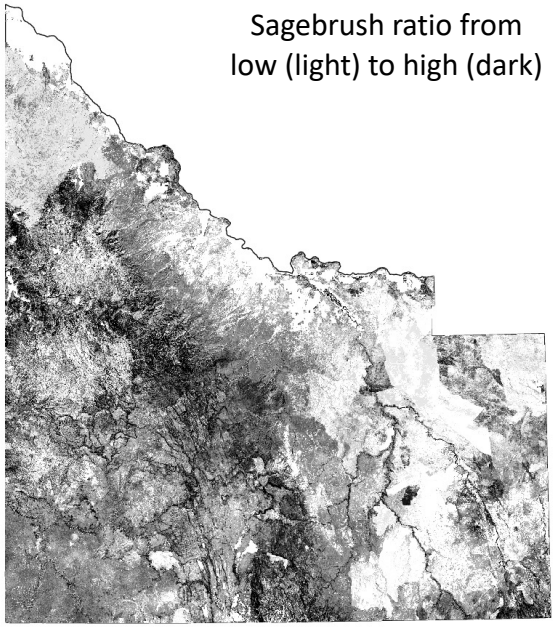
Results: land systems



Source: NLCD



Exotic annual grass ratio from low (light) to high (dark)

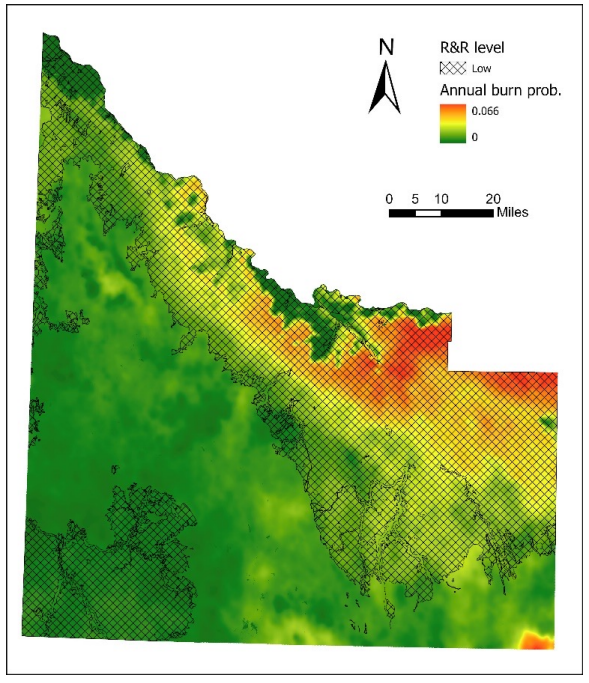


Sagebrush ratio from low (light) to high (dark)

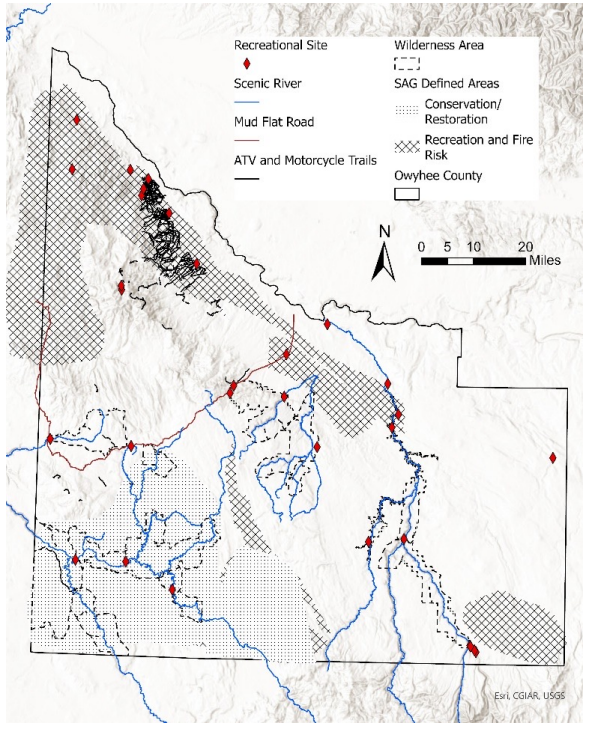
Source: RCMAP

Scenario	Urban	Sagebrush	Exotic annual grass	Ag. land
BAU	0.85%	-0.35%	0.25%	0.30%
DRO	1.50%	-0.65%	0.65%	0.20%
EC	0.50%	0.50%	-0.45%	0.30%
MR	1.00%	0.35%	-0.25%	0.40%

Results: spatial policies



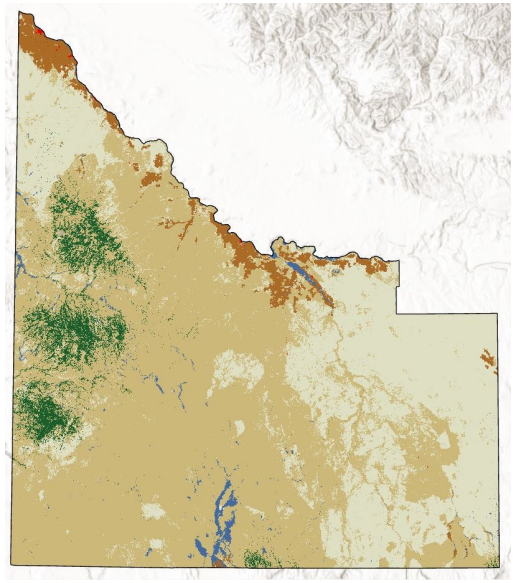
Source: 1) resilience and resistance (R&R) (Maestas et a;., 2016); 2) Burn probability (Projection based on Gao et al., 2021)



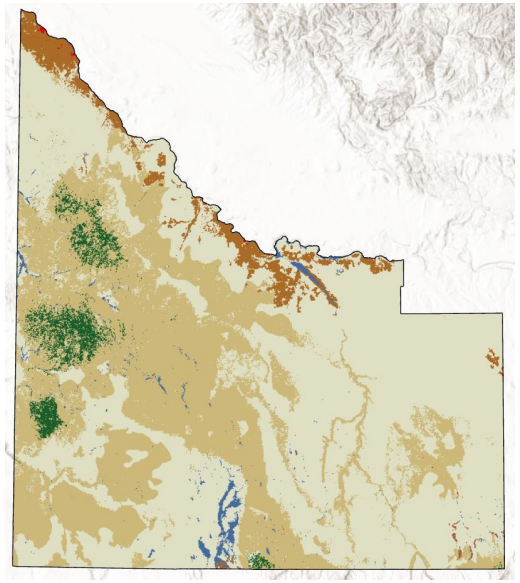
Source: 1) recreational sites (RIDB); 2) Trails, scenic rivers, wilderness areas (BLM)

Scenarios	Restriction for changes	Grassland preference	Shrubland preference
BAU		Low R&R	
DRO	SAG conservation	Low R&R/Rec sites/Fire Prob/SAG Risk	
EC		Low R&R	SAG conservation/SAG risk
MR		Low R&R/Rec sites/Fire Prob/SAG Risk	SAG conservation

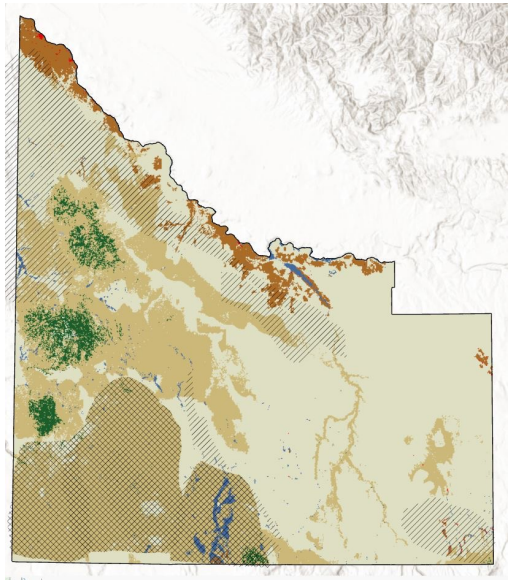
Results: future scenarios



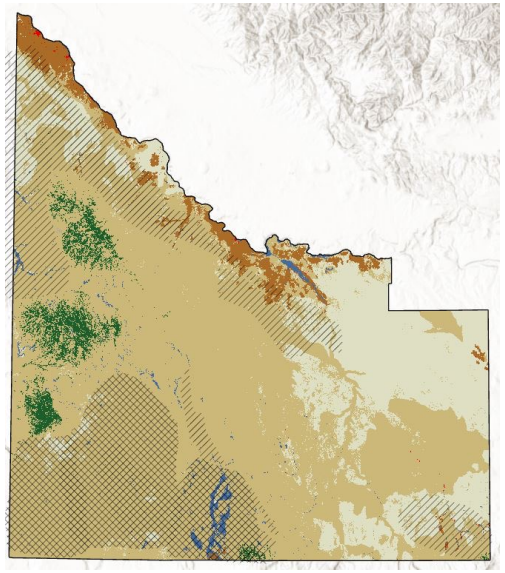
Land use, 2019



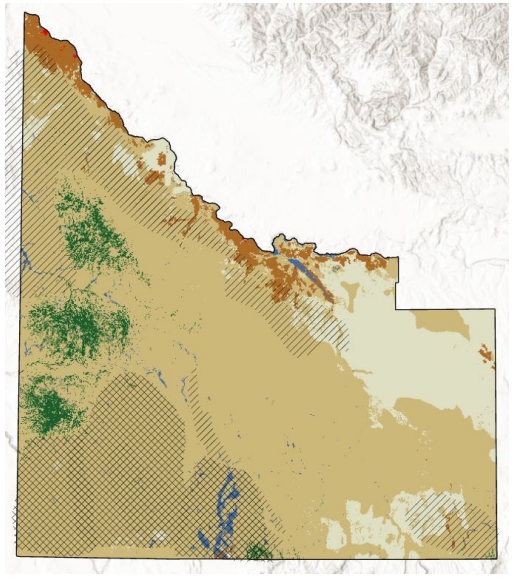
DRO, without SAG input



DRO, with SAG input



MR, with SAG input

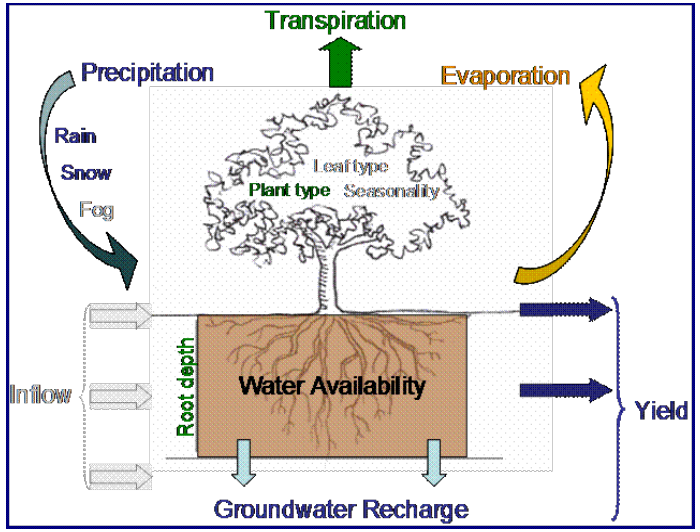


EC, with SAG input

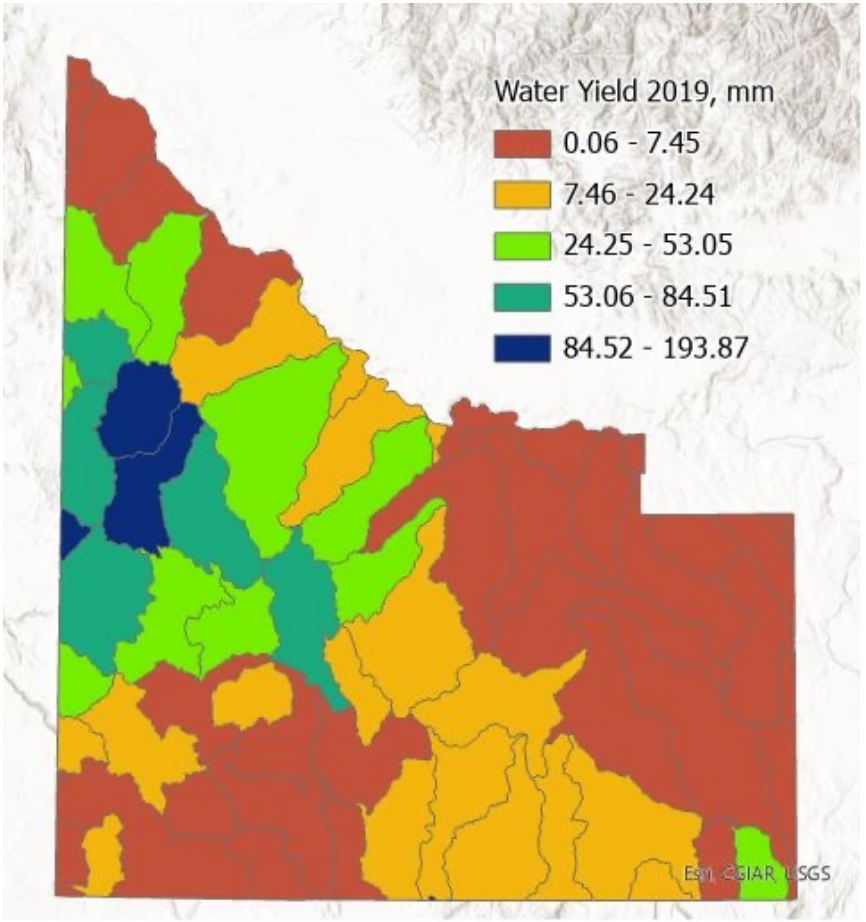
Results: ecosystem services

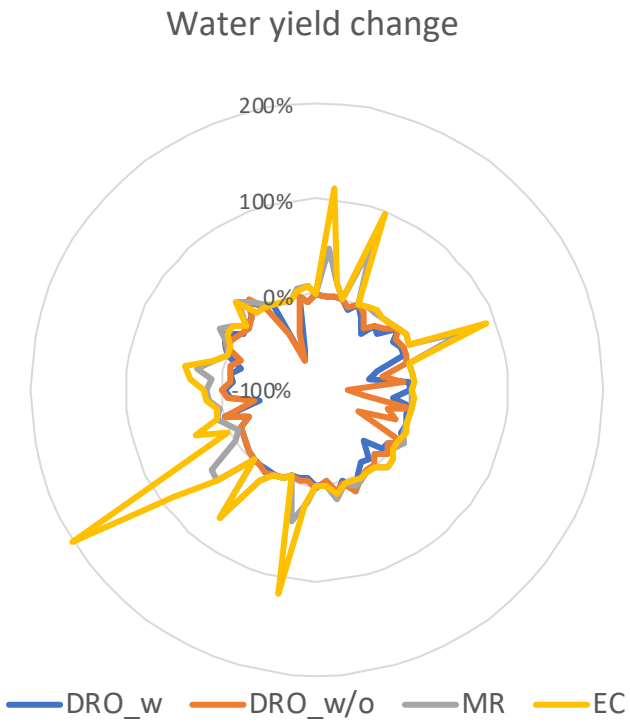
InVEST

Integrated Valuation of Ecosystem Services and Tradeoffs



(natural capital project)





Conclusion

- The results show that with different planning implementations, the spatial allocation of land use change will be altered to improve or mitigate the detrimental effects to ecosystem services.

- Land systems perspective and stakeholder engagement help to reach a more nuanced understanding of the SES drivers and impacts of scenarios, and to search for sustainability solutions for land management.

Acknowledgements

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Thank you!
Any questions?

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