



The Promise and Challenges of Diversified Farm  
Management For Multiple Ecosystem Services:  
Review of the Evidence

*Rodd Kelsey*

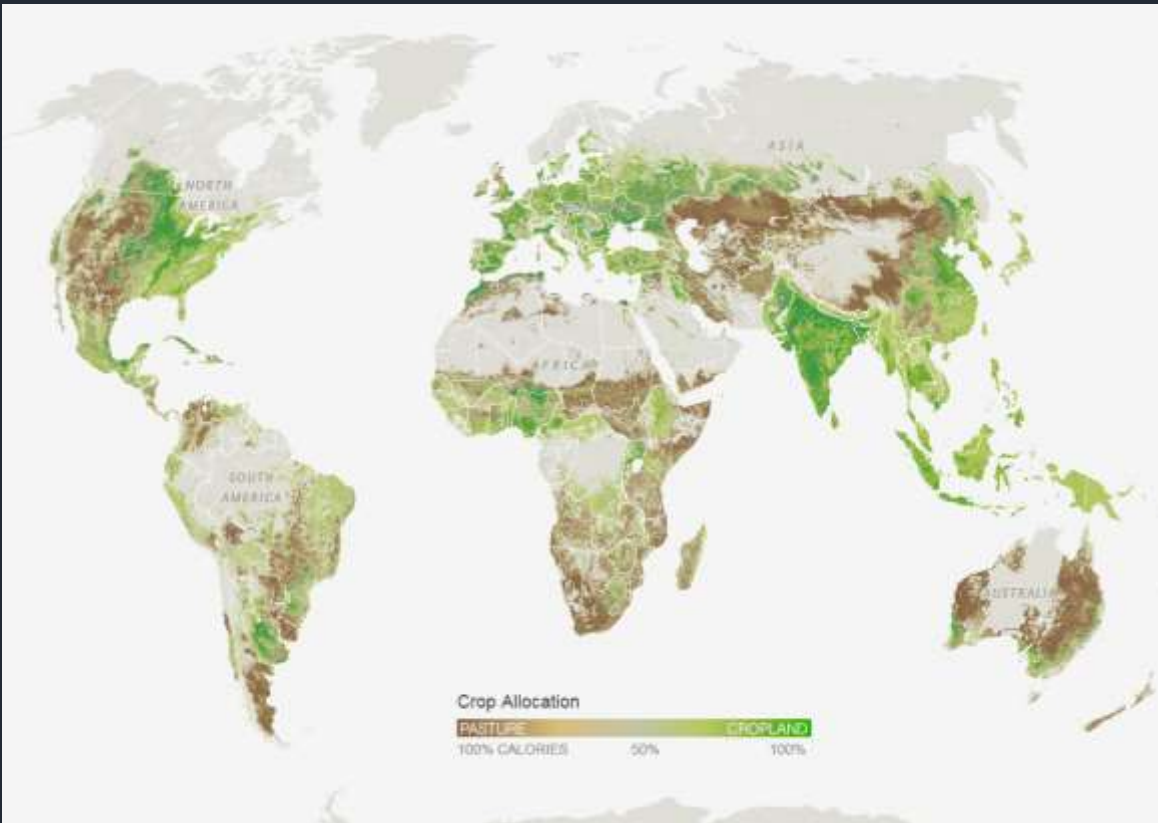
*Gorm Shackelford*

*David Williams*

*Rebecca Robertson*

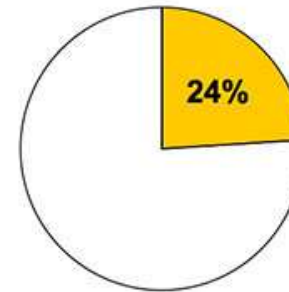
*Lynn V. Dicks*

# Agriculture's Global Impact



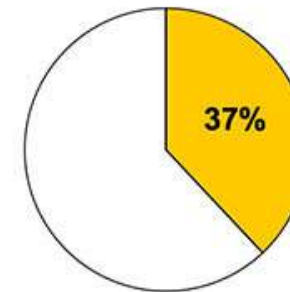
## Agriculture's Share of Global Environmental Impact (2010)

GREENHOUSE GAS EMISSIONS



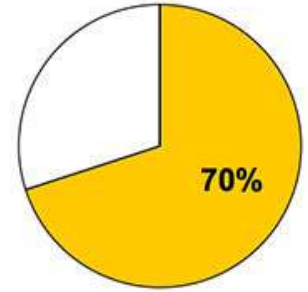
100% = 49 Gt CO<sub>2</sub>e

EARTH'S LANDMASS (EX-ANTARCTICA)



100% = 13.3 bn ha

WATER WITHDRAWAL



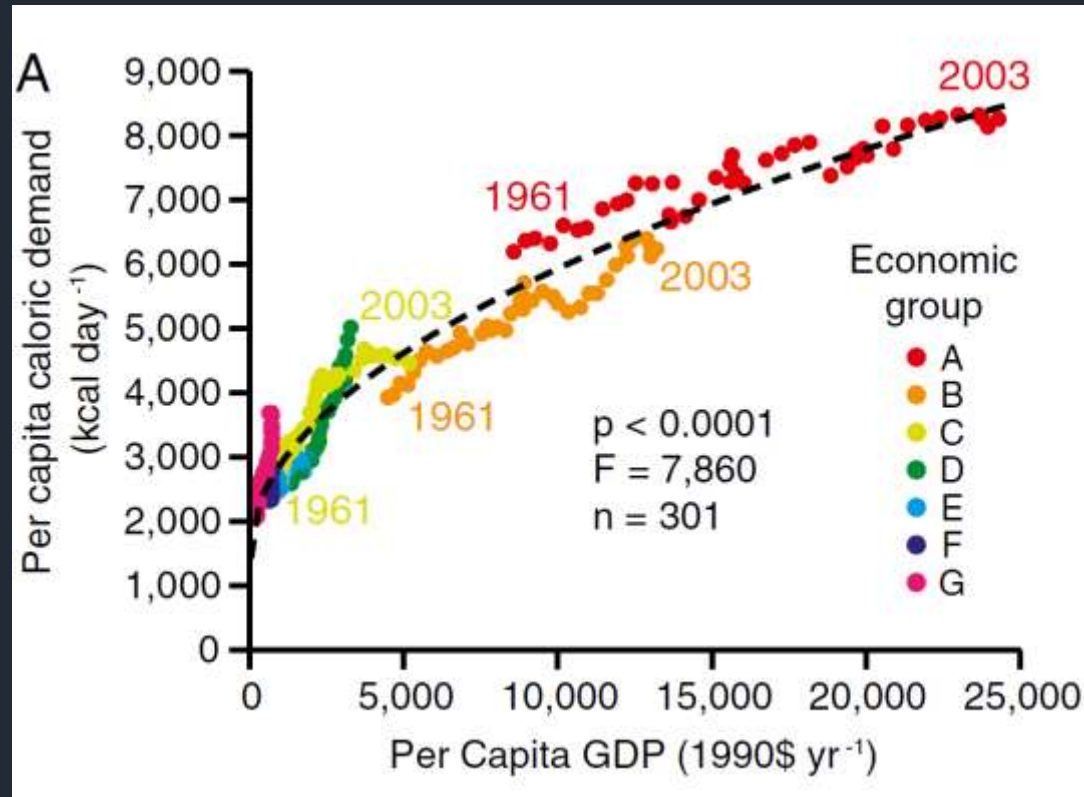
100% = 3862 km<sup>3</sup> H<sub>2</sub>O



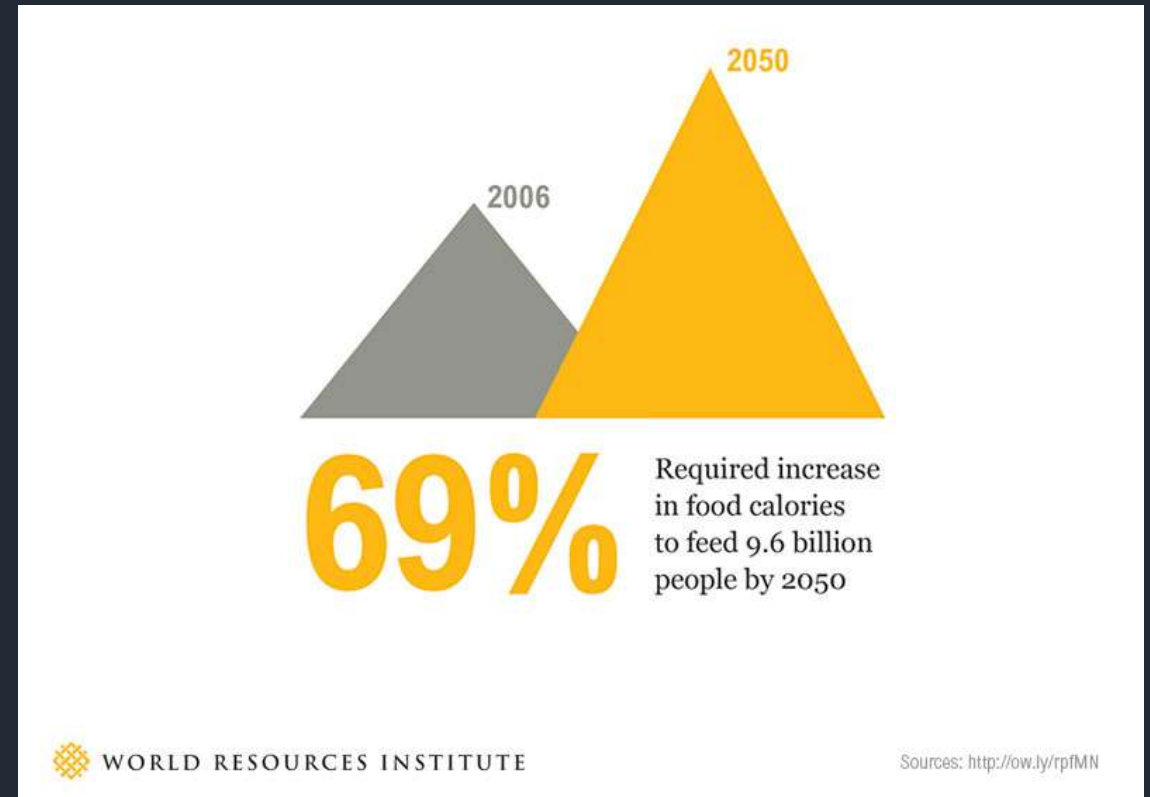
WORLD RESOURCES INSTITUTE

Sources: <http://ow.ly/rpfMN>

# Growth in Food Demand



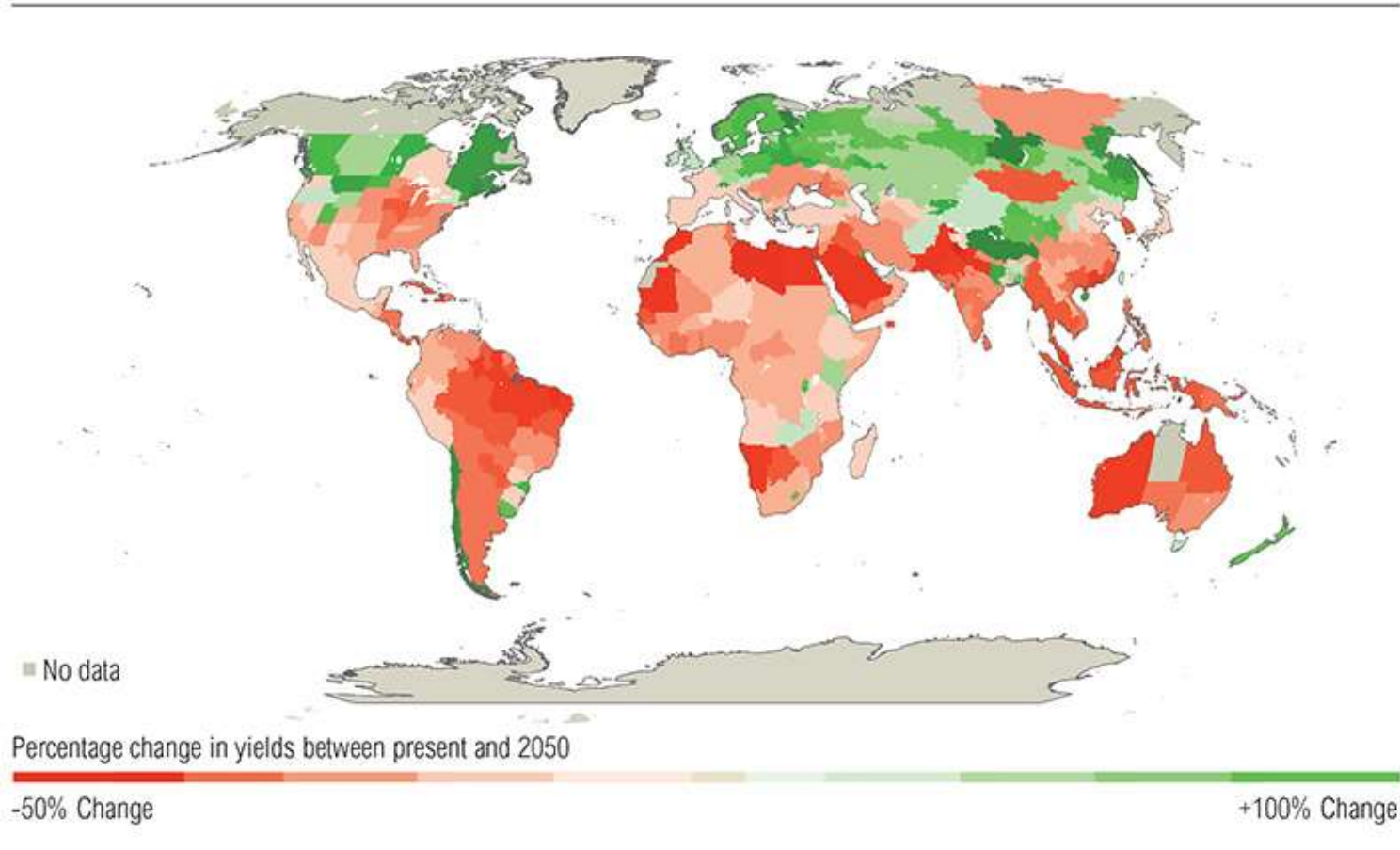
Tilman et al. 2011





# Declining yields with climate change

Most studies now project adverse impacts on crop yields due to climate change (3°C warmer world)



Muller et al. 2009

# Sustainable Intensification and Agroecology

Reduce Impact on  
Wildlands



Functional Biodiversity

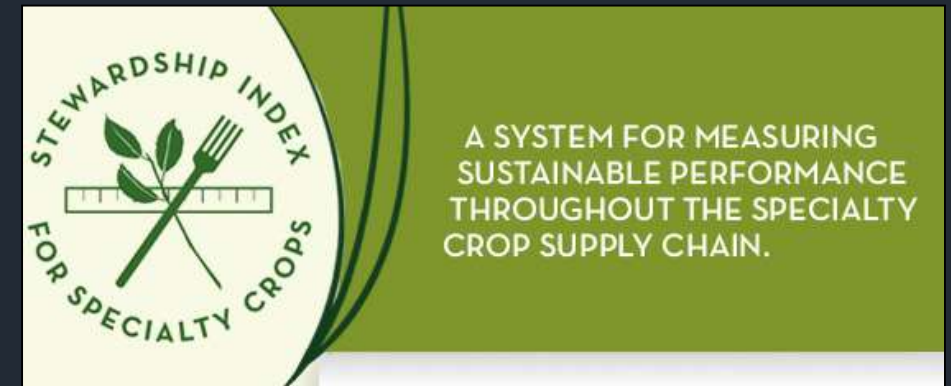


Increase Resilience





# Sustainability Programs & Goals

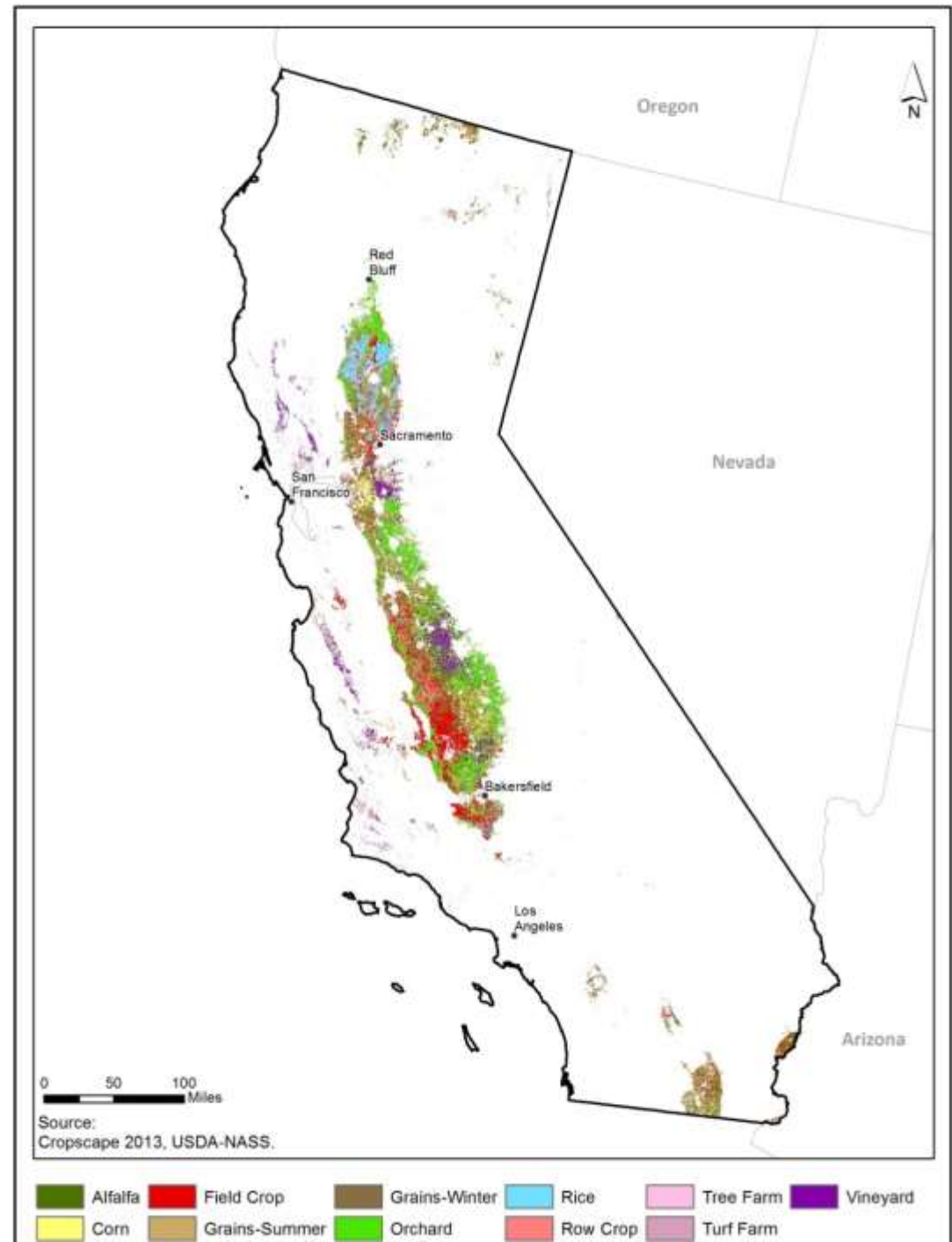


# CA Agriculture Footprint

~10 million  
acres

\$45 billion

Over 400  
different crops



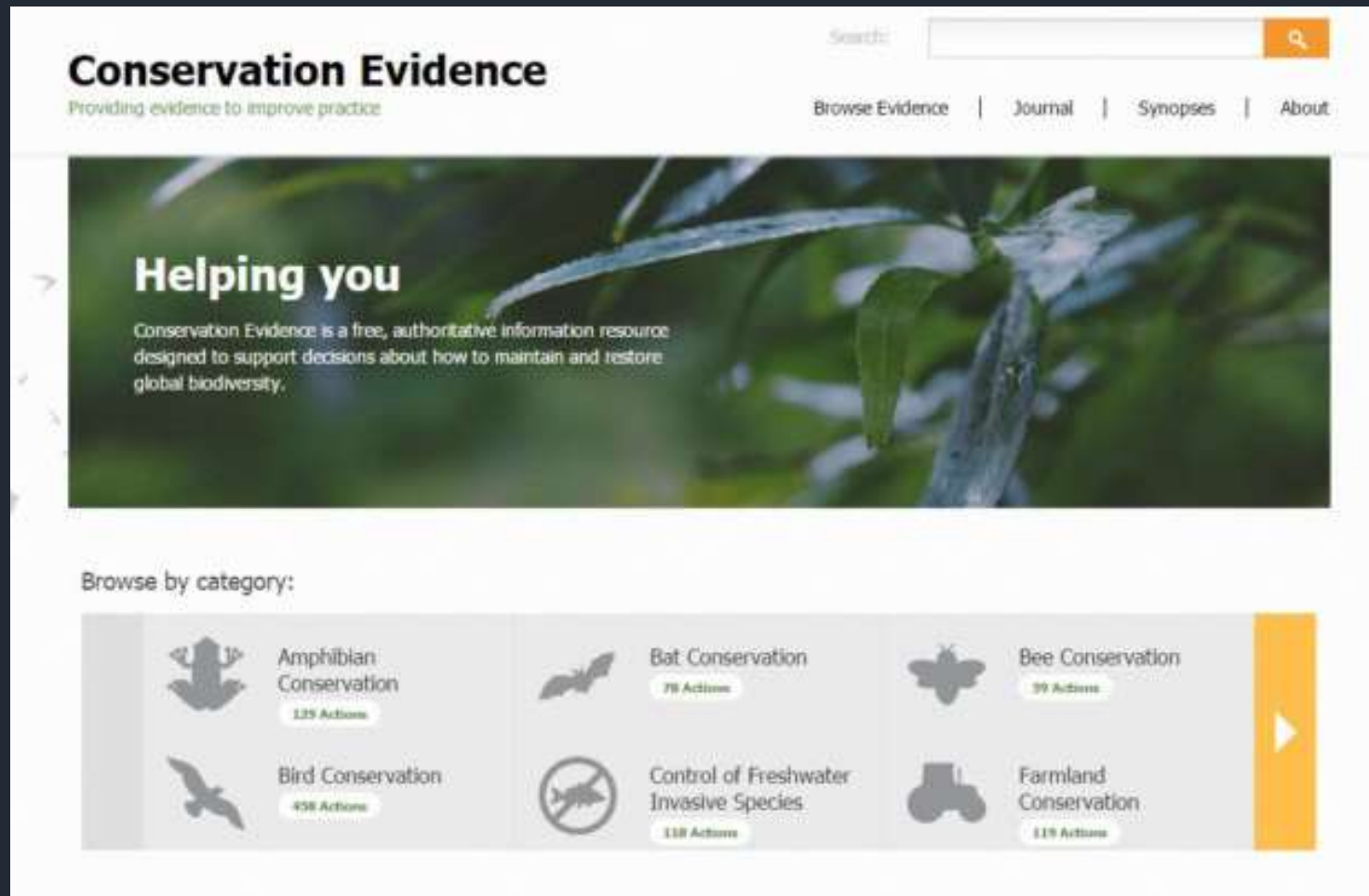
# Objectives of this study

1. Synthesize evidence for the ecosystem service and biodiversity benefits
2. Evaluate effectiveness, synergies and trade-offs
3. Strategy maps to guide investments and spatial optimization



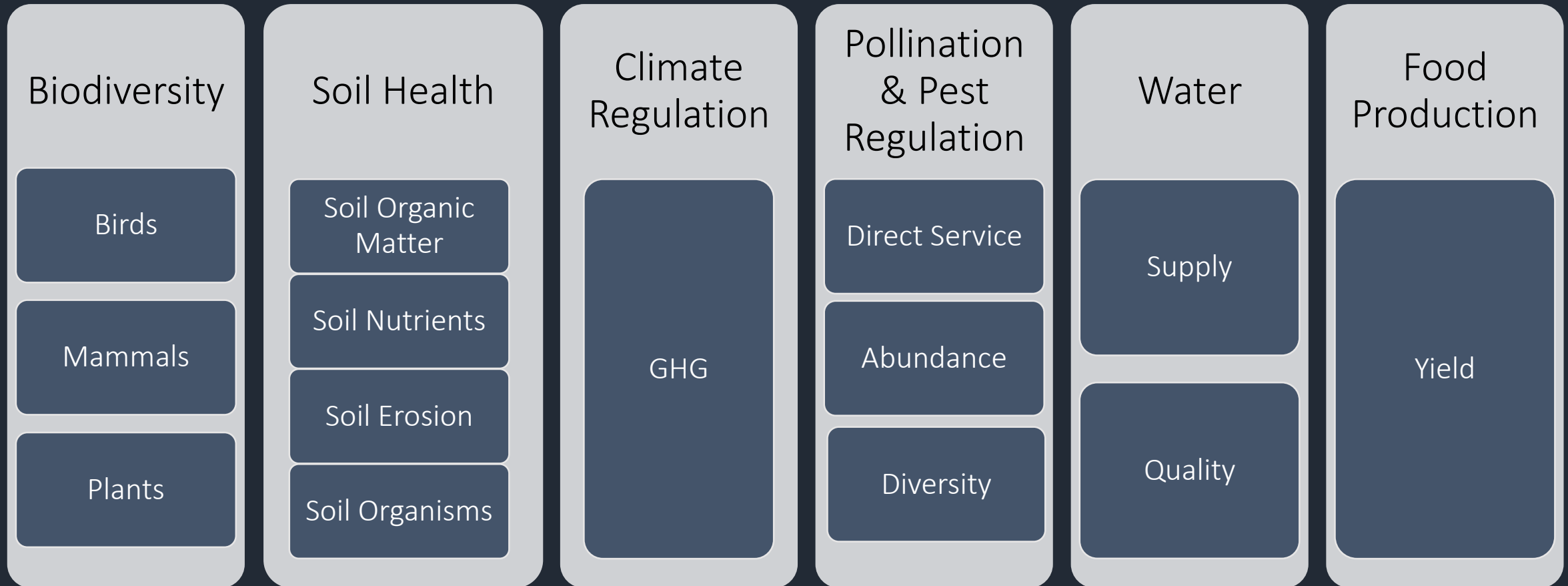


*www.conservationevidence.com*

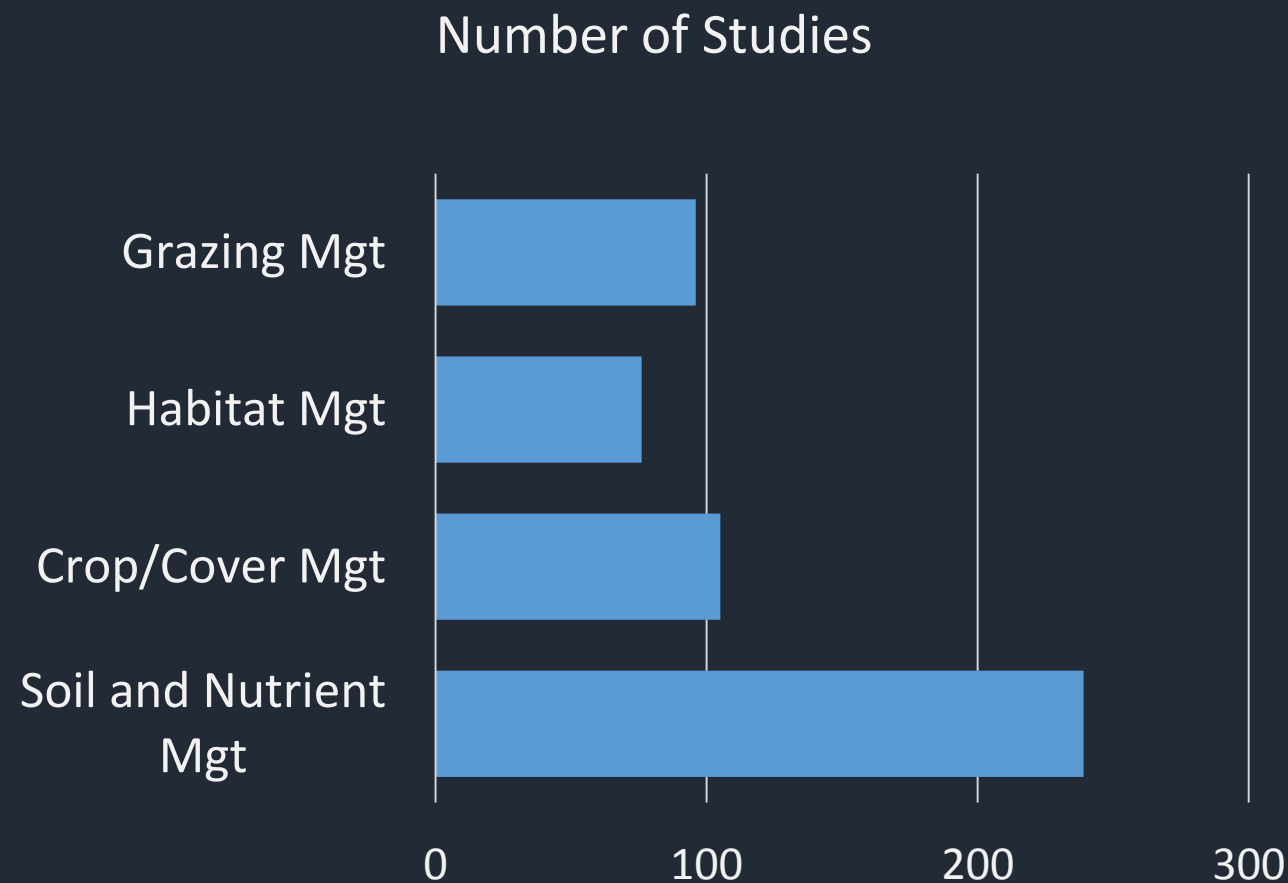


1. Assemble, summarize, and synthesize into Key Messages
2. Evaluate evidence for Effectiveness and Certainty through expert review using modified Delphi Technique

# Targets and Metrics



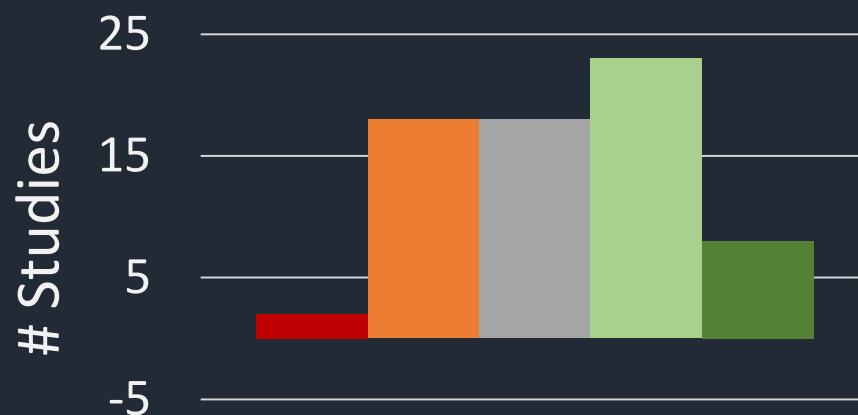
# Body of Evidence: 516 Studies



Country	# Studies	%
Australia	20	3%
France	21	3%
Israel	25	3%
Italy	76	10%
Portugal	31	4%
Spain	215	29%
California	299	41%



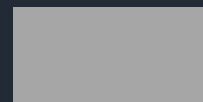
# Results



**Strong Negative:** all comparisons in studies (>1) showed significantly negative impacts



**Negative:** some comparisons in studies showed significantly negative impacts



**Non-Significant/Mixed:** no significant differences or mixed results in all studies



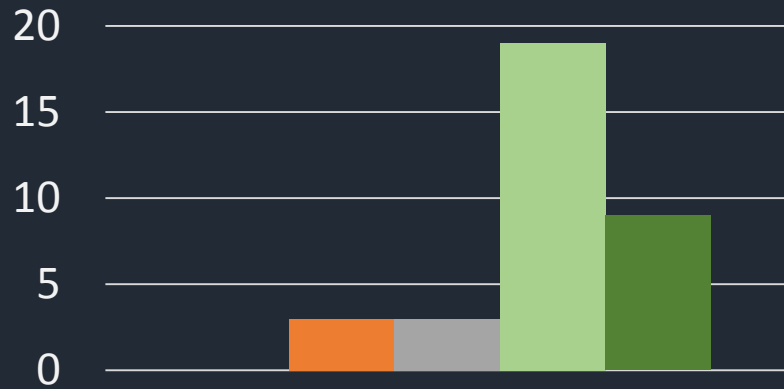
**Positive:** some comparisons in studies showed significantly positive impacts



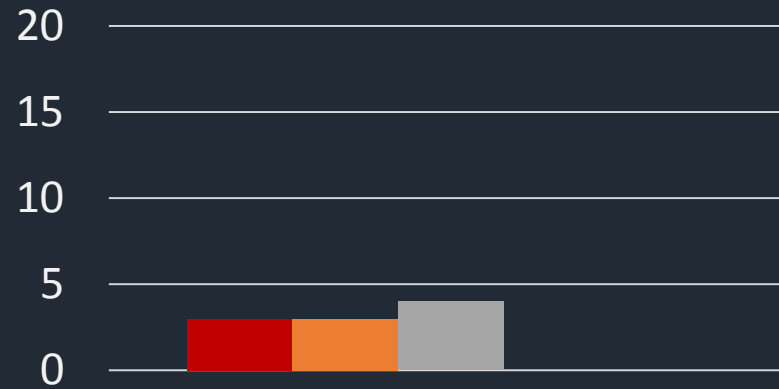
**Strong Positive:** all comparisons in studies (>1) showed significantly negative impacts

# Add Compost

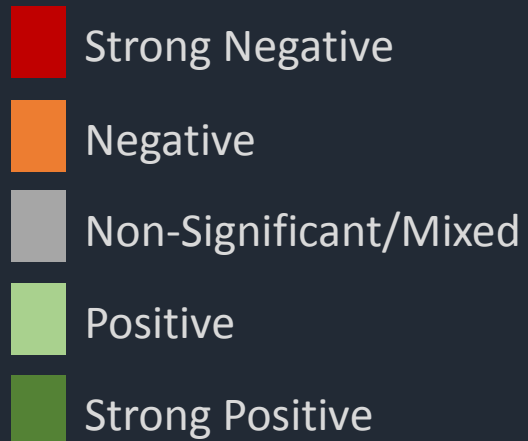
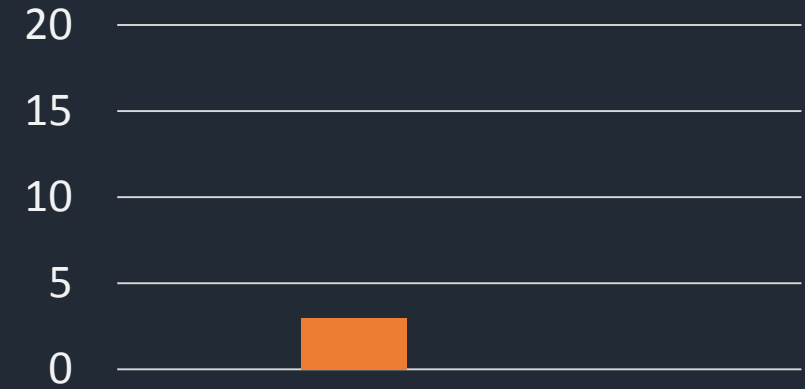
Soil Health



Greenhouse Gases

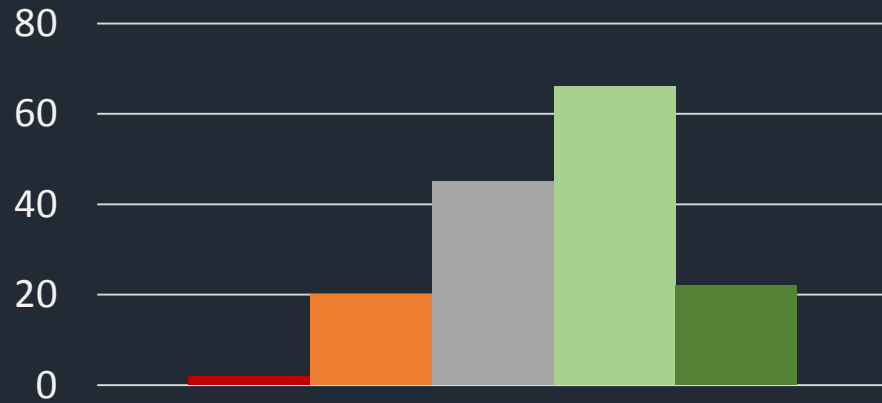


Water Quality

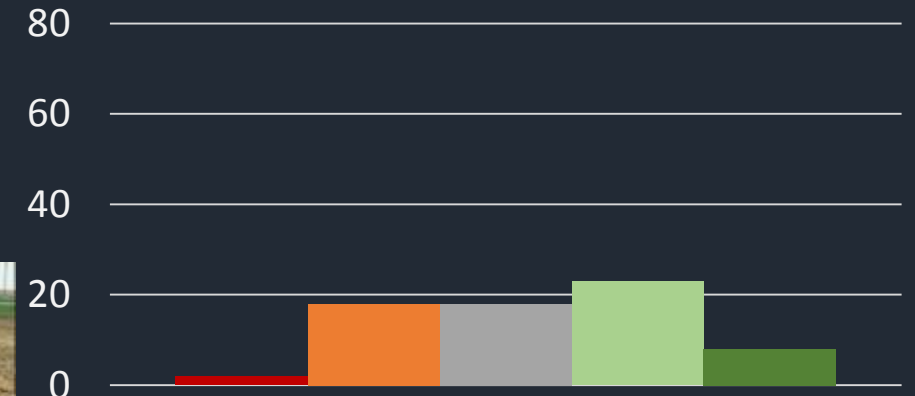


# Conservation Tillage

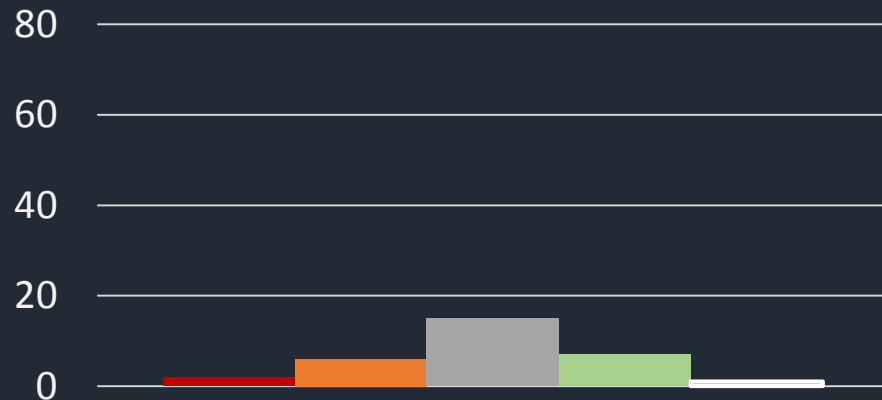
Soil Health



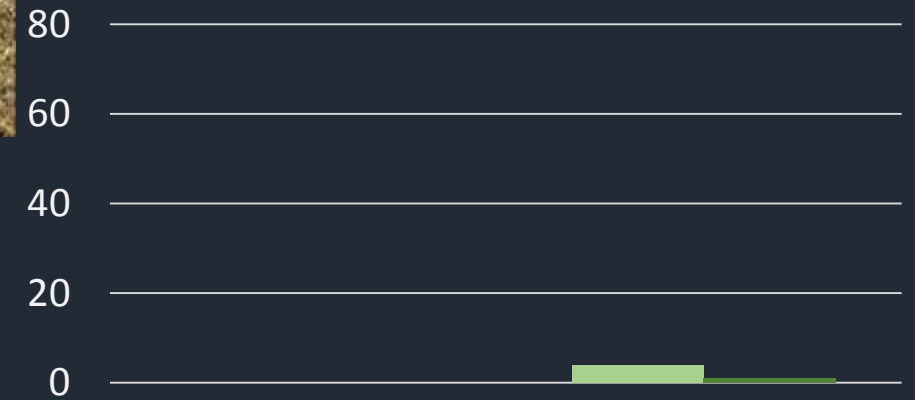
Food Yield



Greenhouse Gas Emissions



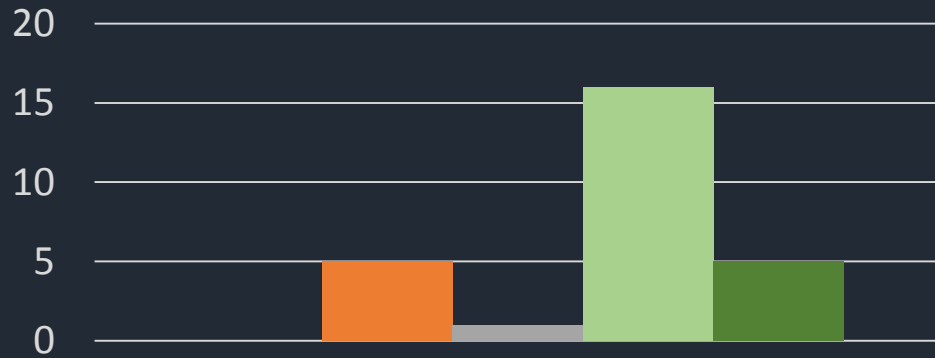
Water Efficiency



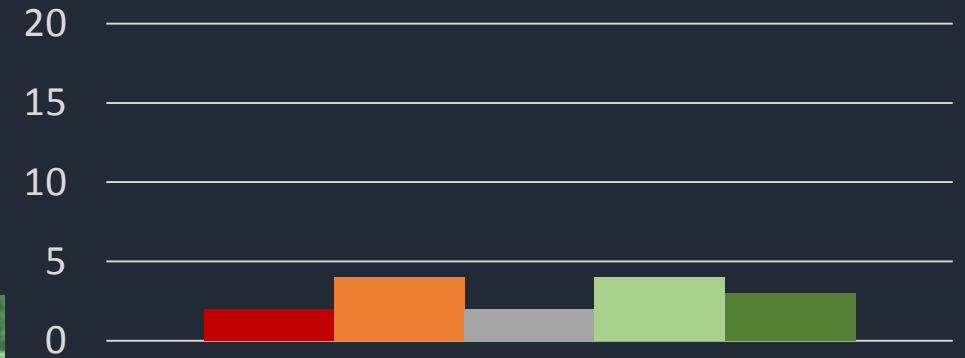


# Grow Cover Crops

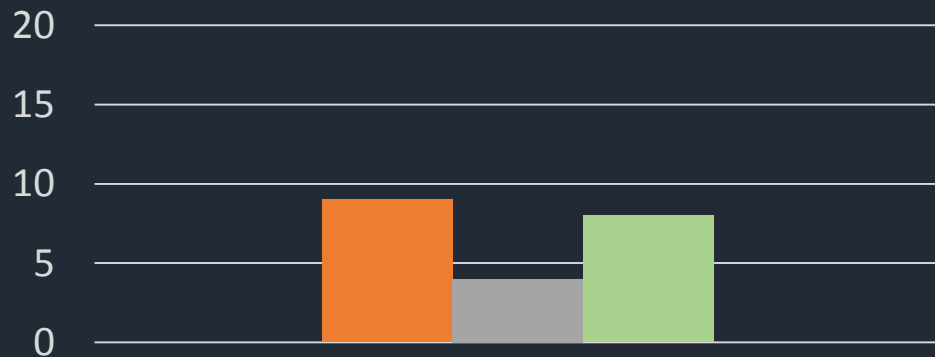
Soil Health



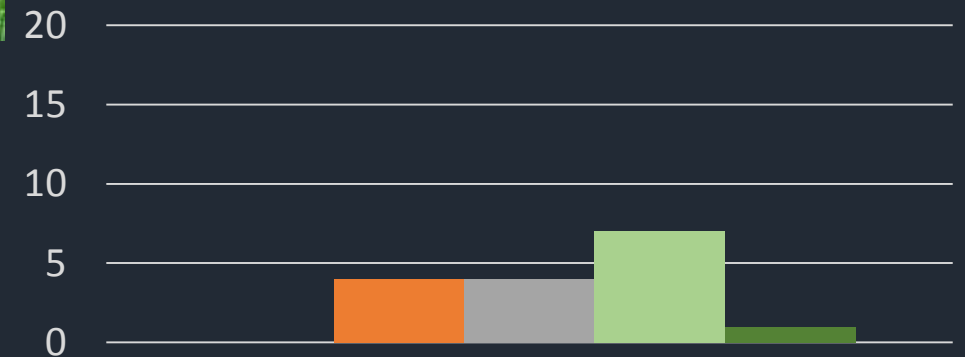
Water Availability



Food Production

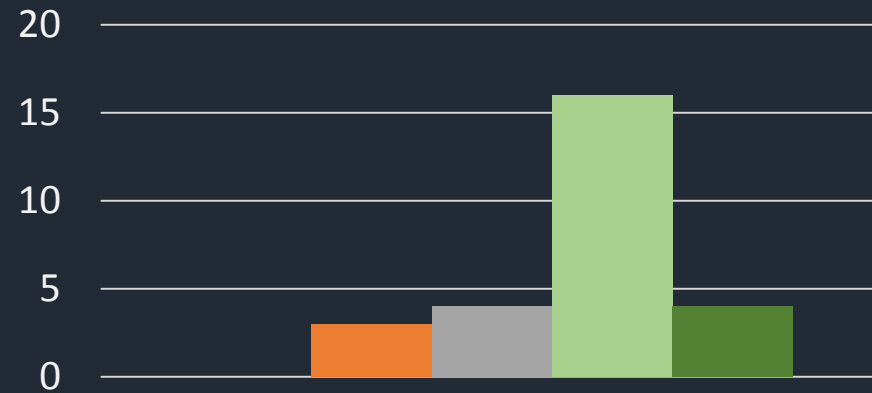


Pest Regulation

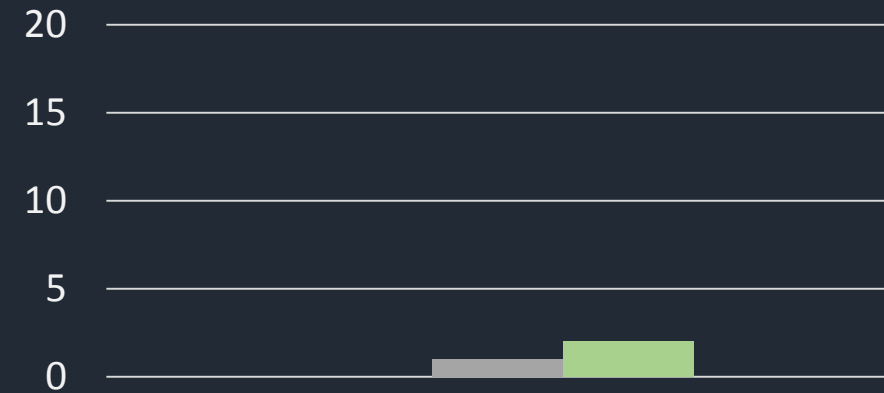


# Planting Edge Habitats

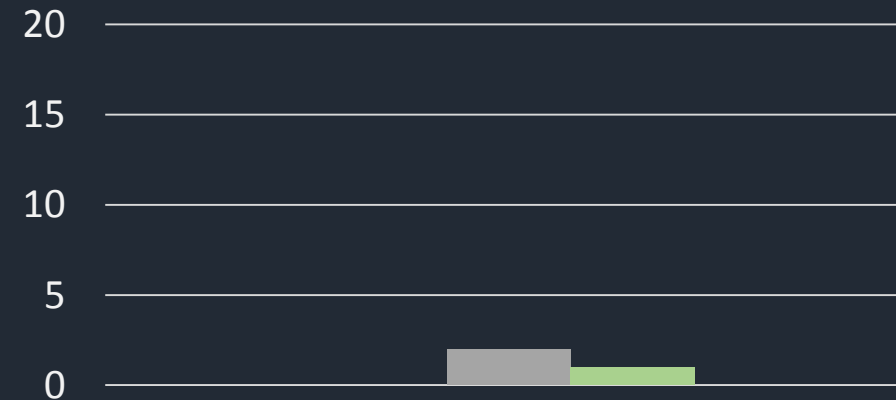
Pollination and Pest Control



Food Production

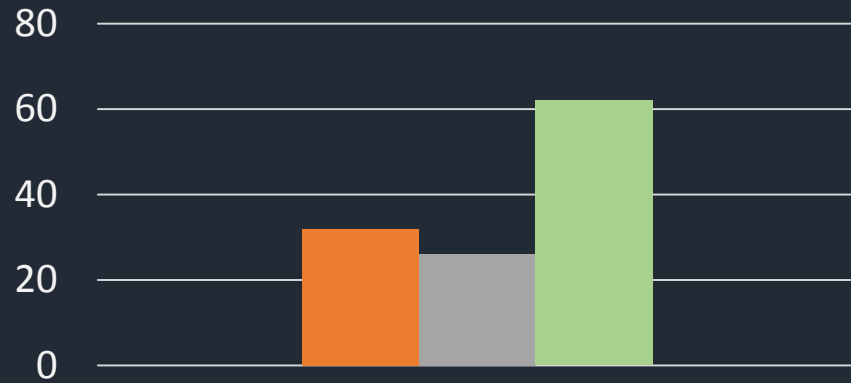


Biodiversity

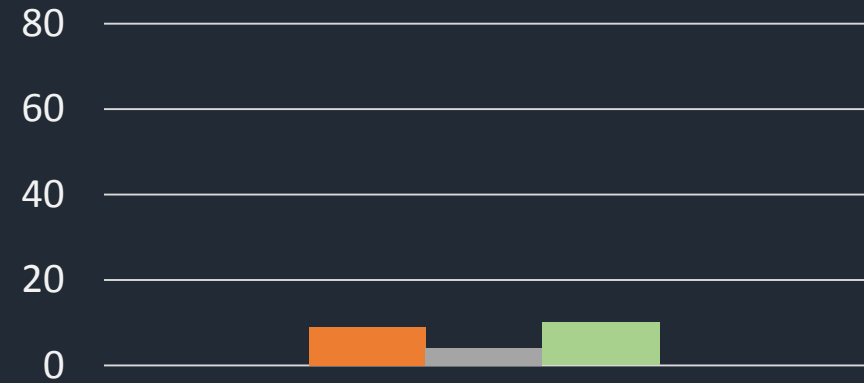


# Grazing Management

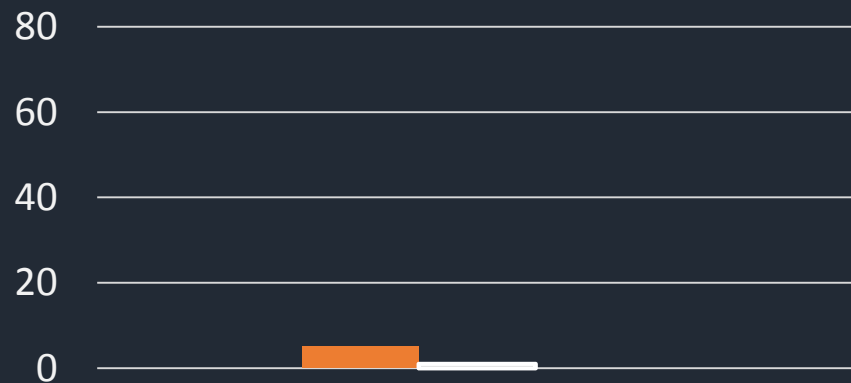
Biodiversity - Plants



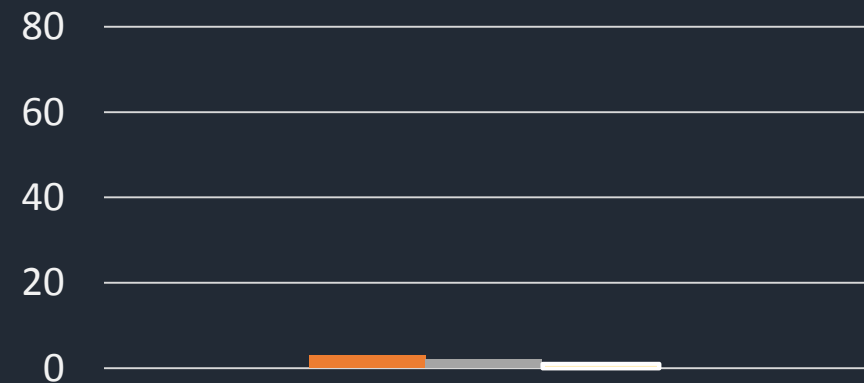
Biodiversity - Wildlife



Soil Health



Greenhouse Gas Emissions





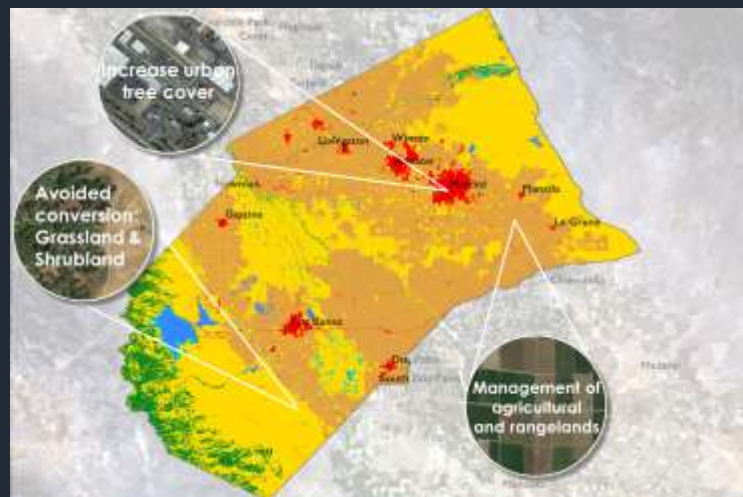
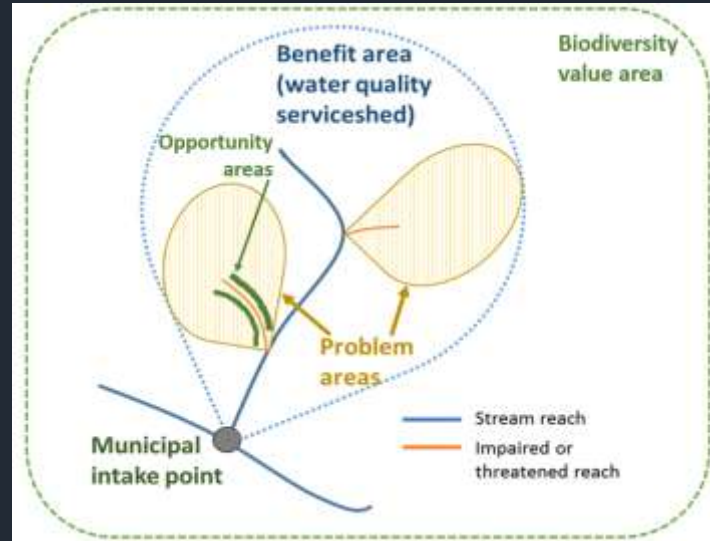


# Summary and Key Messages

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- Good evidence for agronomic practices
- Significant evidence gaps for biodiversity and less agronomic oriented services
- Lack of integrated view across ecosystem services
- Potential trade-offs, as well as synergies

# Next Steps







*Thank You*

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