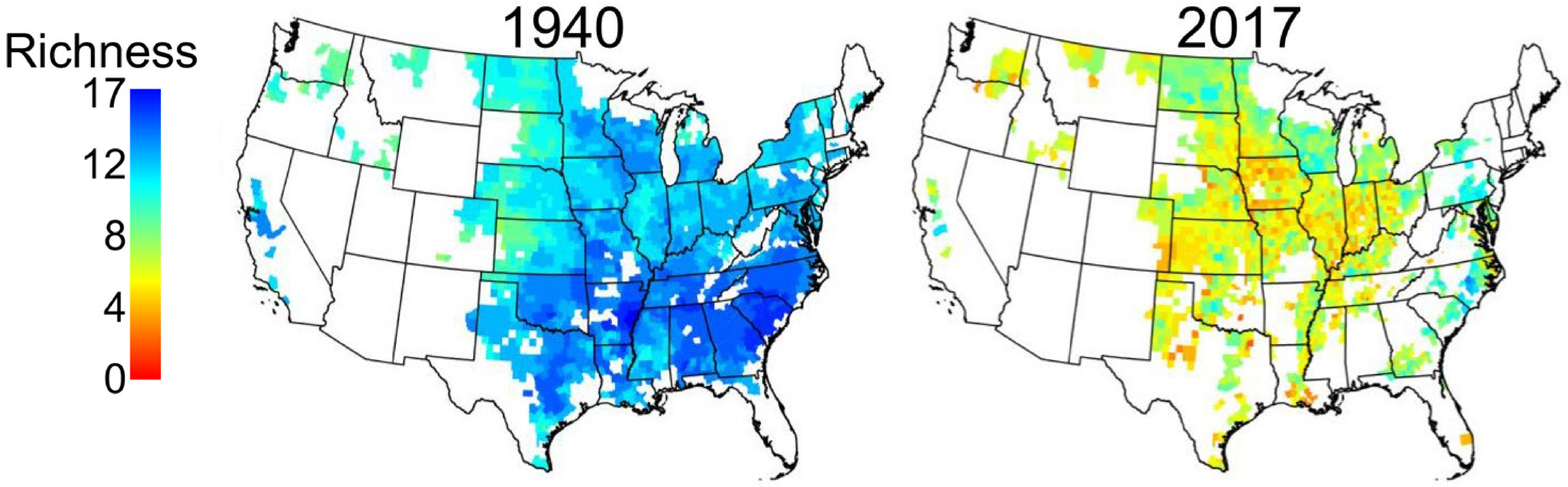
Framework for evaluating economic barriers to crop diversification

Cameron Pittelkow, **Sara Rosenberg**, Whitney Brim-DeForest,
Michelle Leinfelder-Miles, Bruce Linquist, Luis Espino, Kassim Al-Khatib

UC Davis and UC Cooperative Extension (UCANR)

Cropping system diversification

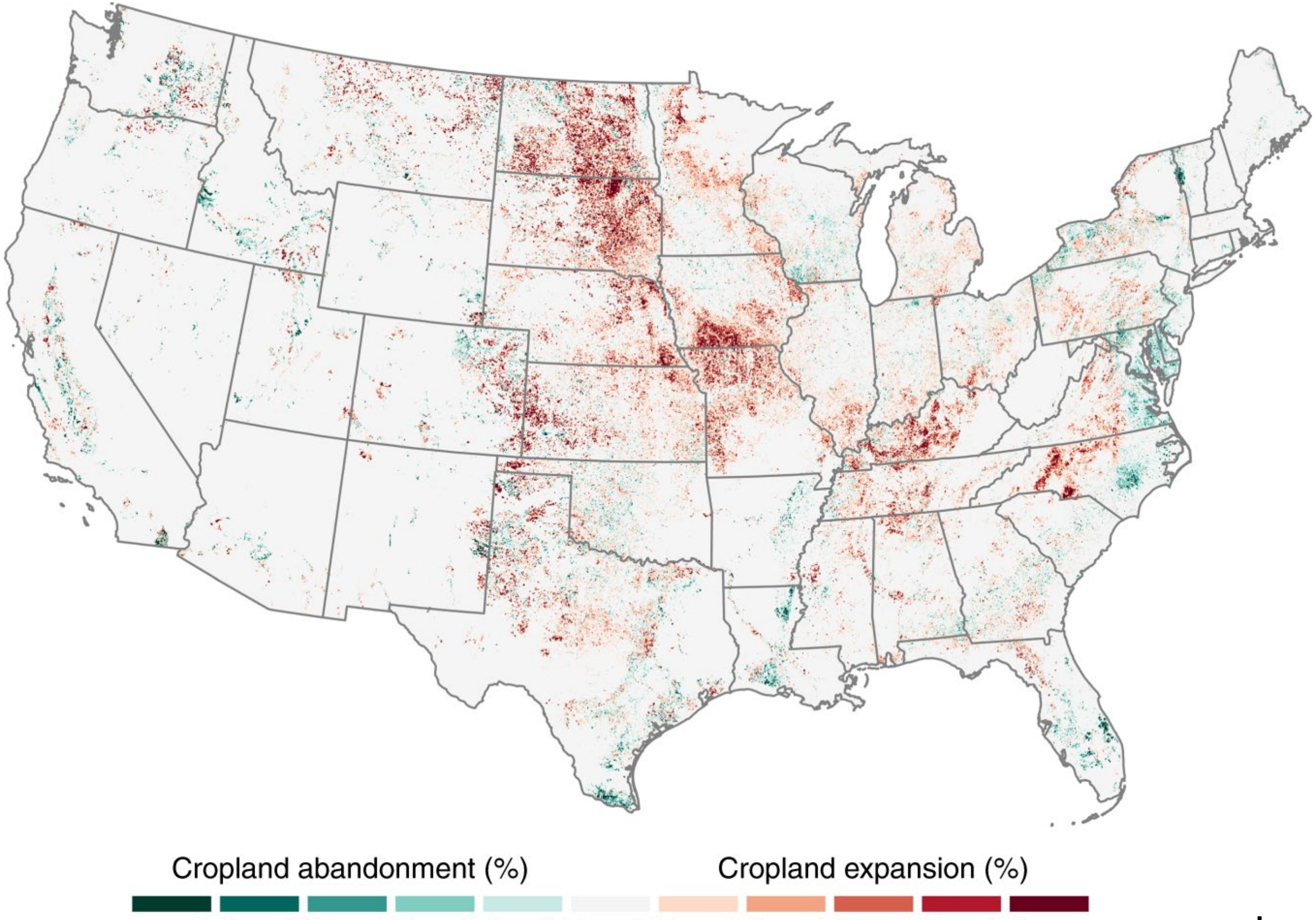
Specialization + concentration of crop production



From 88% of counties with >10 crops to 2%, mostly occurring after 2000

Crossley et al. 2020

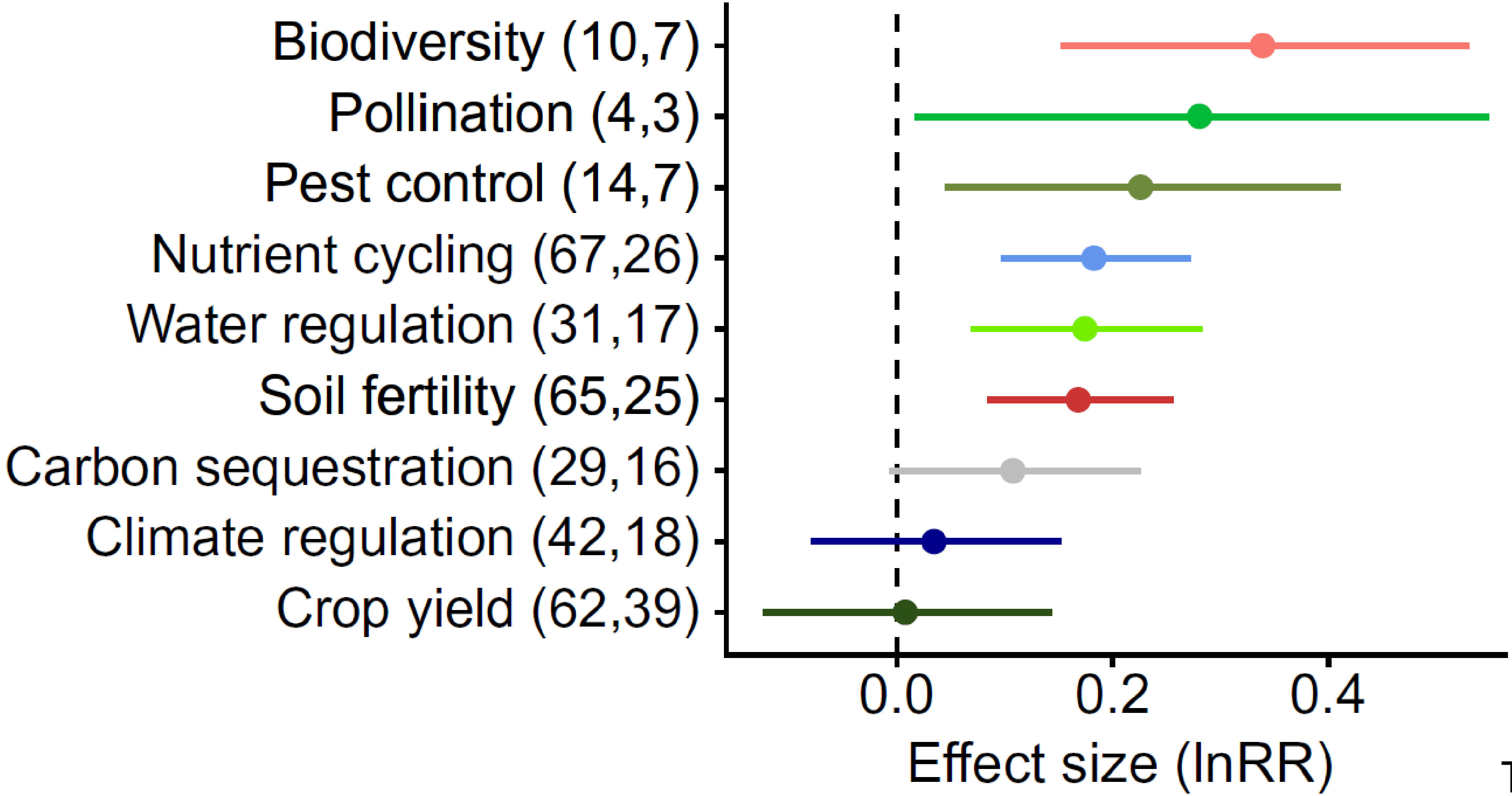
Cropland expansion > 1 m acres per yr



Lark et al. 2020

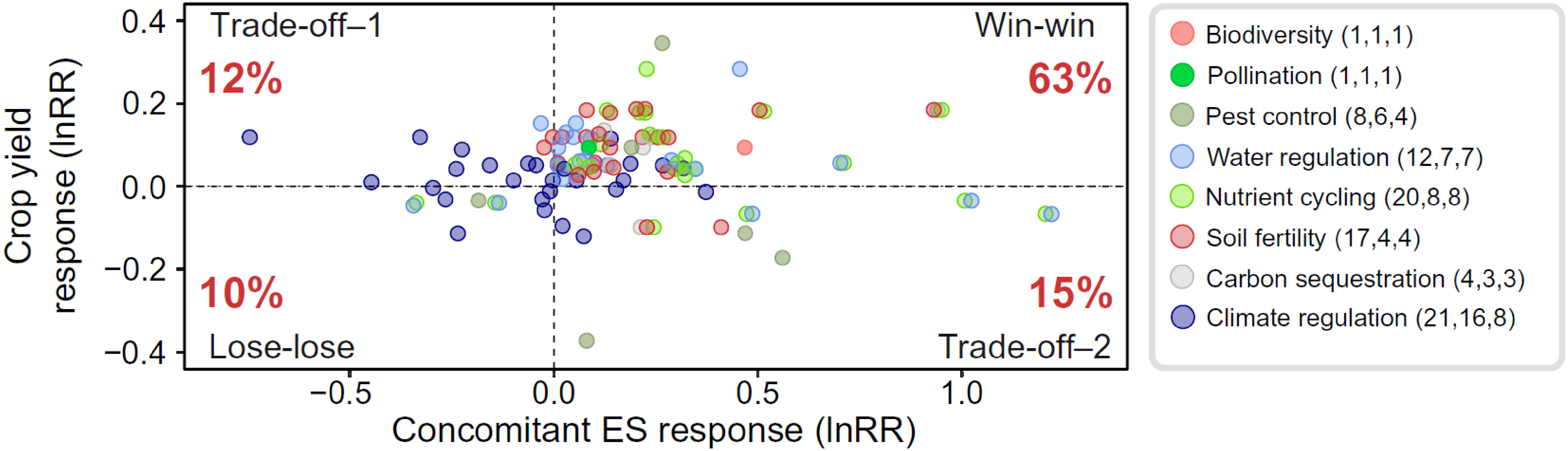
Science is clear

Second-order meta-analysis (5160 studies, 41,946 comparisons)



Tamburini et al. 2020

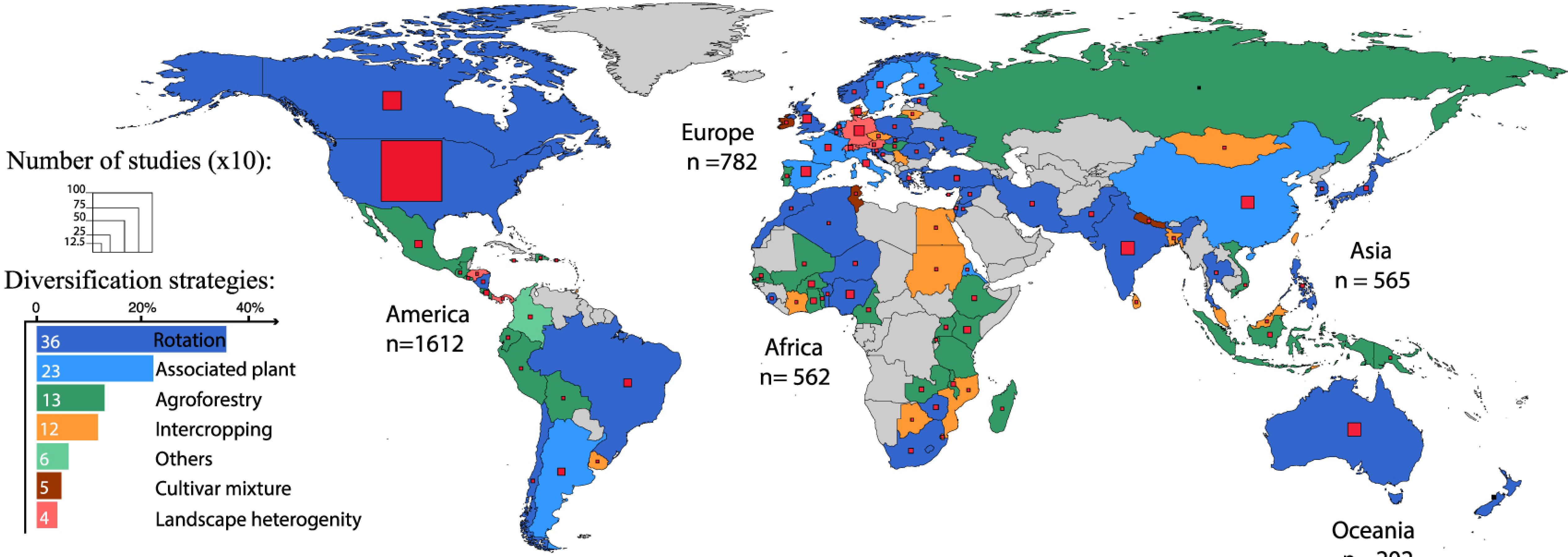
Ecosystem service and productivity tradeoffs



Tamburini et al. 2020

Evidence map of 3736 experiments in 99 meta-analysis studies

"We found very few syntheses on the economic impacts of crop diversification"



Beillouin et al. 2020

Objectives

- Case study exploring diversification of rice systems in California

- Link results with broader forces shaping agriculture

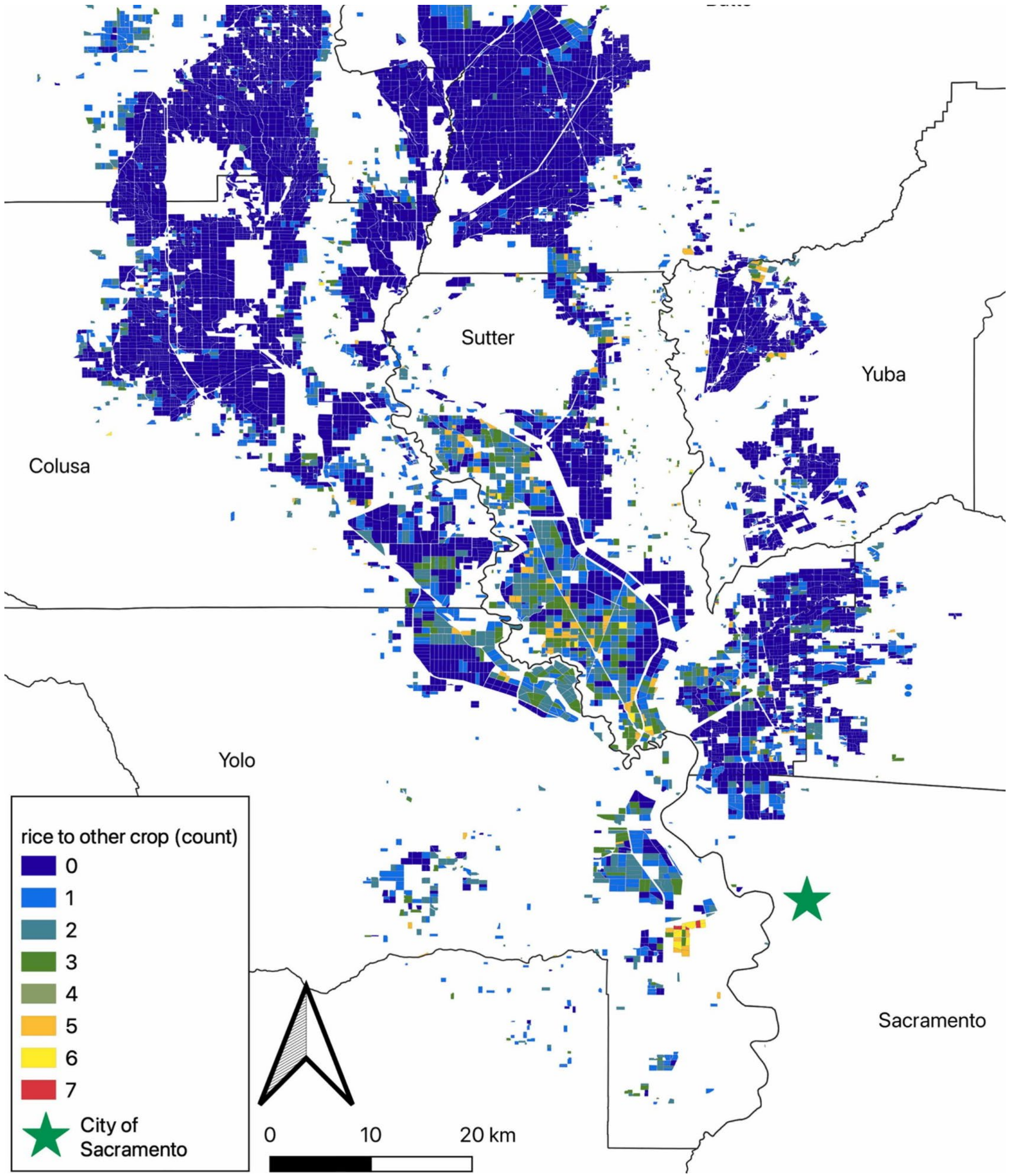
- Question: shift focus from farm-level dynamics to larger policy and market drivers?


California rice systems

Challenges

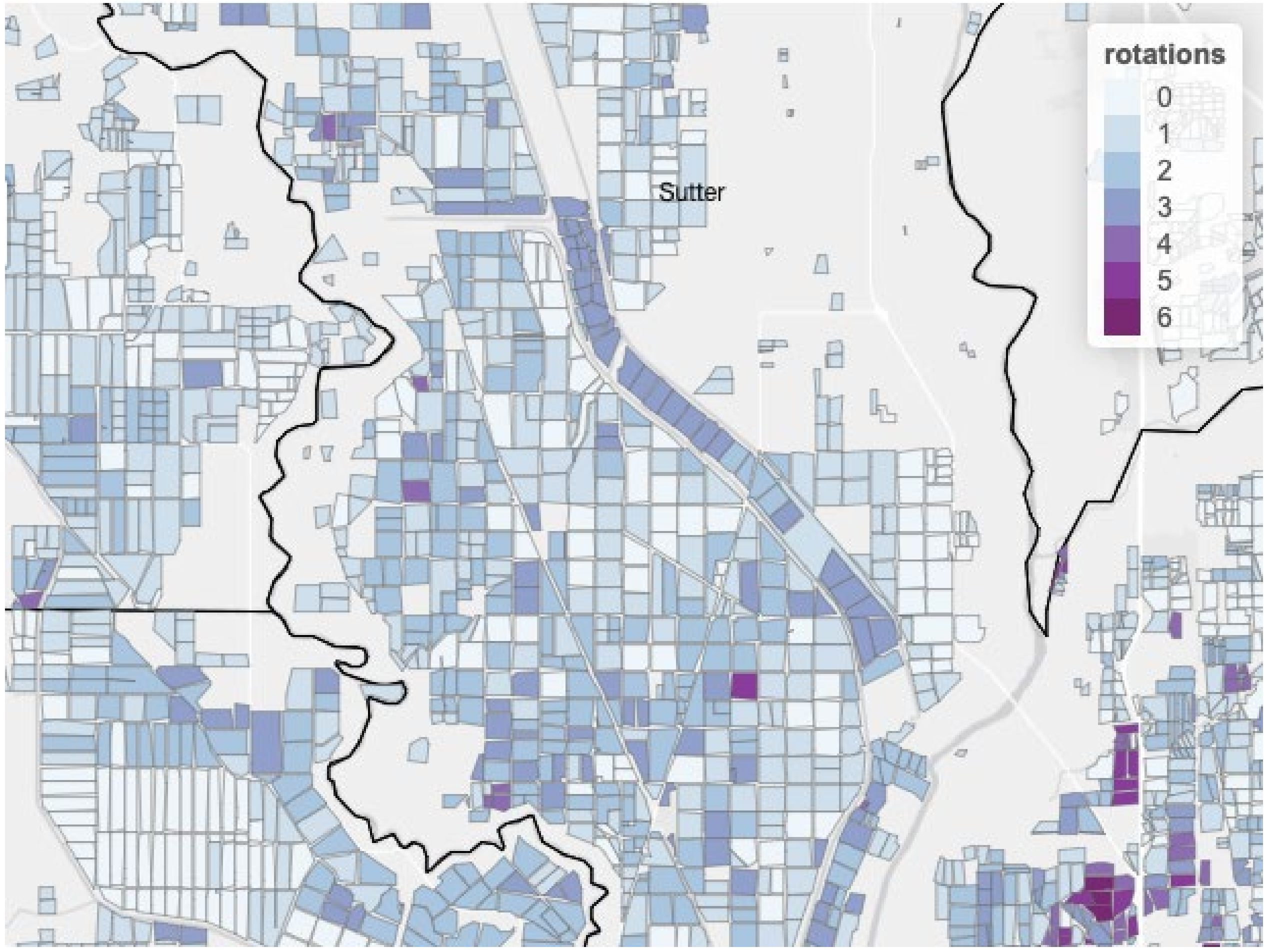
- Herbicide resistance
- Water scarcity
- Costs of production

Sacramento Valley
Current rice-based rotations

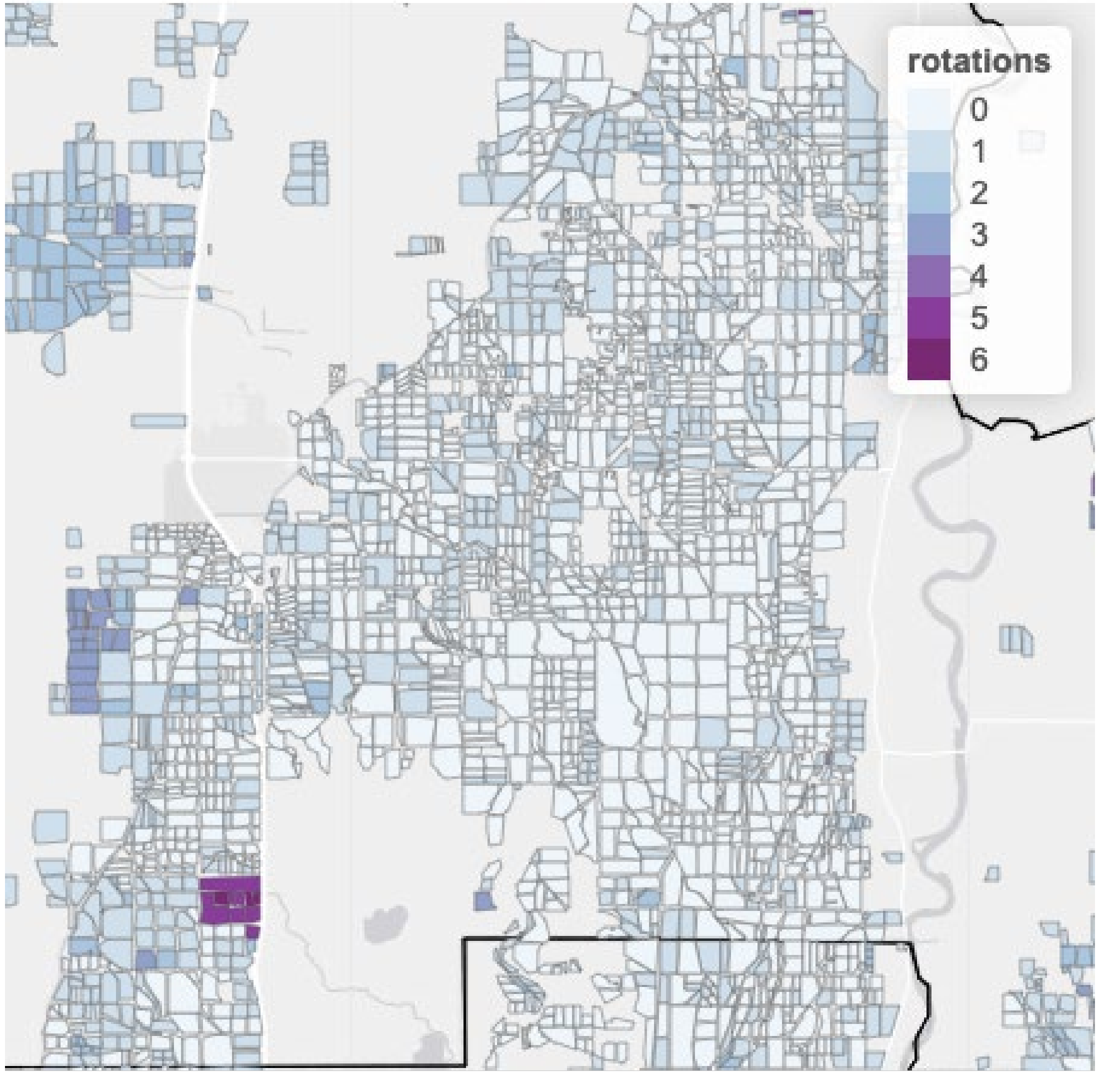


Salvato et al. 2024

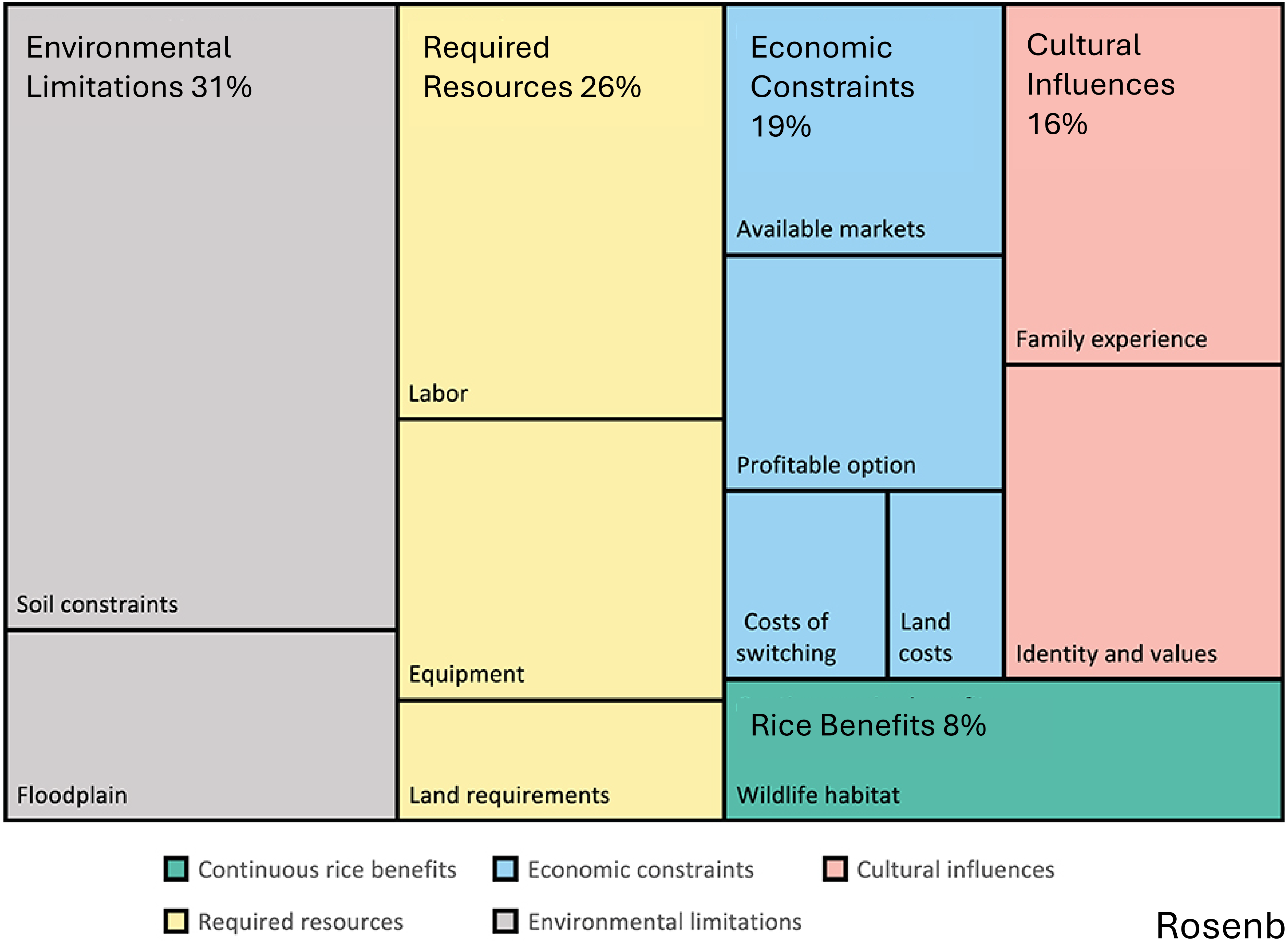
Sutter county



Glenn county



Interactive rotation map: https://rpubs.com/lasalvato/663899



Rosenberg et al. 2022

Framework to quantify challenges and opportunities

1. Evaluate costs and profitability of switching from rice to other crops

2. Compare long-term profitability of select rotations over 15 yr

3. Explore how different scenarios (+/-) influence outcomes

Rotations evaluated

- Continuous rice baseline (standard practice)
- Most feasible alternative crops: tomato, sunflower, beans, safflower
- Low cost and low revenue rotation – safflower and bean rotation
- High cost and high revenue rotation – tomato and sunflower rotation

Scenarios

- Fallow years in continuous rice
- Rotation benefits (10% increase in rice yield and reduced input costs)

Long-term rotation sequences

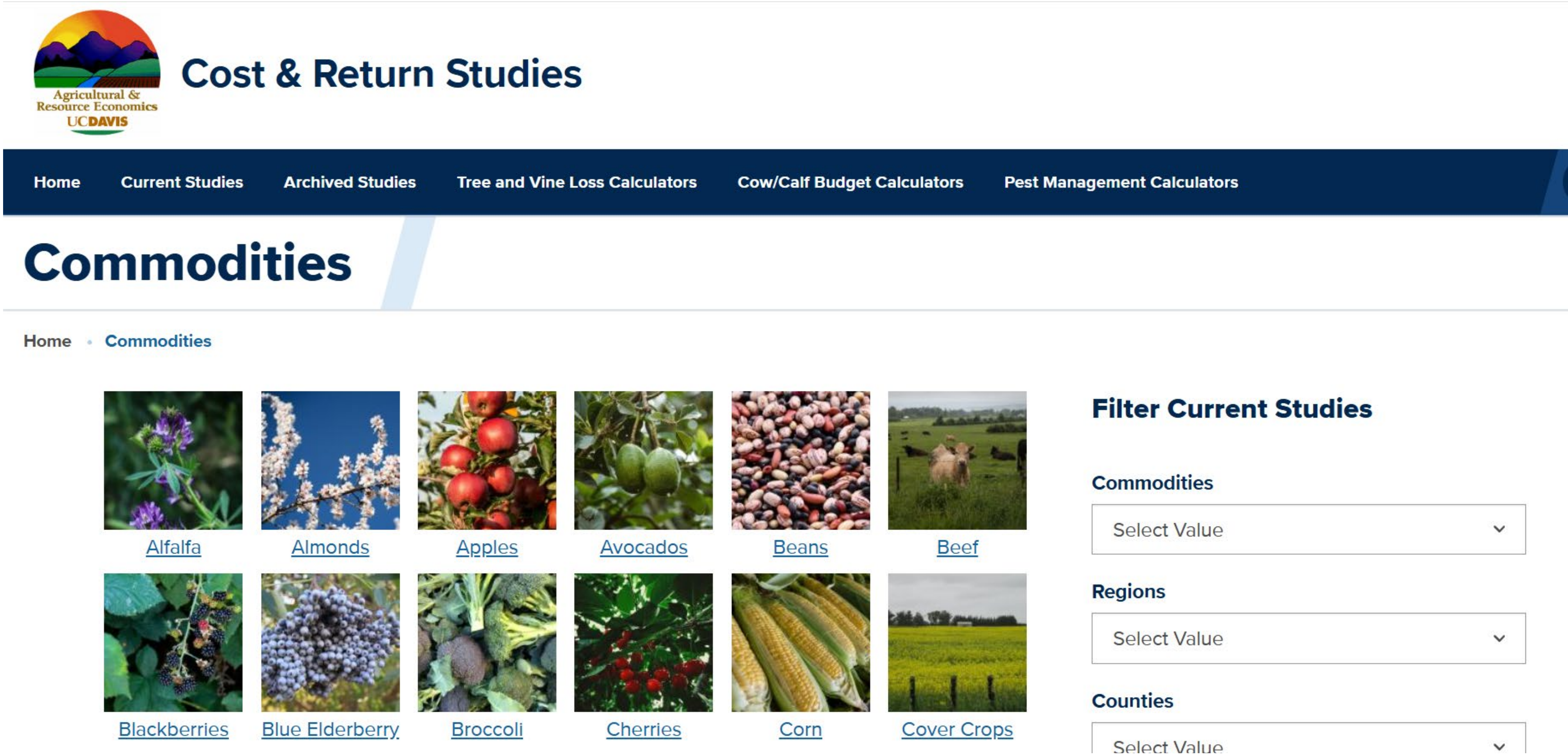
Rice	Rice	Rice	Rice	Rice	Rice	Rice
Rice	Sunflower	Tomato	Tomato	Rice	Rice	Rice
Rice	Safflower	Beans	Beans	Rice	Rice	Rice

Rotation benefits

Rice	Sunflower	Tomato	Tomato	Rice	Rice	Rice
Rice	Safflower	Beans	Beans	Rice	Rice	Rice

Water shortage scenario

Rice	Rice	Rice	Rice	Rice	Rice	Fallow



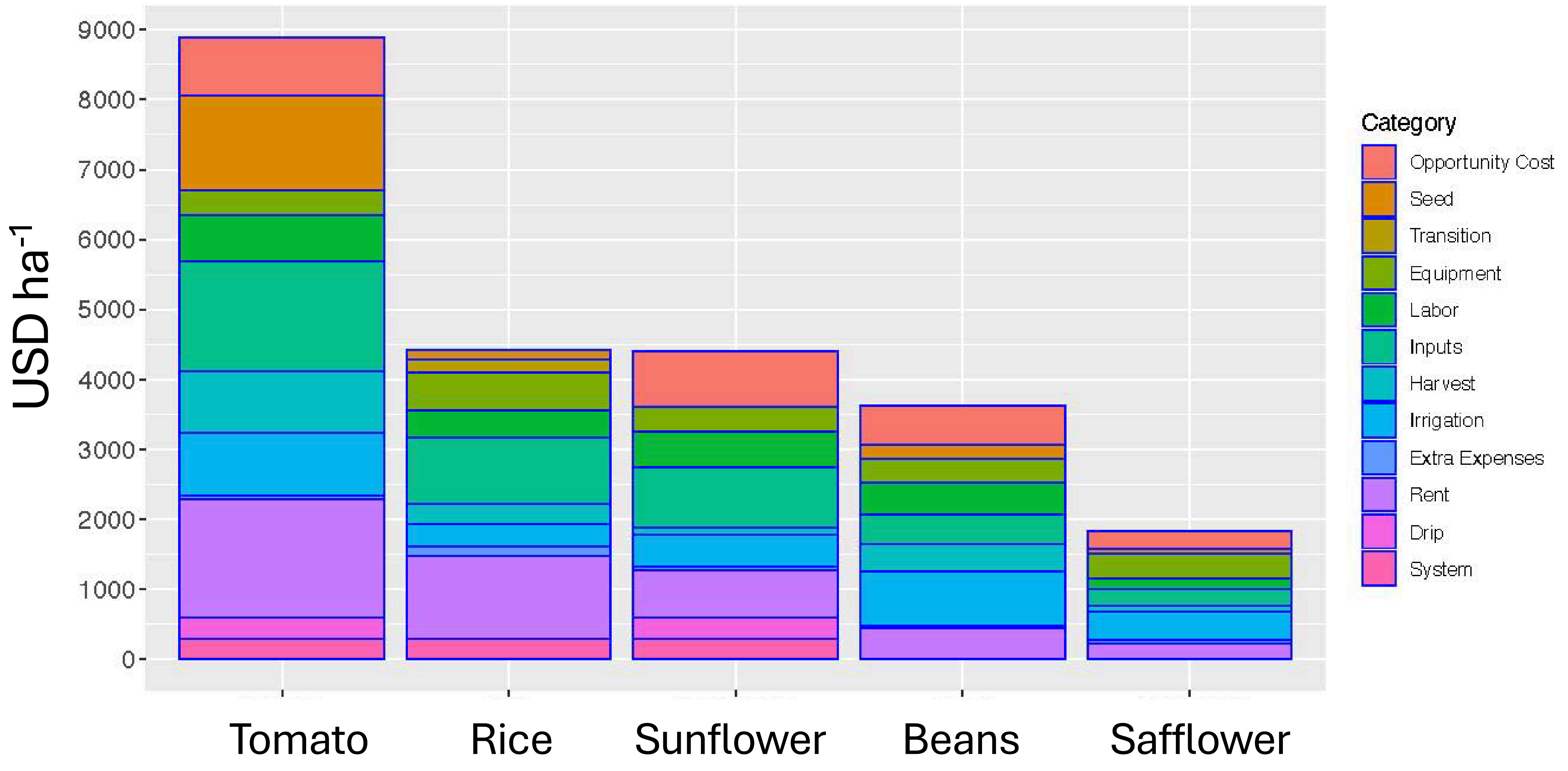
https://coststudies.ucdavis.edu/

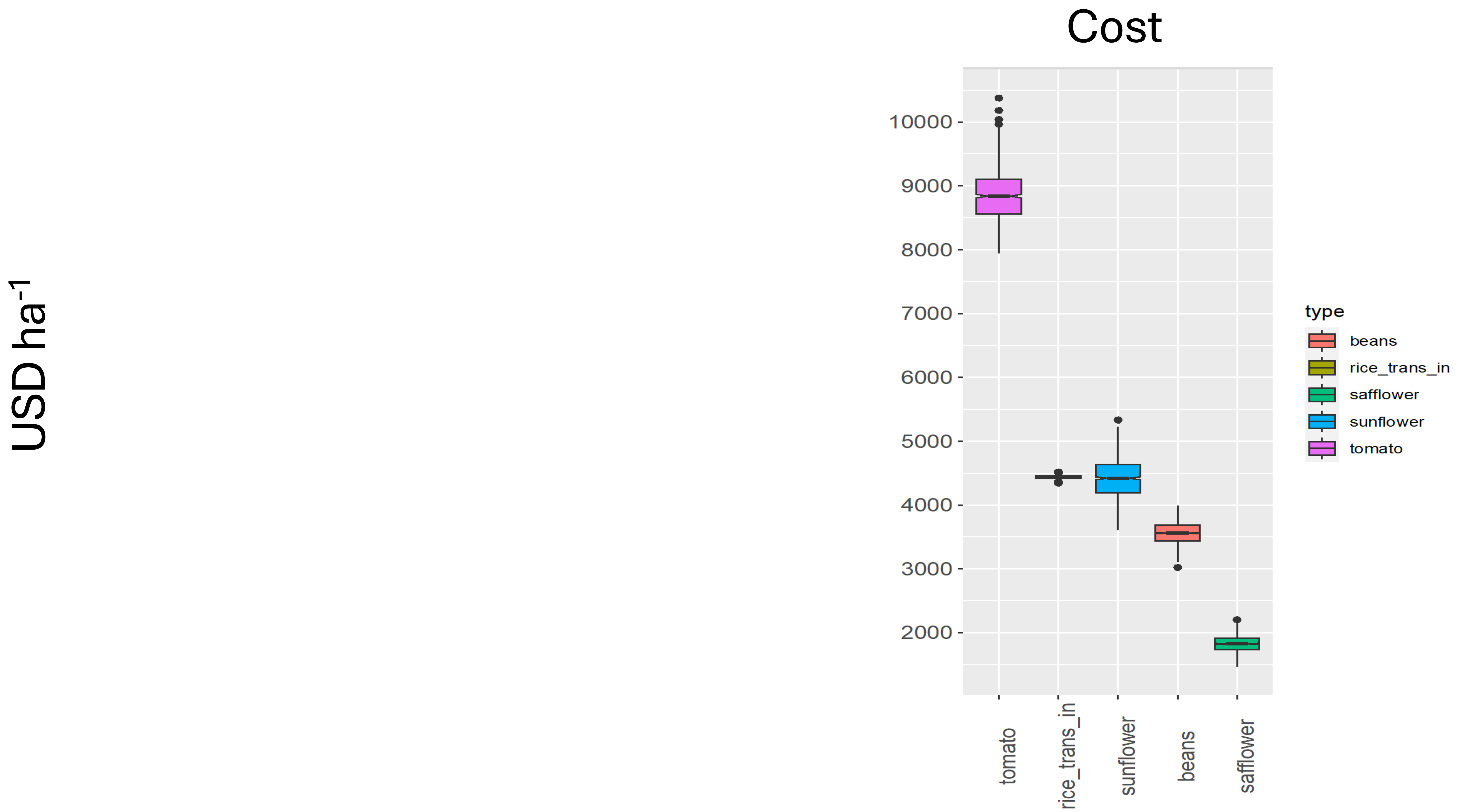
Data sources

Focus groups with growers

- Requirements for transition from rice
- Decision-making based on farm circumstances
- Cost and time/labor estimates
- Information supplementing cost studies

Cost breakdown





USD ha-1
Cost
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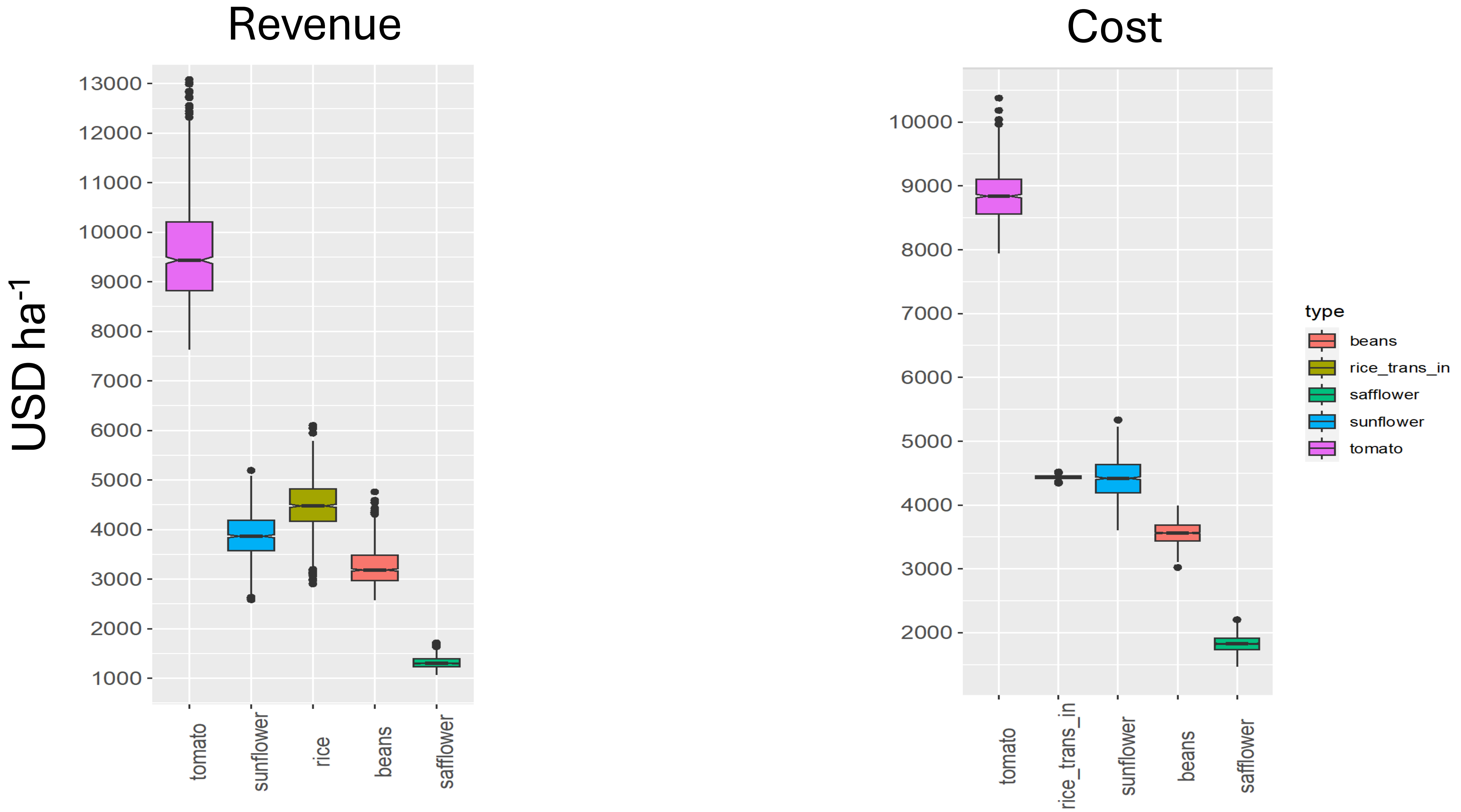

Revenue
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13000
12000
11000
10000
9000
8000
7000
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2000
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tomato
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rice
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safflower
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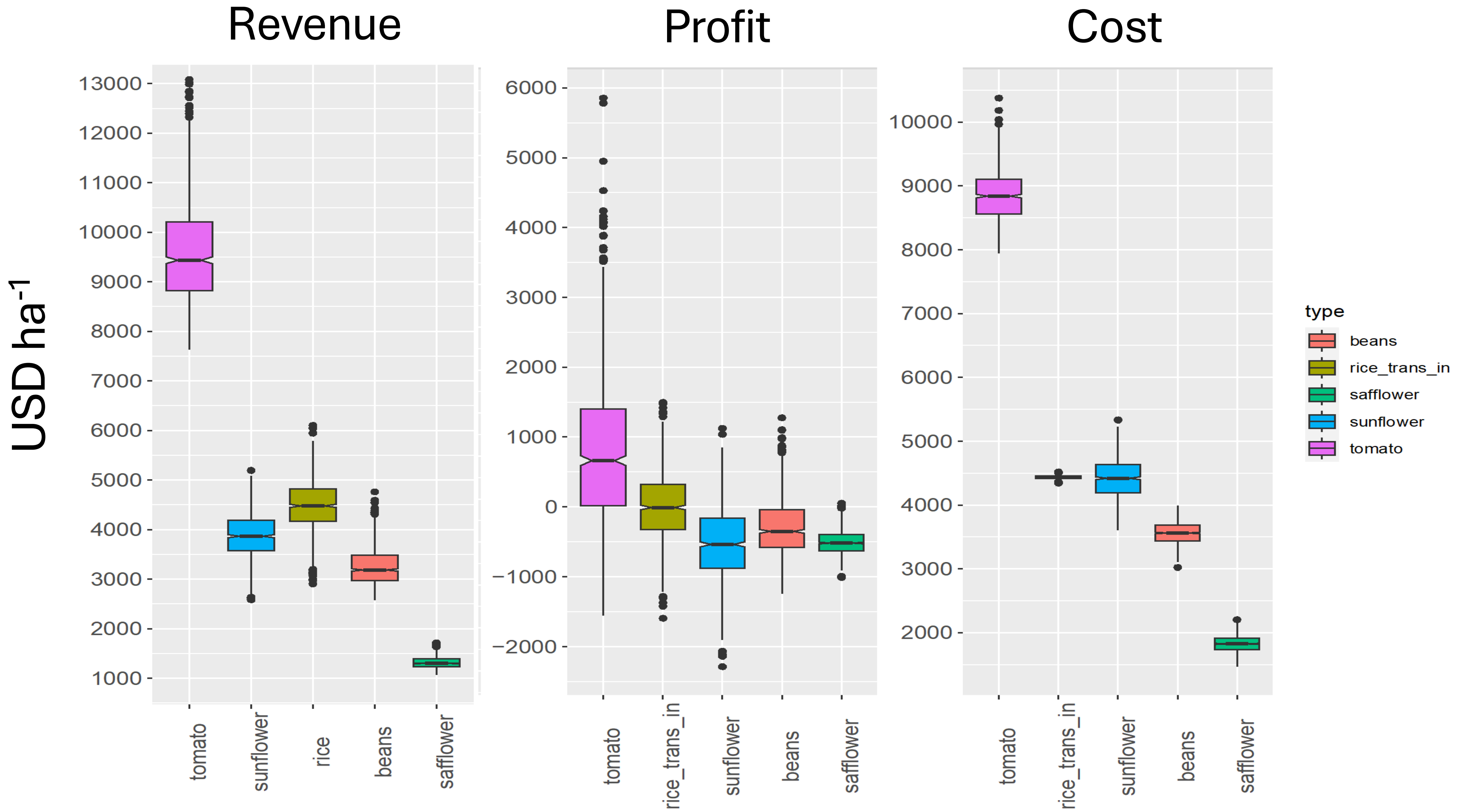

Revenue
Profit
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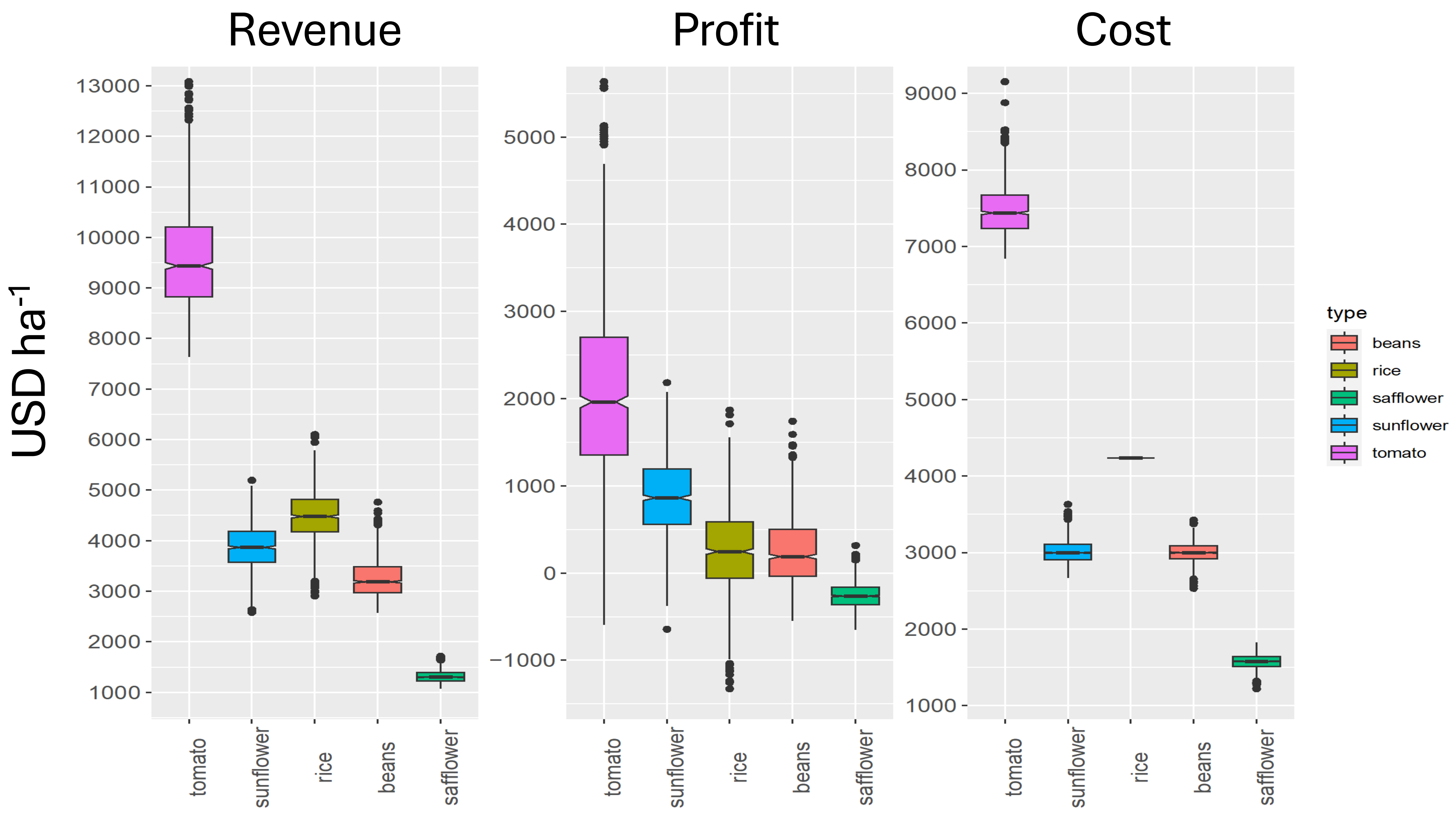

Revenue
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tomato
sunflower
rice
beans
safflower
type
beans
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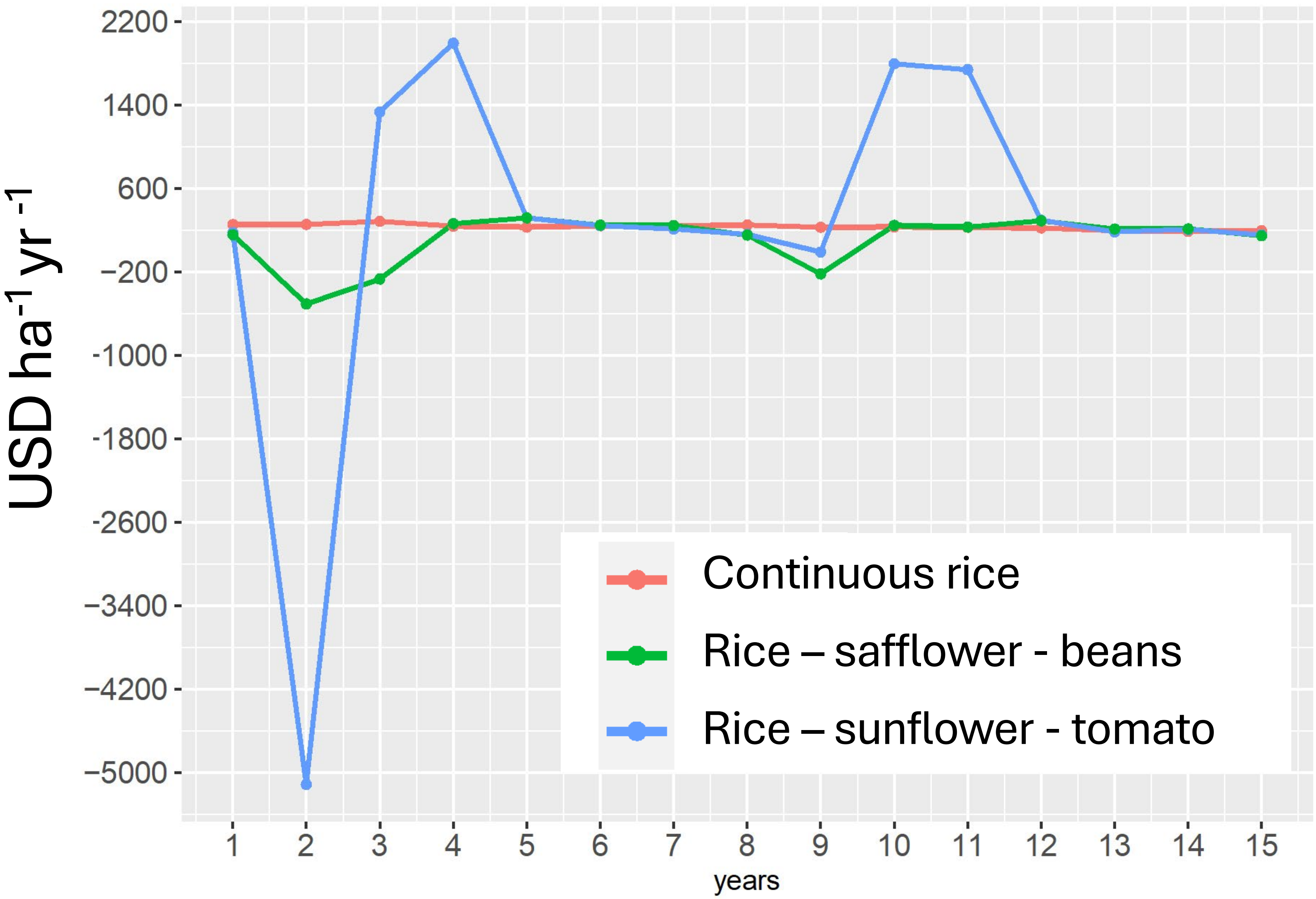
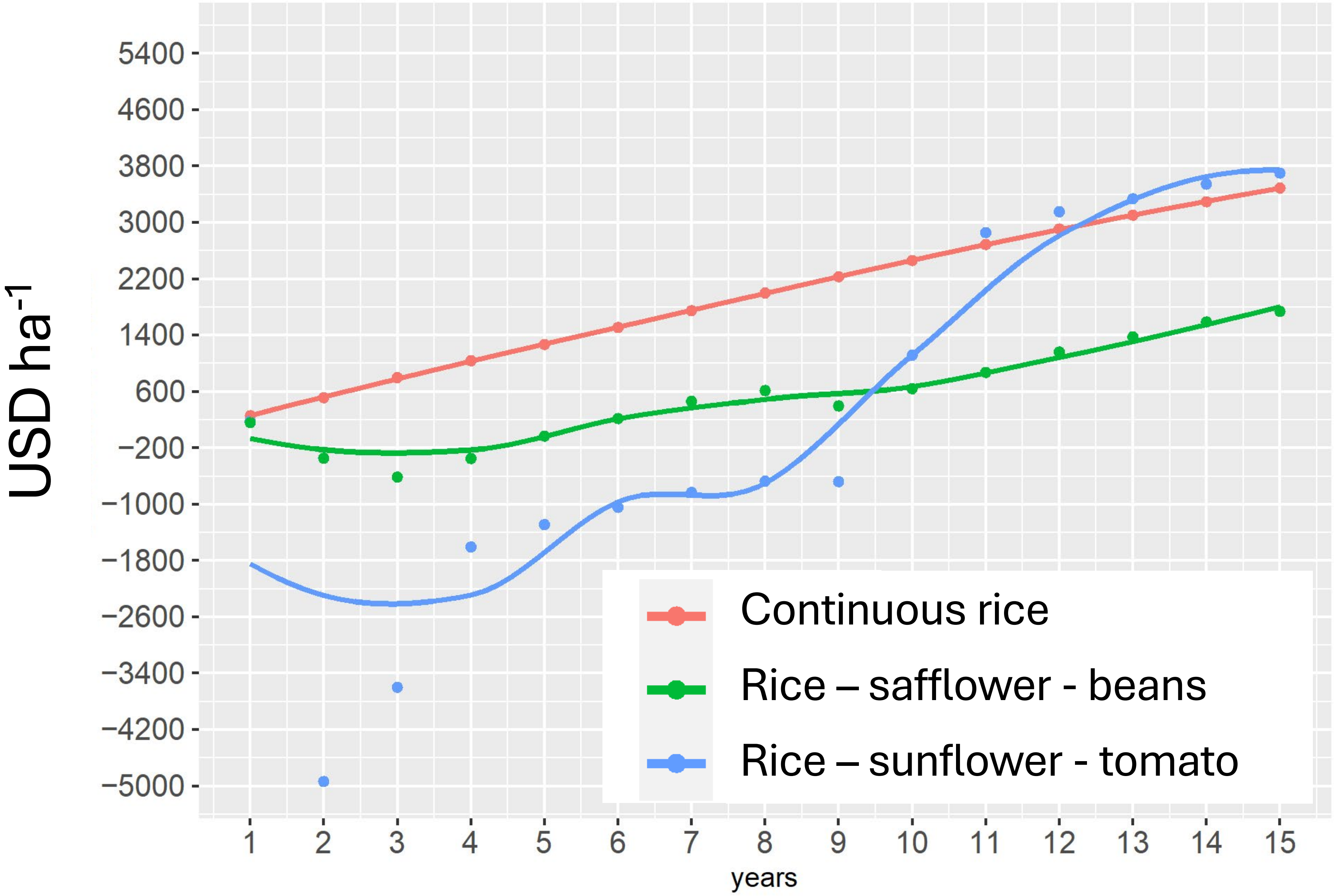
safflower
sunflower
tomato

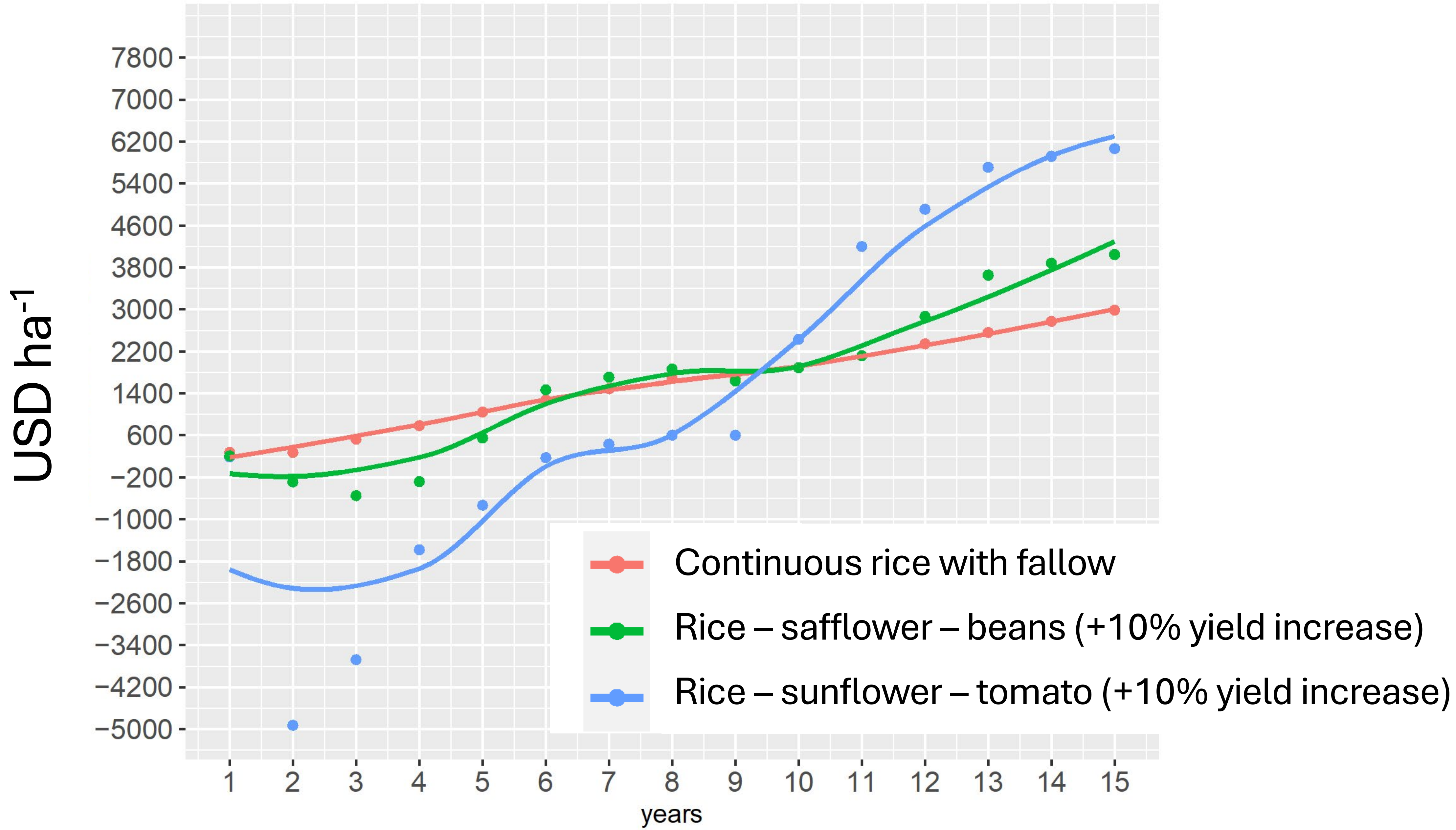
Net present value: annual basis during rotation

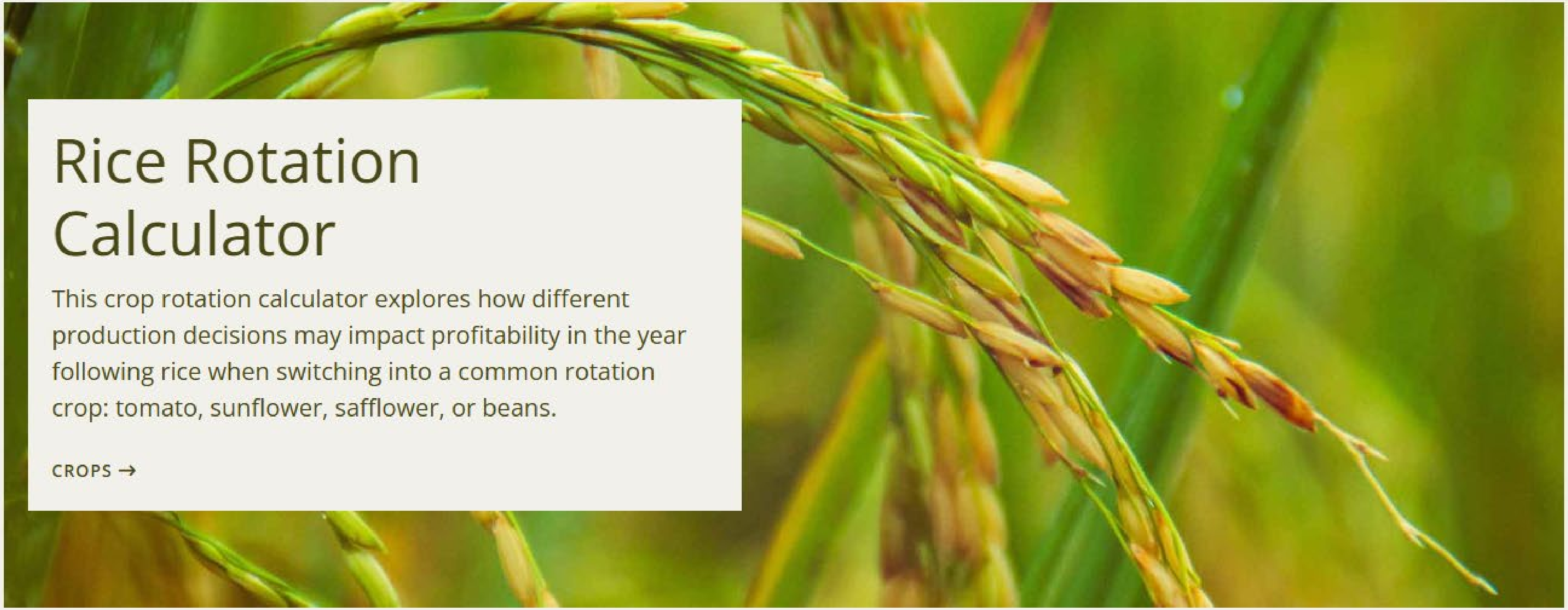


Cumulative net present value over 15 yr



Scenarios: fallow for continuous rice and rotation yield benefits





Rice Rotation Calculator

This crop rotation calculator explores how different production decisions may impact profitability in the year following rice when switching into a common rotation crop: tomato, sunflower, safflower, or beans.

CROPS →

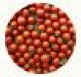
CROPS

Choose crop for calculation

Beans

Safflower

Sunflower



Tomato

UC RICE WORKGROUP
RICE ROTATION CALCULATOR

- FAQ
- Beans
- Safflower
- **Sunflower**
- Tomato

Category

Field reconstruction

- Baseline information
- Opportunity cost
- Seed
- Equipment and implement cost
- Straw management
- Field reconstruction
- Labor
- Inputs
- Harvest
- Irrigation
- Extra expenses
- Crop loss
- Yield
- Rent-crop share
- Rent-fixed rent

Rice	$25.64
Sunflower	$32.51

Summary

Opportunity cost	Cost	$-500
Seed	Saving	$57.09
Equipment and implement cost	Saving	$7.26
Straw management	Cost	$-2.84
Field reconstruction	Cost	$-6.87
Labor	Cost	$-69.87
Inputs	Saving	$209.89
Harvest	Saving	$216.94
Irrigation	Cost	$-58.5
Extra expenses	Saving	$31.79
Crop loss	Cost	6%
Yield	Saving	$103
Rent-crop share	Same	$0
Rent-fixed rent	Same	$0

UC RICE WORKGROUP
RICE ROTATION CALCULATOR

FAQ

Beans

Safflower

Sunflower

Tomato

Category

Field reconstruction

Field reconstruction for Rice

Custom work-gps field leveling (unleveling) (USD per acre)

23.04

Field reconstruction for Sunflower

Labor cost- remove/rebuild levees (every 2 years) (USD per acre)

6.91

Custom work-gps field leveling (unleveling) (USD per acre)

23

Operating cost and overhead of triplane (every two years) (USD per acre)

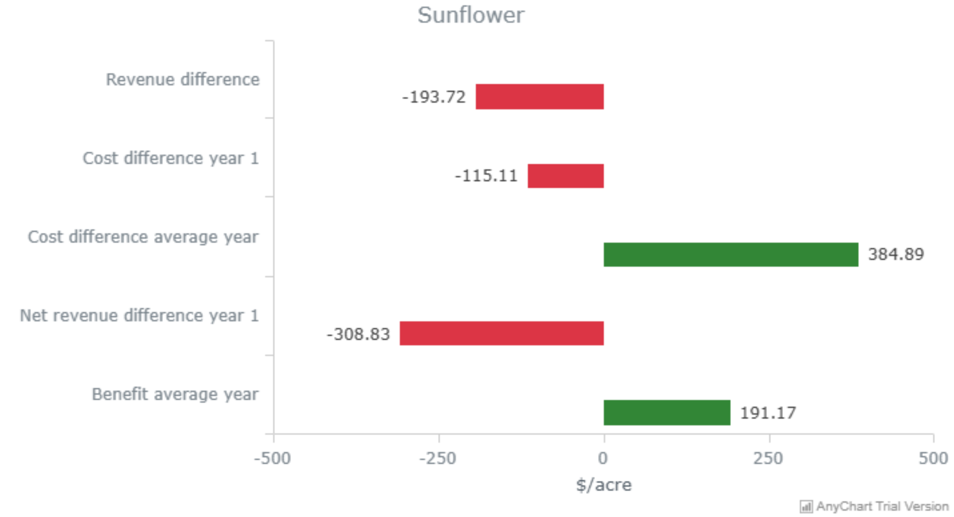
0.6

Field reconstruction Totals

Rice	$25.64
Sunflower	$32.51

Results

Chart



Costs and benefits of switching over to sunflower compared to staying in rice production. Dollar per acre.

Summary

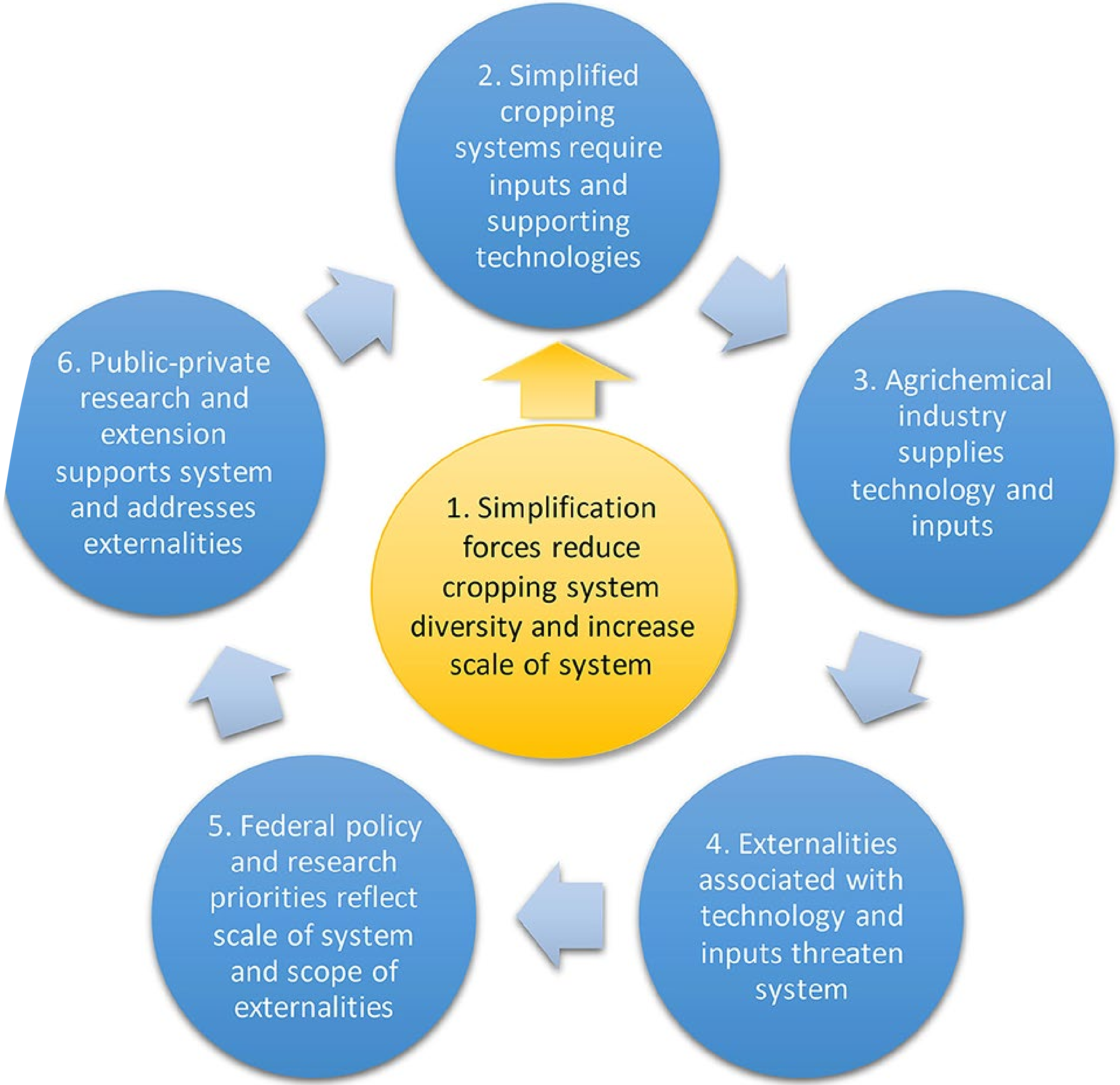
Opportunity cost	Cost	$-500

Implications of results

- Wide range of costs, revenue, and profit, decision-support tools need to capture this
- Many barriers including cost and additional time, labor, and management (opportunity cost)
- Specialization has benefits (avoid transition years… with guaranteed market)
- Higher profit potential only in long-term, many growers not in that financial position

These ideas are not new …

- High land rental rates
- Lack of markets
- Crop insurance subsidies
- Direct payments for certain crops
- Low margins -> economies of scale
- Specialized equipment and experience

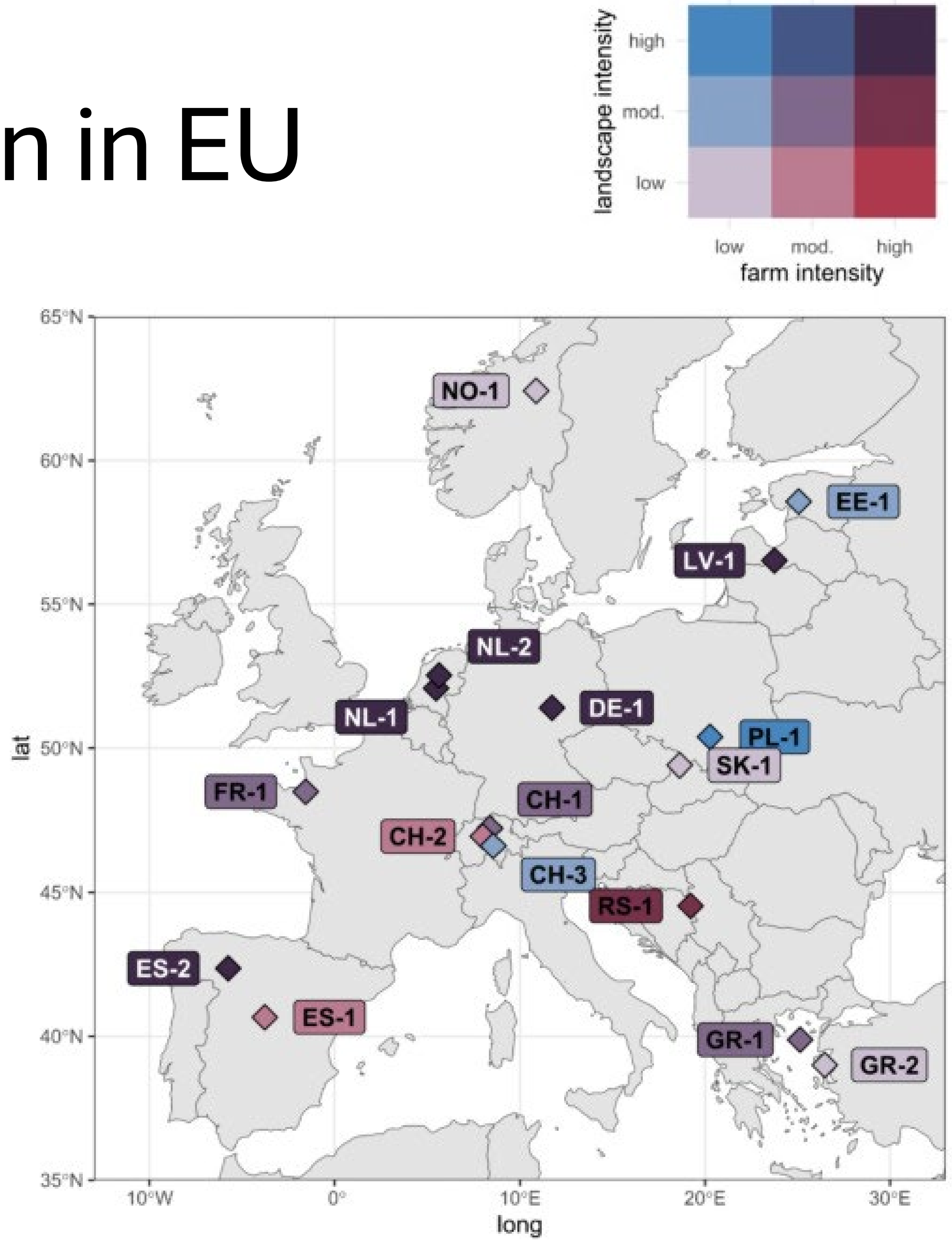


Agricultural scientists cannot be a neutral party only focused on data – must help change federal funding and policy to address the root causes

Mortensen and Smith, 2020

Lessons from diversification in EU

"Pathways that increase multifunctionality arise mostly by necessity. Successful agricultural transformation will therefore require policy to create enabling environments that provide socioeconomic benefits for farmers to increase multifunctionality, and a civil society and market conditions that value sustainable agriculture."



Helfenstein et al. 2024

CAST
COUNCIL FOR AGRICULTURAL SCIENCE AND TECHNOLOGY

ISSUE PAPER

NUMBER 6 FEBRUARY 1996

DIVERSIFYING U.S. CROP PRODUCTION

THE *JEFFERSON INITIATIVE* PROPOSES THE KIND OF SUBSTANTIAL, LONG-TERM, AND COORDINATED FRAMEWORK NECESSARY FOR THE CREATION OF A SUCCESSFUL NATIONAL STRATEGIC PROGRAM IN NEW-CROPS DEVELOPMENT.

SUMMARY

For more than a century, U.S. agriculture has been beset by the pressures of crop price instability. These pressures have caused severe economic problems in rural America. In the past 60 years, federal programs, based on subsidies and acreage reduction, have attempted to stabi-

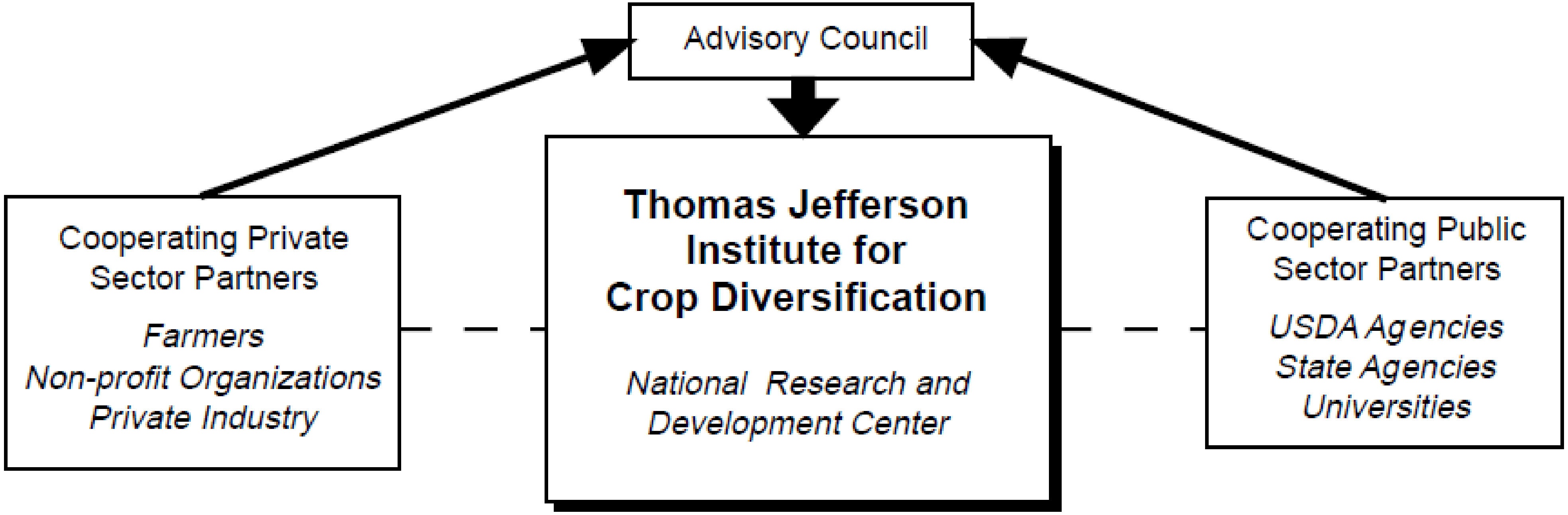
undermined the potential of new crops to alleviate related concerns and pressures. Although support for the development of new and alternative crops has been proposed consistently, publicly funded research has been scarce and fragmented.

The authors of this document propose the *Jefferson Initiative* as a way

AUTHORS: JULES JANICK (Chair), Indiana Center for New Crops and Plant Products, Department of Horticulture, Purdue University, West Lafayette, Indiana; MELVIN G. BLASE, Department of Agricultural Economics, University of Missouri, Columbia; DUANE L. JOHNSON, Department of Soil and Crop Science, Colorado State University, Fort Collins; GARY D. JOLLIFF, Department of Crop and Soil Science, Oregon State University, Corvallis; ROBERT

THE JEFFERSON INITIATIVE

Diversifying U.S. Agriculture Through Innovative Systems Research and Collaborative Public-Private Partnerships



Signed into law with 1998 Farm Bill (Title 7 - Agricultural Research, Extension, and Education Reform Act) but was later repealed in 2008

Enroll Now!

The USDA has many exciting climate-smart commodities projects in every state and many territories that partners are leading through Partnerships for Climate-Smart Commodities grants, which support climate-smart practice implementation, marketing and monitoring. If you're a producer or landowner interested in enrolling in one of our partners' projects, enrollment is through the project lead. Visit usda.gov/climate-smart-commodities to find a project in your area.

By providing support for climate-smart practice implementation, USDA can help you absorb risk associated with practices that often have a high up-front cost of adoption.

Enrolled producers and landowners can take advantage of some of the following benefits:

- Access to expanded markets, premiums and incentives for producing climate-smart commodities
- Cost share and technical assistance to implement climate-smart practices
- More productive and resilient agricultural land, increasing profits and decreasing input costs in farming operations
- Access to large-scale climate-smart data to inform farm management decision-making

USDA is an equal opportunity provider, employer, and lender.

July 2024

USDA U.S. DEPARTMENT OF AGRICULTURE

Partnerships for Climate-Smart Commodities

www.usda.gov/climate-smart-commodities

> $3 bn to develop markets and MRV

CLIMATE-SMART MARKETS FOR PRODUCERS

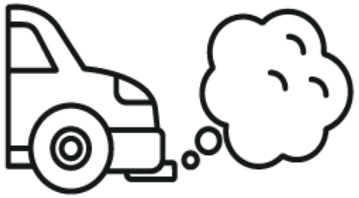
+14,000 ENROLLED FARMS

Connects producers to climate-smart markets, premiums, and incentives, helping them build more economically & environmentally resilient operations.

CLIMATE-SMART PRACTICES

+3,200,000 ACRES OF ENROLLED WORKING LAND

Provides financial and technical assistance specifically for climate-smart practices that reduce greenhouse gas emissions and sequester carbon.



COMPREHENSIVE DATA COLLECTION

+400,000 METRIC TONS OF CARBON SEQUESTERED TO DATE

Climate and environmental benefits associated with climate-smart practices progressively build over time, with +60 million metric tons of carbon estimated to be captured. Final numbers calculated at project completion (~5 years).

Conclusions

Where to put our efforts?

- Soil, crop, and environmental benefits of diversification are clear
- Economic factors may not favor diversification at the farm-level and beyond, tools to explore options may help
- Strong structural barriers and market forces working against diversification – who is addressing them and how can we help?