

The Potential of Agroforestry as a Pathway to Sustainability in California Agriculture

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UCDAVIS

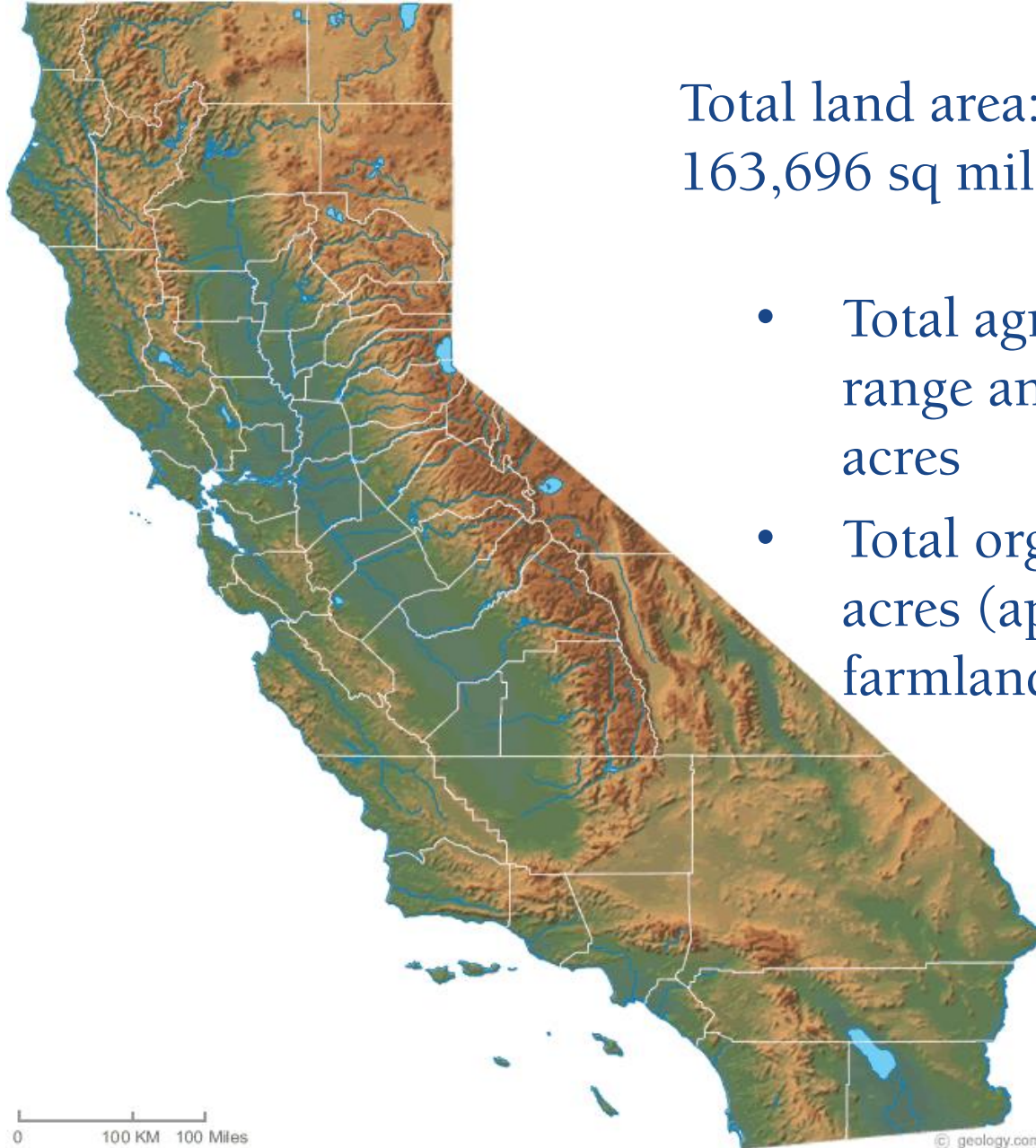
**AGRICULTURAL
SUSTAINABILITY INSTITUTE**

College of Agricultural and Environmental Sciences



University of California
Agriculture and Natural Resources

California Topography and Agriculture



Total land area:

163,696 sq miles (423,970 sq km)

- Total agricultural land (including range and pasture): 25.4 million acres
- Total organic farmland: 486,169 acres (approx. 2% of total farmland)

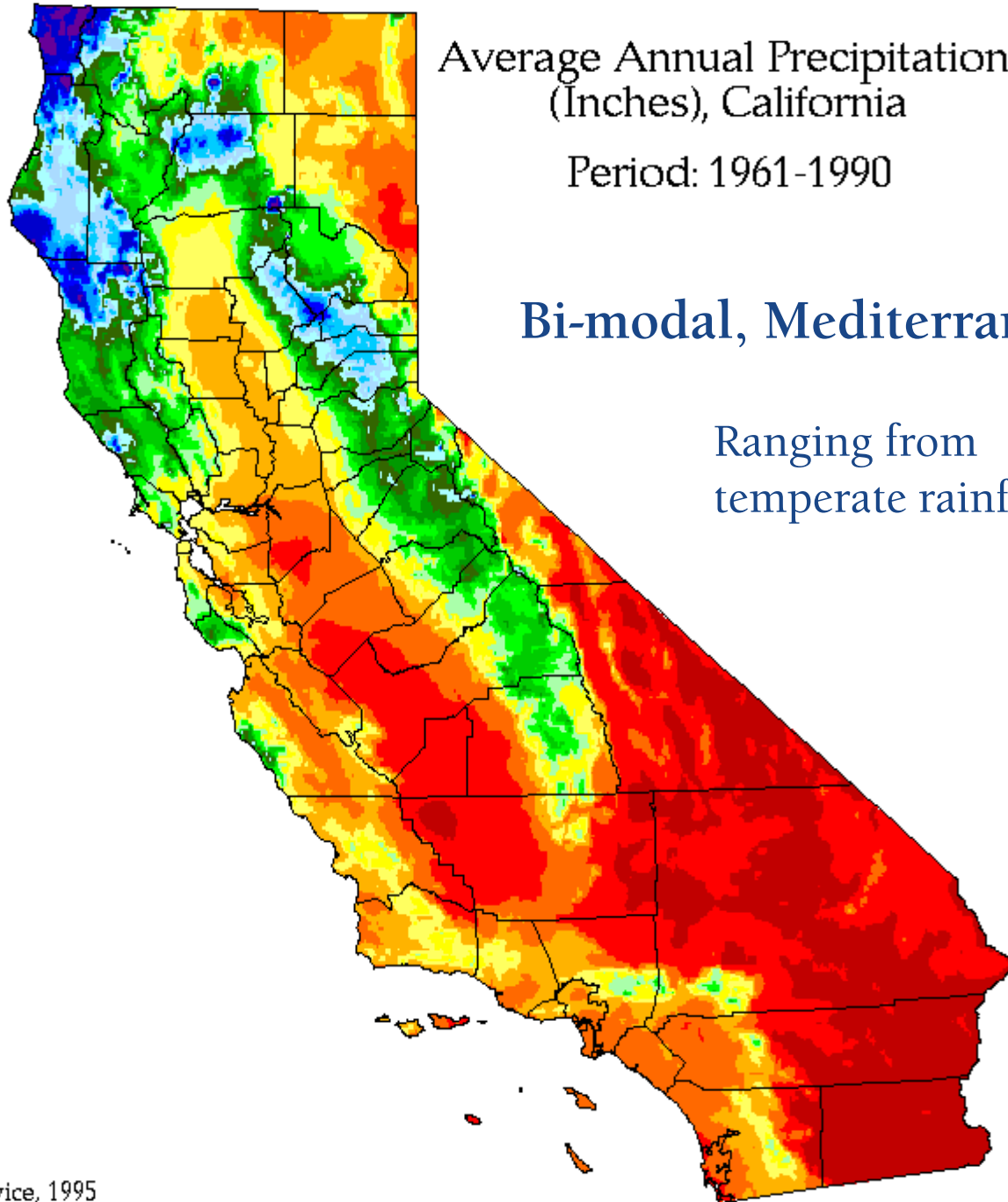
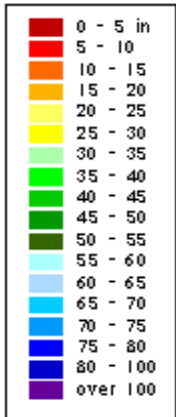
0 100 KM 100 Miles

Average Annual Precipitation (Inches), California

Period: 1961-1990

Bi-modal, Mediterranean climate

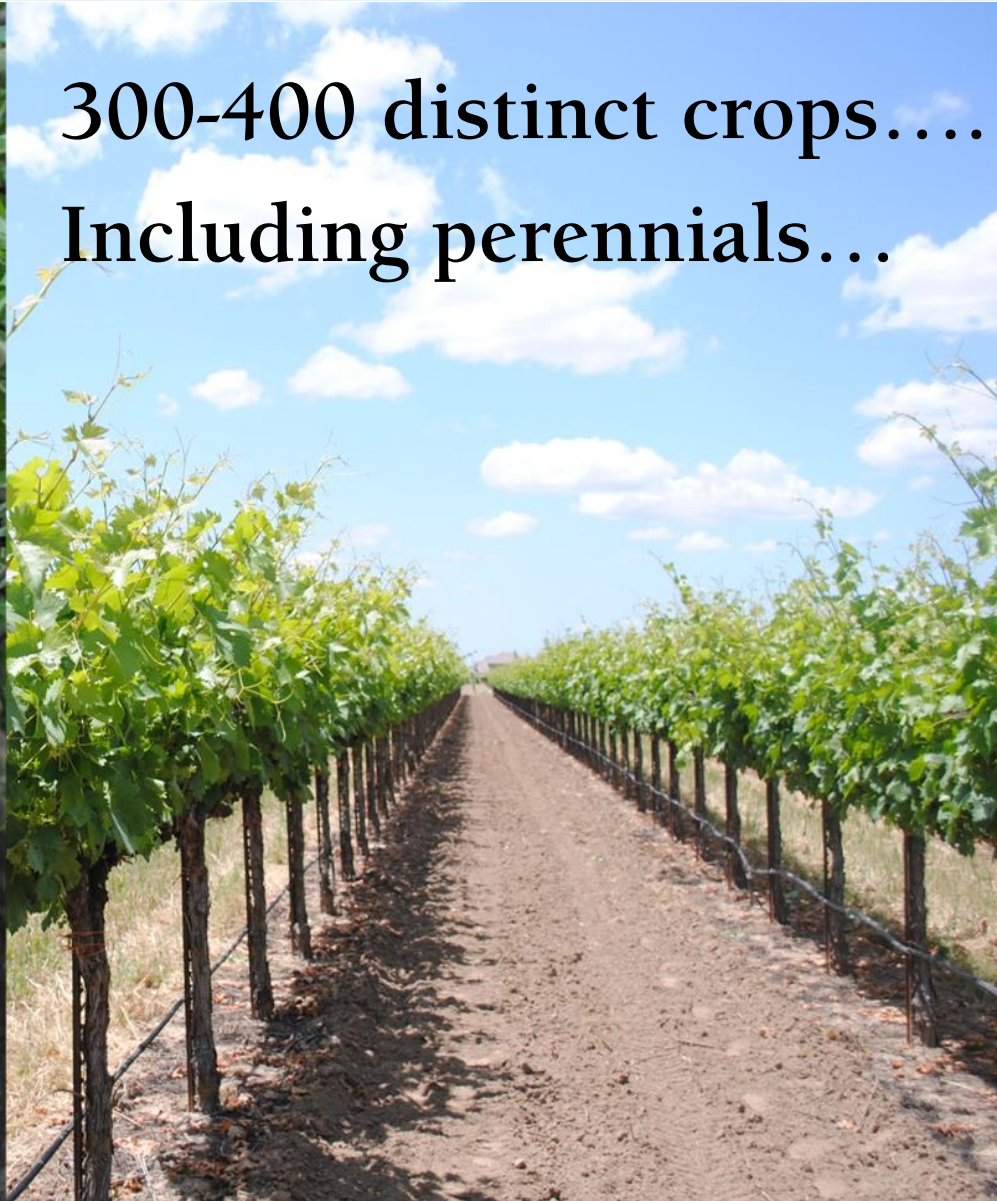
Ranging from
temperate rainforest to desert



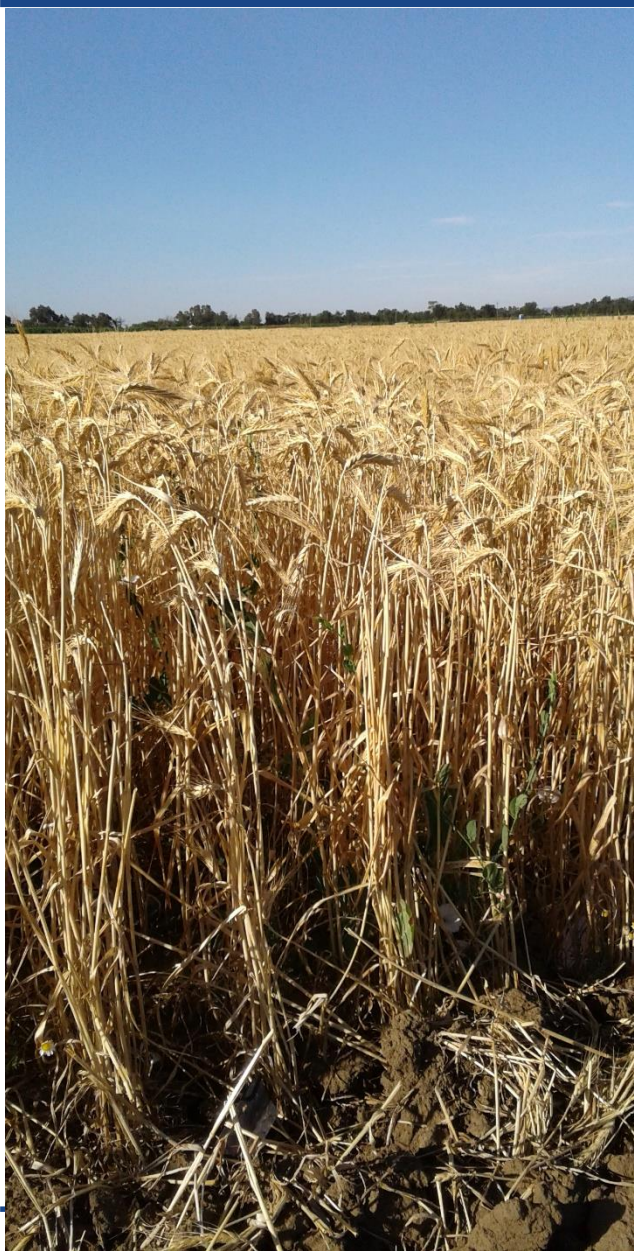
California Agriculture



300-400 distinct crops....
Including perennials...



California Agriculture



...and annuals...

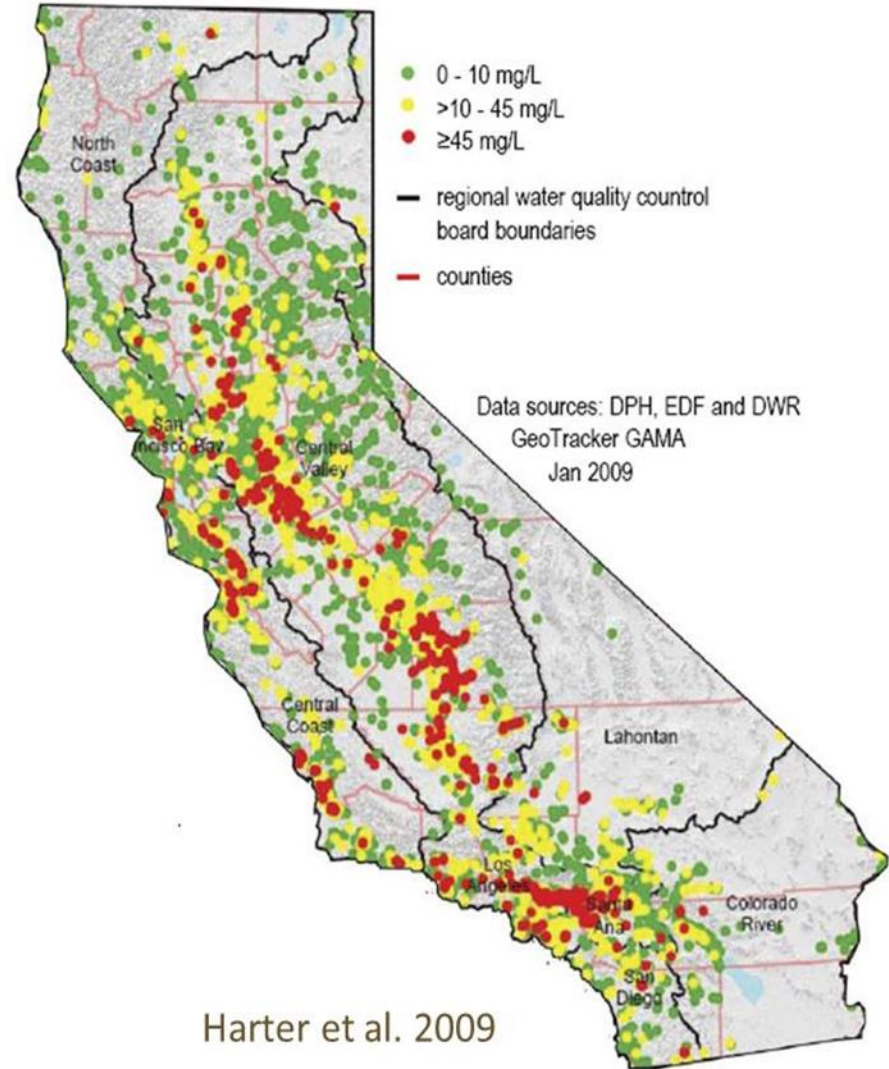


California Agriculture

...and livestock.



Intensive input use and pollution issues



Research Questions:

What kinds of agroforestry systems are even agronomically and economically feasible under California conditions, at commercial scale?

Does combining crops into agroforestry systems offer ecosystem services benefits? Especially any that

- assist in crop production
- reduce inputs
- increase system resilience

(Permaculture hypothesis)

Farmer:

“I have a goal which is a symbiotic farm system.”

“I really enjoy systems that work.”

Research Questions:

What are the **challenges** of agroforestry systems in California? What are the **constraints** to more widespread adoption? What are the **research and information needs**?

Farm Characteristics of Sample

Snowball survey – no sampling frame available
NOT a representative sample

Open-ended survey questions about systems, pros, cons

- 10 non-farmers – researchers, extension, NRCS, non-profit
- 15 farmers
 - Farm size: 4.5 – 6000 acres (median: 87.5)
 - Tenure:
 - all or some leased land: 4 farms
 - 100% owned: 8 farms
 - Years of experience with agroforestry practices: 1 – 42 yrs (Dad)

Types of Agroforestry Systems

Two better-studied systems with documented agroecosystem benefits:

- Cover crops in orchards and vineyards (6 farmers)
- Hedgerows on edges of crop fields (4 farmers)

PLUS.....

5 additional systems....



Orchard Intercropping – New Orchard



Orchard or Vineyard Intercropping --

Mature orchards



Grazing in Orchards and Vineyards



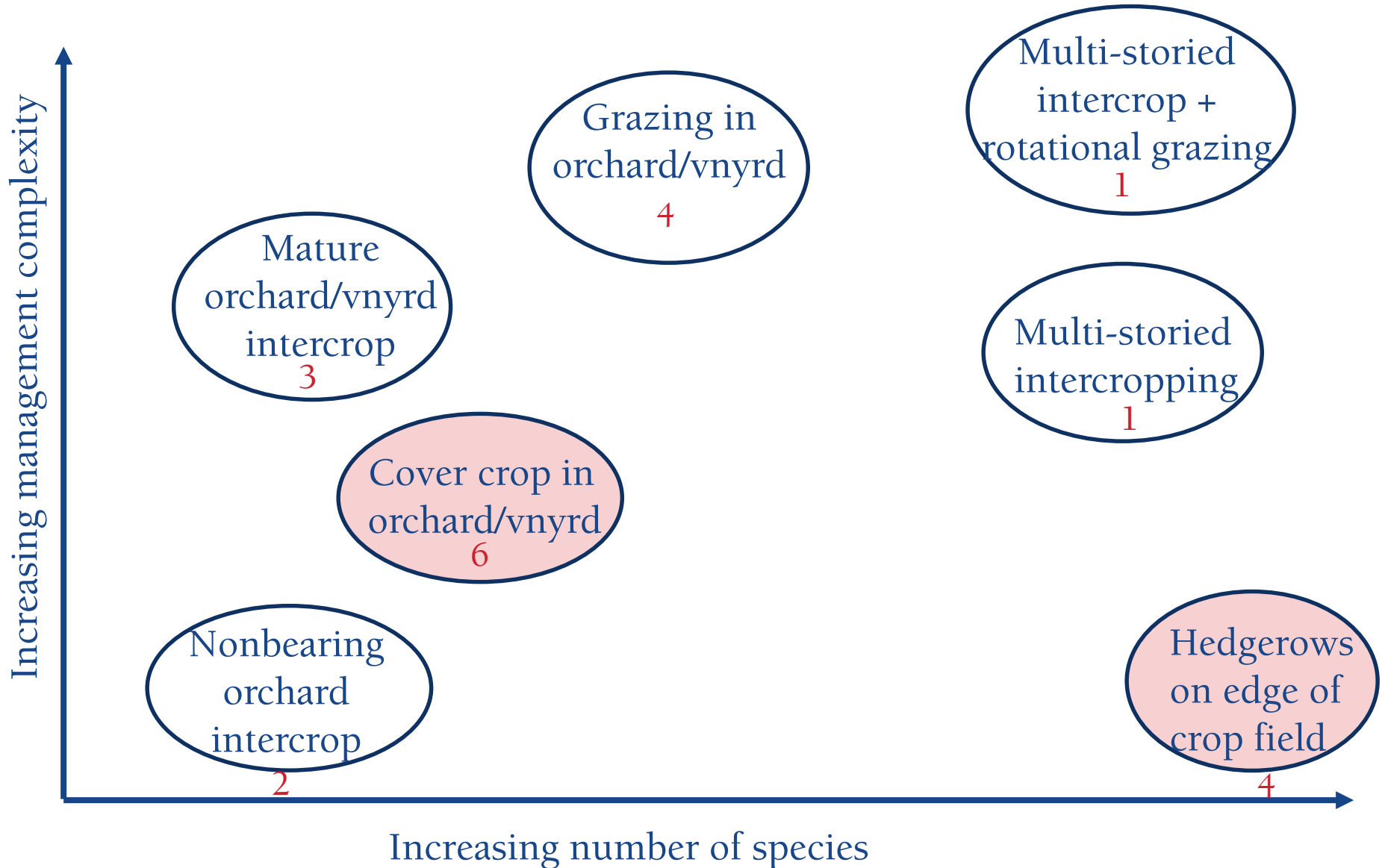
Grazing in Orchards and Vineyards



Multi-storied Intercropping (+ Grazing)



Complexity of Agroforestry Systems



Survey Results: Benefits of Agroforestry Systems

Reduce external inputs and provide more needs from within the system (8 farmers, 0 non-farmers)

Reduce production costs (2 farmers)

Nutrient cycling/soil fertility (8 farmers)

Soil health (6 farmers)

Pest control: insects, mites, disease (7 farmers, 2 non-farmers)

Water – improved infiltration, retention, reduce erosion (7 farmers, 3 non-farmers)

Extend season, improve yields, more consistency (3 farmers)

Diversify income, mitigate risk (6 non-farmers)

Survey Results: Drawbacks & Challenges of Agroforestry Systems

More labor intensive (8 farmers, 2 non-farmers)

Need to adapt equipment (4 farmers, 3 non-farmers)

More management complexity

- Diverse irrigation requirements of different crops (4 farmers)
- Timing of different activities (4 farmers)
- Time intensive to learn about additional elements (2 farmers)
- Other specific issues (e.g. sheep when not in orchard)(3 farmers, 3 non-farmers)

Knowledge Gaps

ID, quantify, and value ecosystem services (5 farmers, 7 non-farmers)

Water savings versus water use? (3 farmers, 3 non-farmers)

Machinery design (2 famers, 1 non-farmer)

Role of soil health and diversification in plant nutrition, food nutrition (5 farmers, 1 non-farmer)

Preliminary Observations and Research Needs

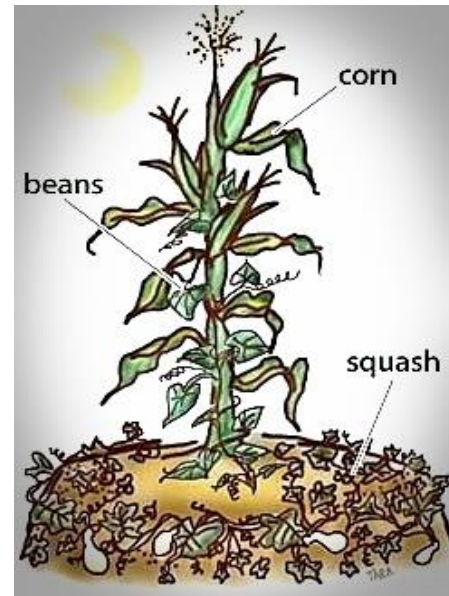
Observation

More crops tended to lead to more labor and management needs – permaculture hypothesis?? *Except pest and weed management...*

Research Need

Intentional systems design and a knowledge base to support it:

- Optimal species assemblages
- Varietal breeding
- Management practices to optimize totality, not just one crop
- Ecological succession?



Need more designs that work, e.g. “Three Sisters”



Preliminary Observations and Research Needs

Observation

High per acre value of tree crops means these crops always take highest priority, even if at expense of intercrop.

Research/Extension Need

Equipment for row crops adapted for narrow orchard/vineyard middles



Preliminary Observations and Research Needs

Observation

Tree crops in main ag areas utilize natural resources and labor differently – e.g. drive for water use efficiency per dollar earned may limit farmers' willingness to combine with other, lower-value crops.

Research Need

What is most logical **direction of change** for adoption of agroforestry?

- Marginal ag landscapes? (CA foothills)
- Commercialization of hedgerow crops (e.g. elderberry, herbs)?
- Contracting infrastructure to allow for specialization of roles?



Summary Highlights

Agroforestry offers potential for beneficial ecosystem services and reduced input use, but most models in California are **not yet optimally designed for best possible systems performance.**

We need to apply design methods and **lessons from cover cropping and hedgerows** to create successful integrated systems with more commercial crops.

We need to take into account **large differences in commercial value of different crops** (especially high value tree crops) and high labor and capital investment costs in large scale systems.

Livestock grazing in orchards and vineyards is garnering attention and shows potential for agronomic optimization and business entrepreneurship for sheep and poultry managers.

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