Ecosystem Service Opportunities in Agriculture: Are We Missing the Forest for the Trees?

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Tech to Market Advisor – ARPA-E

June 29, 2022

Summary

Agricultural ecosystem services

Supply chain realities in ag

Market bridges - value streams for farmers

What is an ecosystem service?

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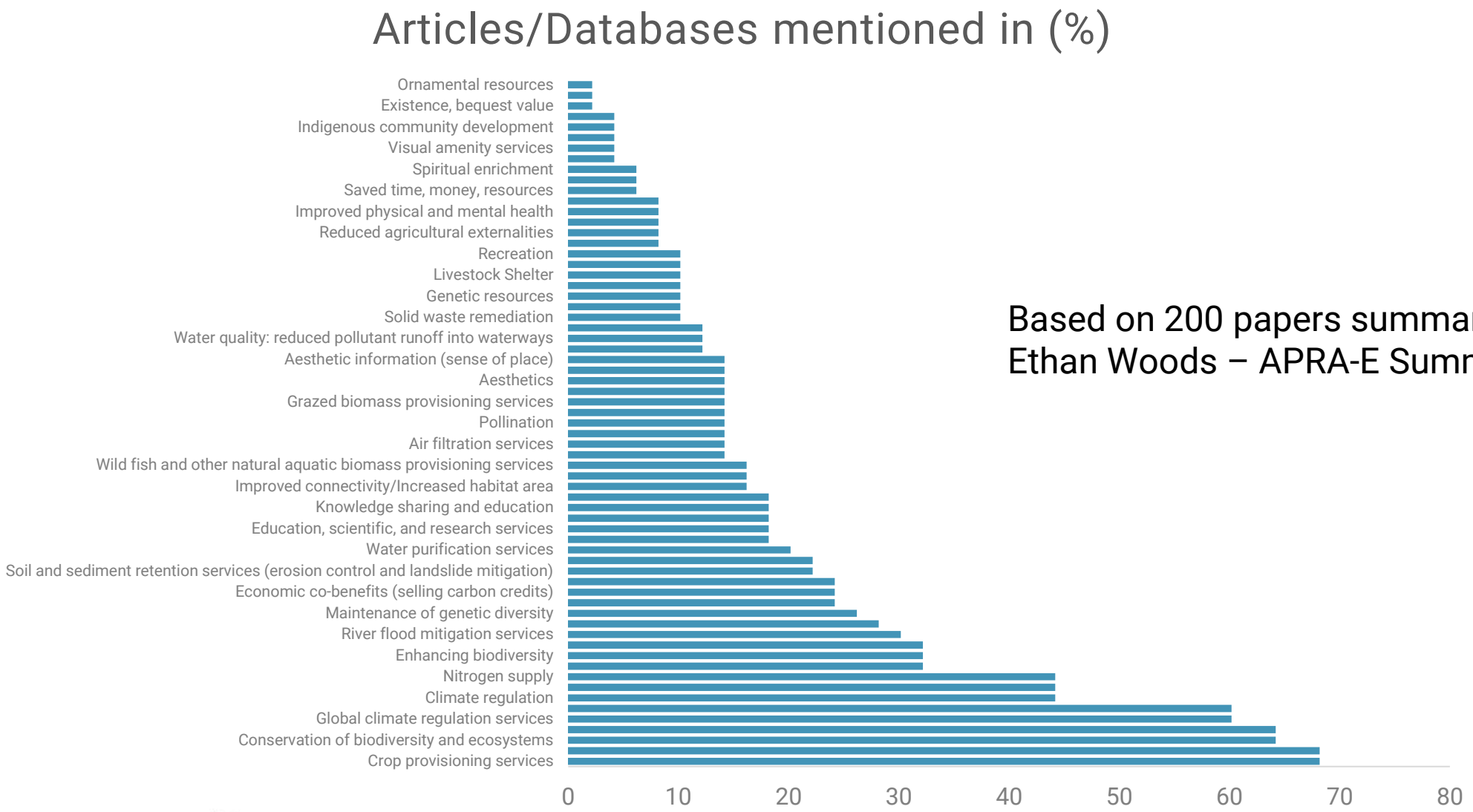

Based on 200 papers summarized by Ethan Woods – APRA-E Summer Scholar

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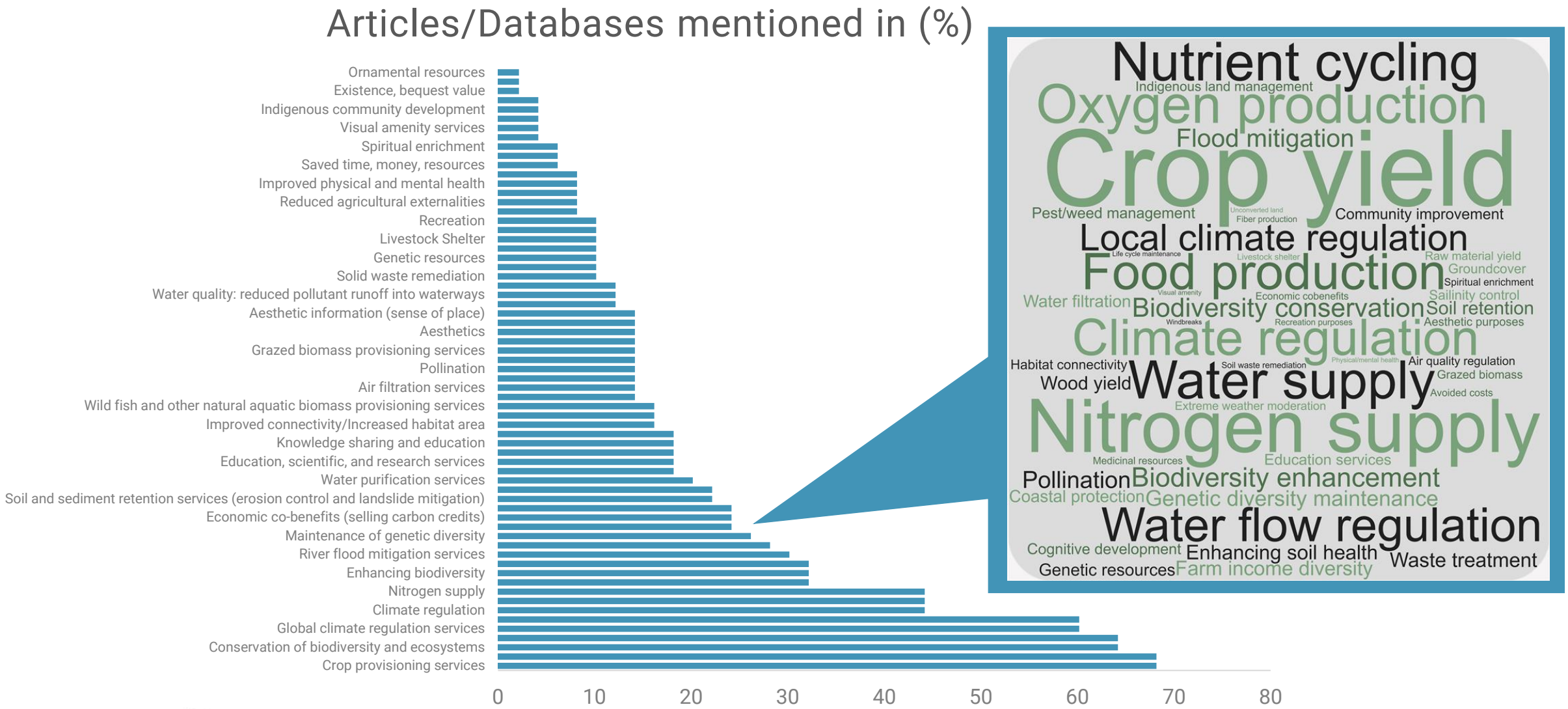

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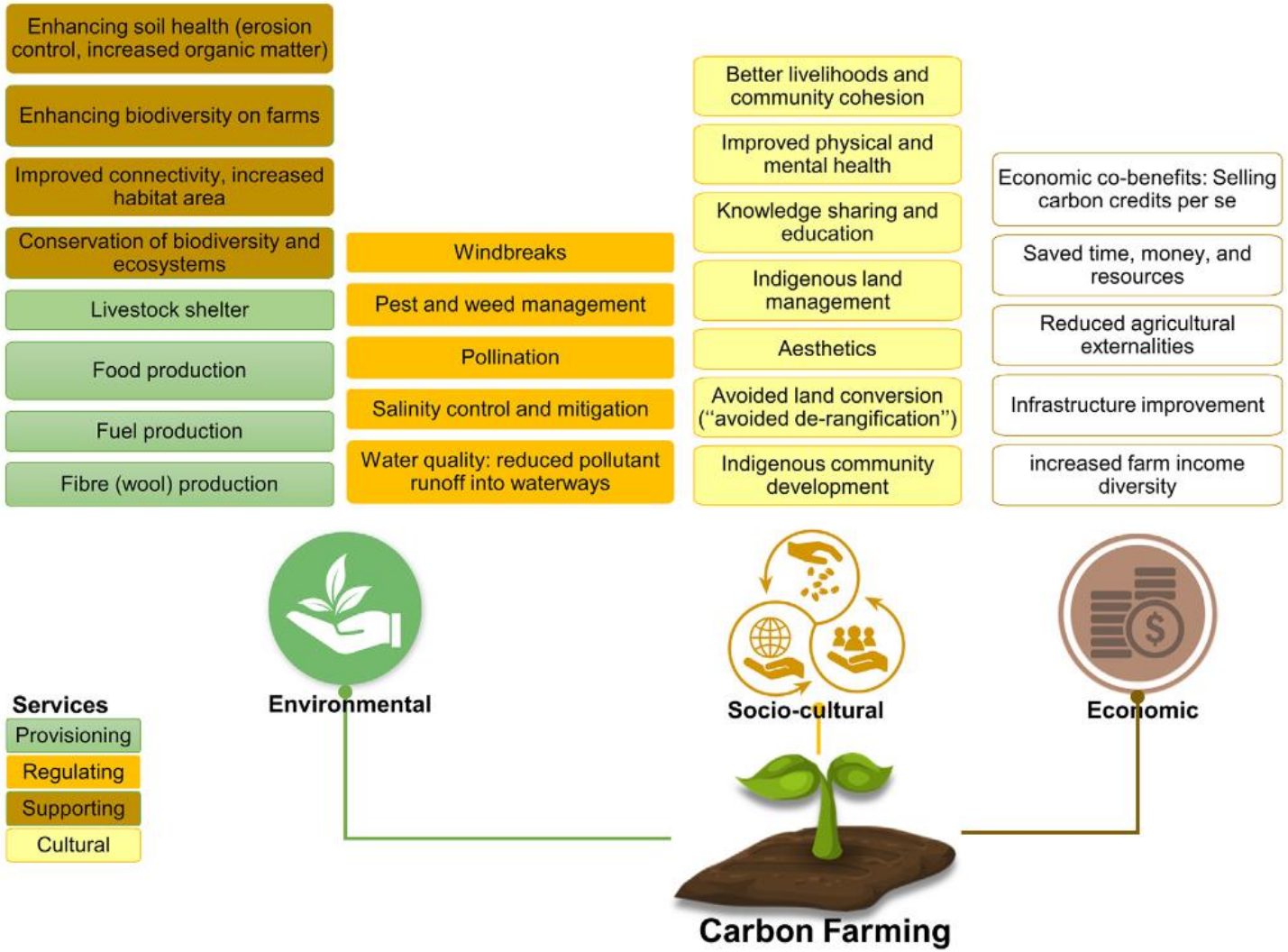

Baumber, A., Metternicht, G., Cross, R., Ruoso, L. E., Cowie, A. L., & Waters, C. (2019). https://doi.org/10.1016/j.ecoser.2019.100982

Carbon farming?

- What enables carbon sequestration or other ecosystem services?

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- What empowers farmers and ag supply chain partners to avoid emissions?

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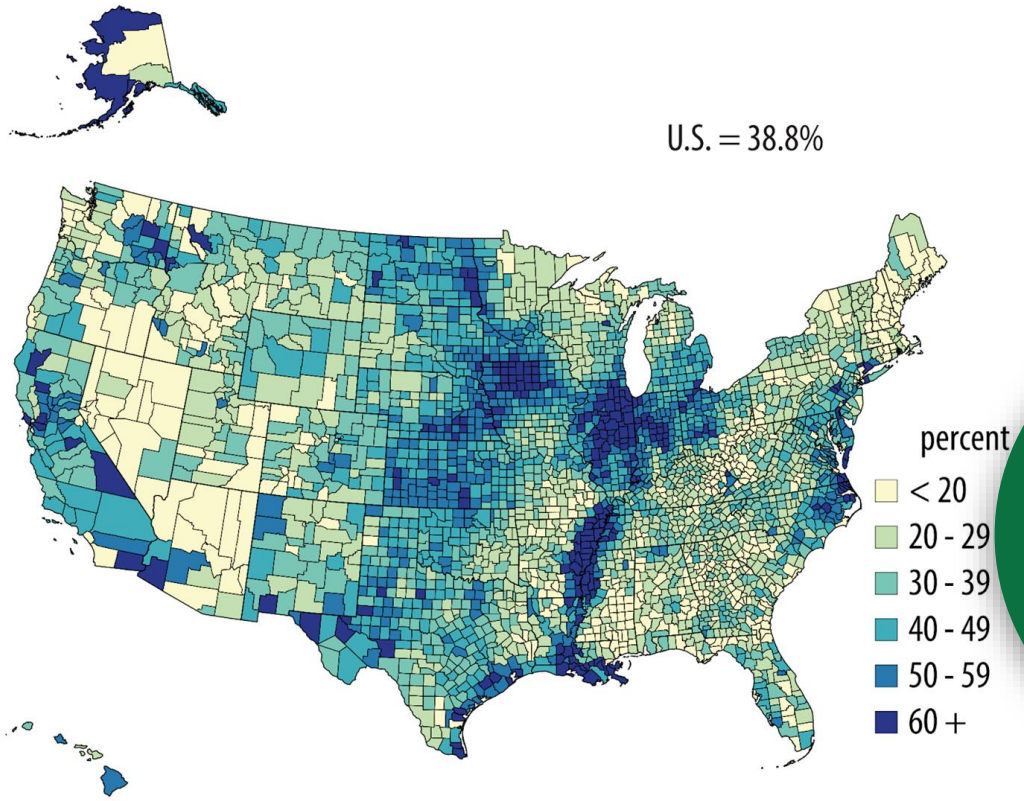
- What enables carbon sequestration or other ecosystem services?
- What empowers farmers and ag supply chain partners to avoid emissions?
- Are we losing site of the bigger picture of influence, agency and innovation?

U.S. farm realities

Percent of U.S. Farmland Rented or Leased, by County, 2012



Source: USDA NASS, 2012 Census of Agriculture.

Institutional knowledge variation

2 million farm businesses

Risk, operational loans and capital constraints

High fragmentation at farm level (crops)

Catalyzing change? Change bias?

Storage/marketing

Preparation

Yield limiting factors in plant/crop production (generally)

Weather

Fertility

Genetics and placement

Previous vegetation

Plant population

Plant protection

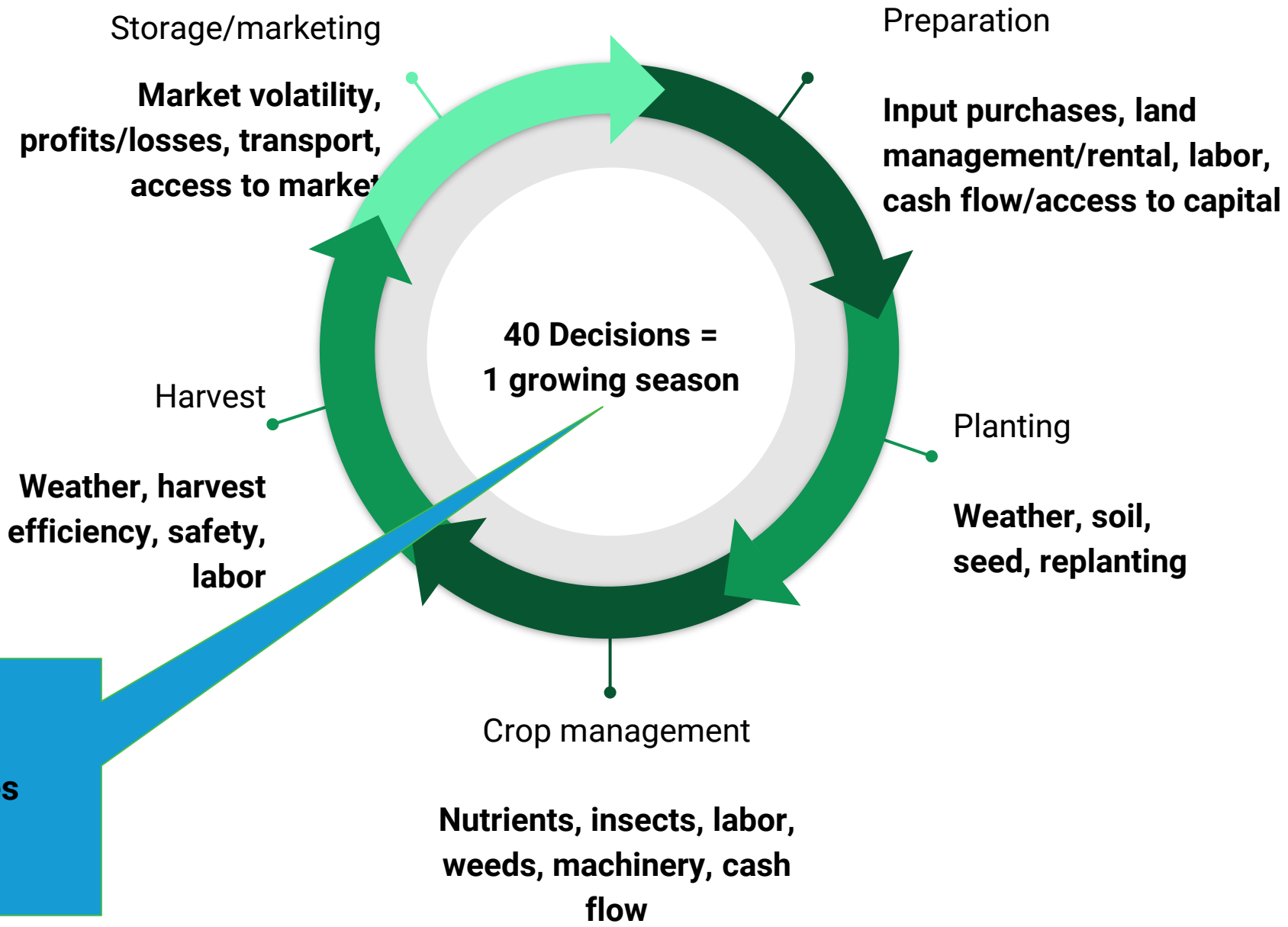
Risk

Market

Decision tools

flow

Catalyzing change? Change bias?

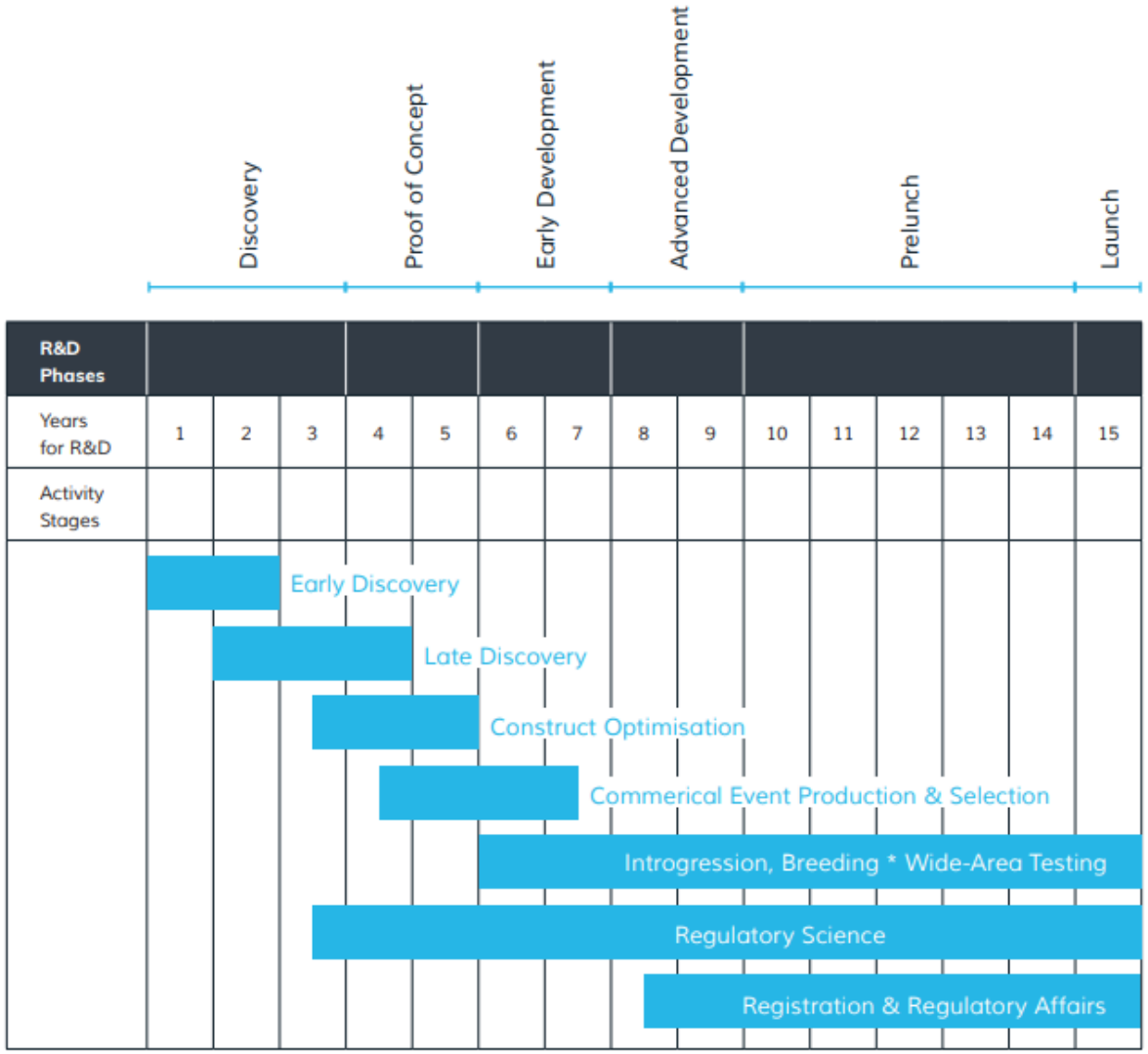


Risk

Market Opportunities

Decision tools

Upstream of the farm: Bringing ag technologies/products to market



Activity Stage	Cost ($ m.)
Early Discovery	2.8
Late Discovery	4.8
Construct Optimisation	13.4
Commercial Event Production & Selection	21.8
Introgression, Breeding & Wide-Area Testing	29
Regulatory Science	32.9
Registration & Regulatory Affairs	10.3
Total	**115**

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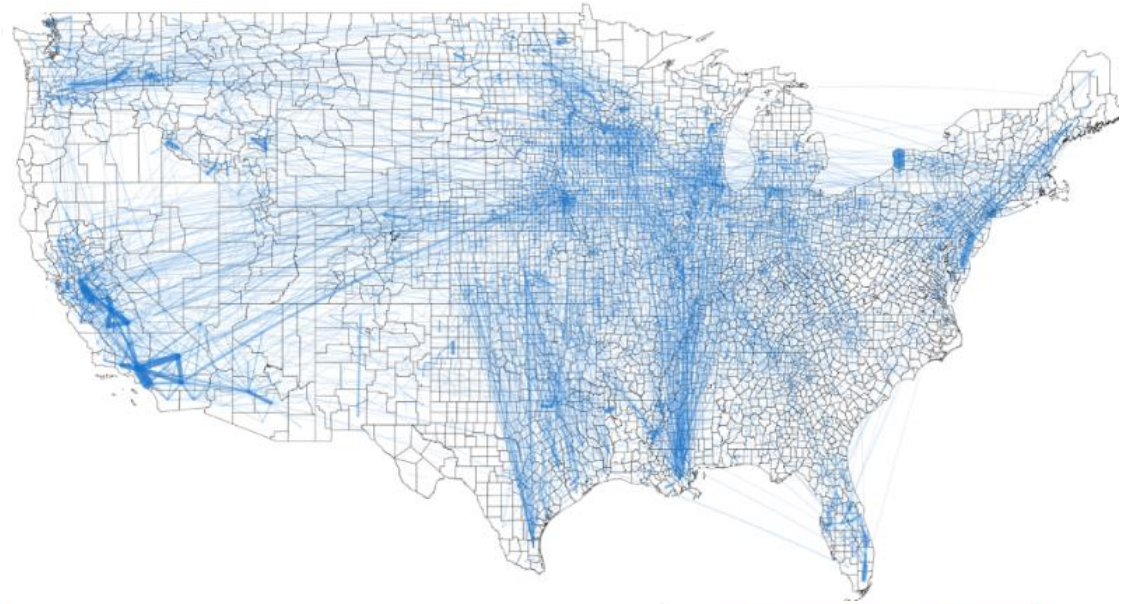
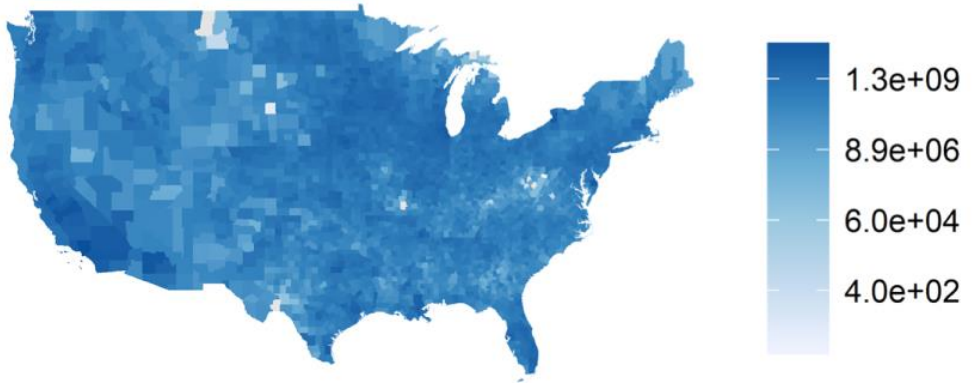
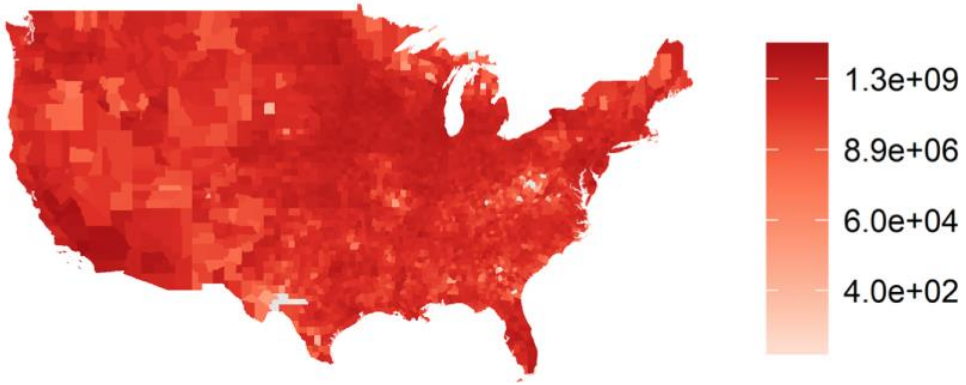
AgbioInvestor-Trait-RD-Branded-Report-Final-20220512.pdf (croplife.org)

Downstream of the farm: grain movement

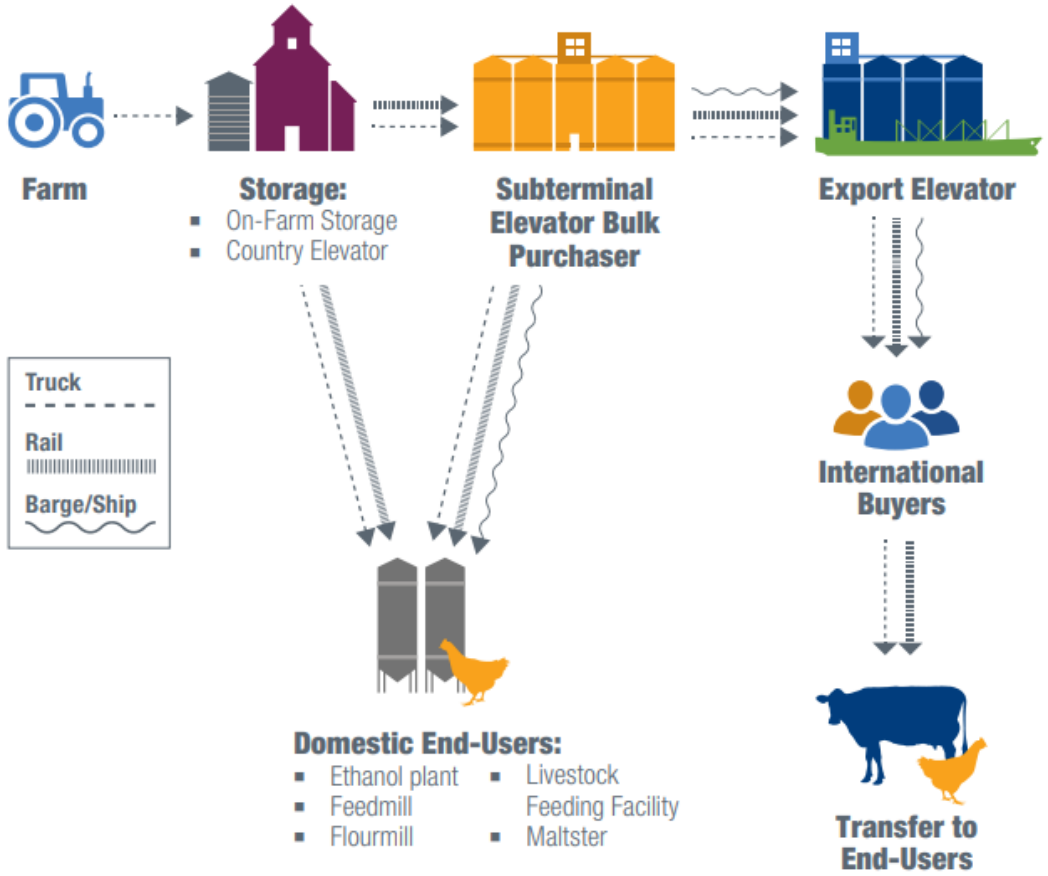






Food flows between counties in the United States - IOPscience

Infrastructure: how do commodities move?



U.S. GRAINS COUNCIL
www.grains.org

Sources: U.S. Department of Transportation, Waterways Council, Inc., Association of American Railroads, and the Transportation of U.S. Grains A Modal Share Analysis ams.usda.gov/sites/default/files/media/TransportationofUSGrainsModalShare1978_2016.pdf

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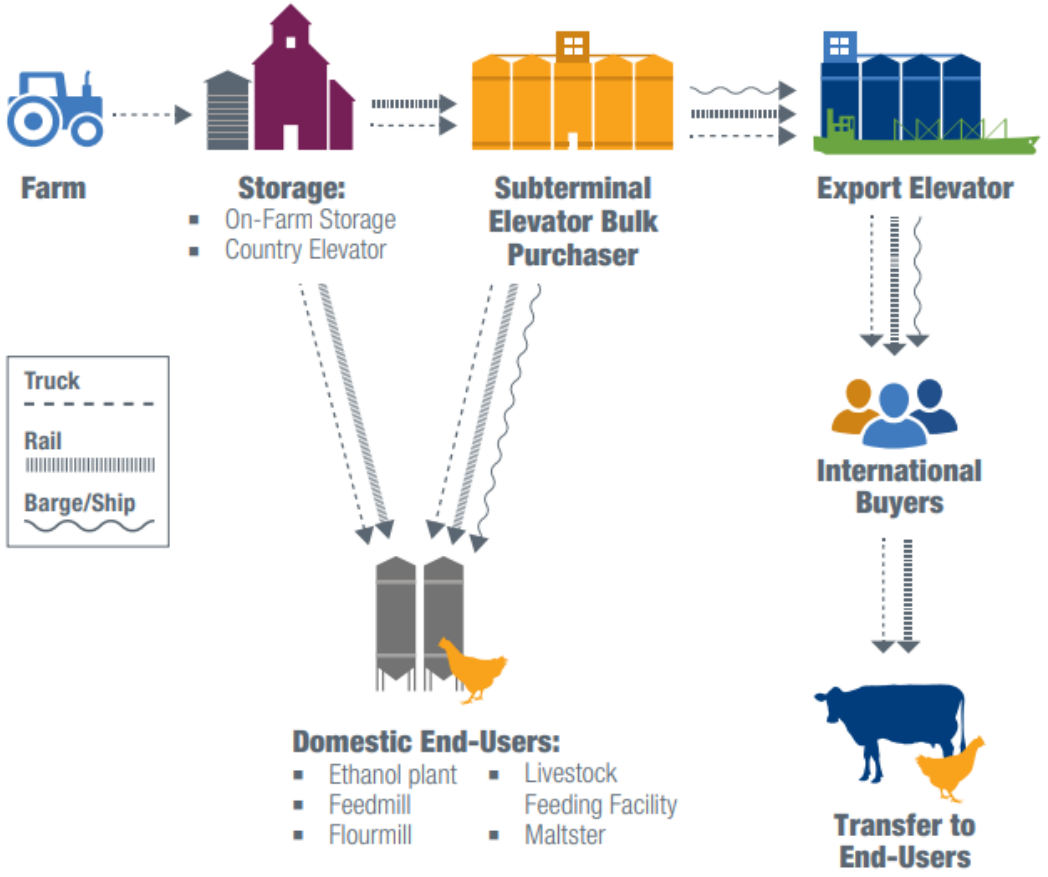

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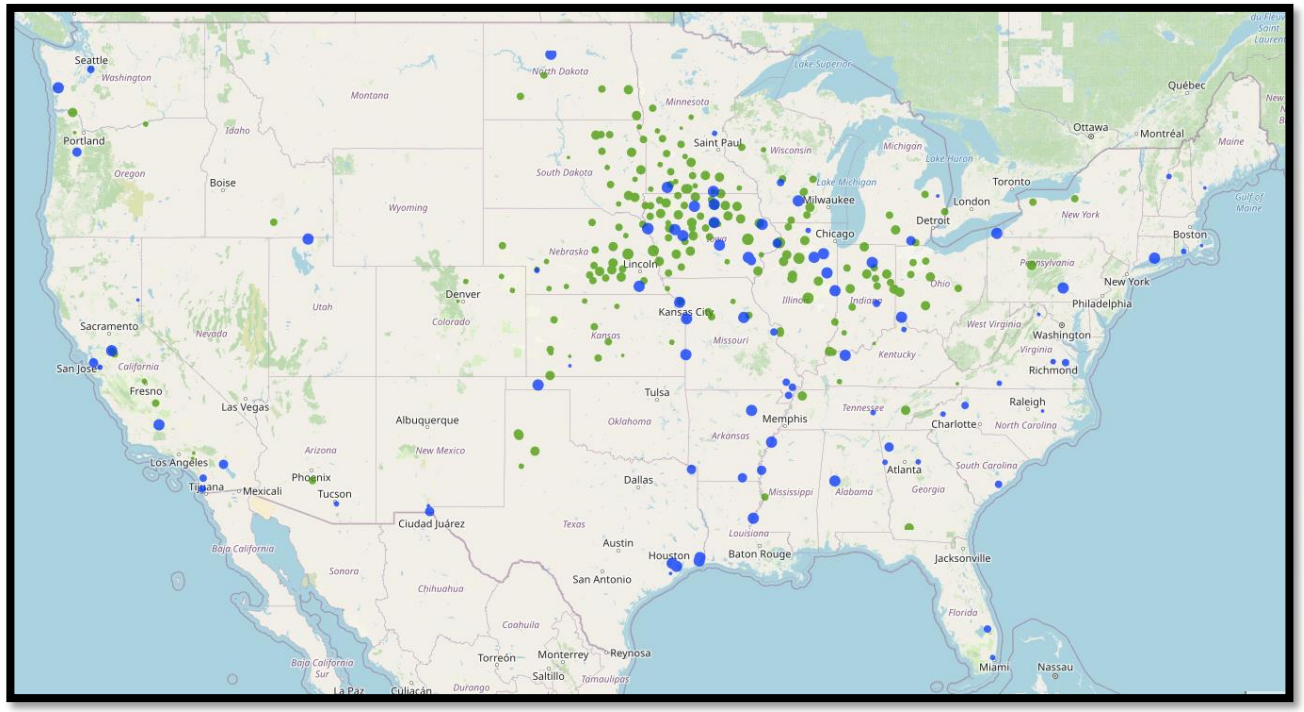

Biofuels Atlas (nrel.gov)

Biodiesel and ethanol plants

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Infrastructure: how do commodities move?

In 2018, the U.S. transportation system moved a daily average of about 49 million tons of freight, valued at nearly $53 billion.

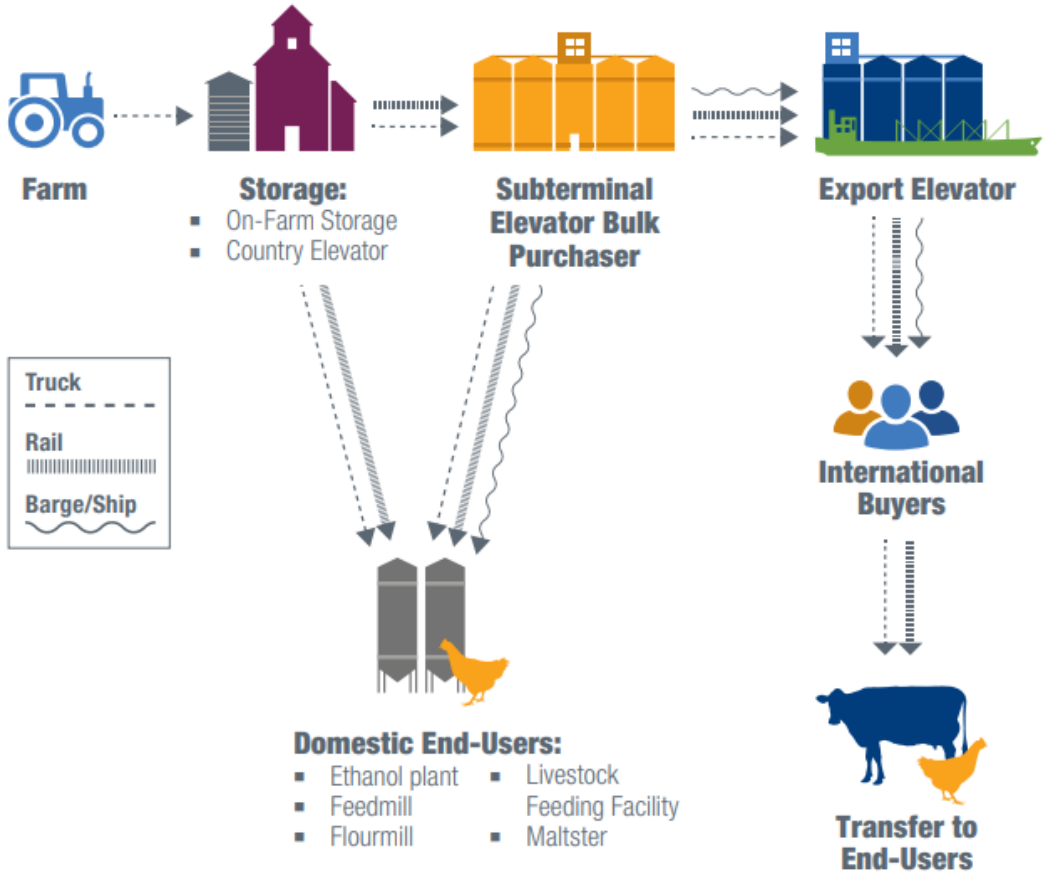

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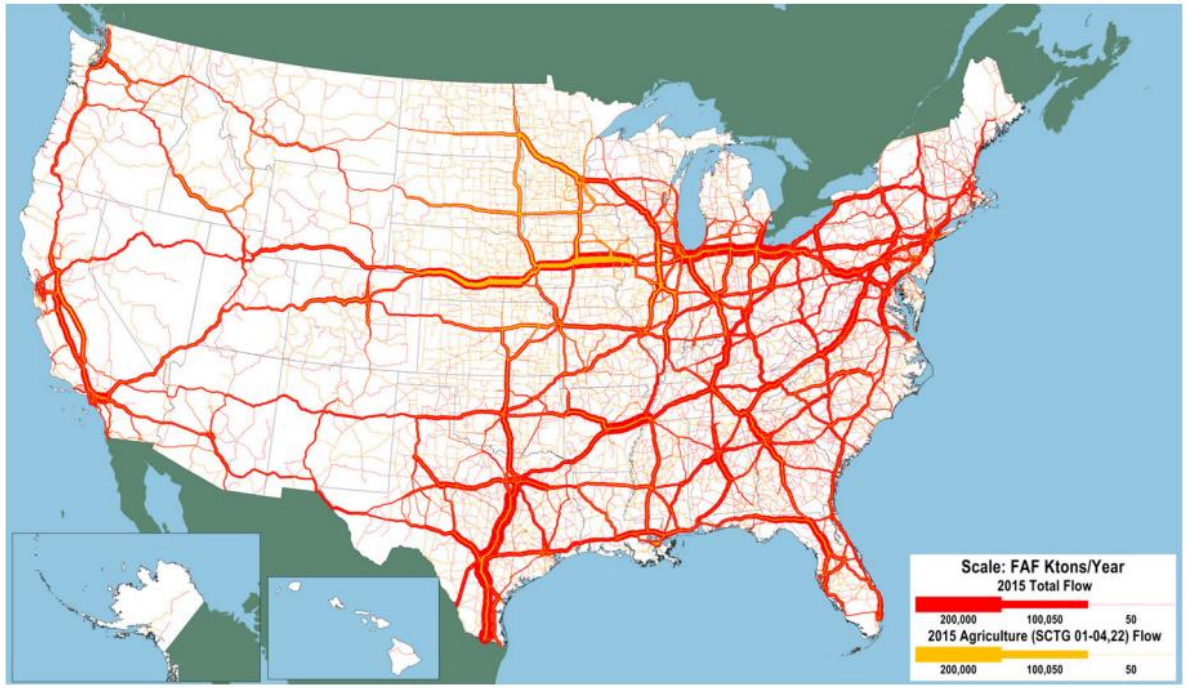
Figure 1: Modeled Agricultural and Total Freight Flows on U.S. Highways, 2015



Source: Freight Analysis Framework, version 4.3 (Bureau of Transportation Statistics (BTS) and FHWA, 2017)

Highway systems

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End use paradigm and shifts towards circularity?

- Linear flows
- Consolidation
- Segregation and transport infrastructure
- Aggregation/processing infrastructure
- Consumer preferences

Market importance of US Agriculture

11% of U.S. employment
2.6 million jobs from direct on-farm employment

Domestic food production: The agriculture industry provides consumers with fresh, high-quality food that allows them to be healthy and productive in other sectors. Efficient transportation helps keep these prices low for consumers and allows for regional specialization and division of labor to move products from fertile agriculture production areas to major population centers.

Employment: Agriculture and related industries accounted for 11% of U.S. employment in 2017, equivalent to 21.6 million jobs, including about 2.6 million jobs from direct on-farm employment (USDA, 2018).

Economic value: Agriculture commands approximately 5.5% of all U.S. Gross Domestic Product (GDP), a value over $1 trillion in 2017 (USDA, 2018).

International competitiveness: The value of agricultural exports account for 10-11% of all U.S. exports, and the freight system contributes to competitive prices (Cooke et al., 2017).

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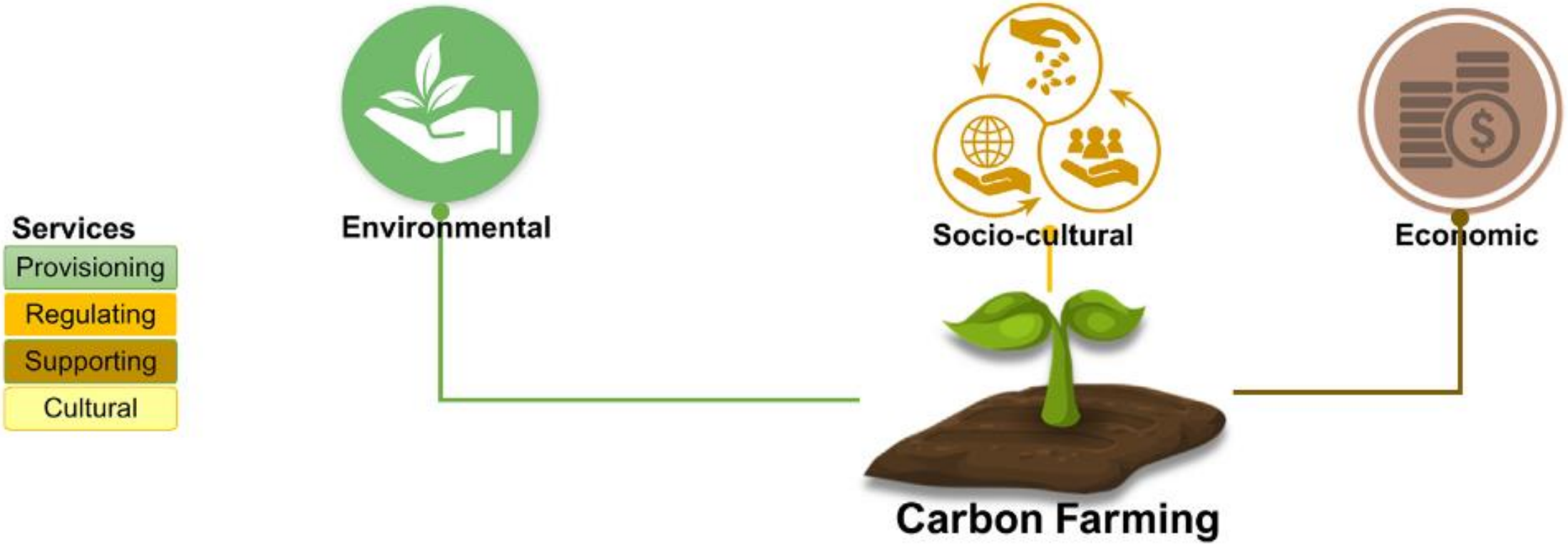
Mitigating/managing ecosystem service risks in carbon farming



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Agricultural supply chain value streams

Land valuation	Financing	Insurance products	Succession planning	Workforce development
Markets	Volume, quality, consistency	Regulatory	Pricing	Customer acquisition and loyalty
	Shareholder investment	Marketing, branding	Market share	

Landscape of tools helping in value capture and transfer

- Ecosystem service market platform
- Policy and farm programs
- Education
- Farm management
- Research and development
- Ag product market development
- PR/reputational capital/investor relations

What can we leverage to transition?