INFEWS/T3

SOCIAL-ECOLOGICAL-TECHNOLOGICAL SOLUTIONS TO WASTE REUSE IN FOOD, ENERGY, AND WATER SYSTEMS

(NSF 1639529)

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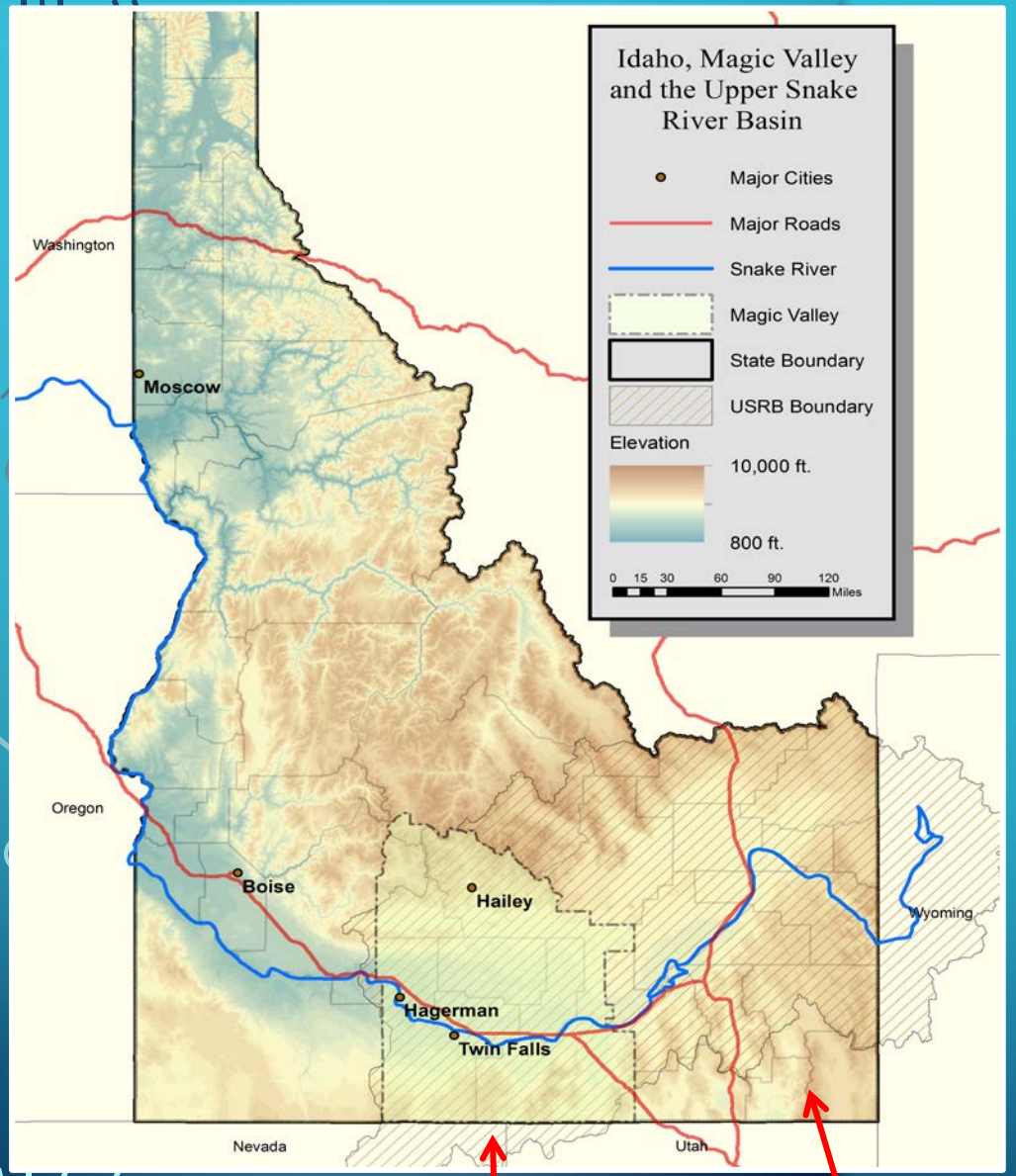


Magic Valley

Upper Snake River Basin (USRB)

RESEARCH QUESTIONS

1. How is the FEW system structured as a Social-Ecological-Technological System (SETS) at the watershed scale?

   What are the baseline interactions between food production, waste streams, energy recapture, and water use?

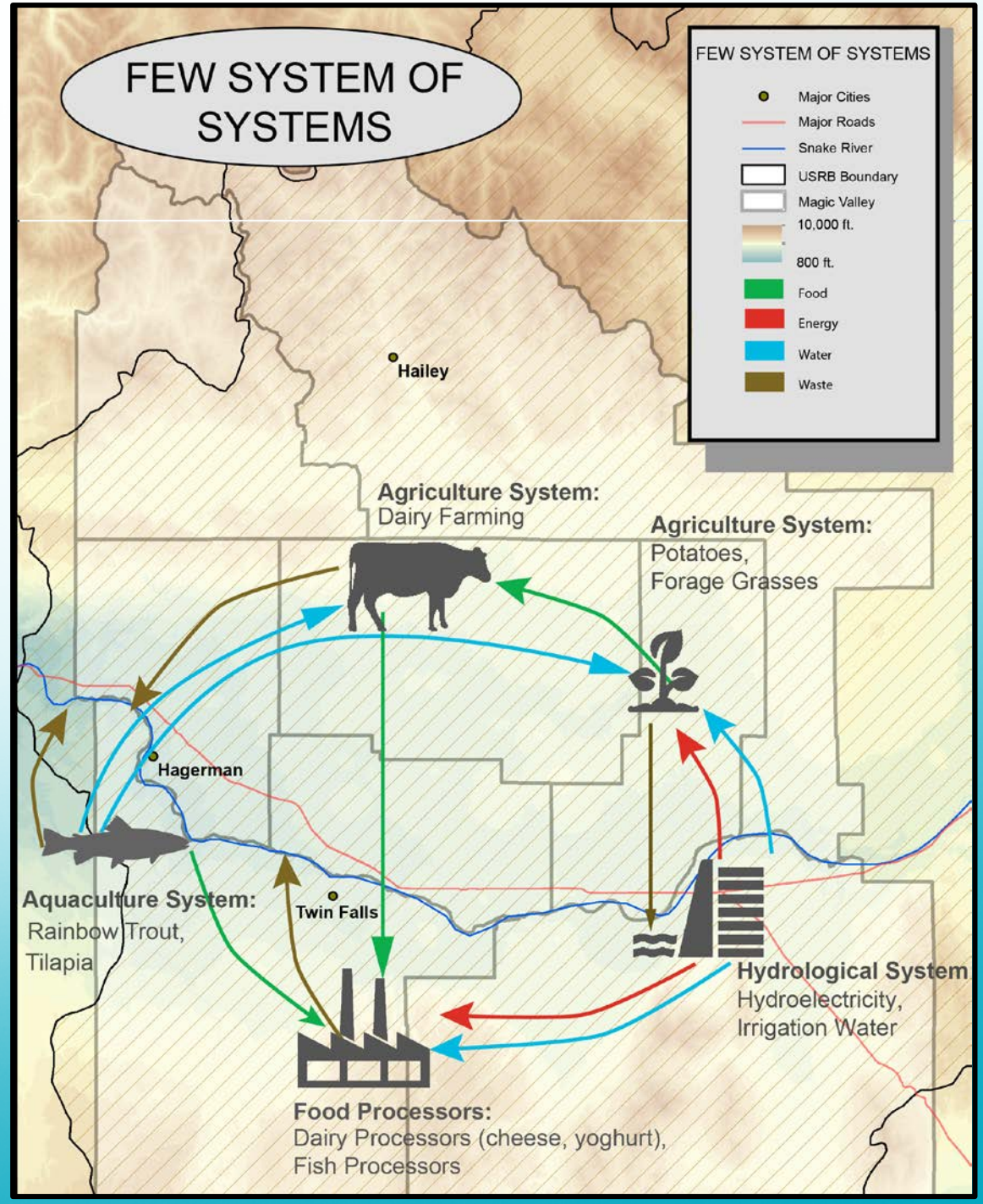
2. What existing waste recovery and reuse approaches are readily available?

   How can they be configured in an integrated system to recapture different waste streams for optimizing a FEWS?

3. How can interactions of waste streams, technologies, and stakeholder behaviors be modified to increase FEWS resilience under scenarios of changing climate, adoption of resource recovery technologies, demographic, and economic development?

SYSTEM OF SYSTEMS

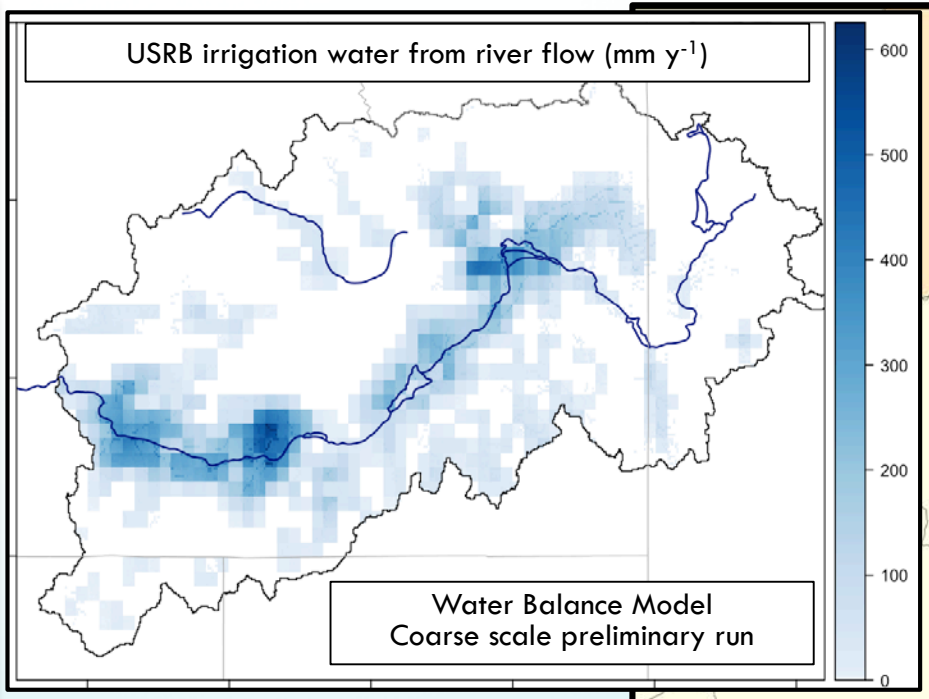
- Upper Snake River Basin (USRB) in Idaho, Wyoming, Nevada, Utah
- Magic Valley, ID (8 counties)
  - designated wilderness,
  - irrigated cropland,
  - dairy farms,
  - food processing plants,
  - aquaculture facilities, and
  - several small cities.
- Competition for water resources
  - Water governance
- Primary industries have waste
  - How can these be repurposed?

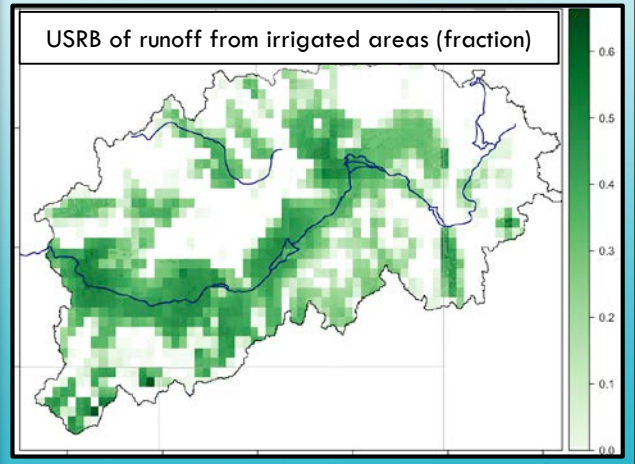


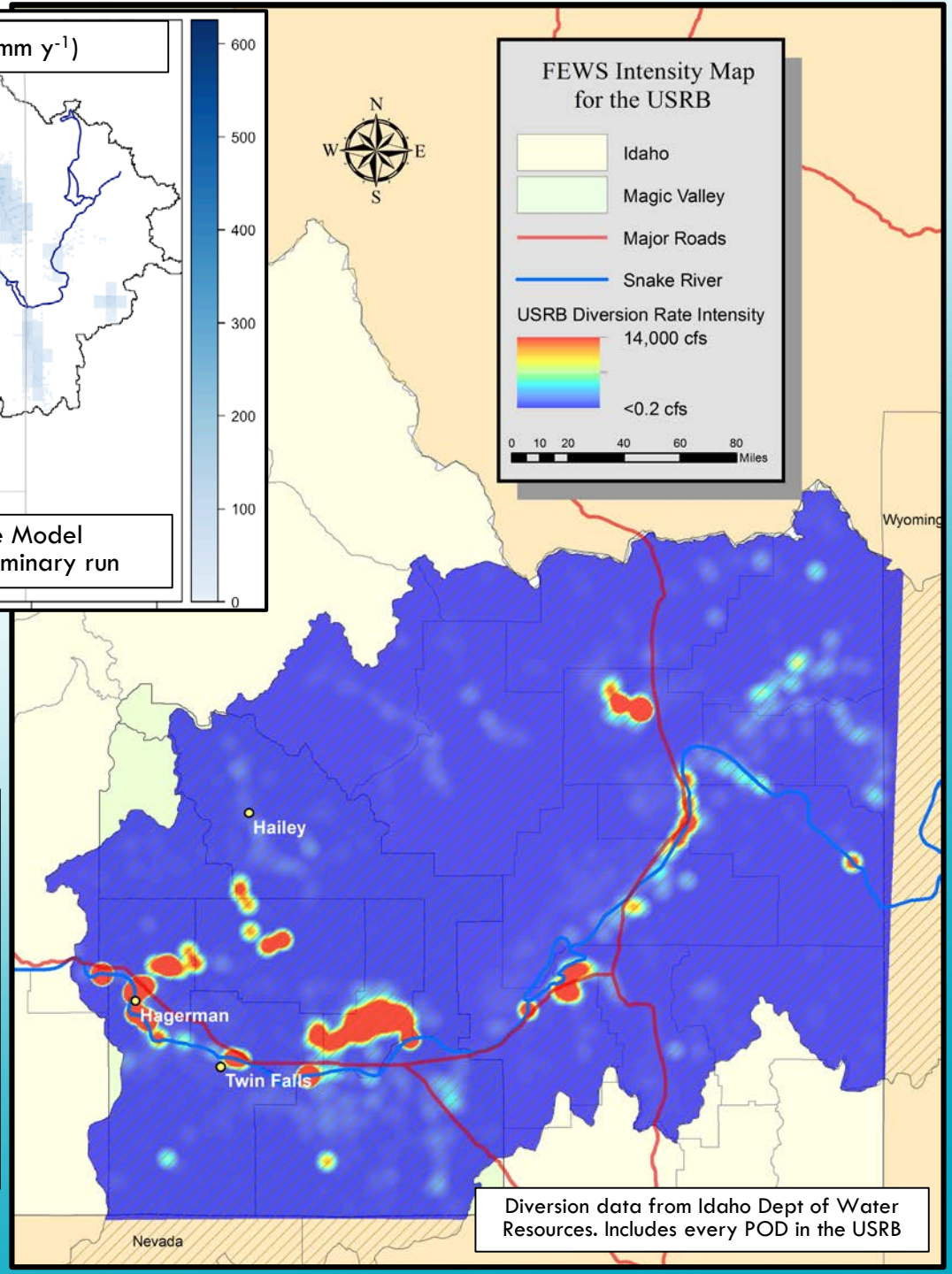
Magic Valley, Idaho

RESEARCH FOCUS

- FEWS Structure: Baseline and hotspot mapping
- Identification of solutions & coupled systems of solutions
- System Interactions
  - Water Balance Model (WBM)
  - Soil & Water Assessment Tool (SWAT)
  - Agent-Based Model (ABM)
  - Computable General Equilibrium (CGE)
- Future Scenarios
  - Coupled models
  - Stakeholder focus groups
  - Indicators
  - Visualization tools







IDAHO: NOT SO MANY POTATOES, BUT LOTS OF COWS, CHEESE, AND MANURE

- Dairy in Idaho 2017 (courtesy of United Dairymen of Idaho):
  - 3rd or 4th largest dairy producing state in US (tied with New York in practical terms)
  - 490 dairy farms
  - 580,000 + cows (avg. 1,184 per farm)
  - 14.6 billion pounds of milk
- 1998-2008 (courtesy of BSU and Idaho Dairymen's Association):
  - 533% increase in milk production in Idaho (48% increase nationally)
  - 633% increase in cheese production in Idaho (147% increase nationally)
- Where is the ~500% increase in manure going?

STAKEHOLDER ADVISORY GROUP (SAG)

- Two primary functions:
  - Help to characterize and understand the USRB FEW system through participation in **Expert Forums** (Fall of 17, 18, and 19)
  - Help to guide the research team by reviewing quarterly progress reports and interacting during the **Annual Meeting** (Spring 17, 18, and 19)
- Primary benefits (to stakeholders):
  - Interaction with researchers and innovators in the field
  - Opportunity to influence future policy
  - Opportunity to engage in research activities

TWO SAG MEETINGS HELD TO DATE

- May 2017—Recruitment, familiarization with issues, and building a stakeholder network from contacts through University Extension, College of Agriculture, and College of Natural Resources
- November 2017—Continue building the SAG, & First Scenarios Workshop

SAG COMPOSITION BY BACKGROUND

- Small Dairy Farmers
- Tribal Members from the Fort Hall Reservation
- Water Commissions and Soil Districts
- Municipal Waste and Water Departments
- Food Processors (R&D and Environmental Health and Safety)
- Rural Development
- Commodity Crop Farmers
- GAPS: Large Dairy Farms; Large Aquaculture Producers; State/Federal Regulators

STAKEHOLDER INPUT TO MODELING AND MAPPING OF THE USRB

- Ground-Truthing of model assumptions and outputs
- ABM Model Parameterization—Agent Types, Decision Making Processes, Values
- Scenarios Development—Likely, Desired, and Undesired Futures

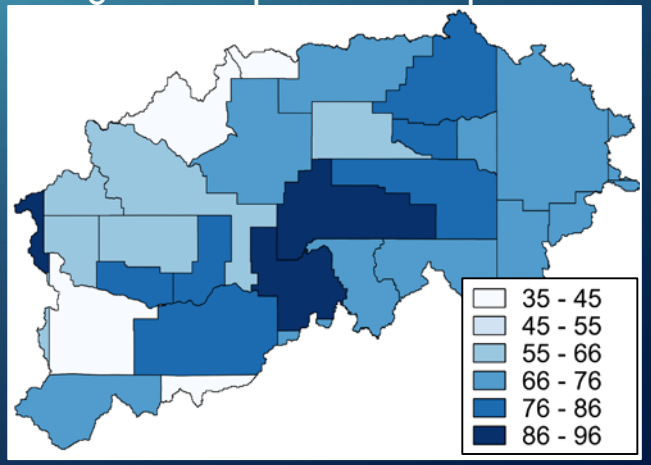
UNH Water Balance Model - Irrigation Technology

Process	Efficiency		
	Low	Medium	High
Conveyances	**Ditch** Losses: Percolation & Evaporation	**Canal** Losses: Evaporation	**Pipe** Losses: None
Losses: $L_{Evap} \alpha A_{conveynce} PET$ $L_{Perc} \alpha A_{conveynce} Perc$			
Application	**Flood**	**Sprinkler**	**Drip/Direct**
Losses: $L_{Evap} \alpha DU\ A_{irr} PET$ $L_{Perc} \alpha DU\ A_{irr} Perc$ $L_{runoff} \alpha DU\ A_{irr}$			

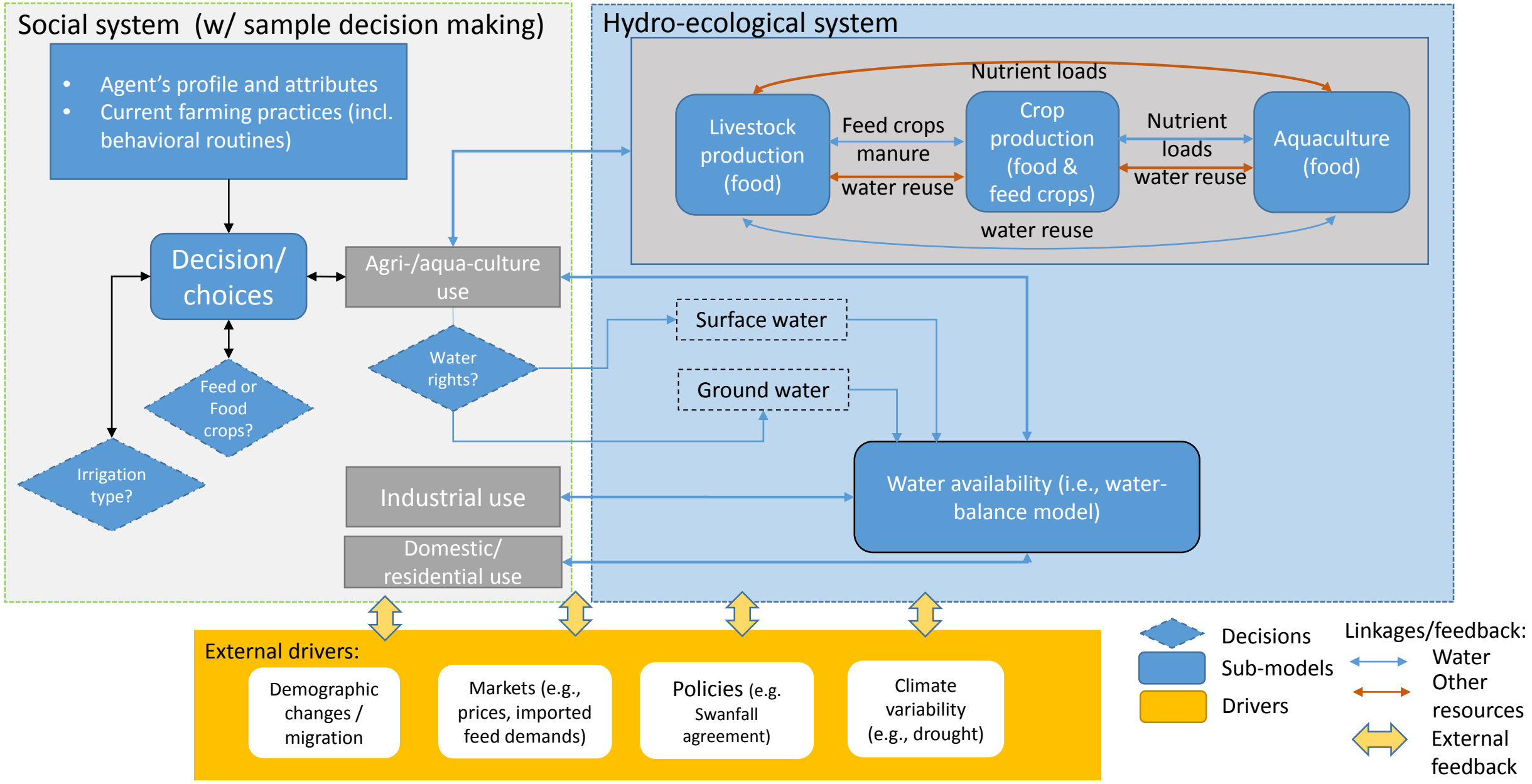
Module developed from Jägermeyr et al (2015).
DU: fraction of soil surface above field capacity when irrigated

- Water losses from evaporation, percolation, and surface runoff.
- Losses from conveyances: Conveyance surface area, and processes relevant to each technology.
- Losses during application: Irrigated area and degree of soil saturation caused by each technology.
- Technology parameterizations are constant.
- Proportions of each technology vary spatially.

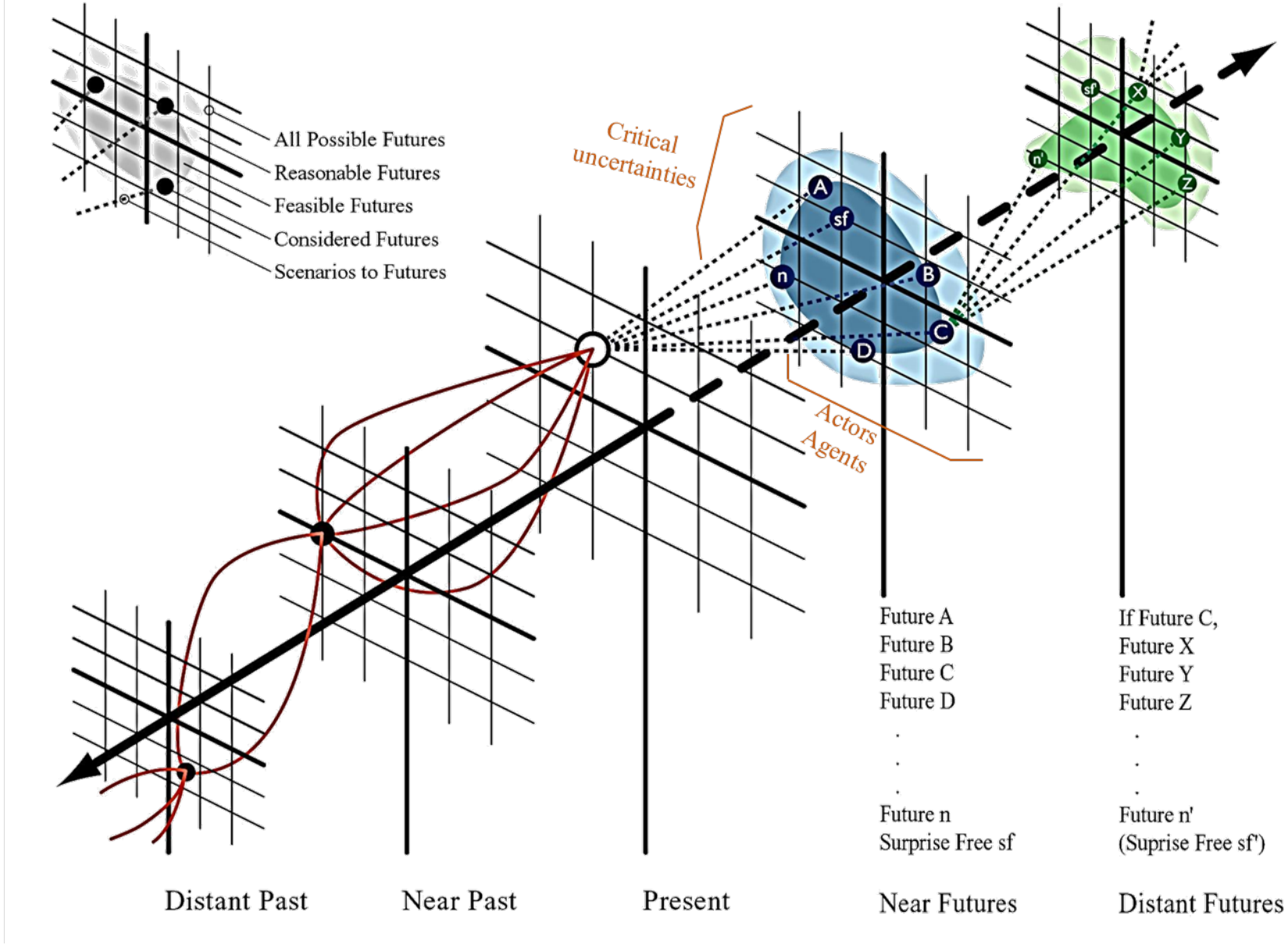
Irrigated cropland from sprinkler



Proposed conceptual model of FEWS dynamics for USRB: **water management**



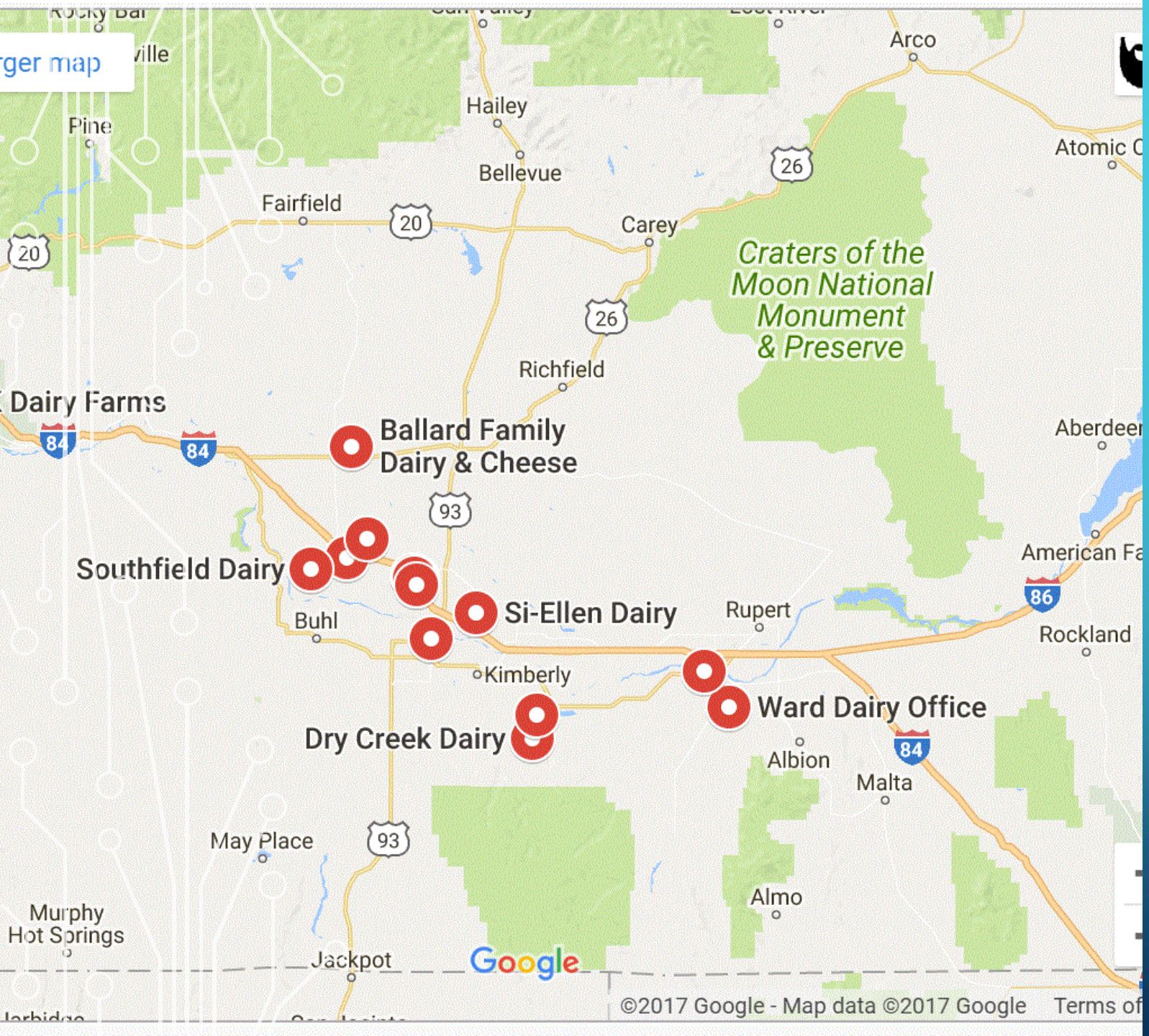
Scenarios and Alternative Futures



Modified from Shearer 2005

WHAT WE'VE LEARNED SO FAR

- Stakeholders have different concerns about the FEWS than researchers (education & workforce development; immigration policy; local and regional growth)
- Stakeholders have a very different concept of what solutions and future outcomes might be for the USRB (management cooperatives; government intervention; reforming water rights law)
- Stakeholders are willing and eager to engage with researchers on FEW questions, and want more than the "shake and steak" model of stakeholder engagement.



WHERE ARE THOSE 500 DAIRY FARMS, ANYWAY?

- Publicly available information on dairy farm locations is very, very poor in Idaho (and not that great in US in general)
- Idaho Power, through participation in the SAG, has offered us exact locations for 400+ dairies based on their customer database.

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University of Idaho

CRC CENTER FOR RESILIENT COMMUNITIES University of Idaho

NSF

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