

Using values-informed mental models to understand agricultural producer, water manager, and scientist use and perceptions of hydrologic models

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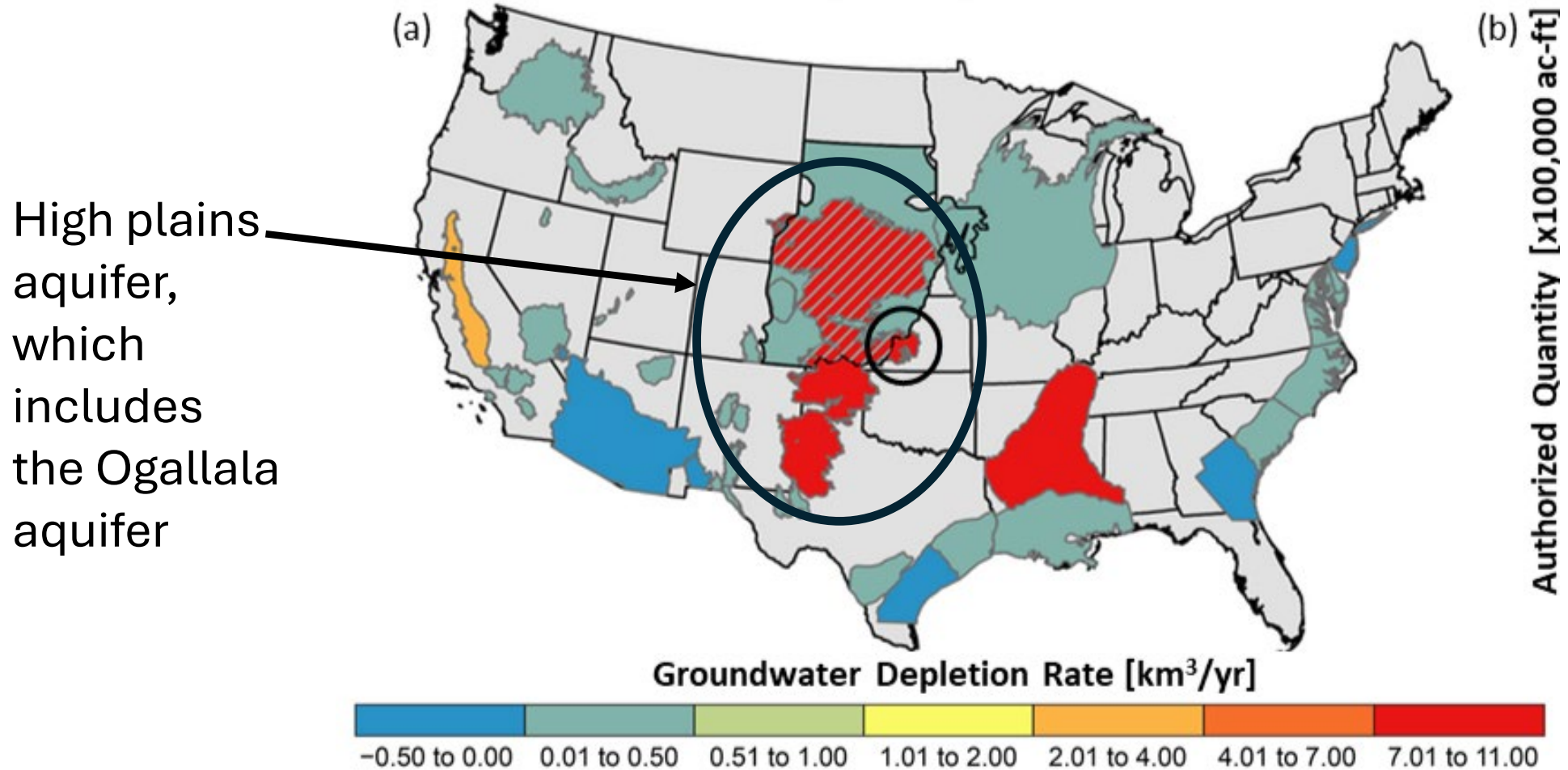
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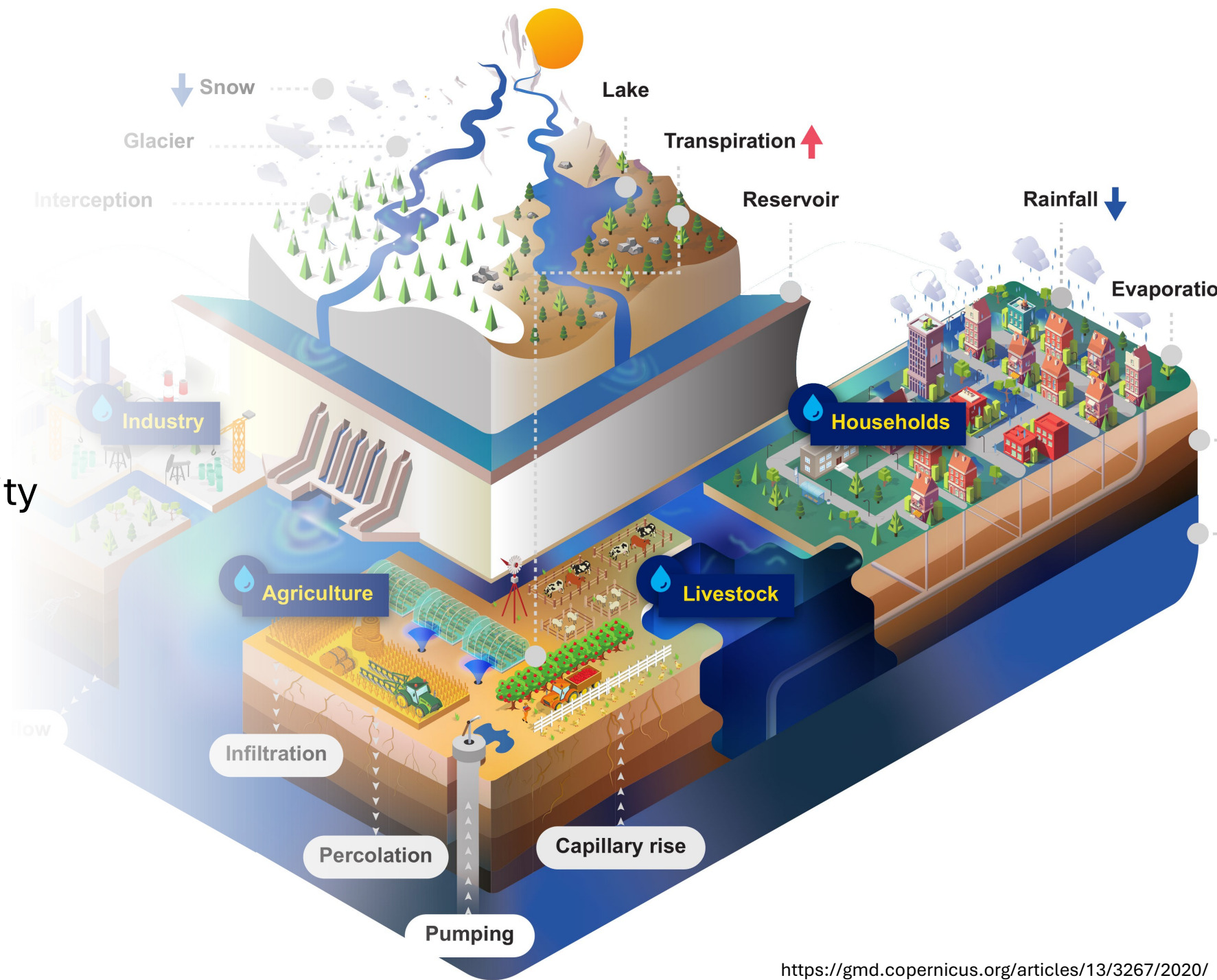
Groundwater depletion in the US



Groundwater depletion rate in major US aquifers (2001 – 2008 average)

Hydrologic Models

- Mathematical representation
- Accuracy and usability trade-offs
- Not always adopted
 - Role of values



Nature and epistemic values

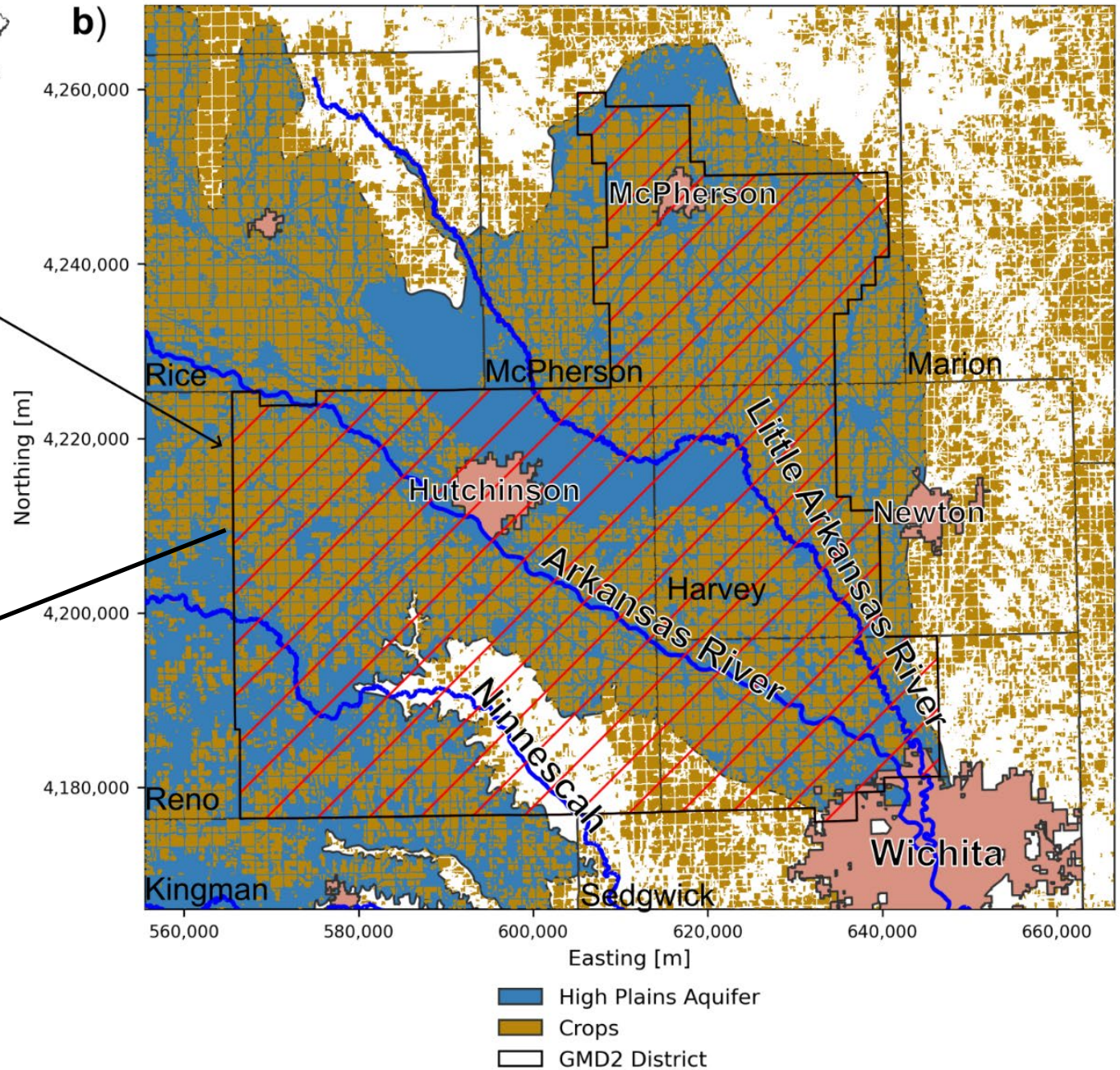
- **Nature values:** how humans understand and relate to nature
 - Oneness
 - Livelihood
 - Health
 - Stewardship
- **Epistemic values:** principles that guide pursuit of knowledge
 - Accuracy
 - Methodological soundness
 - Testability
 - Transparency
 - Usability



Study Area

Equus Bed Groundwater Management District 2 in south-central Kansas.

96% of the water used for irrigation comes from groundwater in Kansas



Research Questions

What is the percentage prevalence of nature and epistemic values for each participant group regarding water decisions?

What water management decisions do end users make using hydrologic models?

And what and how are these values considered in decisions made using hydrologic model outputs?

Approach: Values-informed Mental Models

- Create values-informed mental models to assess how information and values (epistemic and nature) influence water decisions using hydrologic models.
- Mental models: cognitive representation of the external world.
- Useful in identifying gaps in understanding
- Model outputs can be linked to different values across groups

Data collection

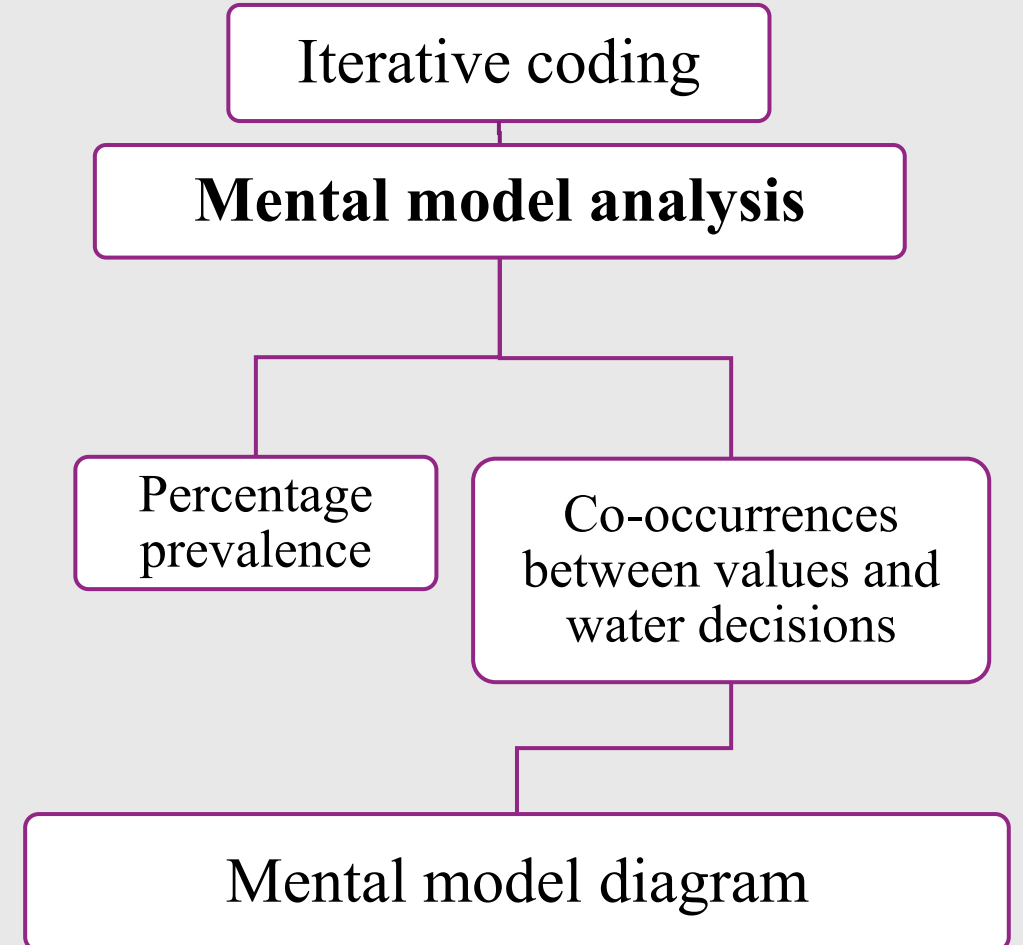


22 Semi-structured interviews

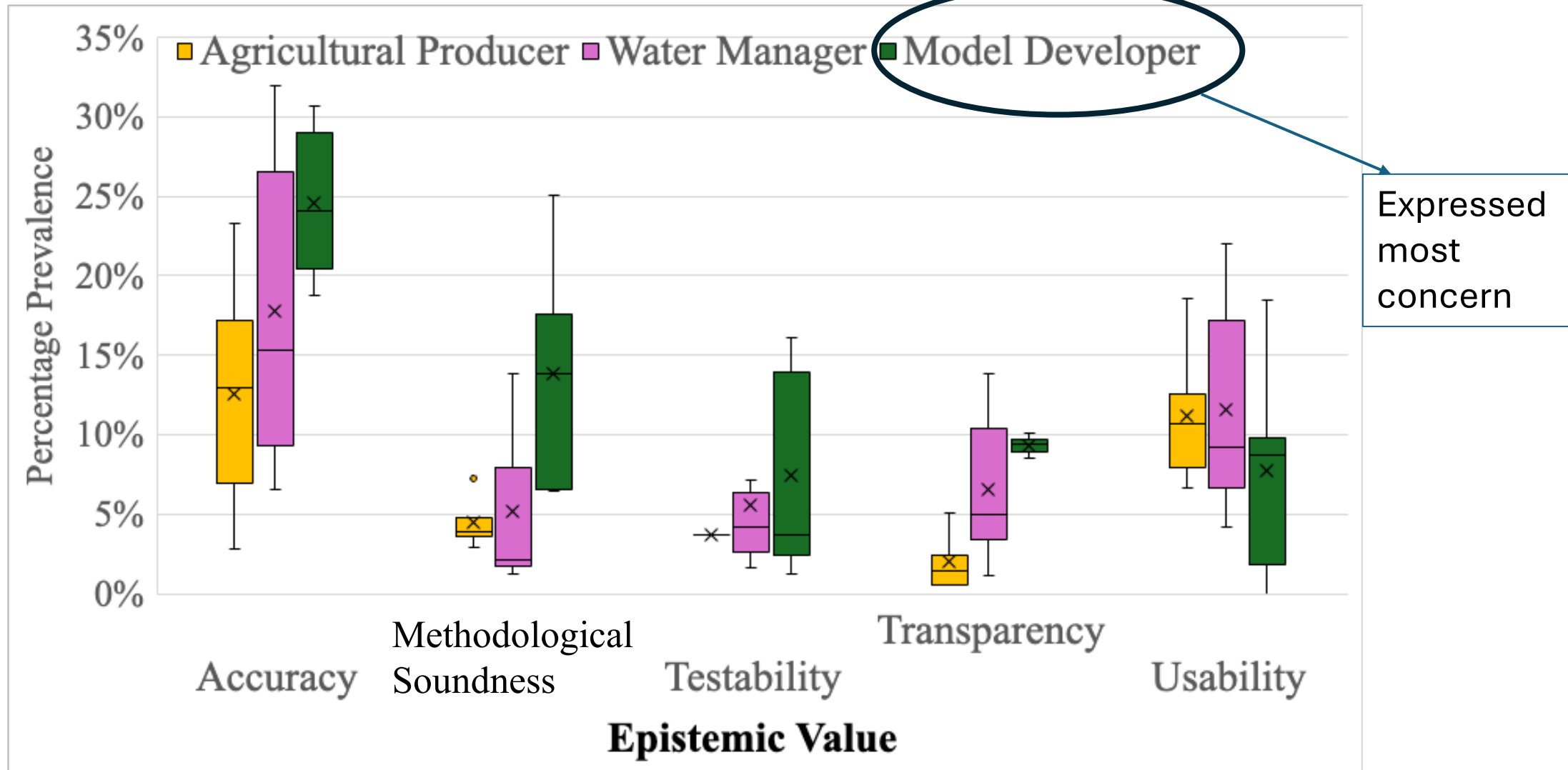


Population: 7 agricultural producer,
5 modeler, 10 water manager.

Data analysis

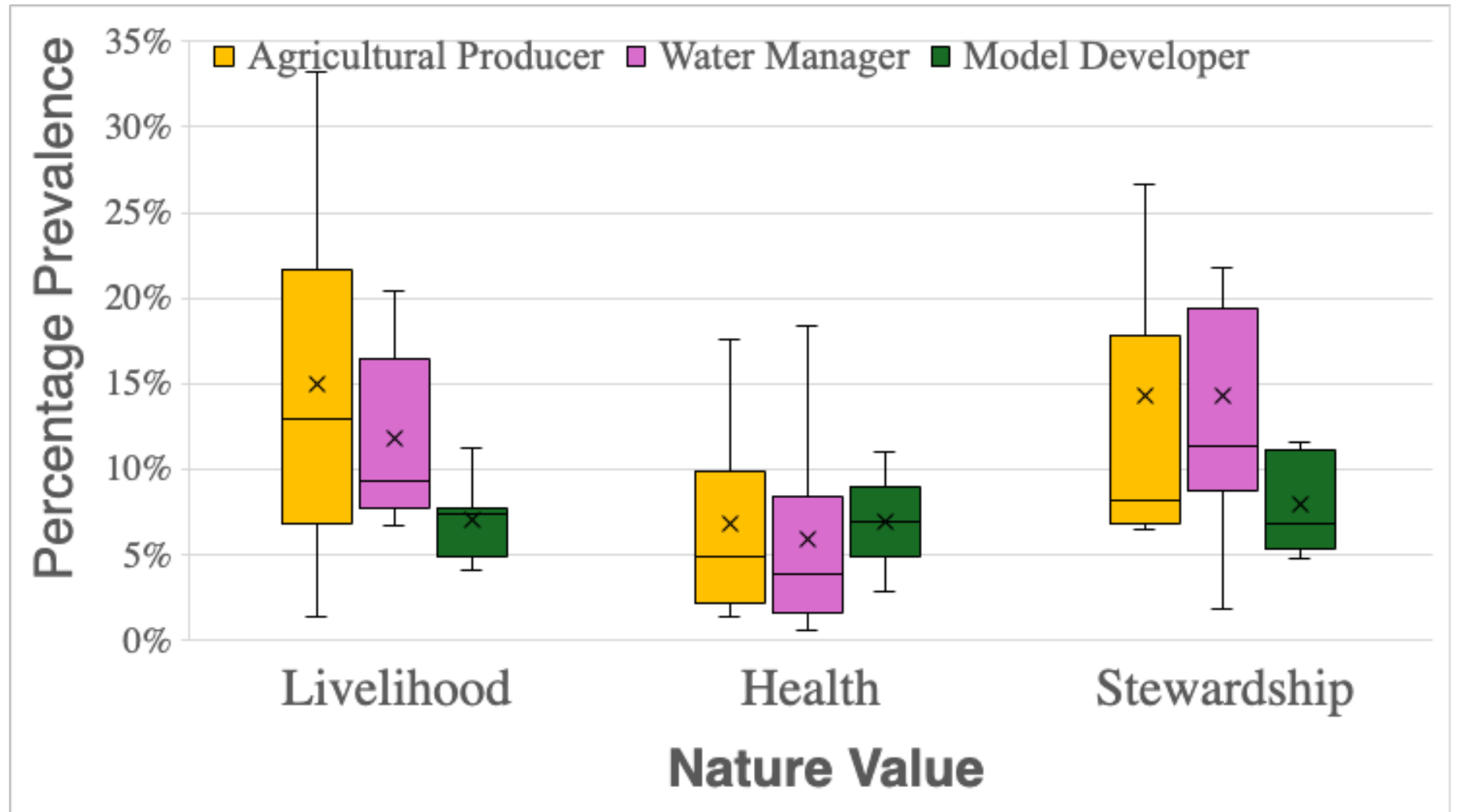


Results: Percentage prevalence of epistemic values



Results: Percentage prevalence of nature values

- Livelihood:
Agricultural
producer
- Stewardship:
water
manager



Example Quotes

Stewardship

“There is a need recognized in law that we need to consider the environment. We need to consider wildlife in the kinds of uses that take place. So, there's a recognition that's valuable and important and from my personal point of view, it's hugely important.” (Water Manager)

Transparency

I think the area where they had least accuracy [the modelers would] point out. And that would be a lot of that hydraulic effect, leakage, if you will, into the river and out. There's several of them in Little Arkansas. Well, it's a big one. So, I think that is the area they [would] point out: Hey, this isn't flawless.” (Agricultural Producer)

Types of water decisions made using hydrologic models

Regulatory

Long-term planning

Conservation-related

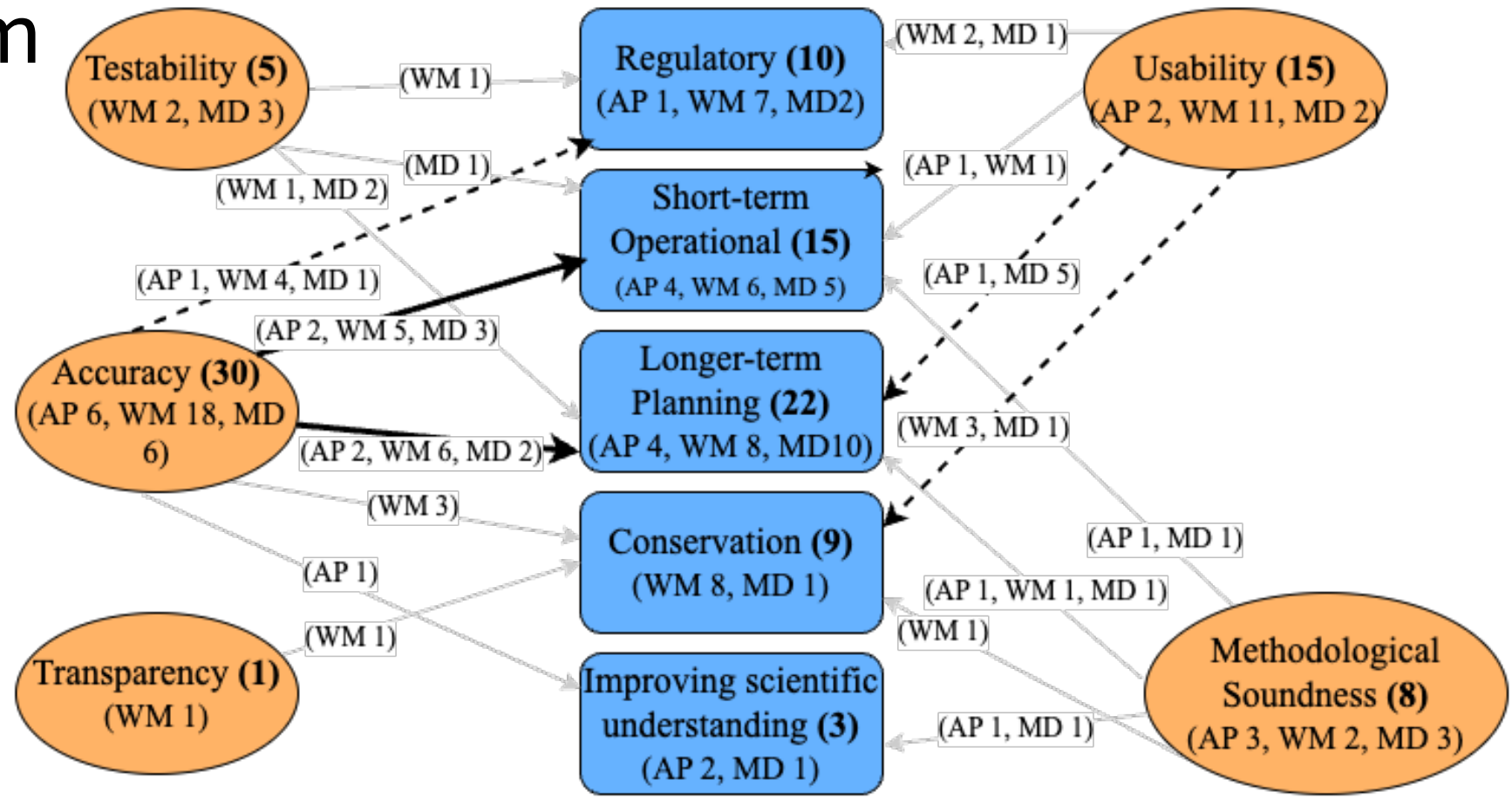
Short-term operational

Improving scientific understanding

Results: Mental model diagram

Accuracy: most important value

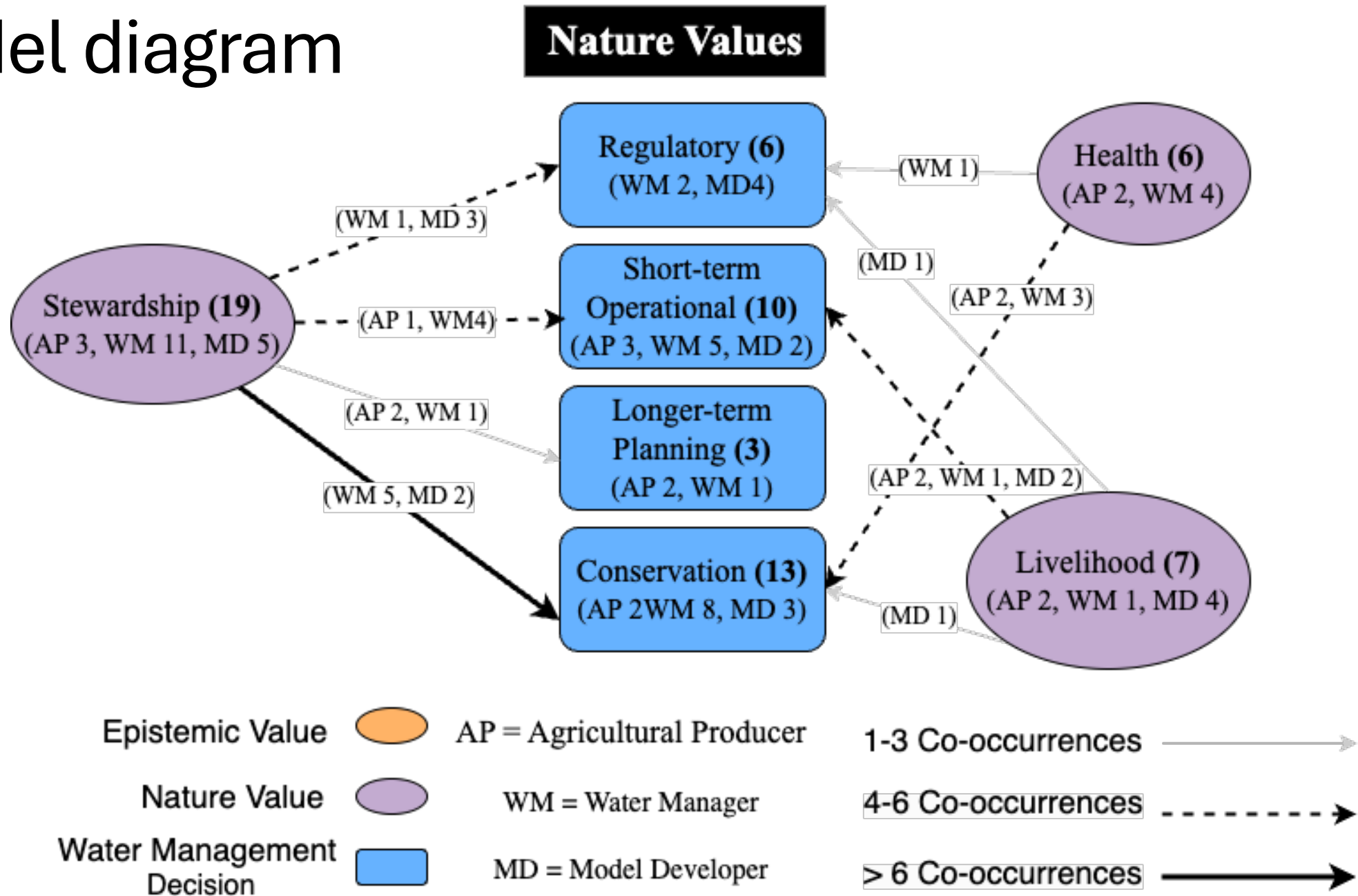
Epistemic Values



Epistemic Value		AP = Agricultural Producer	1-3 Co-occurrences	
Nature Value		WM = Water Manager	4-6 Co-occurrences	
Water Management Decision		MD = Model Developer	> 6 Co-occurrences	

Mental model diagram

- Stewardship:
Most important
value



Implications

- Agricultural producers and water managers as end-users express different values
- Balancing among usability, reliability and feasibility
- Modelers can find opportunities to increase transparency and communicate the process to different types of information users to improve trust in modeled decision-support systems.
- Incorporating values into external communications, like how data can support sustainable livelihoods, could increase interest and use



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 - **Adam Zwickle**, Michigan State University
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 - Logan Swenson, University of Kansas | Kansas Geological Survey