

Linking Ecological and Economic Models that Support Conservation Auctions to Reduce Harmful Algal Blooms in Lake Erie



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How does this framework apply to Lake Erie?



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The New York Times

Behind Toledo's Water Crisis, a Long-Troubled Lake Erie

By MICHAEL WINES AUG. 4, 2014



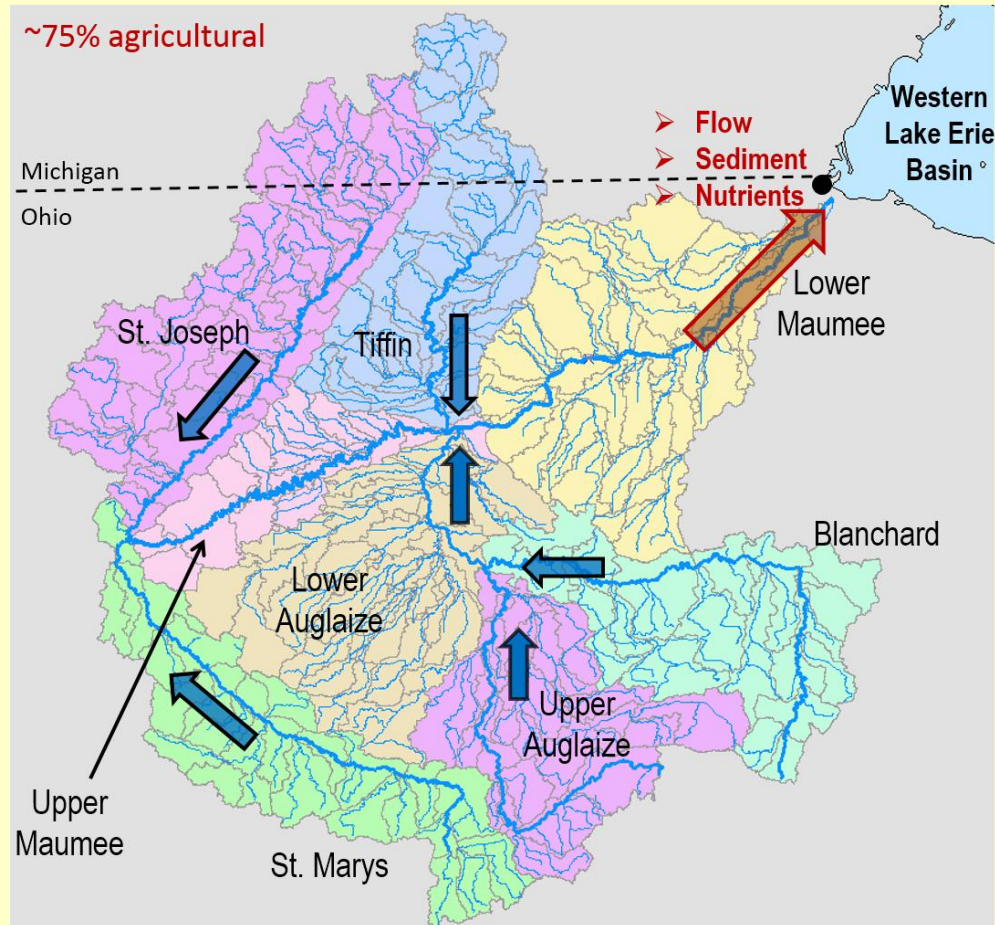
Classic externality problem: Agricultural nutrient loss is the primary source of phosphorus in Lake Erie that fuels harmful algal blooms (HABs).



Farmers have property rights.

Conservation programs and payments for environmental services.

Models and pay-for-performance conservation



How can we get the most environmental benefit using a limited budget?

Pay based on predicted performance

Rank projects:
$$\frac{Cost}{Env. Benefit}$$

What types of models are needed?

❖ **Economic models**

- ❖ **Budgeting model of direct costs of conservation BMPs**
- ❖ **Farmer decision models**

❖ **Ecological models**

- ❖ **Field run-off model**
- ❖ **In-stream nutrient transport model**
- ❖ **Lake algal bloom model (WLEEM)**

Linking models to inform conservation auctions

Procurement (reverse) auction

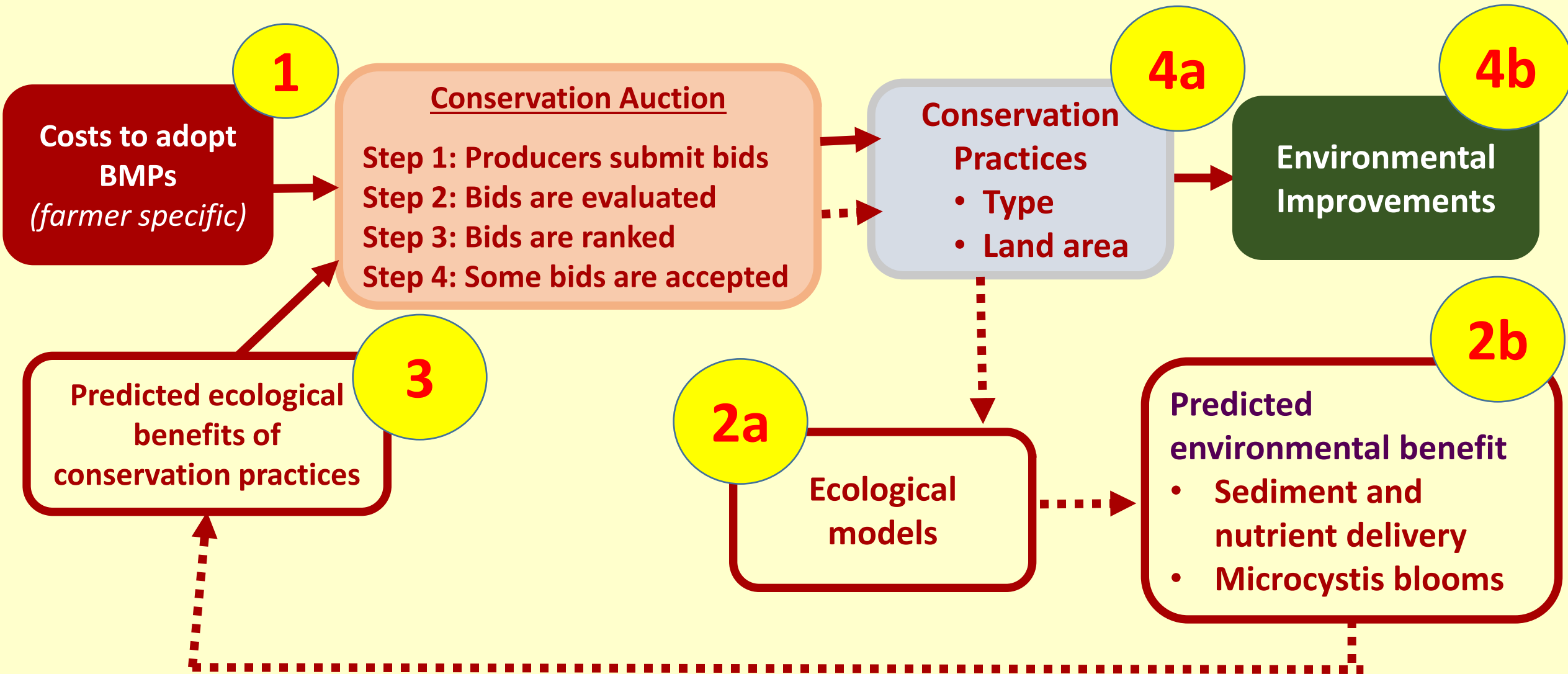
Allows multiple landowners (sellers of environmental services) to compete for land conservation contracts from one buyer.

Bid are selected based on the payment requested and predicted environmental benefits.

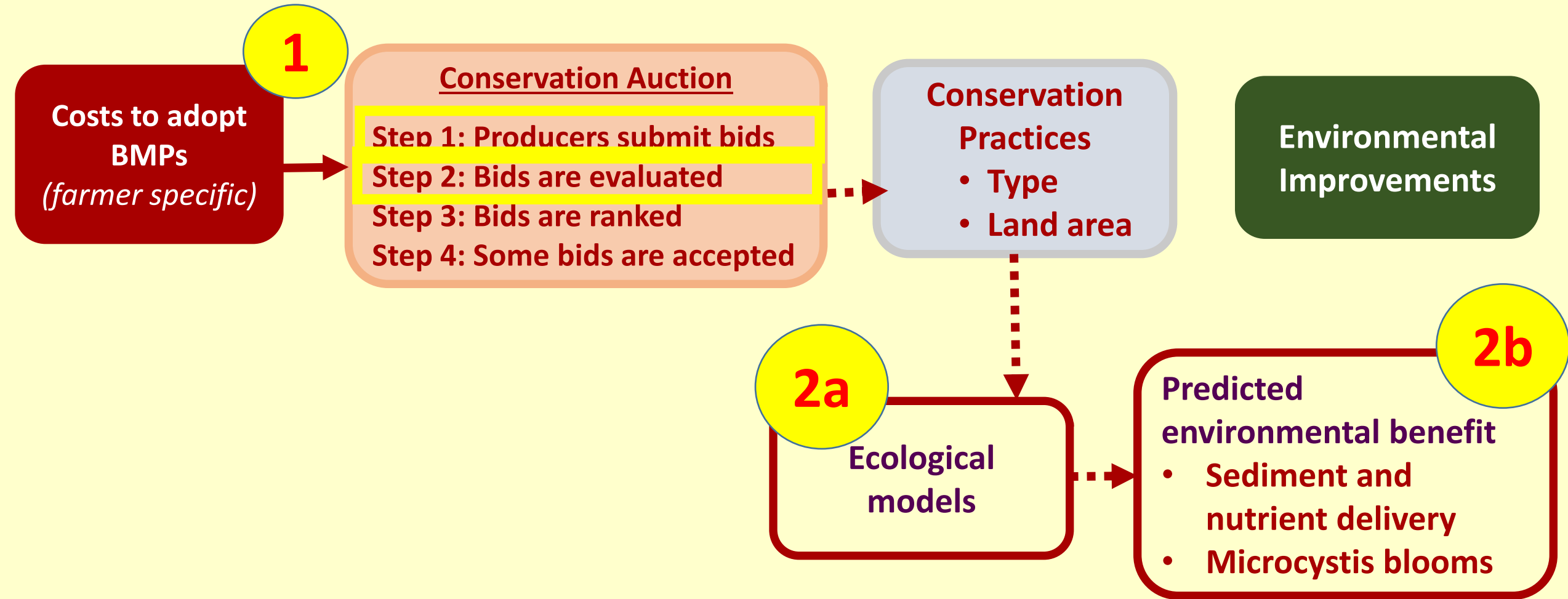
→ Requires biophysical models



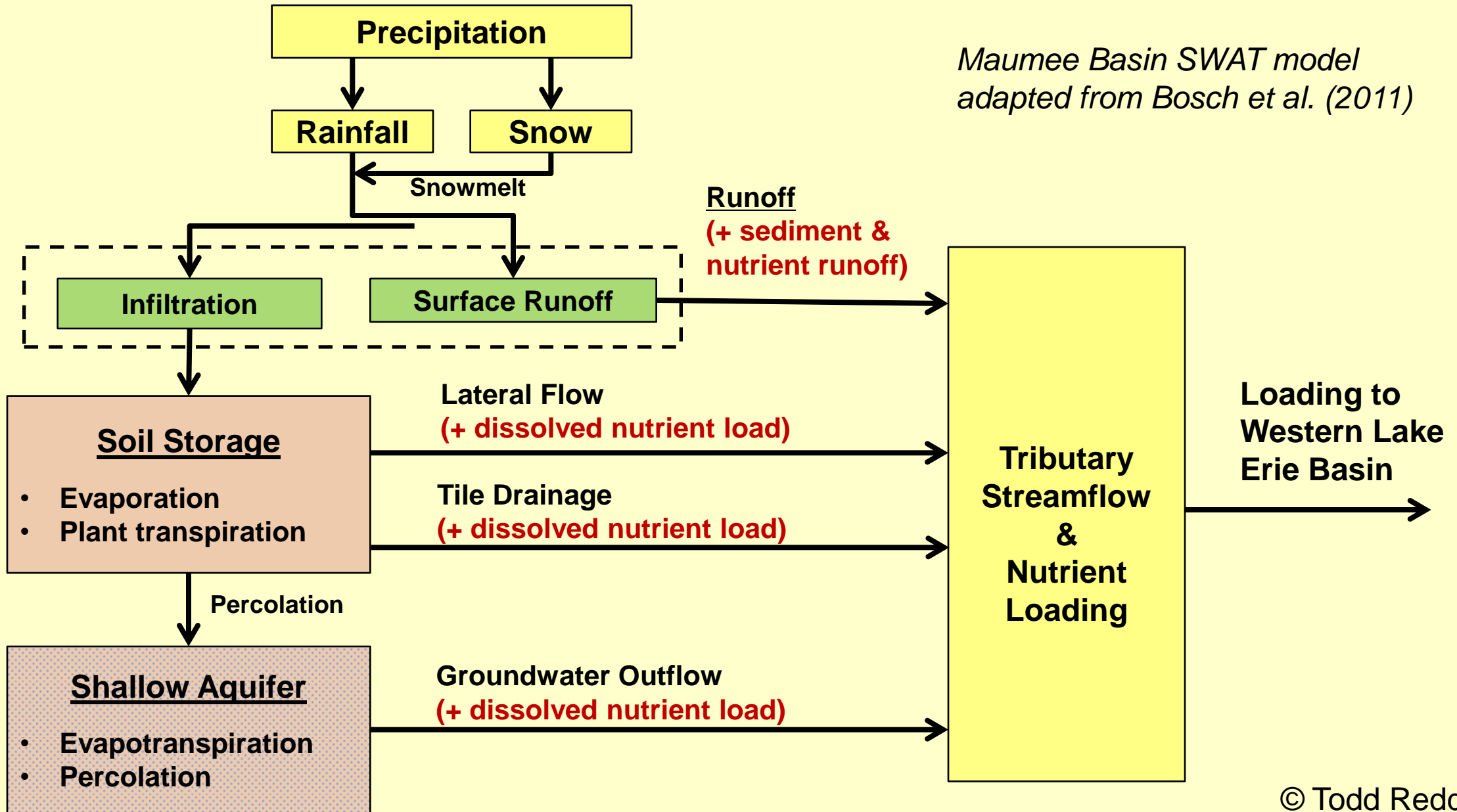
Integrating models to pay-for-performance



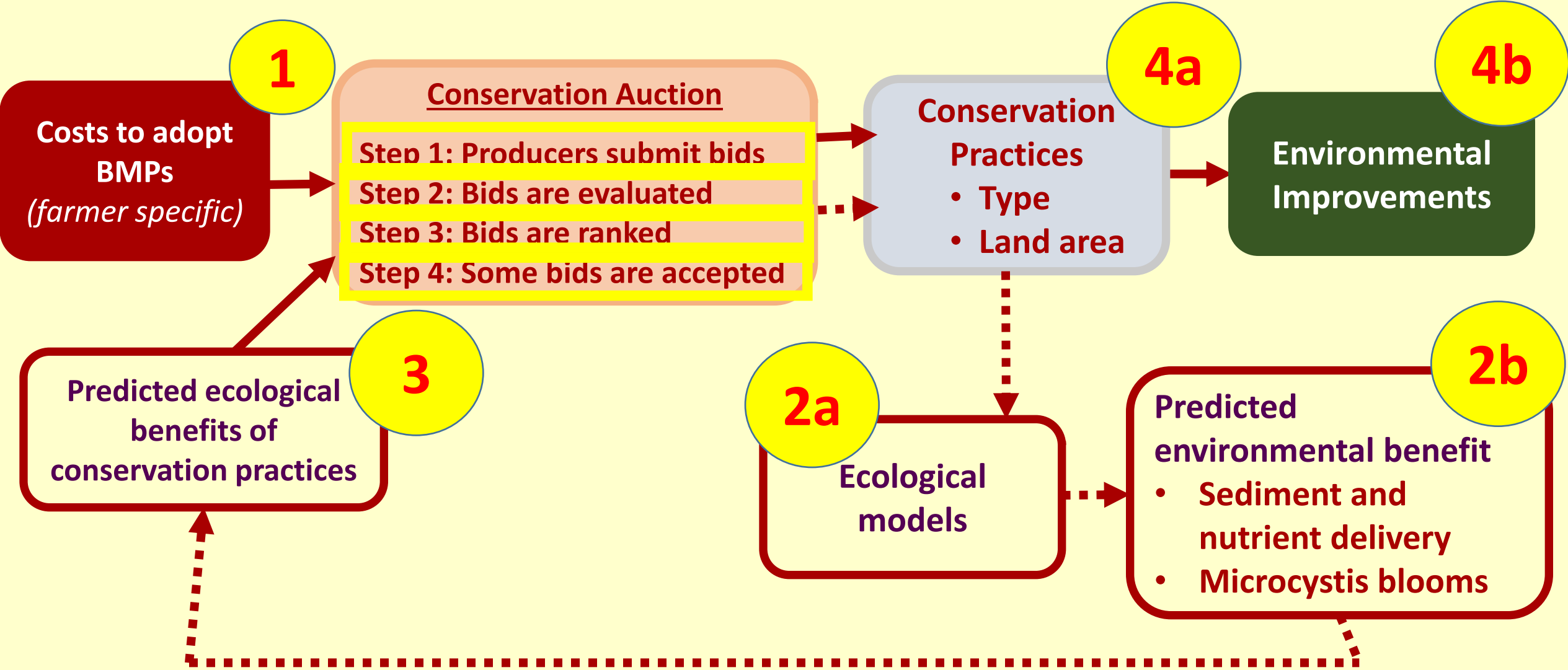
Using ecological models to inform auctions



Maumee SWAT Model Conceptual Diagram



Integrating models to pay-for-performance

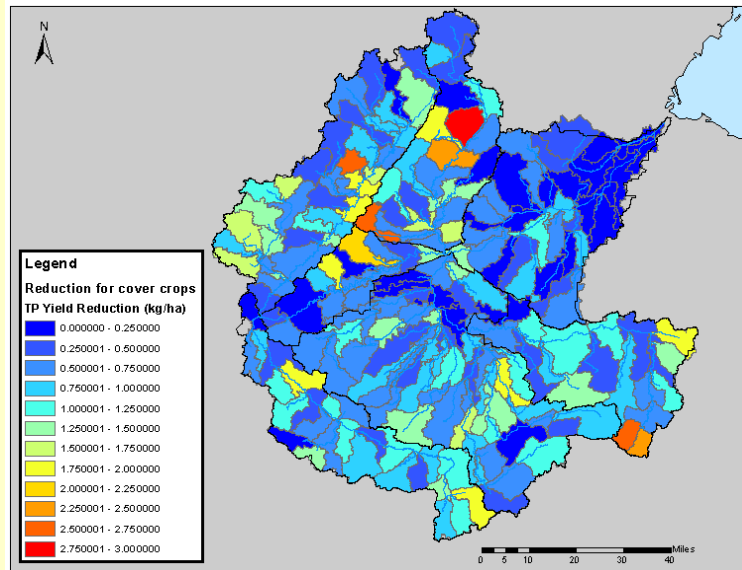


Biophysical models supported pilot auctions



Analyzed farmer preferences for different types of conservation incentives.

SWAT Models Total Phosphorus Yield for Mock Farms



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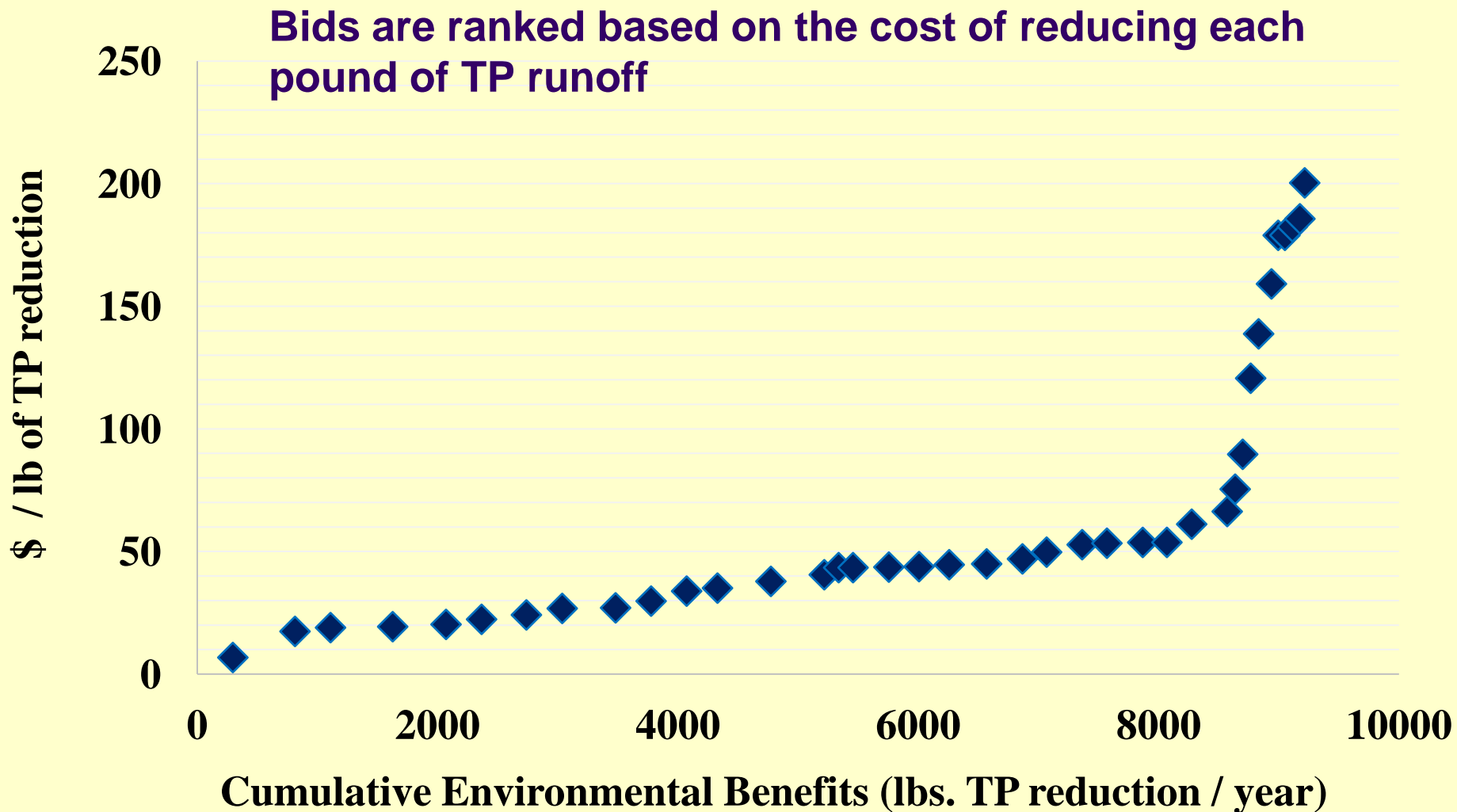


Mock farms – control heterogeneity for the experiment.

Developed baseline management regimes

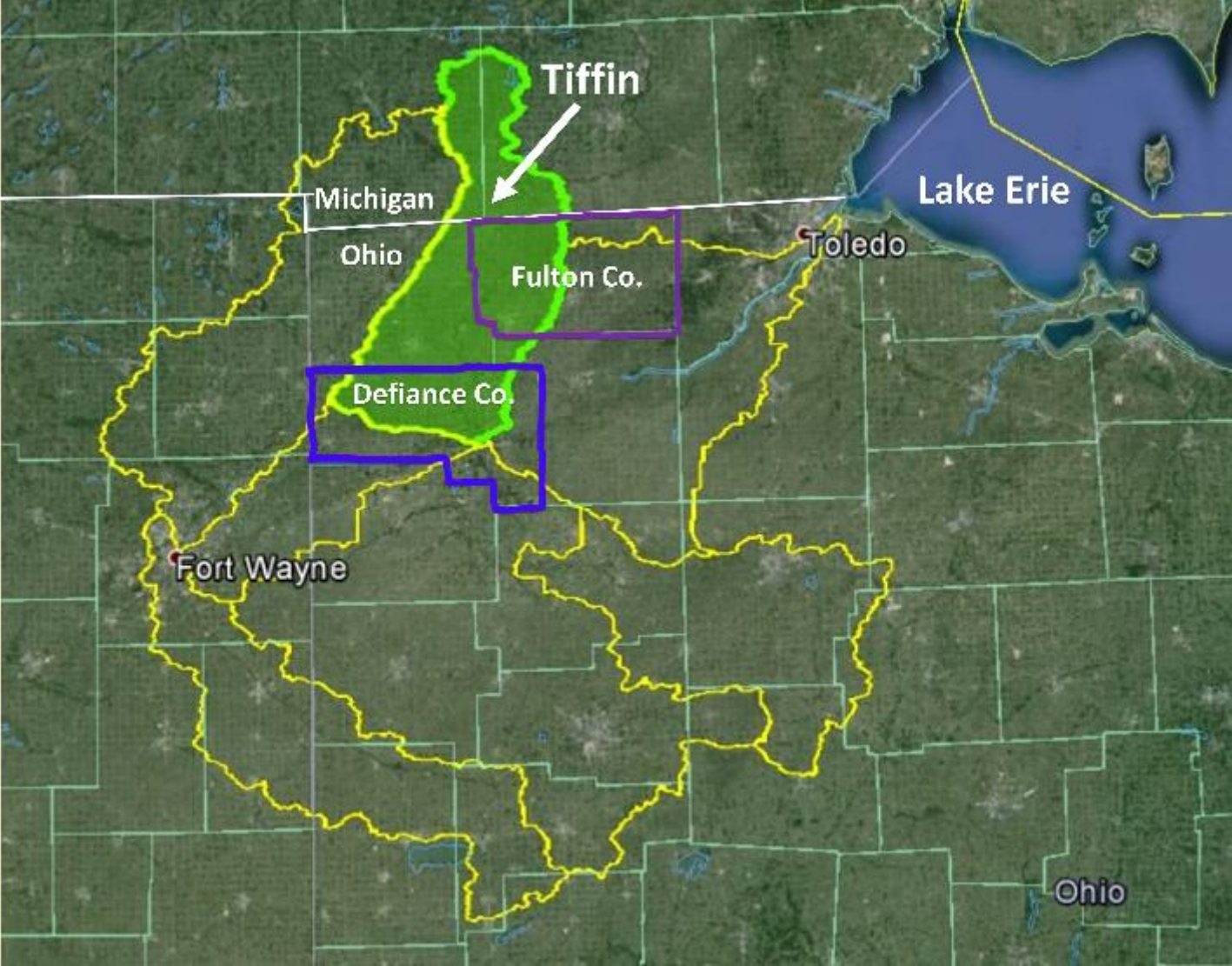
Generated SWAT output in advance

Cost-effectiveness: Some sites provide much better value for money



L. Palm-Forster, unpublished

Real conservation auctions in the Lake Erie Basin



Models predicted reductions in runoff

Scenarios tailored to individual fields

- ❖ The baseline required information about current management.

Bids ranked on the cost per pound of bioavailable phosphorus reduction (SWAT modeling by LimnoTech)

- ❖ Some very low P removal → Extremely expensive
- ❖ Predictions were very sensitive to assumptions about subsurface phosphorus movement.

Improving future modeling

- ❖ Need accurate models of subsurface drainage and how it affects movement of soluble phosphorus

		P Yield Reduction & Ranking (@ Tiffin River mouth)					
		Tile SRP Boundary = 150 ug/L			Tile SRP Boundary = 500 ug/L		
Bid #	BMP Type	Net P Yield Decrease (lb/yr)	Cost:Ben (\$/lb/yr)	Bid Rank	Net P Yield Decrease (lb/yr)	Cost:Ben (\$/lb/yr)	Bid Rank
1	Drain management	-0.2	--	--	1.8	\$1,137	8
2	Drain management	-0.6	--	--	3.9	\$406	2
3	Drain management	-0.3	--	--	0.7	\$2,310	11
4	Drain management	-0.5	--	--	3.6	\$439	3

Modeling participation

- ❖ **Farmers have to make two participation decisions**
 - 1) **Will I apply for the program?**
 - 2) **Will I enroll in the program and comply?**
- ❖ **Identify participation barriers and deterrents.**
 - ❖ **Coordination among multiple land managers is costly.**

Online tools inform land managers

Great Lakes Watershed Management System

login/logout

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Basemaps

Field-scale Analysis

View Baseline NPS Calculate a Baseline Change Compare 2 Scenarios Historical Comparison

Results

Click the 'Activate' button to activate the digitizer, then draw an area to see how erosion, sediment loading, runoff, or pollutant loading may change between two different land cover scenarios. [Learn more.](#)

Digitizer: De-activate Clear Digitized Features

Project Name: Farm 1 (for saving and organizing results)

Model(s) to use:

- HIT (for soil erosion and sediment loading from ag lands)
- L-THIA (for surface run-off volumes and pollutant loading)

(click on a column title for a description)

Edit optional HIT parameters +

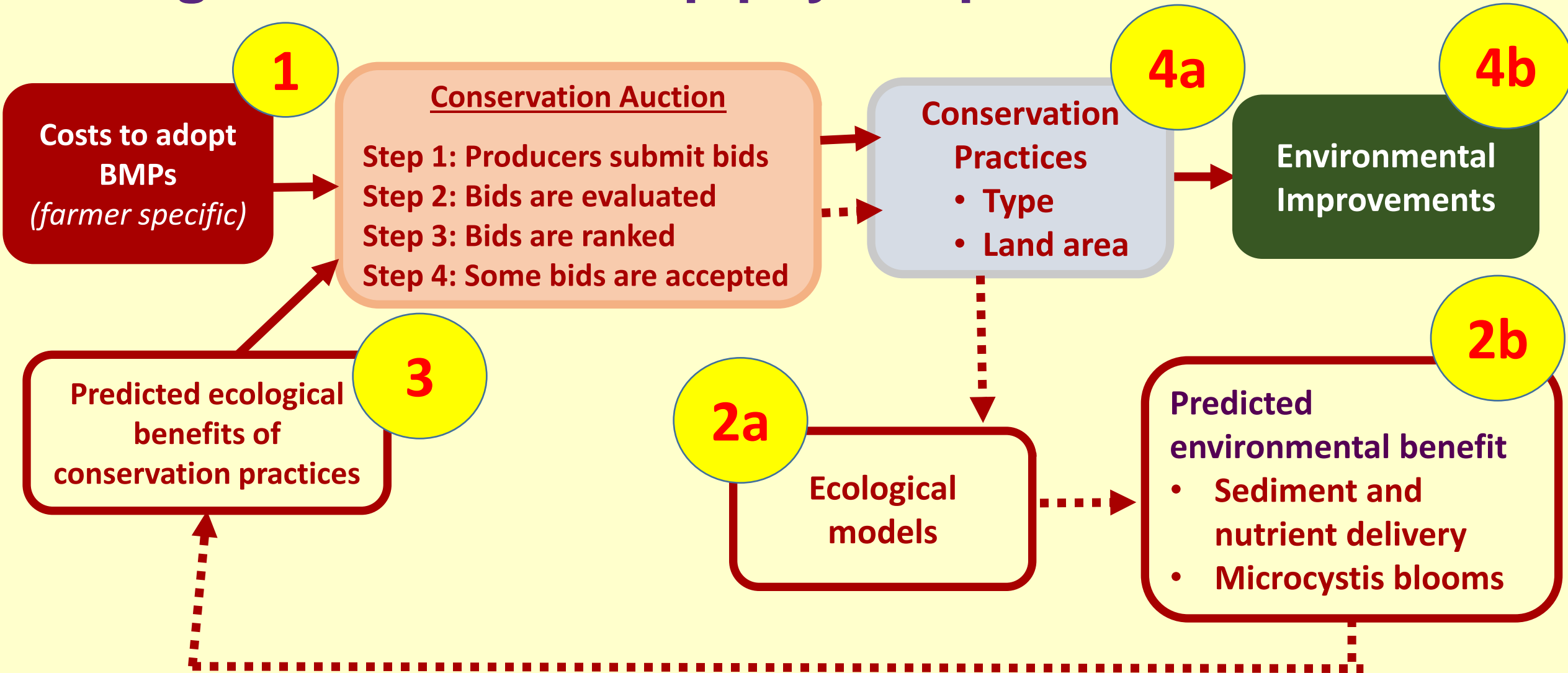
	Feature ID - Scenario	Acres	Cost/acre (\$)
X	1-1	6098	Click to edit
	1-2	6098	Click to edit

Calculate

About the Models

About the Tool

Integrated models help pay-for-performance



Many thanks to our partners & supporters

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Great Lakes
Protection Fund

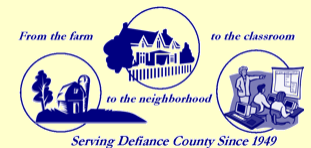
The Nature
Conservancy



LimnoTech



*Defiance Soil & Water
Conservation District*



Ohio Soil and Water Conservation Districts

Ohio Corn and Soybean Farmers



What questions do you have?

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