

### Algal blooms threaten Great Lakes ecosystems

Harmful algal blooms release toxins that endanger aquatic life and human health. This project focuses on how to design conservation auctions to increase the adoption of agricultural management practices that reduce phosphorus runoff from farm land in the Maume watershed in an effort to abate damaging algal blooms in western Lake Erie.

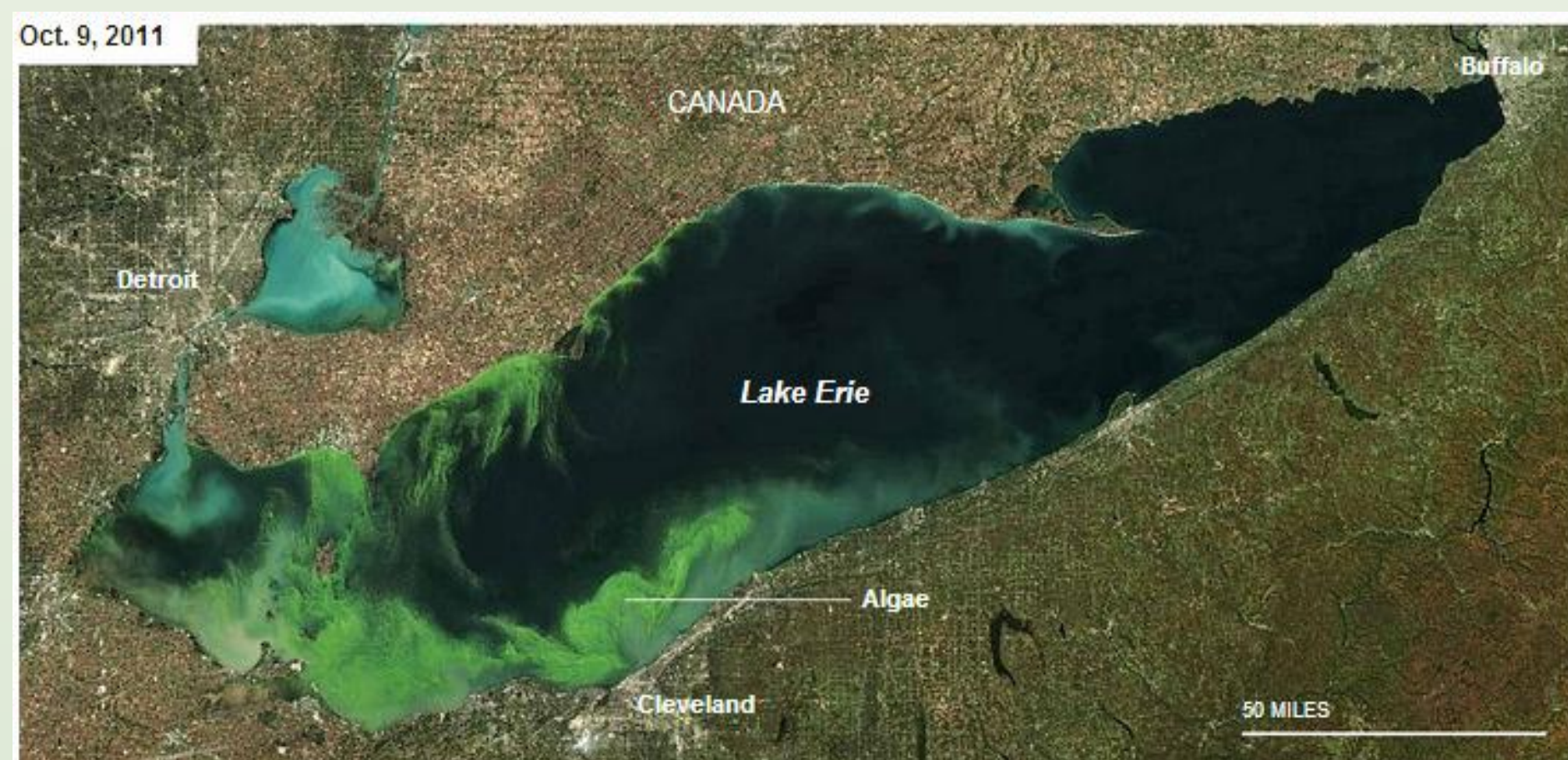


Figure 1. Satellite imagery shows the extensive algal bloom that occurred in Western Lake Erie in 2011.

### Encouraging conservation practices

Agricultural conservation practices can reduce the negative impacts of agricultural land use while maintaining productivity; but they are effective only if farmers adopt them.

Payments are commonly used to promote voluntary adoption of conservation practices, but other types of incentives could prove to be more cost-effective.



**Objective:** Using procurement auctions as a tool, this project will identify cost-effective transactions that can lead to widespread adoption of agricultural practices that improve water resources in the Great Lakes.

### What are conservation procurement auctions?

Conservation procurement auctions allow multiple sellers of environmental goods to compete for contracts from a single buyer of environmental goods.

Procurement auctions are an increasingly popular tool used to select conservation projects because of their ability to reveal privately held information about landowner costs.

- In conservation procurement auctions, farmers compete for conservation contracts by bidding the minimum payment they would accept in exchange for adopting a specified management practice.
- Payments are awarded not simply to the farmer with the lowest bid, but to the one offering the lowest cost per unit of environmental benefits.
- Benefits can be calculated using simple indexes, ecological models, or direct measurements.
  - In this research, ecological models are parameterized for the farm's geographical setting then run to simulate ecological outcomes from the conservation practices bid by participating farmers.
- By knowing the cost bid by each farmer and predicted benefits of each bid, contracts can be awarded to the farmers whose bids offer the most conservation benefit per dollar spent.

### Testing various conservation incentives

Farmer willingness to participate in a conservation program may depend on the incentives used to promote adoption of new practices.

Procurement auctions can be used to test the relative effectiveness of different incentive mechanisms, such as:

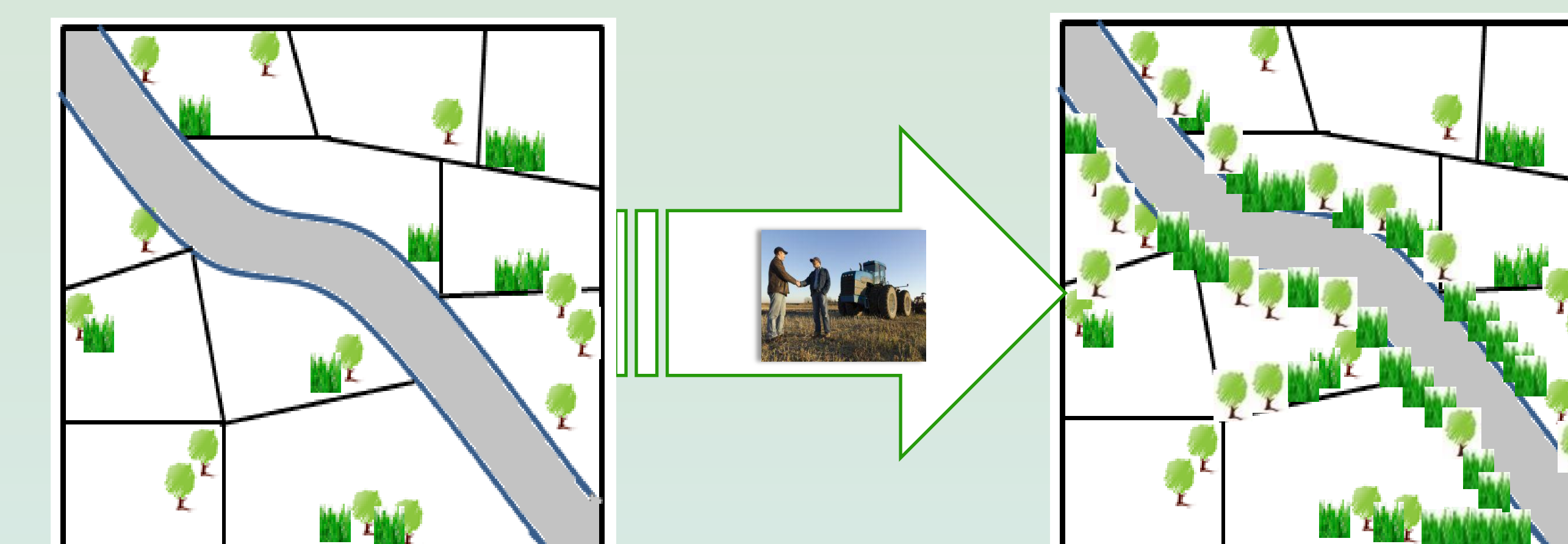


- Direct payments
  - One-time cost-share
  - Annual stewardship payments
- Insurance
  - Offer BMP insurance to reduce risk.
- Market benefits
  - Market access
  - Price premiums
- Rebates/tax reductions
  - Farmers may respond to a tax or fee reduction differently than direct payments.

### Coordinating landscape management

Provision of ecosystem services is often dependent on the spatial configuration of conservation practices across a landscape. For example, filter strips may have more impact on fields near water bodies or on highly erodible land. The marginal impact of using a conservation practice on one farm may also depend on conservation practices adopted by other farmers. In these cases, coordination can lead to optimal provision of environmental services.

**Group bidding has the potential to improve auction outcomes by encouraging the adoption of complementary practices and taking advantage of relative management efficiencies.**



**Project Outcomes:** Results from our research can help guide the development of cost-effective incentive programs that motivate coordinated land management and reduce algal blooms in Lake Erie.

### An illustrative example of conservation auctions

Budget-constrained conservation programs aim to maximize the environmental benefits that can be achieved by paying farmers to adopt conservation practices. This example shows how a procurement auction informed by ecological models facilitates this goal. In this example, the budget constraint is \$100. Accepted bids are in shaded boxes.



Figure 3: Four hypothetical farms in the Maume Watershed

- Ranking based on price of bids.
 

Parcel	Auction bid (\$/year)
1	\$35
2	\$40
3	\$42
4	\$80
- Ranking based on predicted ecological benefits.
 

Parcel	Est. WQI increase
1	10
2	20
3	17.5
4	30
- Ranking based on cost-effectiveness.
 

Parcel	Auction bid (\$/year)	Est. WQI increase	\$/WQI
1	\$35	10	\$3.50
2	\$40	20	\$2.00
3	\$42	17.5	\$2.40
4	\$80	30	\$2.67

Conservation programs can increase procurement of environmental benefits by ranking and accepting bids based on cost-effectiveness instead of accepting the lowest bids or the bids with the highest ecological outcomes.

### Integrating ecological models with farmer auctions

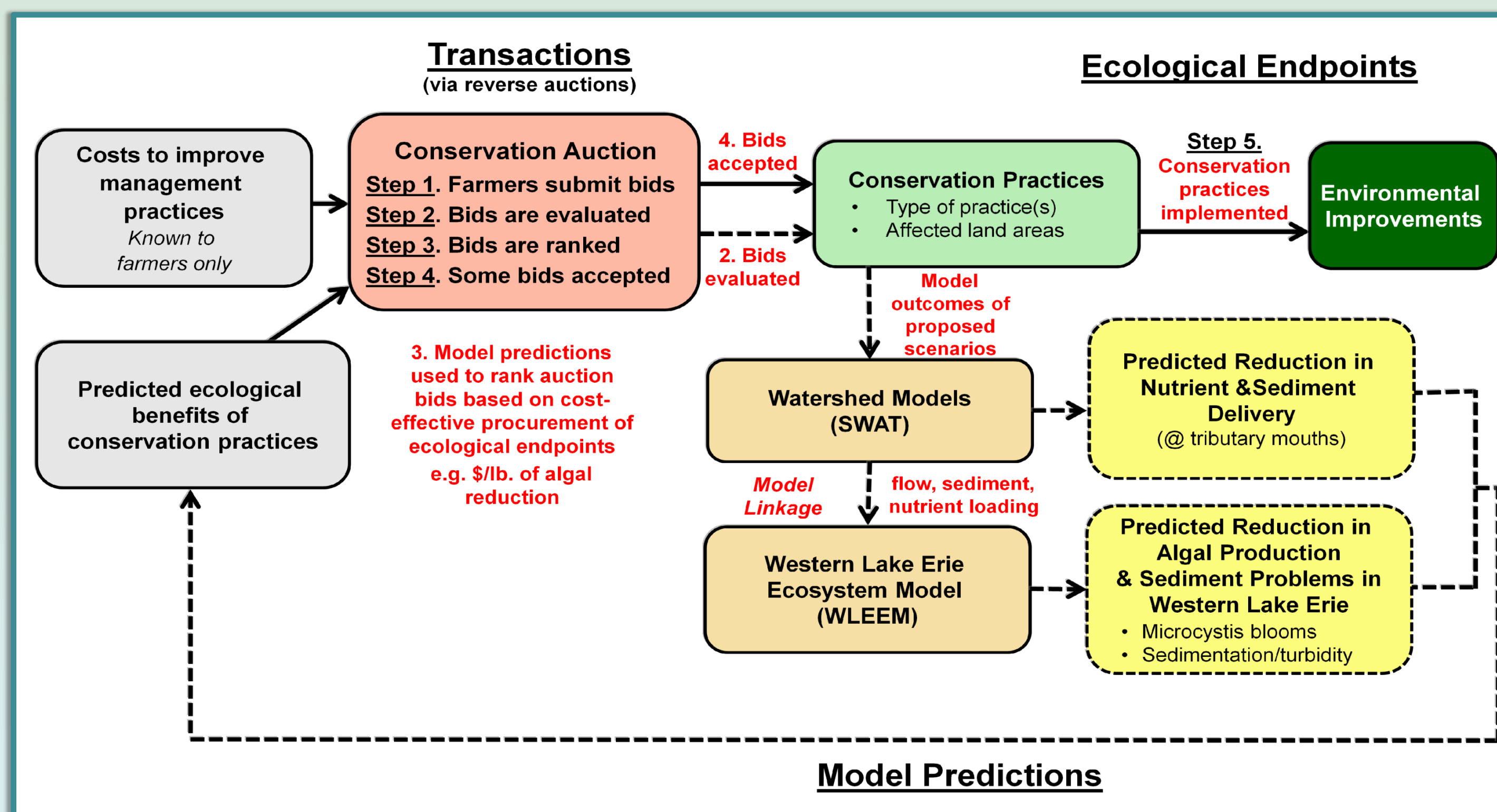


Figure 2. Farmers provide information about the cost of using conservation practices, while ecological models predict the benefits of these practices. Understanding the costs and benefits facilitates cost-effective transactions.

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