

Evaluation of Agri-Environmental Policies and Program Impacts: Building Credible Evidence in Agri-Environmental Policy

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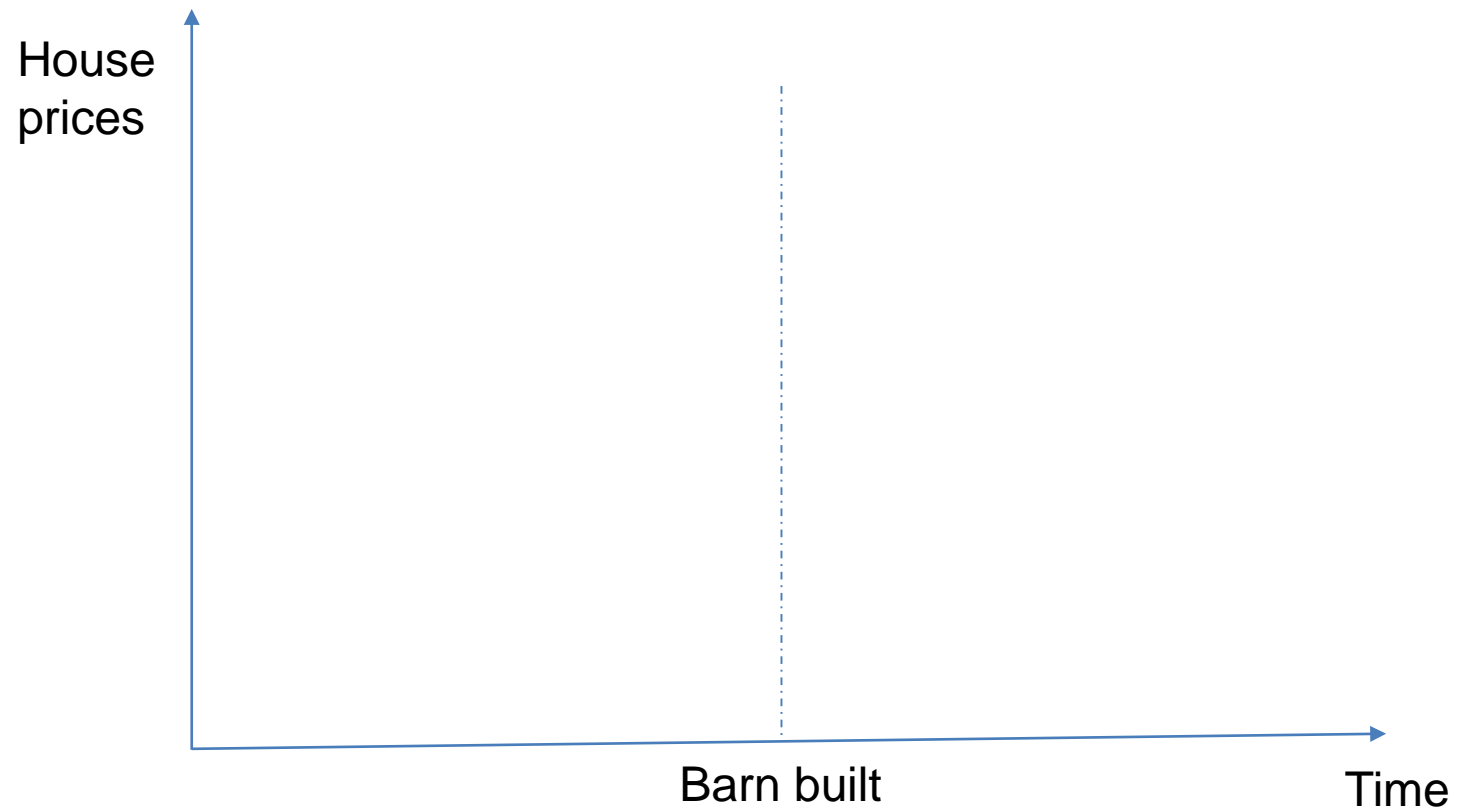
Importance of a counterfactual

What is the impact of a new hog barn on neighboring house prices?

- Manitoba government reopened hog sector expansion
 - Lifts 2006 moratorium on new barn development
- New barn construction requires approval of local councils
 - Significant opposition—perception that house values will fall
 - Bearing on municipal land use plans and setback restrictions

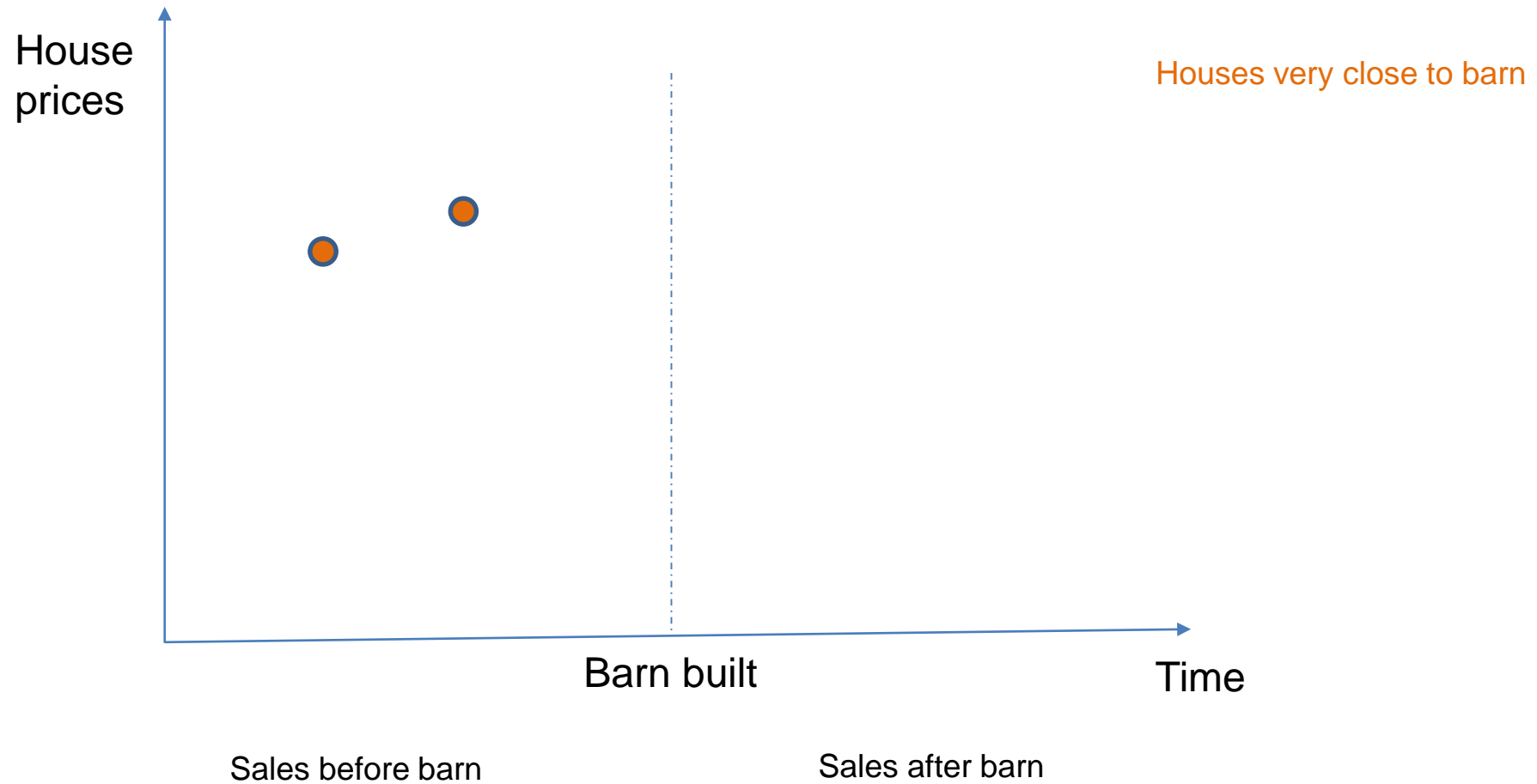
Impact of barns on house prices

As a hypothetical example:



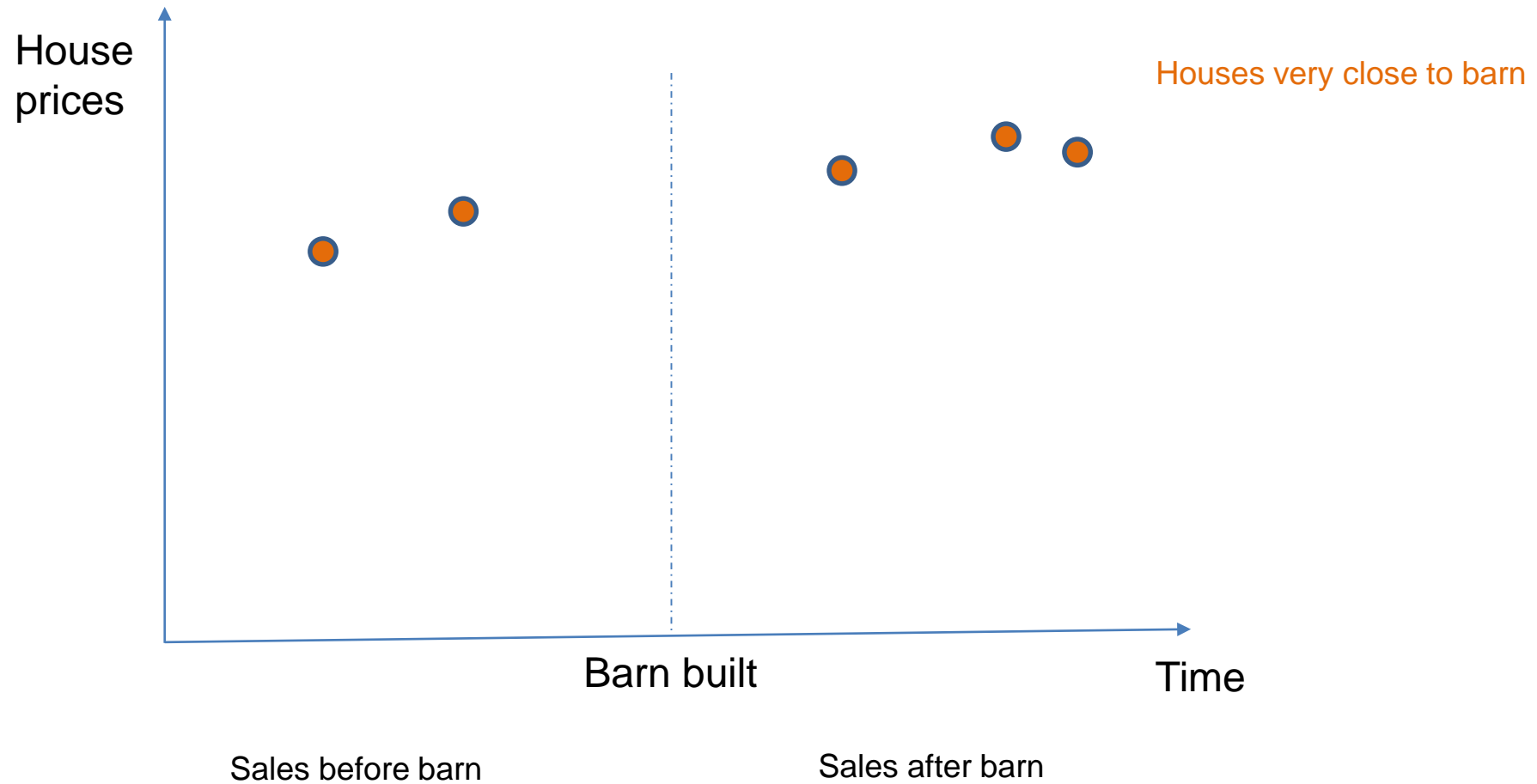
Impact of barns on house prices

1. Collect data on houses before and after barn built



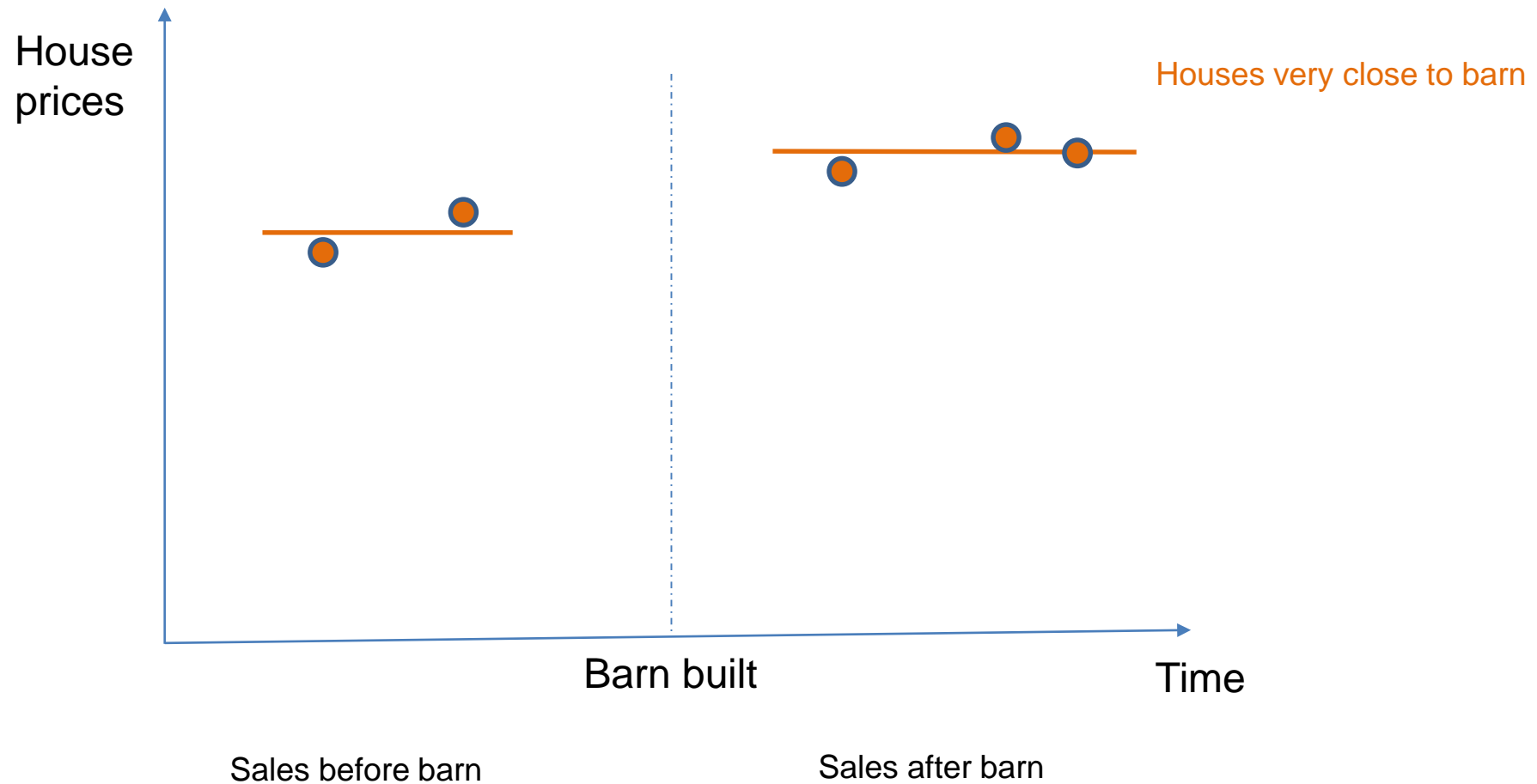
Impact of barns on house prices

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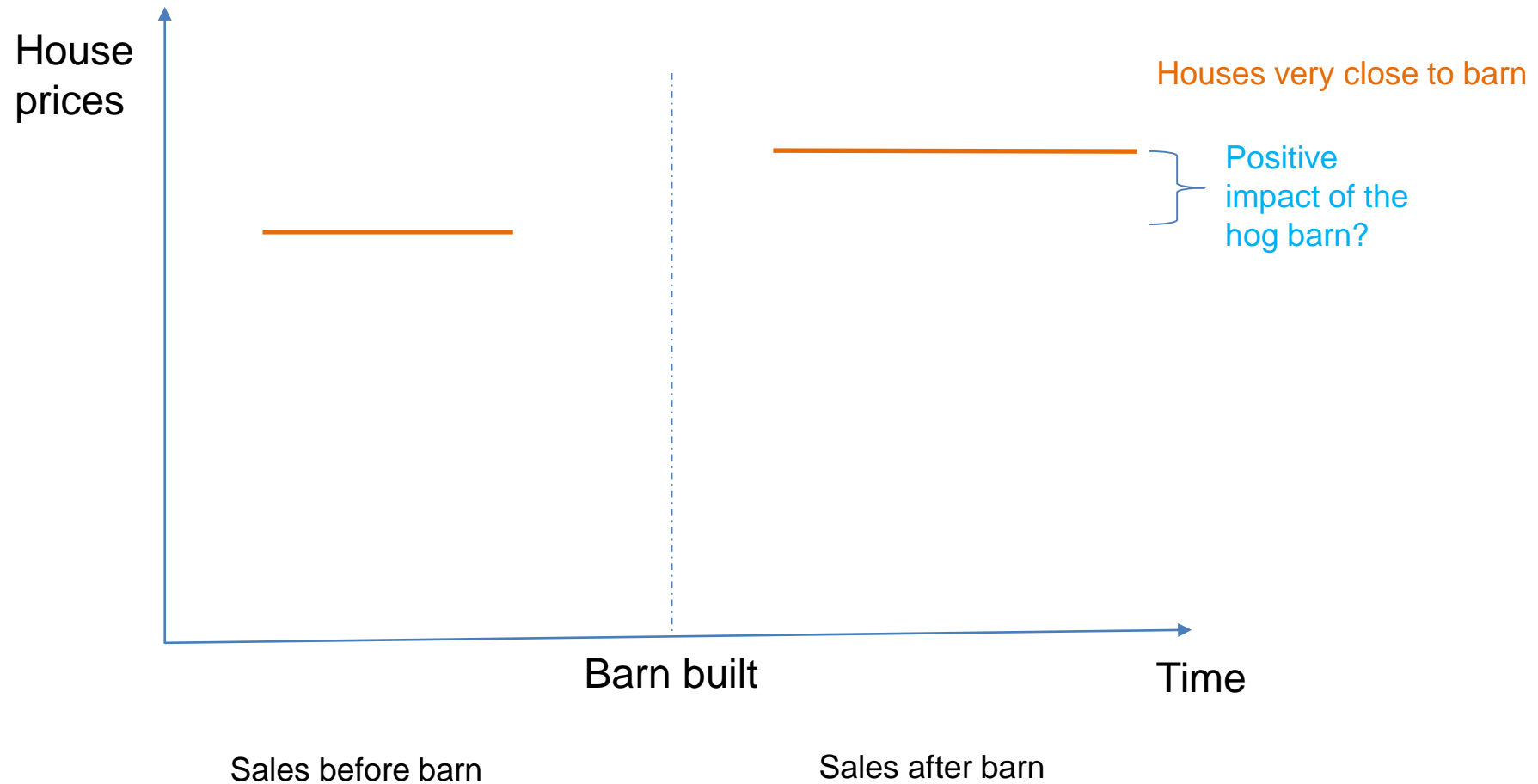
Impact of barns on house prices

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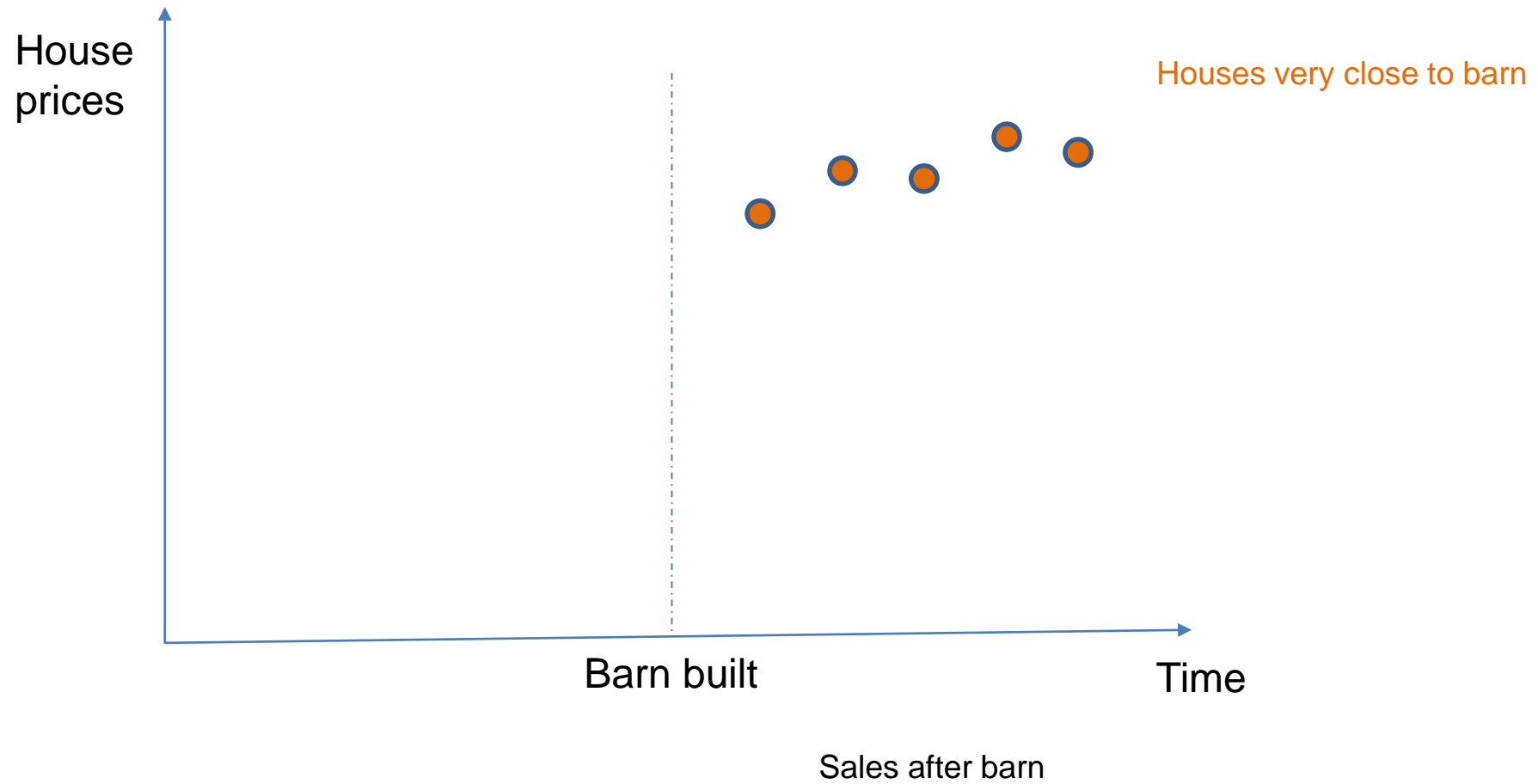
Impact of barns on house prices

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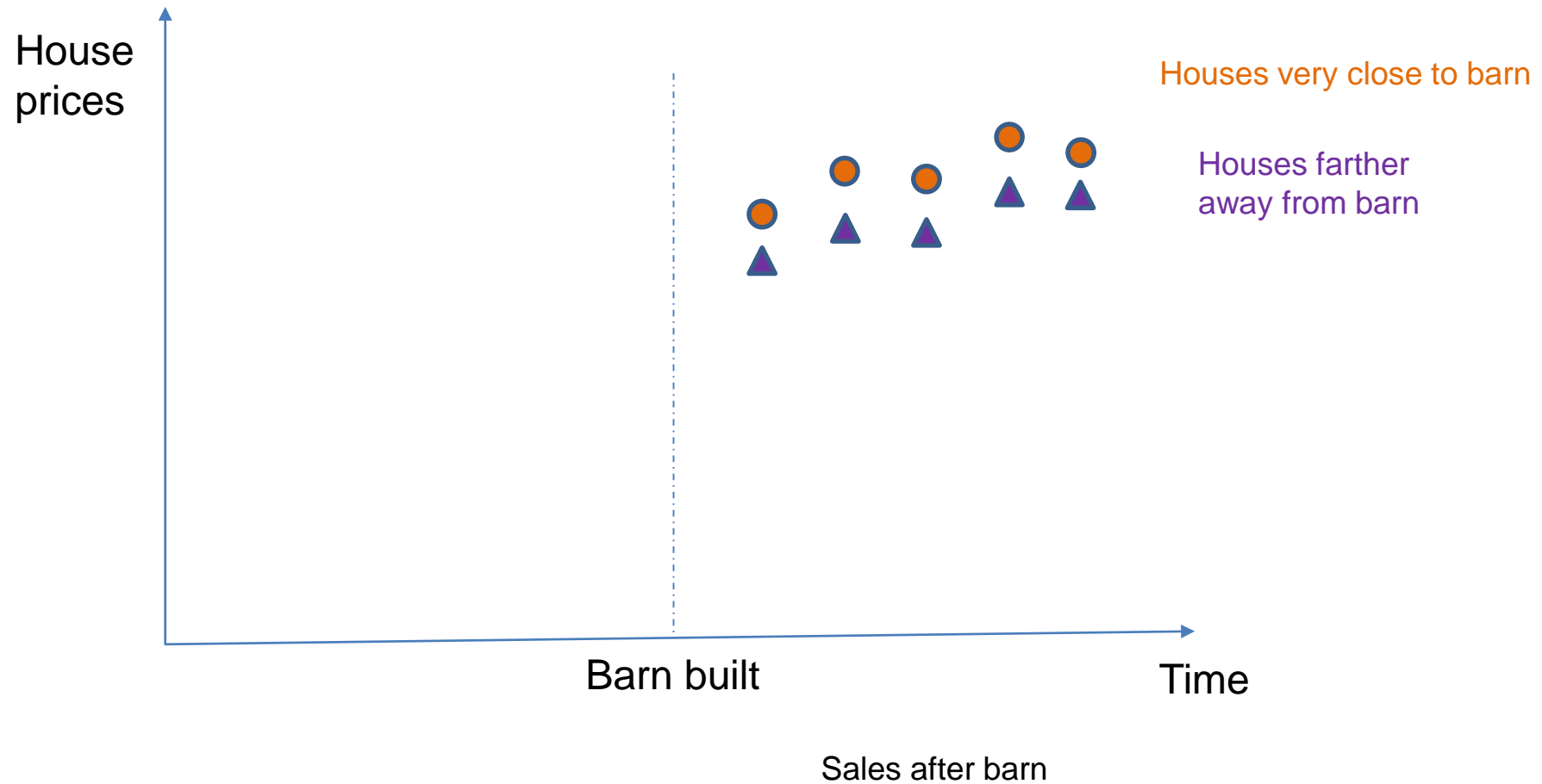
Impact of barns on house prices

2. Collect data on house sales close to barn and further from barn



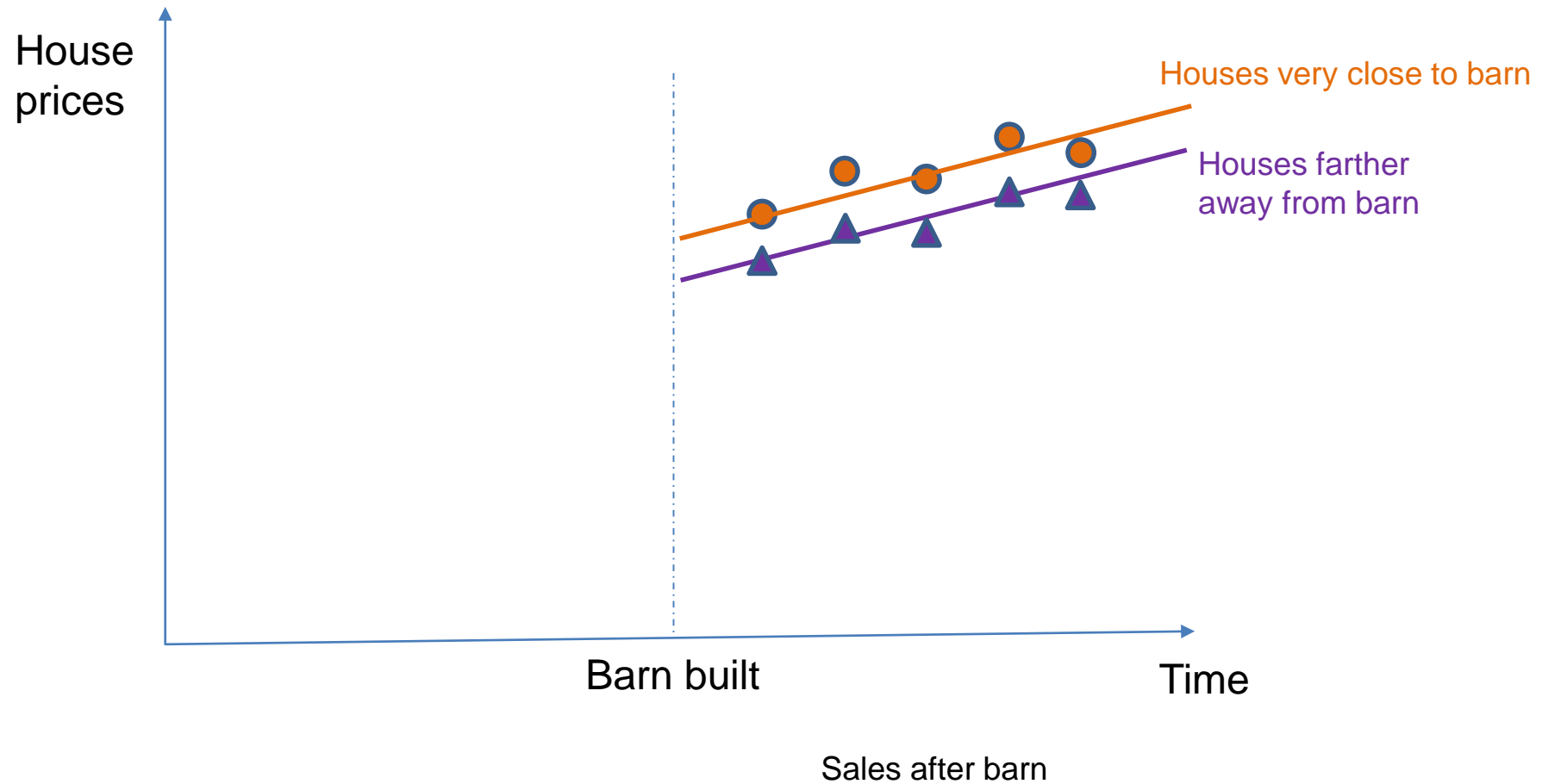
Impact of barns on house prices

2. Collect data on house sales close to barn and further from barn



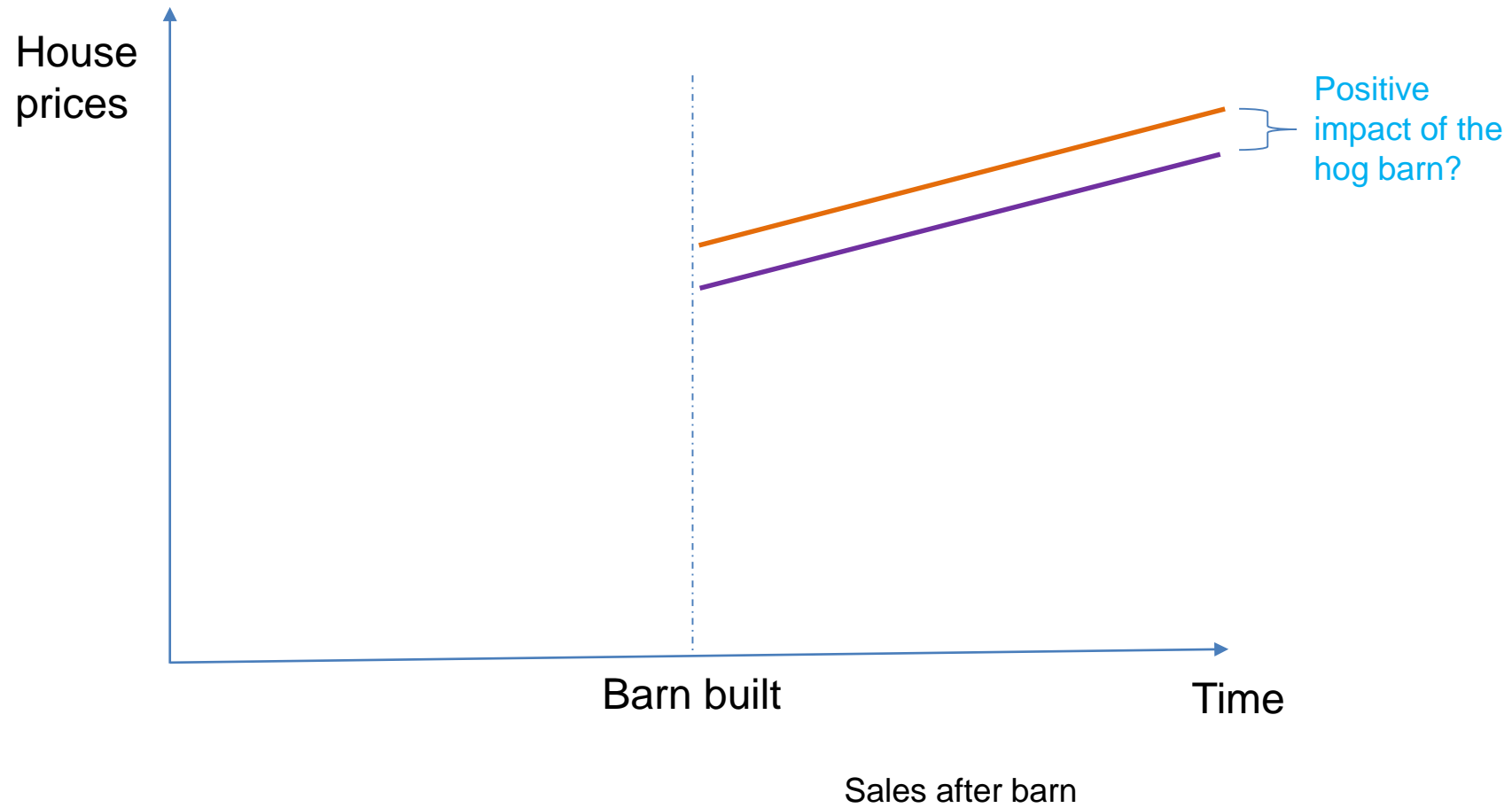
Impact of barns on house prices

2. Collect data on house sales close to barn and further from barn



Impact of barns on house prices

2. Collect data on house sales close to barn and further from barn



**IMPACT ANALYSIS OF INTENSIVE LIVESTOCK OPERATIONS
ON MANITOBA RURAL RESIDENTIAL PROPERTY VALUES
FIVE CASE STUDY LOCATIONS**



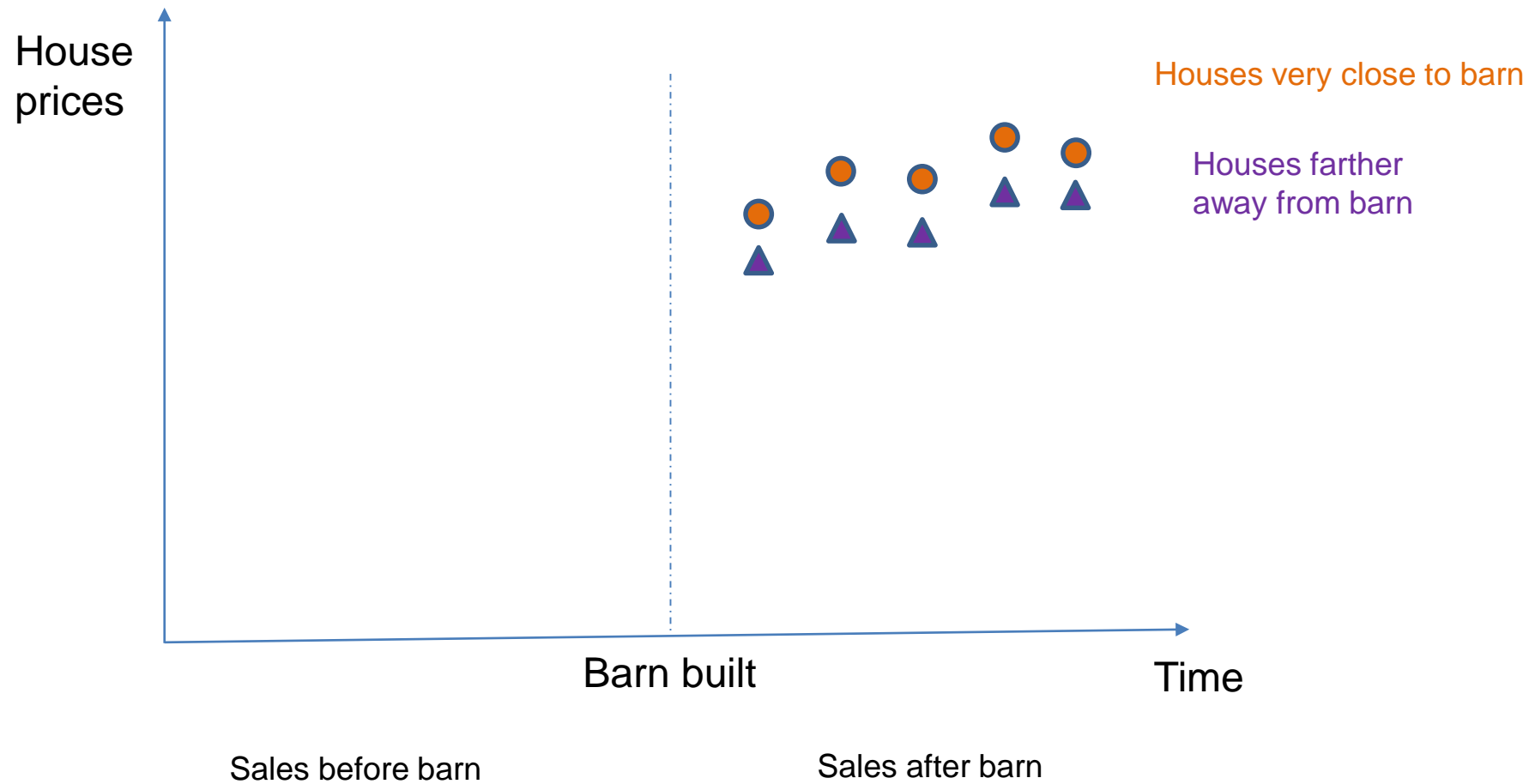
**Prepared for:
Manitoba Pork Council**

**Prepared by:
Royal LePage Stevenson Advisors
Spring 2004**

Our File#03-9038

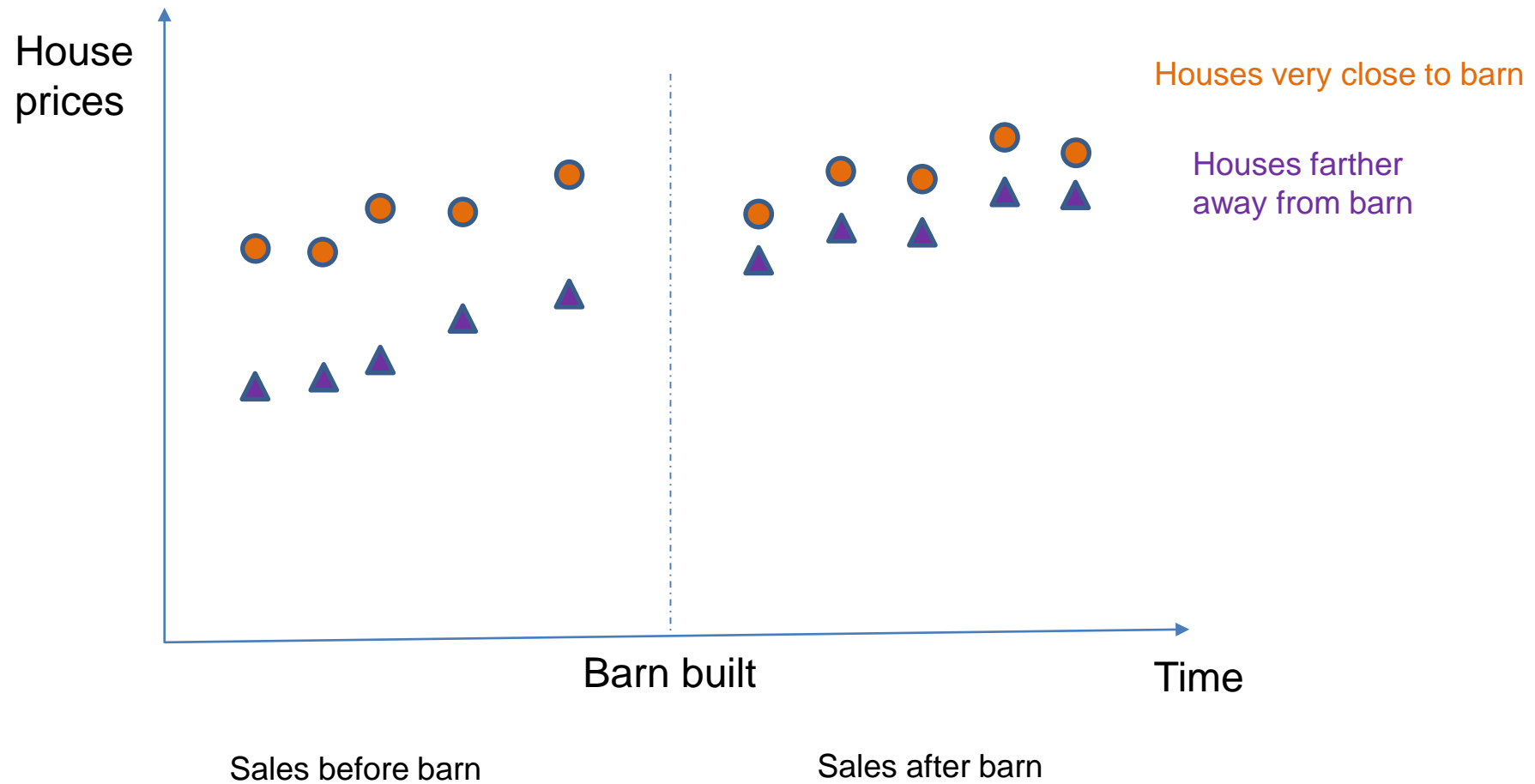
Research design

Put the two datasets together



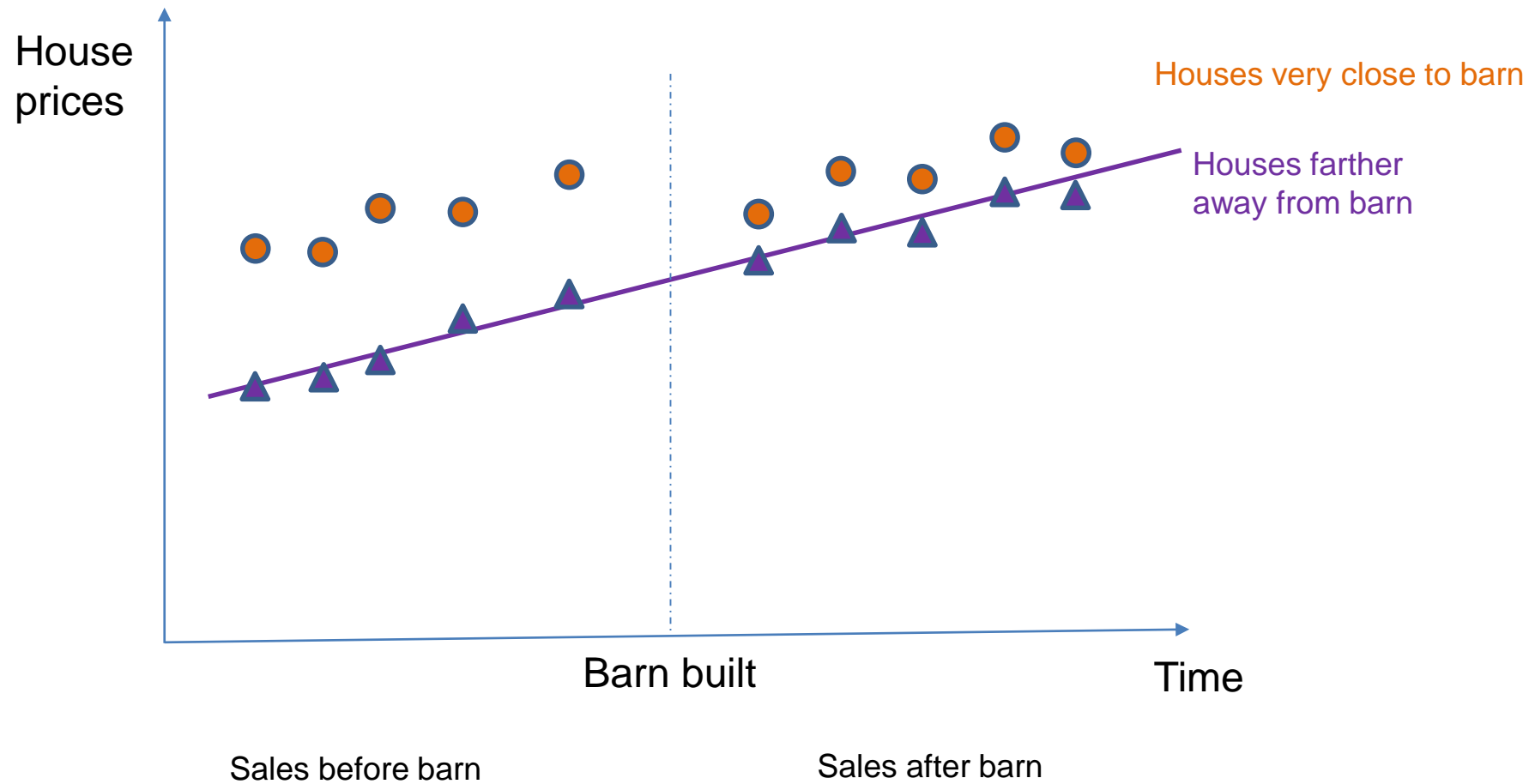
Research design

Put the two datasets together



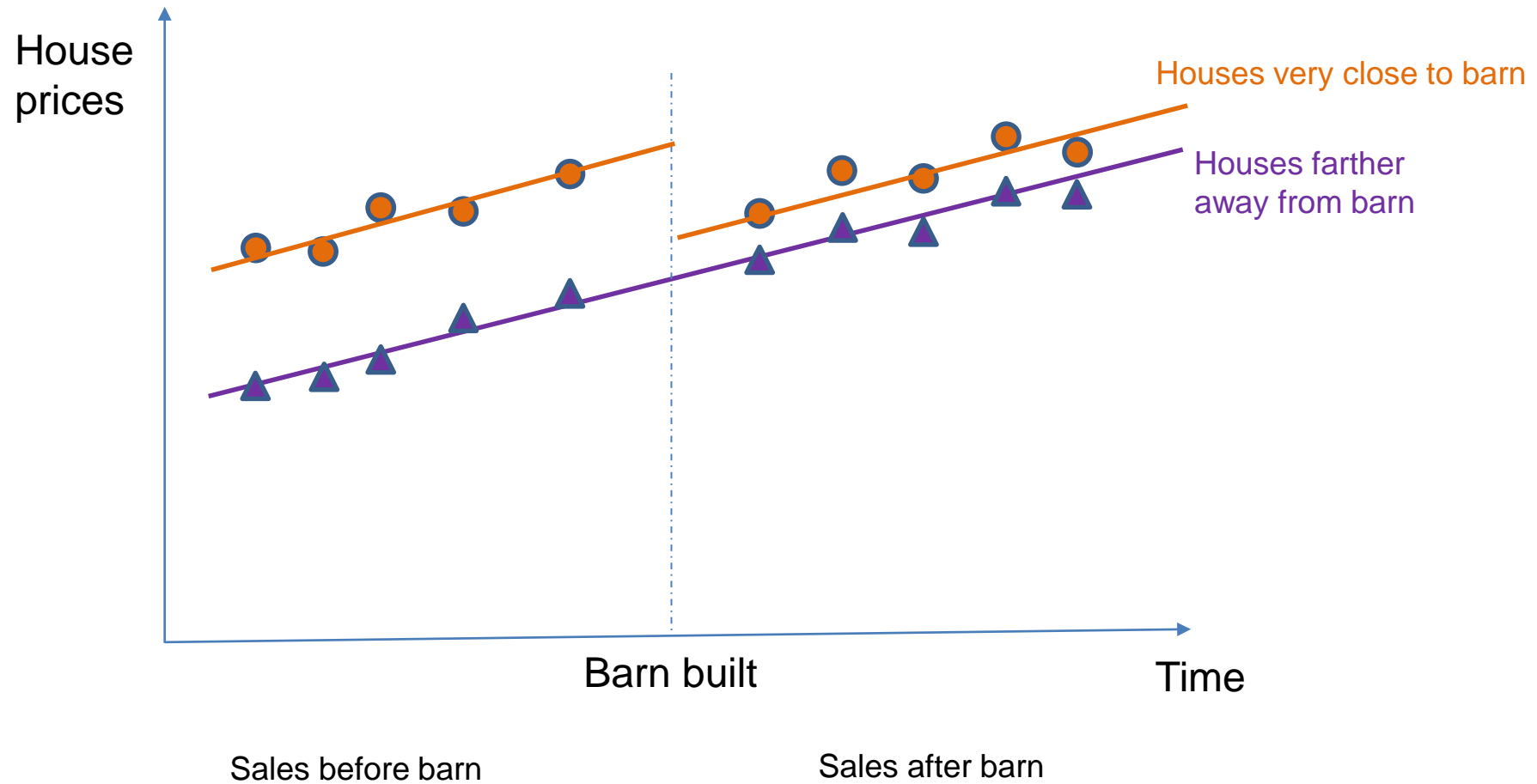
Constructing the counterfactual

Put the two datasets together



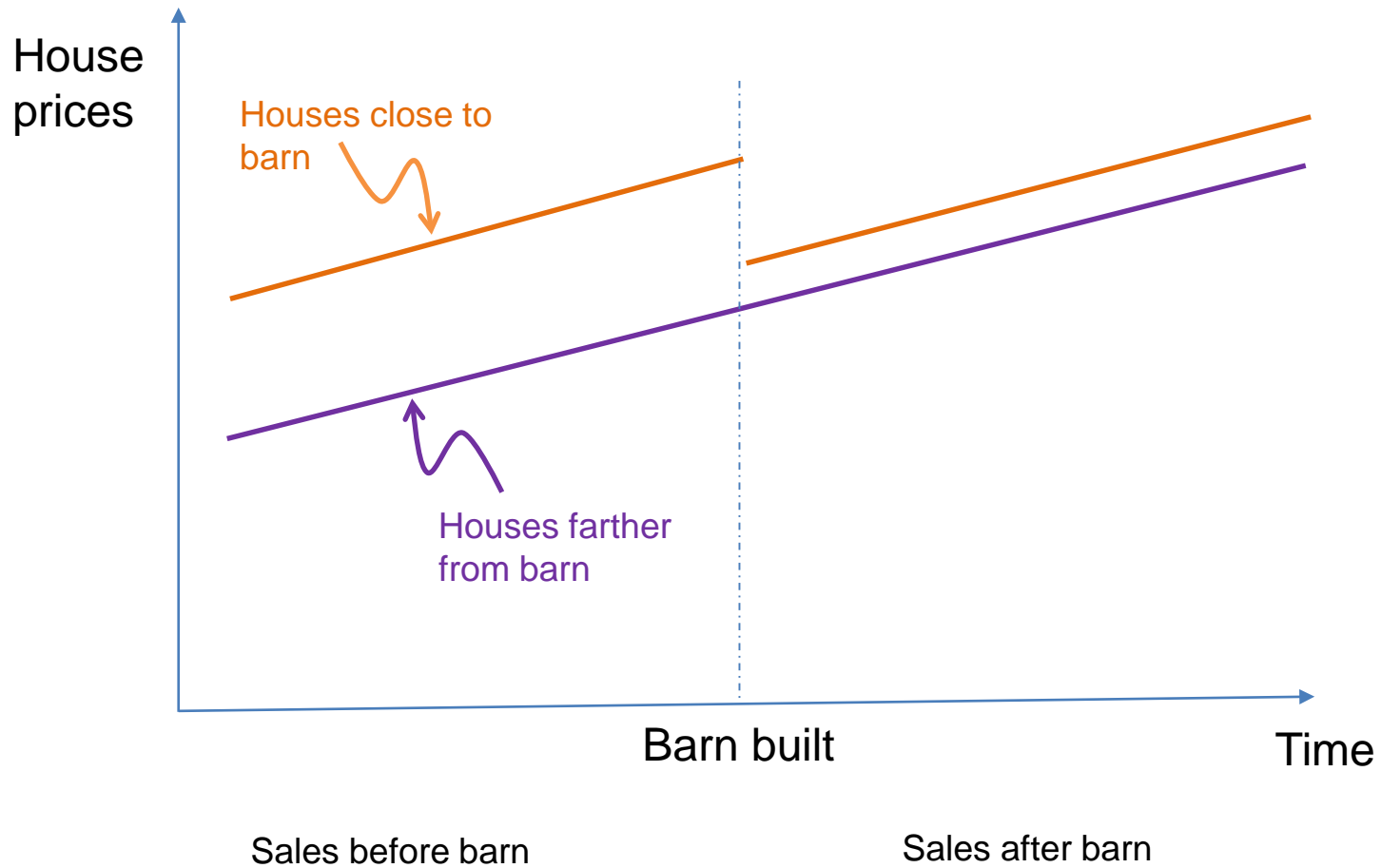
Constructing the counterfactual

Put the two datasets together

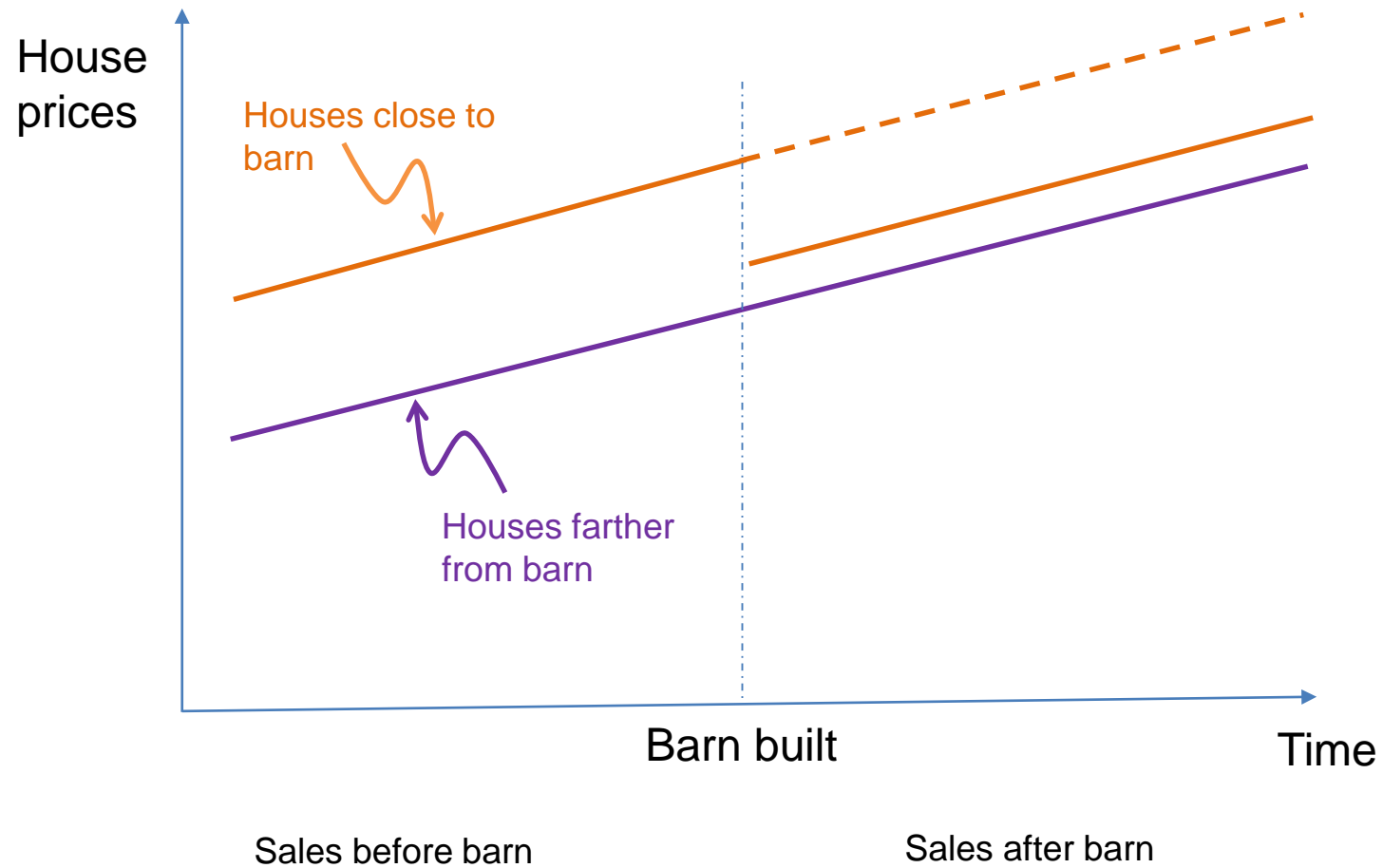


Constructing the counterfactual

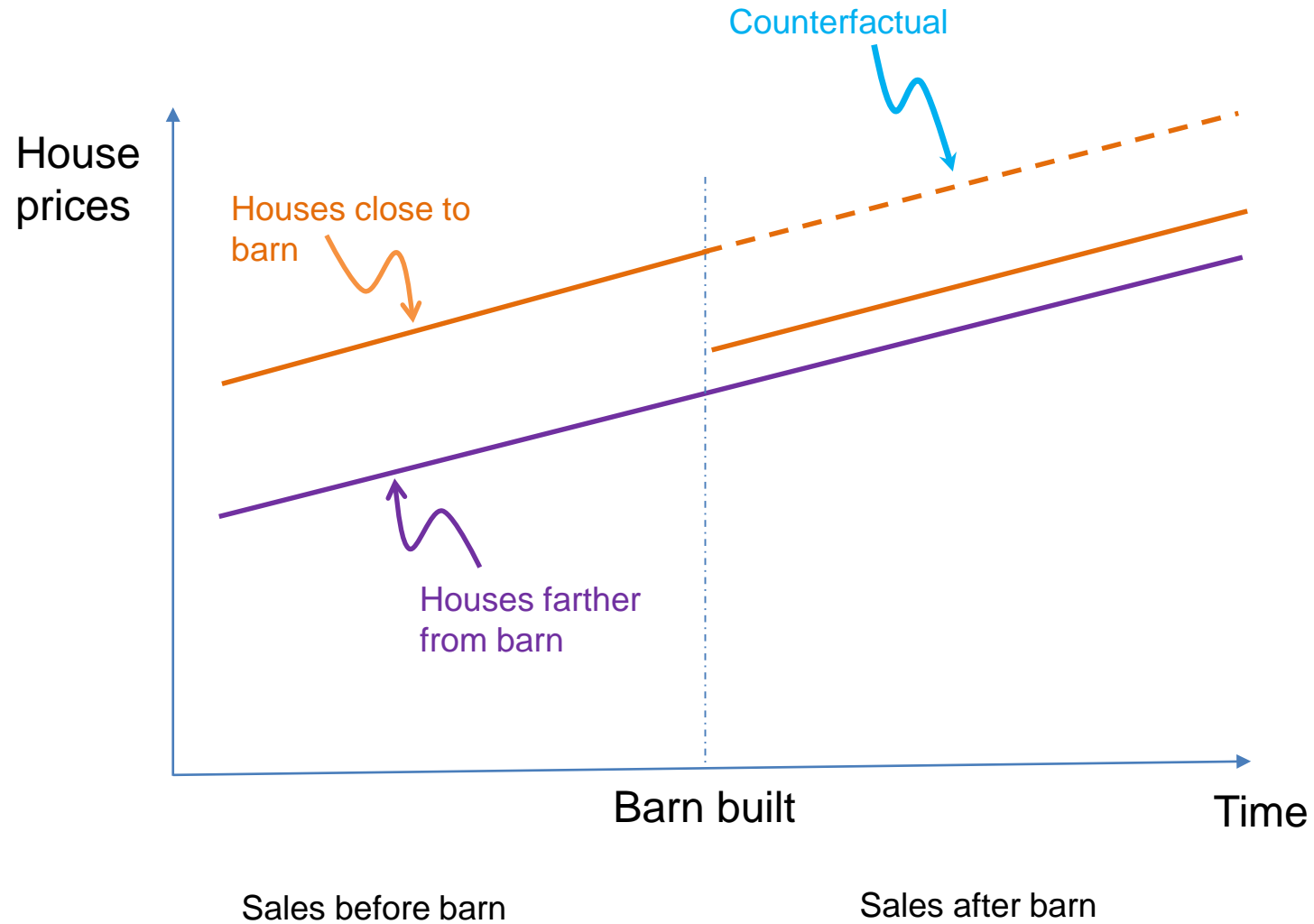
What is the counterfactual?



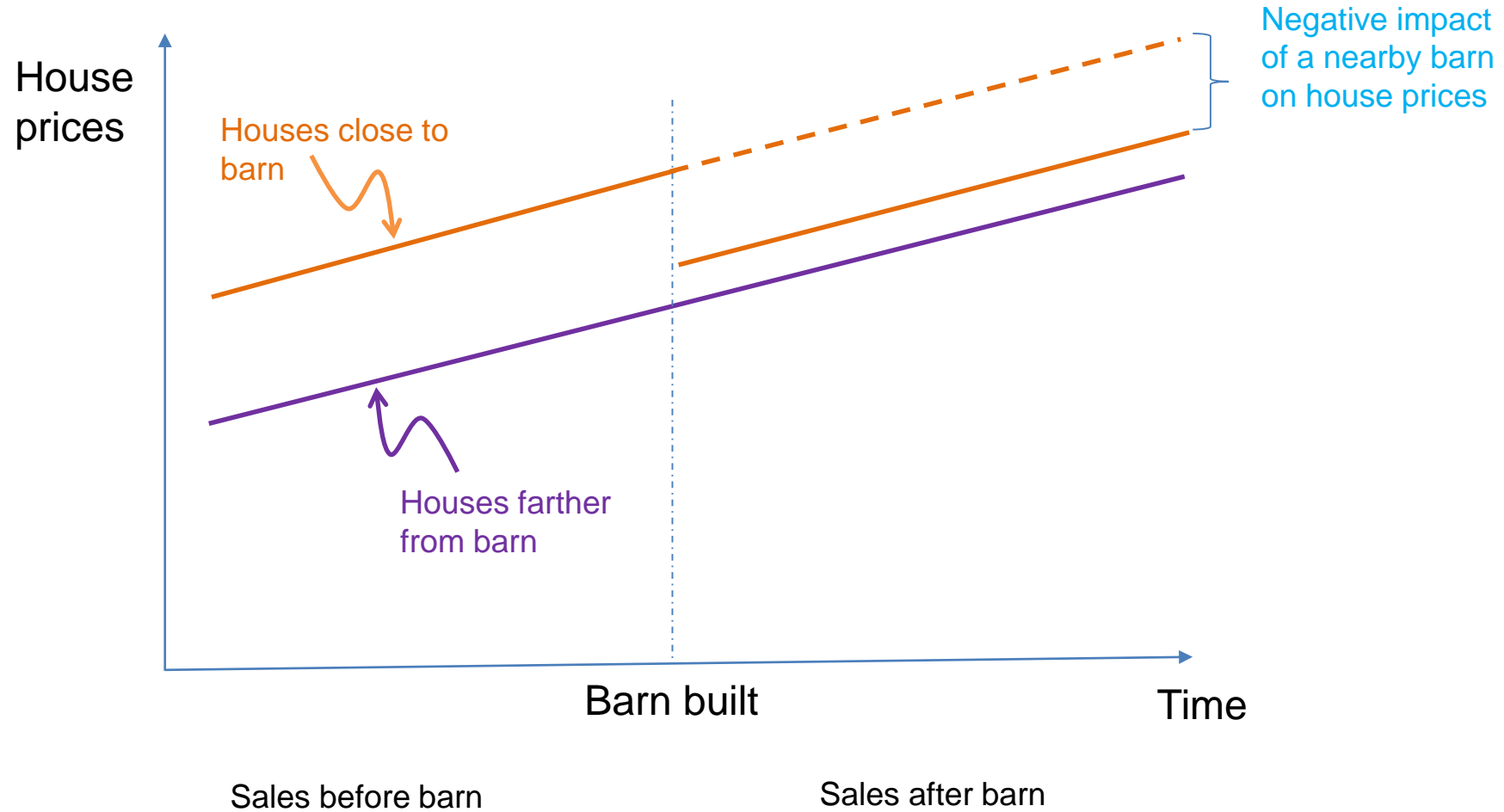
Constructing the counterfactual



Constructing the counterfactual



Estimated impact of barns on house prices



Outline of talk

1. Habitat conservation in Manitoba
 - i. Additionality
 - ii. Spatial targeting
2. Additionality in agricultural cost share programs
3. Evaluation of Canadian agri-environmental policy

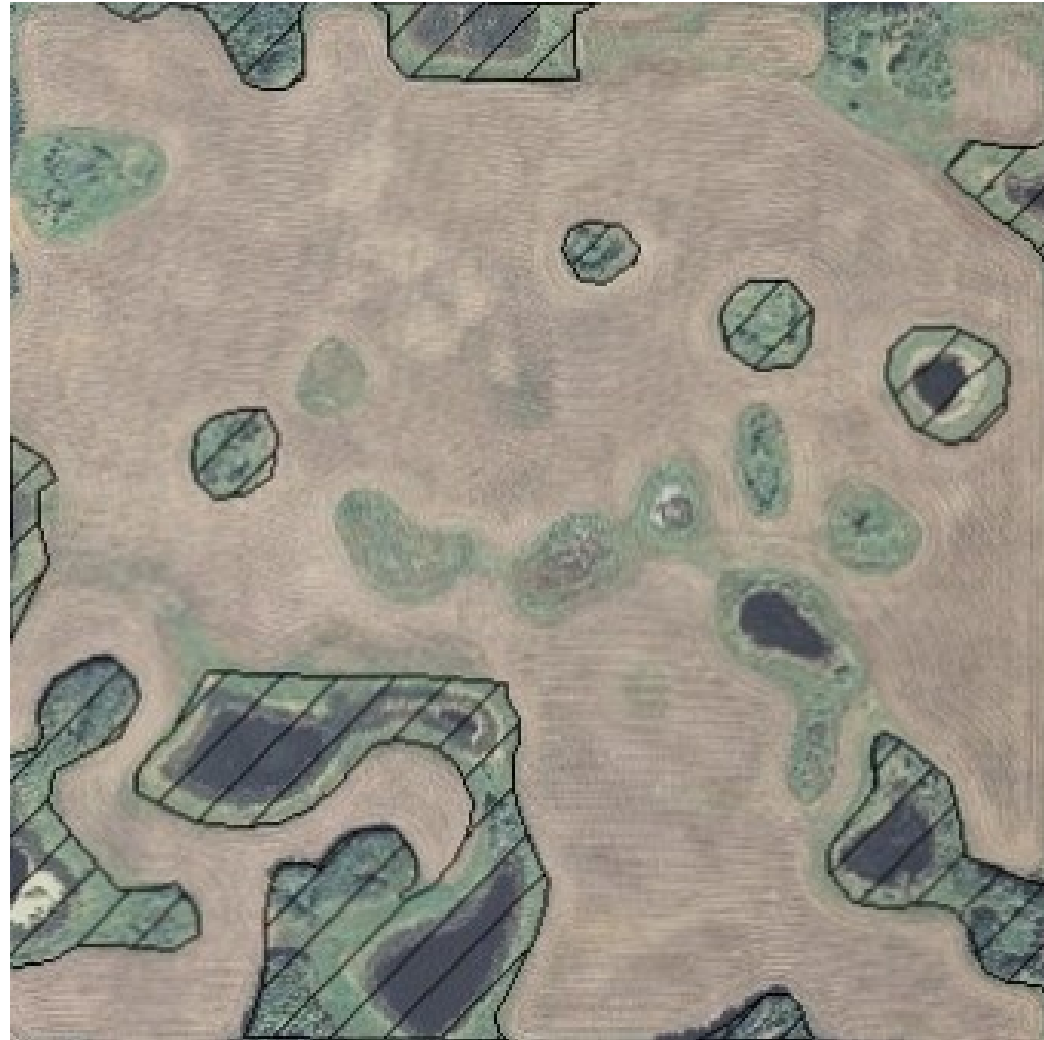
North American Waterfowl Management Plan

- Goal to return waterfowl populations to 1970's levels
- Focus on habitat conservation (wetlands) on private agricultural land

Habitat conservation easements

Conservation easements on wetlands/upland habitat

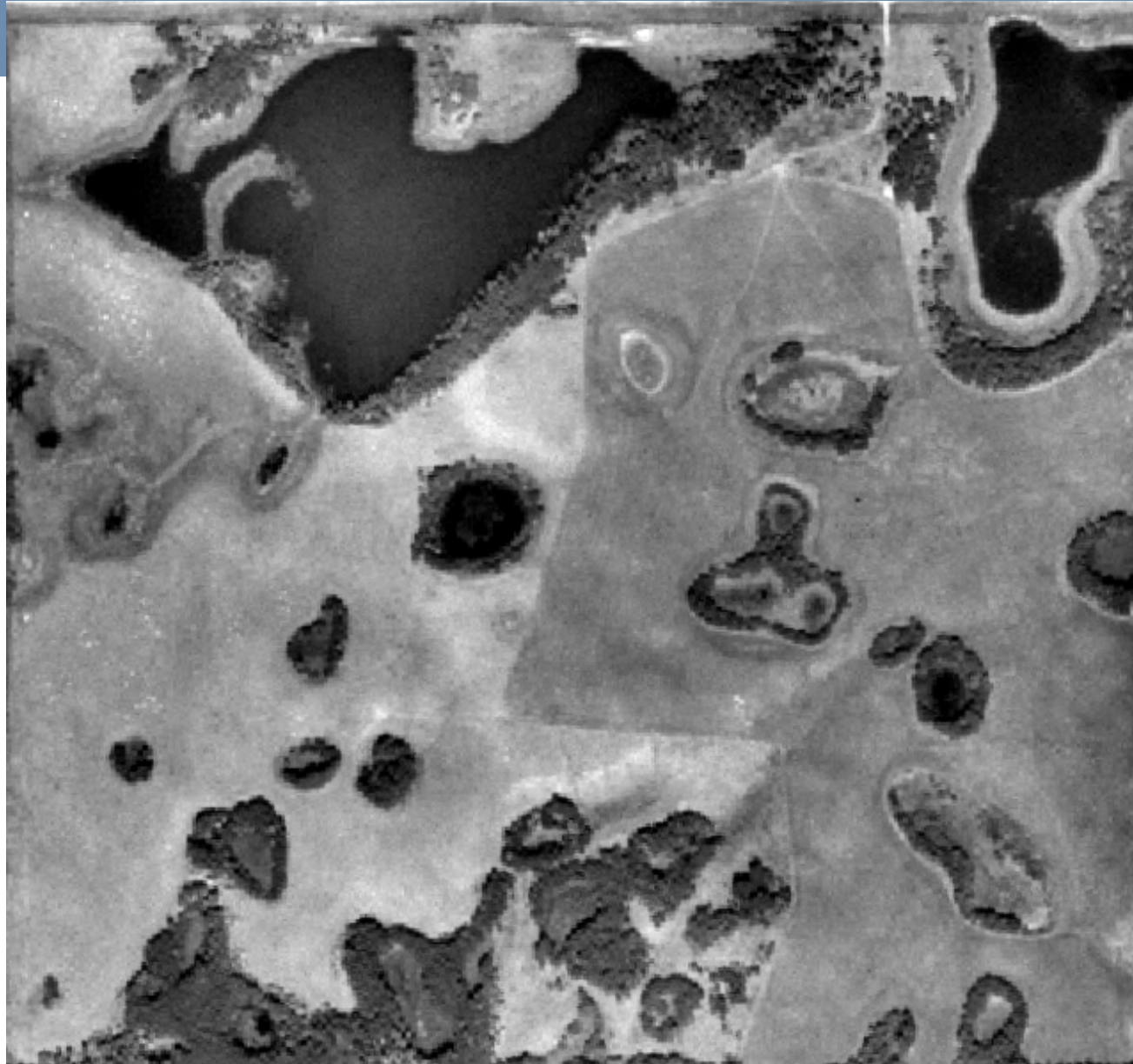
- Agreement between landowner and conservation agency
- One time payment to maintain existing habitat
- Easement follows land title in perpetuity
- Agencies monitor and enforce easements



Source: Manitoba Habitat Heritage Corporation

http://www.mhhc.mb.ca/learn_more/what-is-a-conservation-agreement

1990



2006



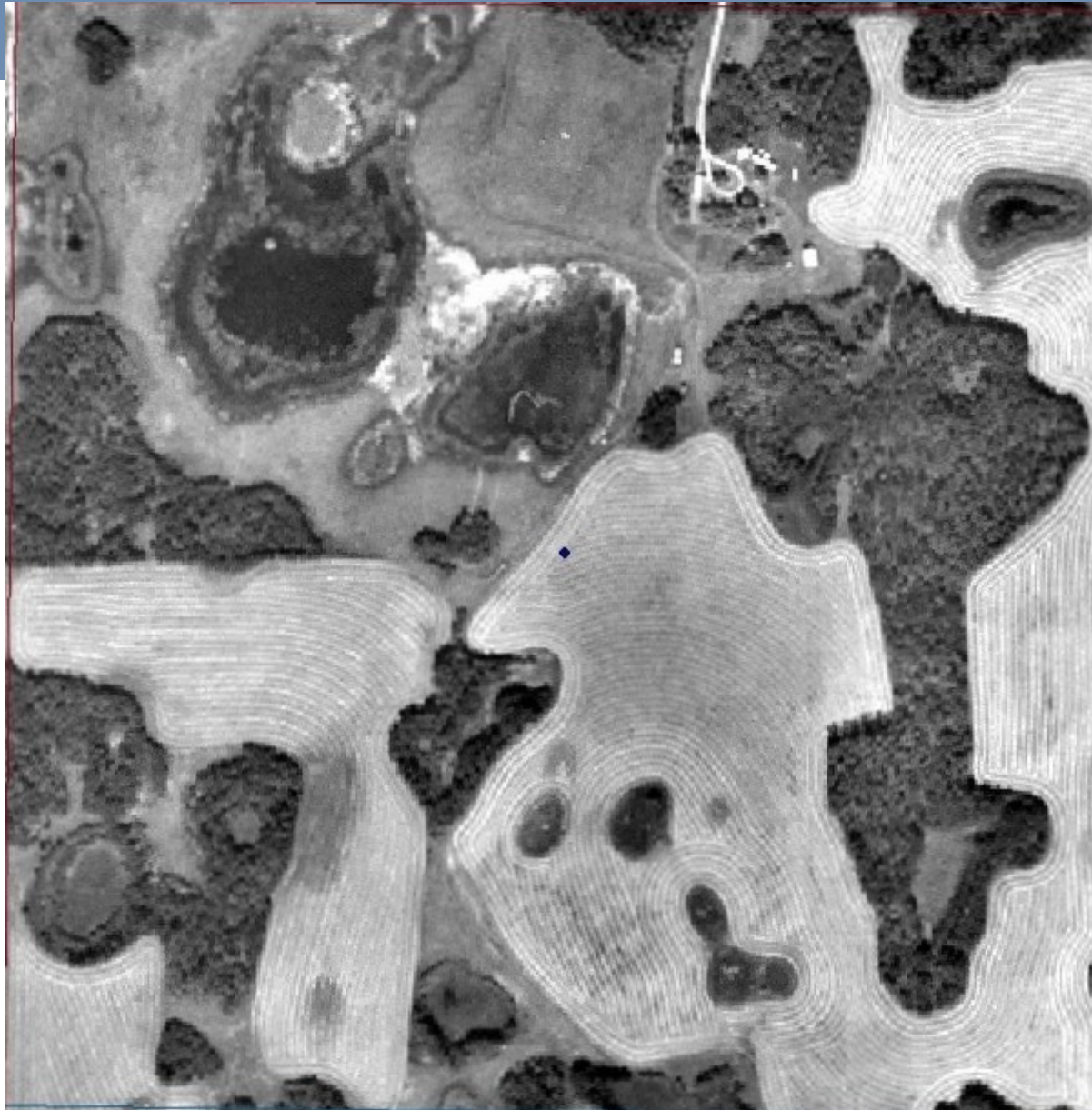
1990



2006



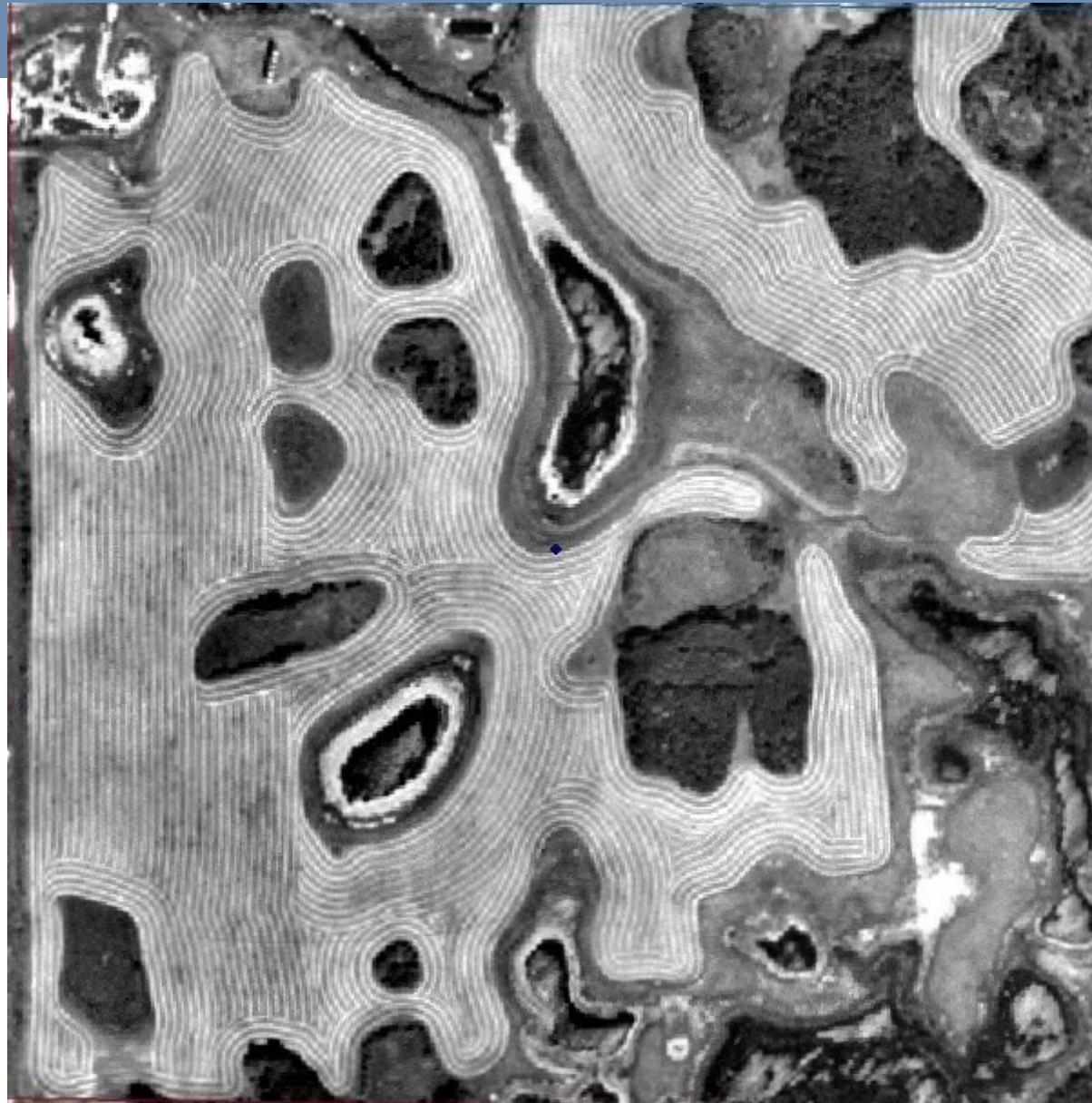
1990



2006



1990



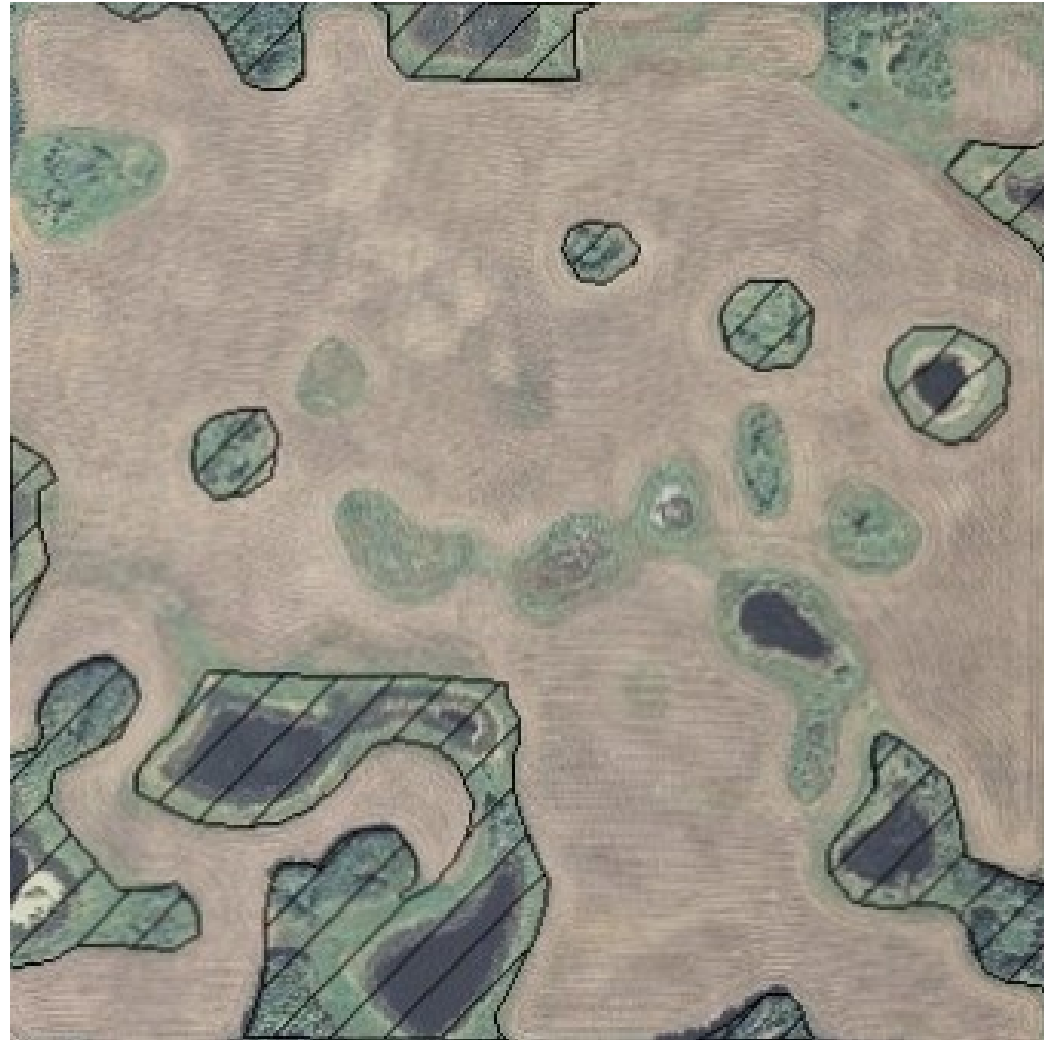
2006



Habitat conservation easements and additionality

Would this habitat be
converted without the
conservation easement?

“Additionality”



Source: Manitoba Habitat Heritage Corporation

http://www.mhhc.mb.ca/learn_more/what-is-a-conservation-agreement

CAPITALIZED COSTS OF HABITAT CONSERVATION EASEMENTS

CHAD LAWLEY AND CHARLES TOWE

Perpetual conservation easements permanently remove the option to convert existing habitat to more intensive agricultural production. If existing habitat is at threat of conversion, removing the option to convert will reduce land values. In this article, we estimate the land value discount resulting from perpetual habitat conservation easements by using propensity score matching. We find that on the average eased parcel, land values fall by approximately \$86 per acre for every acre of eased habitat. On average, our results suggest that landowners have been adequately compensated and conservation agencies have successfully secured habitat at risk of conversion.

Key words Additionality, conservation easements, habitat conversion, land use, land values, prairie pothole habitat, propensity score, wetlands.

Estimating the impact of easements on land values

Conservation easements remove the right to convert existing habitat

If right to convert has value, conservation easement reduces land value

Impact of easement on land value is indicator of “additionality”

- Easement does not reduce land value
 - Zero additionality habitat
- Easement reduces land value
 - Habitat was likely to be converted
 - Positive additionality

Estimating the impact of easements on land values

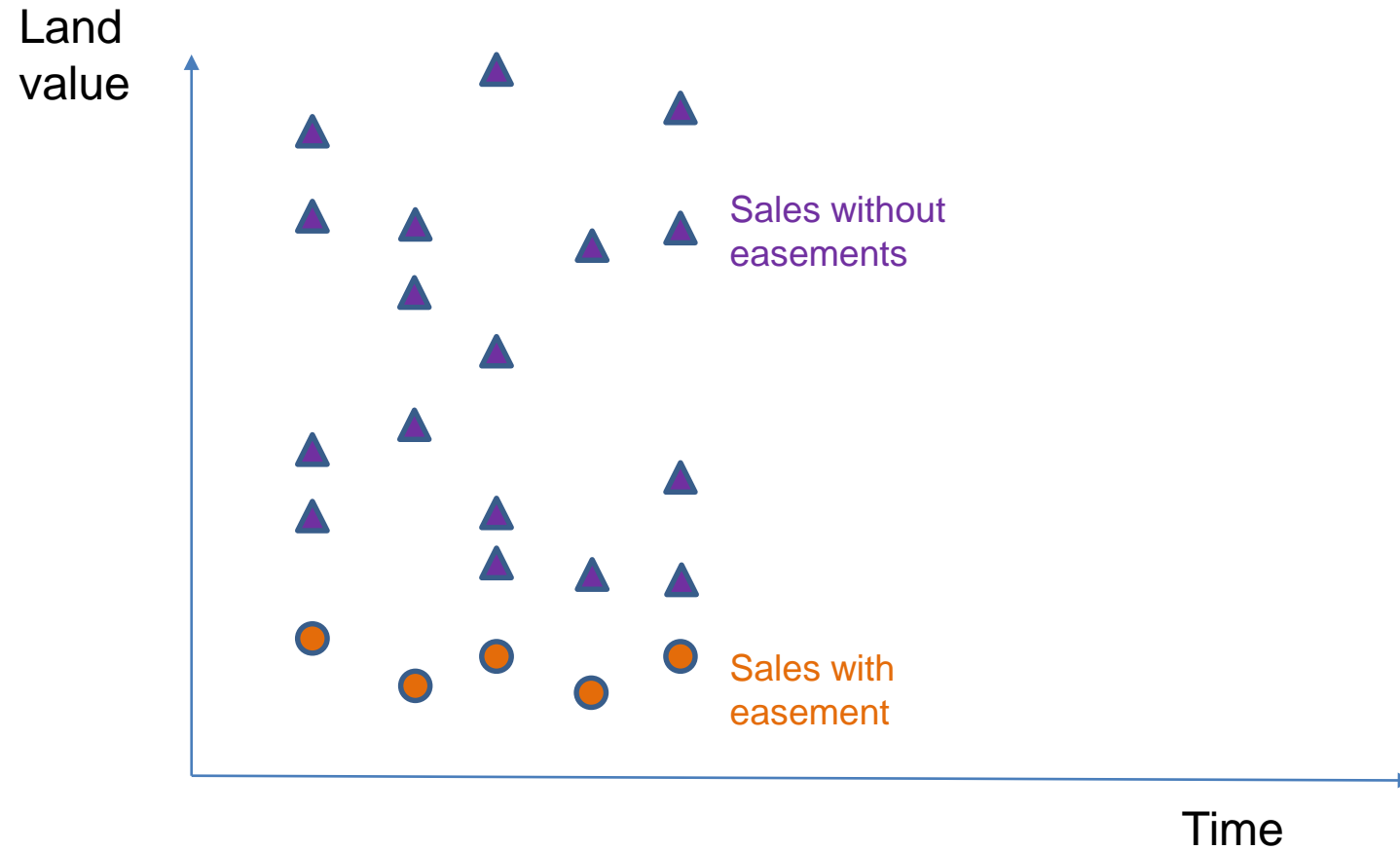
Easements are voluntary

- Negotiation between willing landowner and conservation agency

Selection issues:

1. Agencies target parcels with more habitat
2. Landowners enroll habitat with lowest opportunity cost first

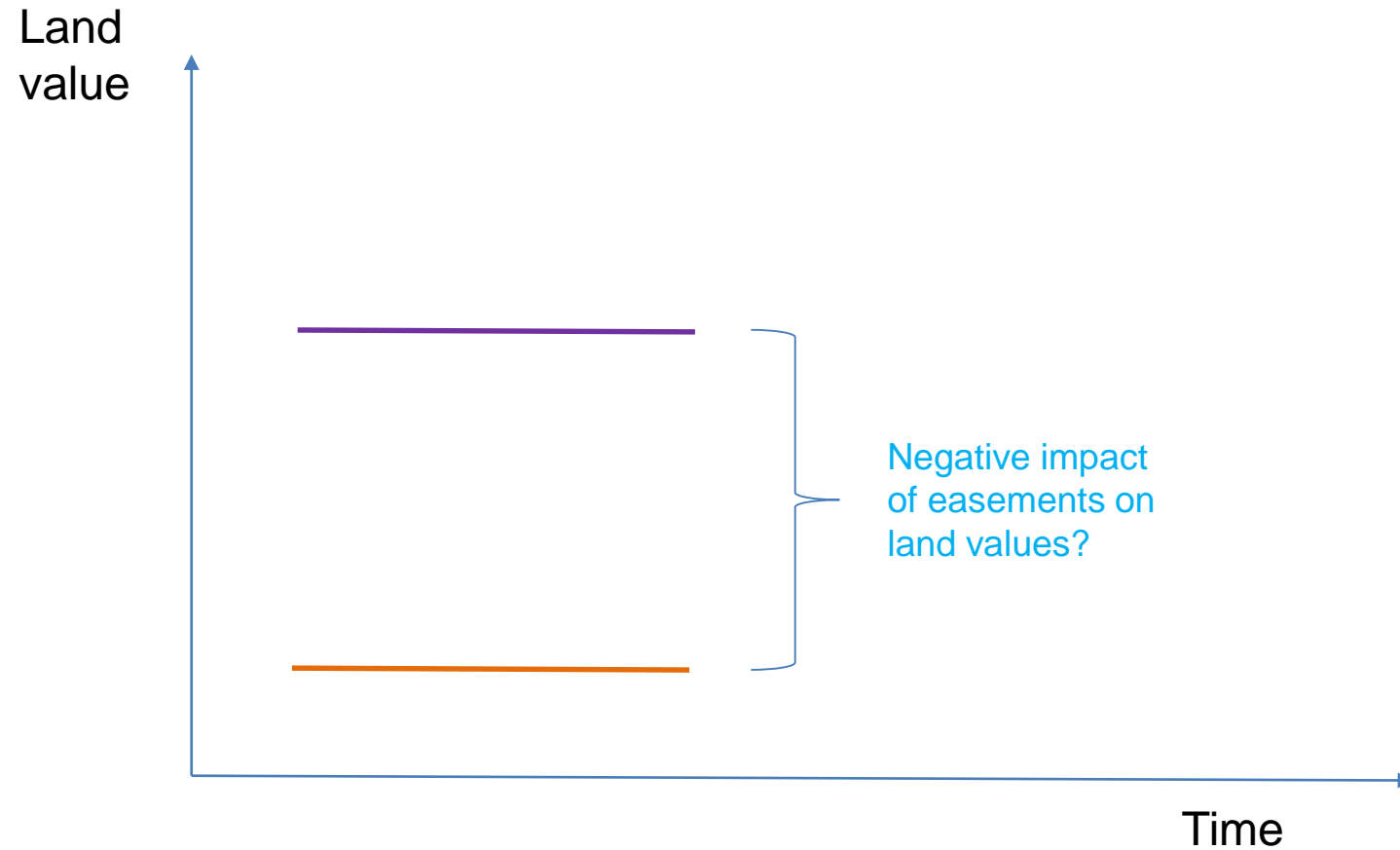
Estimating the impact of easements on land values



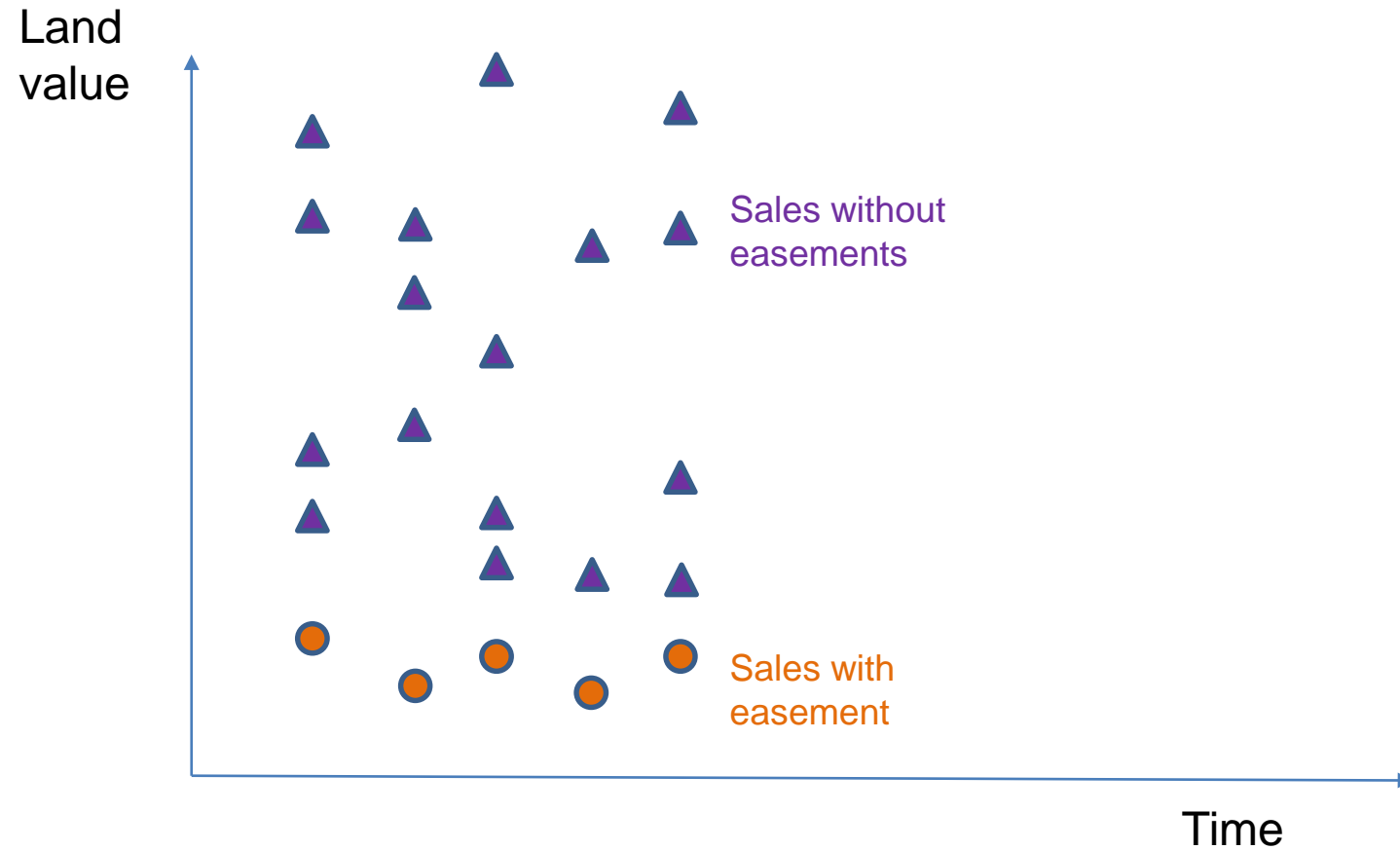
Estimating the impact of easements on land values



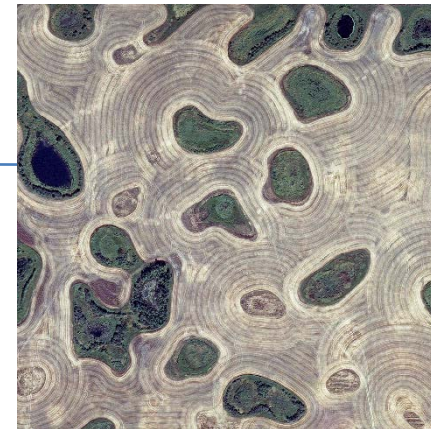
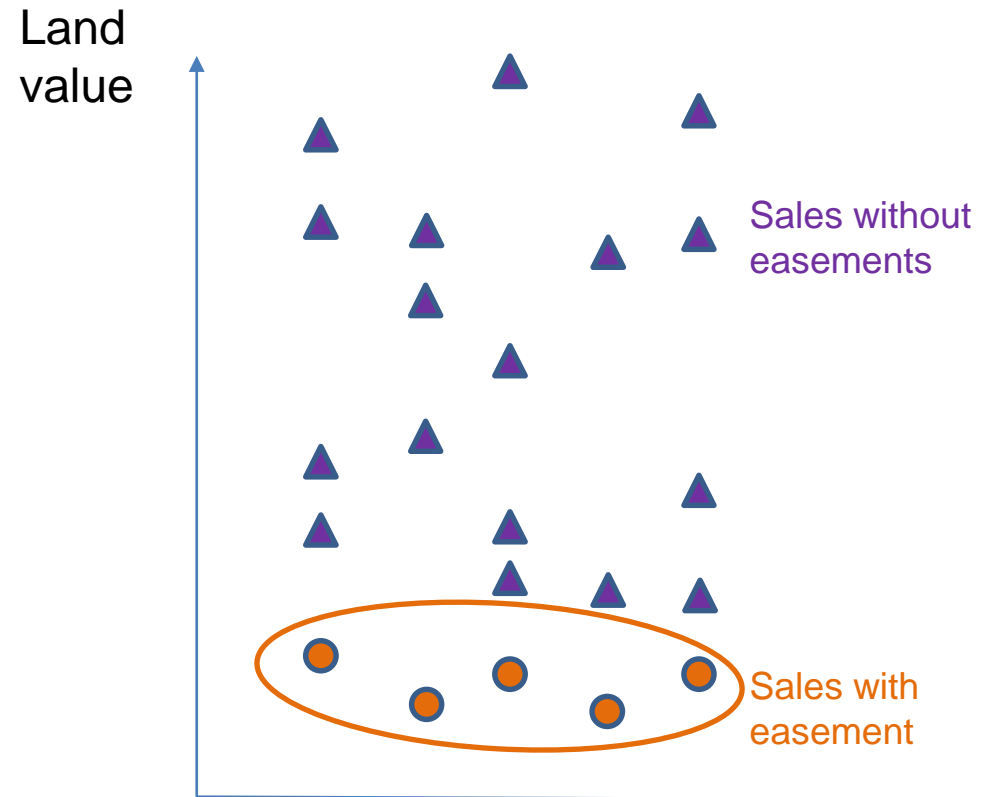
Estimating the impact of easements on land values



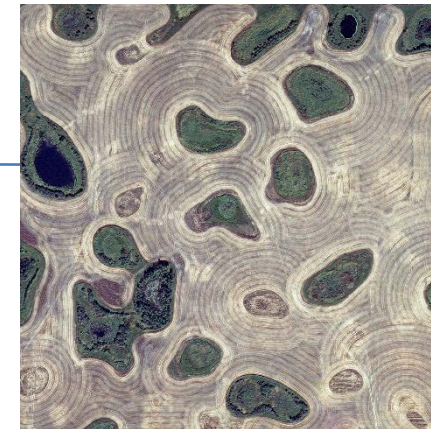
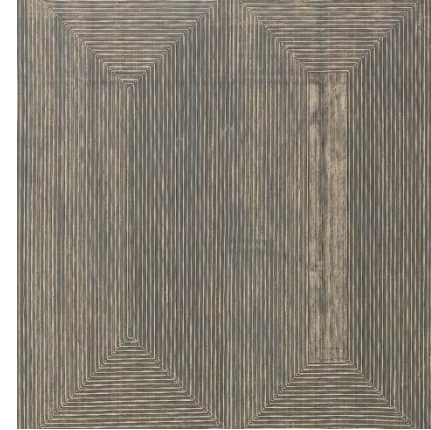
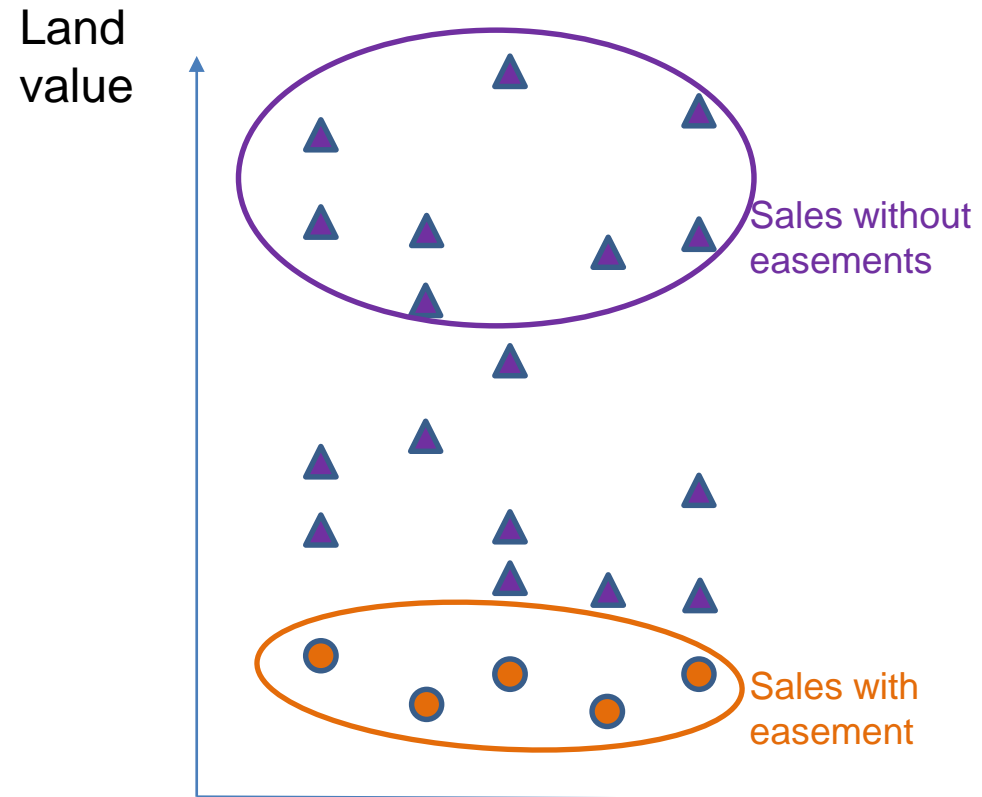
Estimating the impact of easements on land values



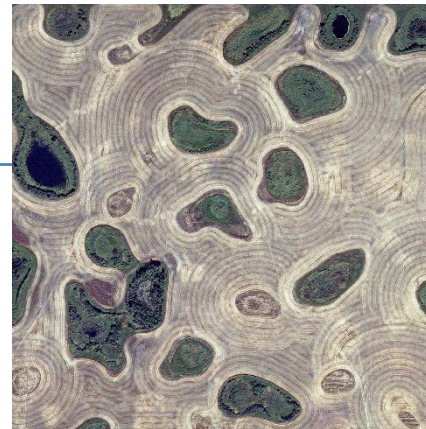
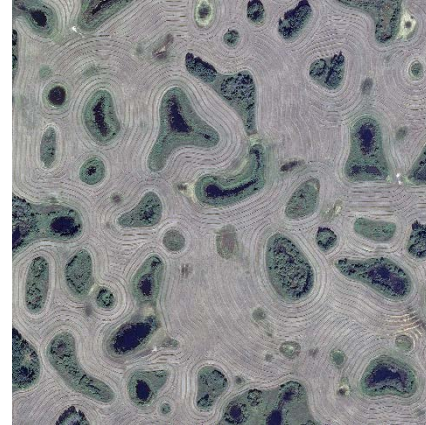
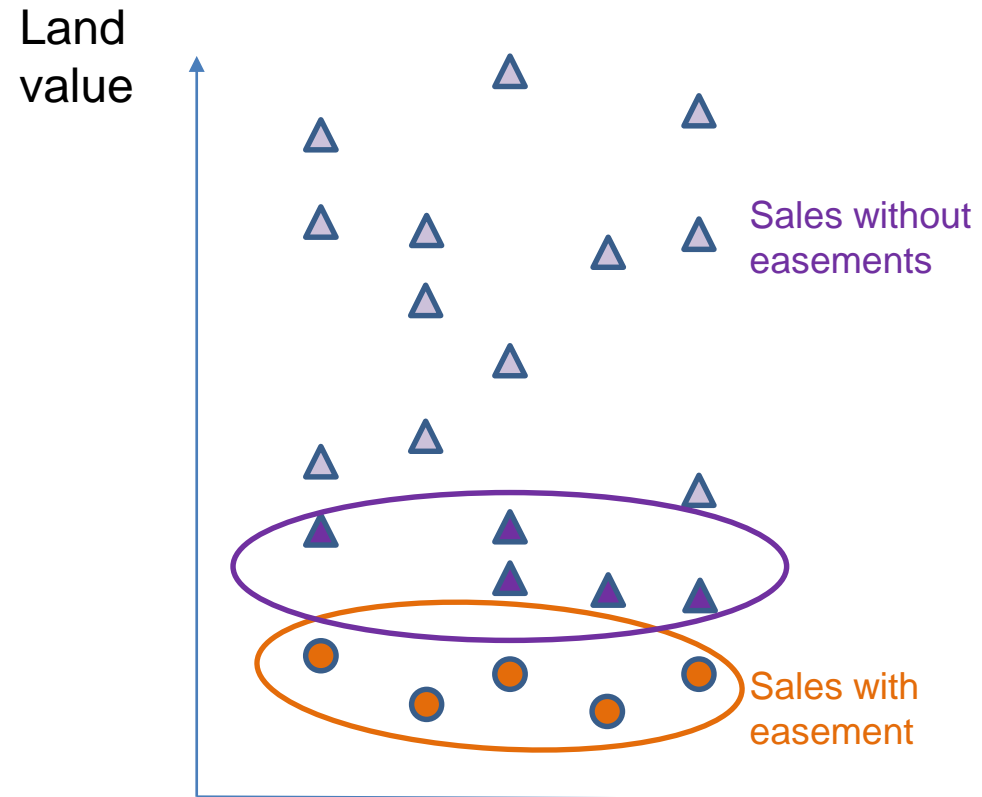
Estimating the impact of easements on land values



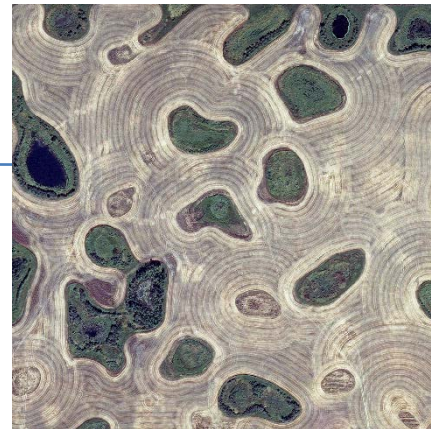
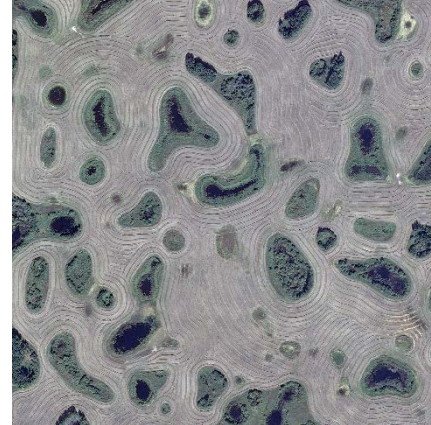
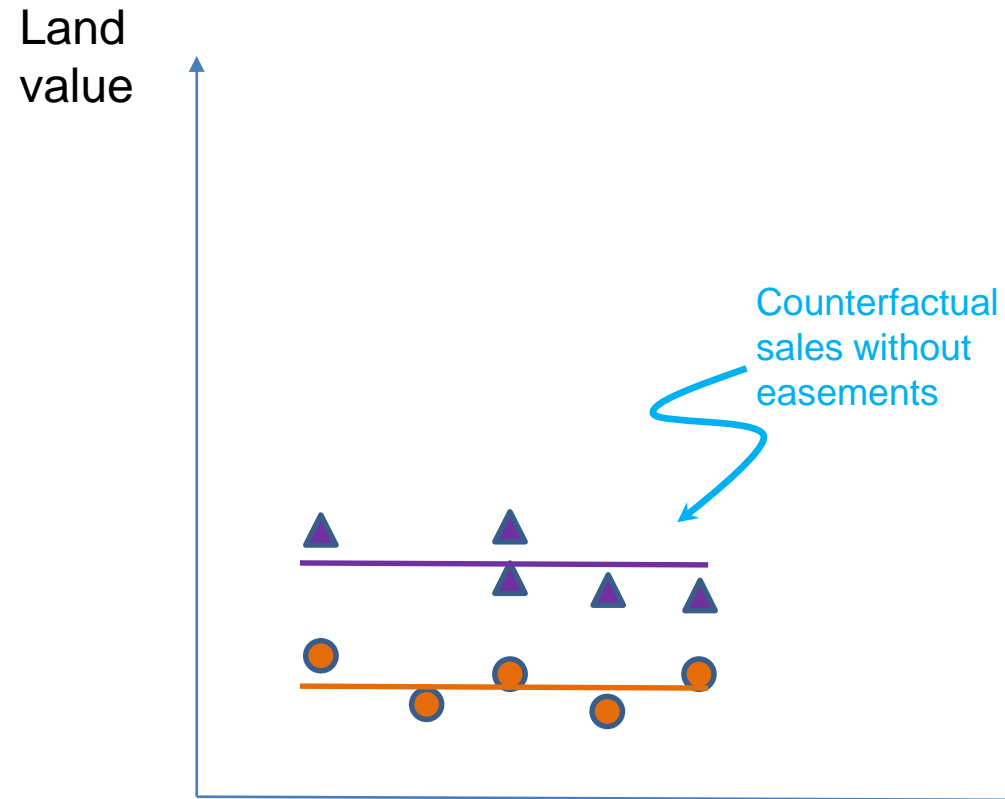
Estimating the impact of easements on land values



Estimating the impact of easements on land values



Estimating the impact of easements on land values

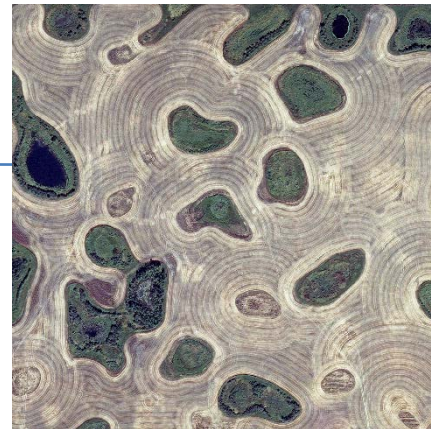
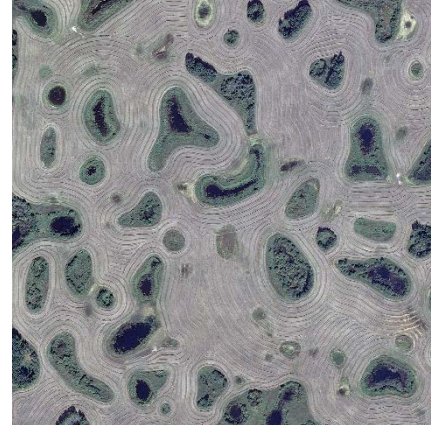


Estimating the impact of easements on land values

Land
value



Negative impact
of easements on
land values



Finding comparable sales

Factors that simultaneously influence:

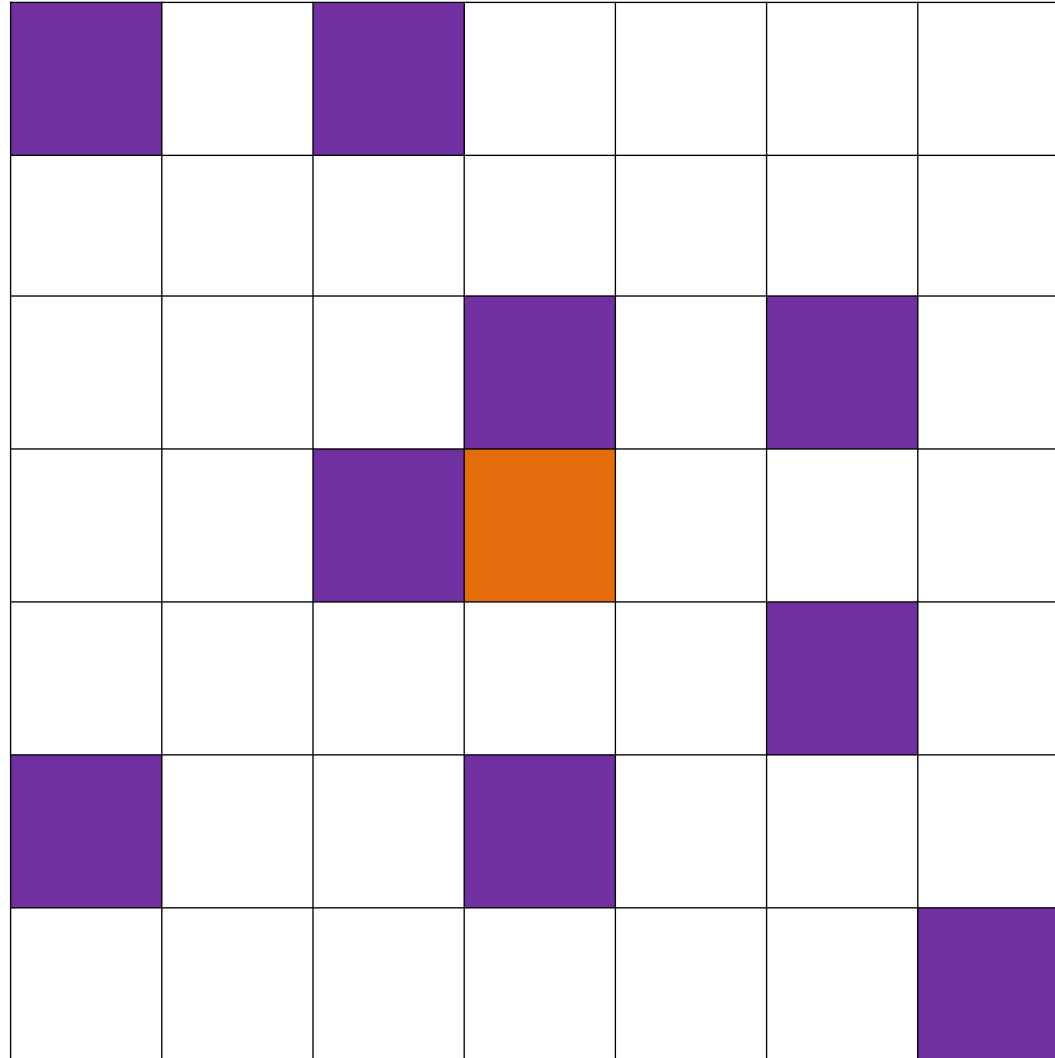
1. Likelihood of parcel having an easement
2. Land value

Characterize the likelihood a parcel has an easement (propensity score)

Match sales with easements to sales without easements based on propensity score

- Propensity score summarizes large set of observable characteristics

Land sales without easements



Estimated probability of easement (propensity score)

Land sale with easement

Land sales without easements

| | | | | | | |
|-------------|--|-------------|-------------|--|-------------|-------------|
| PS= 0.25 | | PS= 0.15 | | | | |
| | | | | | | |
| | | | PS= 0.48 | | PS= 0.51 | |
| | | PS= 0.35 | PS= 0.50 | | | |
| | | | | | PS= 0.50 | |
| PS= 0.47 | | | PS= 0.52 | | | |
| | | | | | | PS= 0.33 |

Estimated probability of easement (propensity score)

Land sale with easement

Land sales without easements

| | | | | | | |
|-------------|--|-------------|-------------|--|-------------|-------------|
| PS= 0.25 | | PS= 0.15 | | | | |
| | | | | | | |
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| PS= 0.47 | | | PS= 0.52 | | | |
| | | | | | | PS= 0.33 |

Estimated probability of easement (propensity score)

Land sale with easement

Land sales without easements

| | | | | | | |
|-------------|--|-------------|-------------|--|-------------|-------------|
| PS= 0.25 | | PS= 0.15 | | | | |
| | | | | | | |
| | | | PS= 0.48 | | PS= 0.51 | |
| | | PS= 0.35 | PS= 0.50 | | | |
| | | | | | PS= 0.50 | |
| PS= 0.47 | | | PS= 0.52 | | | |
| | | | | | | PS= 0.33 |

Match on propensity score

Land sale with easement

Land sales without easements

| | | | | | | |
|-------------|--|-------------|-------------|--|-------------|-------------|
| PS= 0.25 | | PS= 0.15 | | | | |
| | | | | | | |
| | | | PS= 0.48 | | PS= 0.51 | |
| | | PS= 0.35 | PS= 0.50 | | | |
| | | | | | PS= 0.50 | |
| PS= 0.47 | | | PS= 0.52 | | | |
| | | | | | | PS= 0.33 |

Compare sale prices

Land sale with easement

Land sales without easements

| | | | | | | |
|-------|--|--|-------|--|-------|--|
| | | | | | | |
| | | | | | | |
| | | | \$300 | | \$350 | |
| | | | \$250 | | | |
| | | | | | \$400 | |
| \$175 | | | \$275 | | | |
| | | | | | | |

Some results

Manitoba conservation agencies have secured at-risk habitat

- Easements reduce land prices by approximately \$86/eased acre
- Evidence of “additionality”

Landowners were paid approximately \$100/eased acre

- Approximately 16% premium

Important data sources:

- Manitoba Provincial Assessor
- Manitoba Habitat Heritage Corporation and Ducks Unlimited Canada

Funding:

- Linking Environment and Agriculture Research Network (LEARN)

An alternative empirical approach

Assess the risk of conversion directly

- What habitat has been lost over time?

Need to be able to track land use change over time

- Long history
- Fine spatial resolution

Satellite-based land cover assessments

- Relatively coarse spatial scale
- Only available back to 1990's
- Will improve substantially going forward

An alternative empirical approach

Aerial photography

- Available back to the 1950's
- Fine spatial resolution
- Not digitized

“Crowdsourced” land cover classification

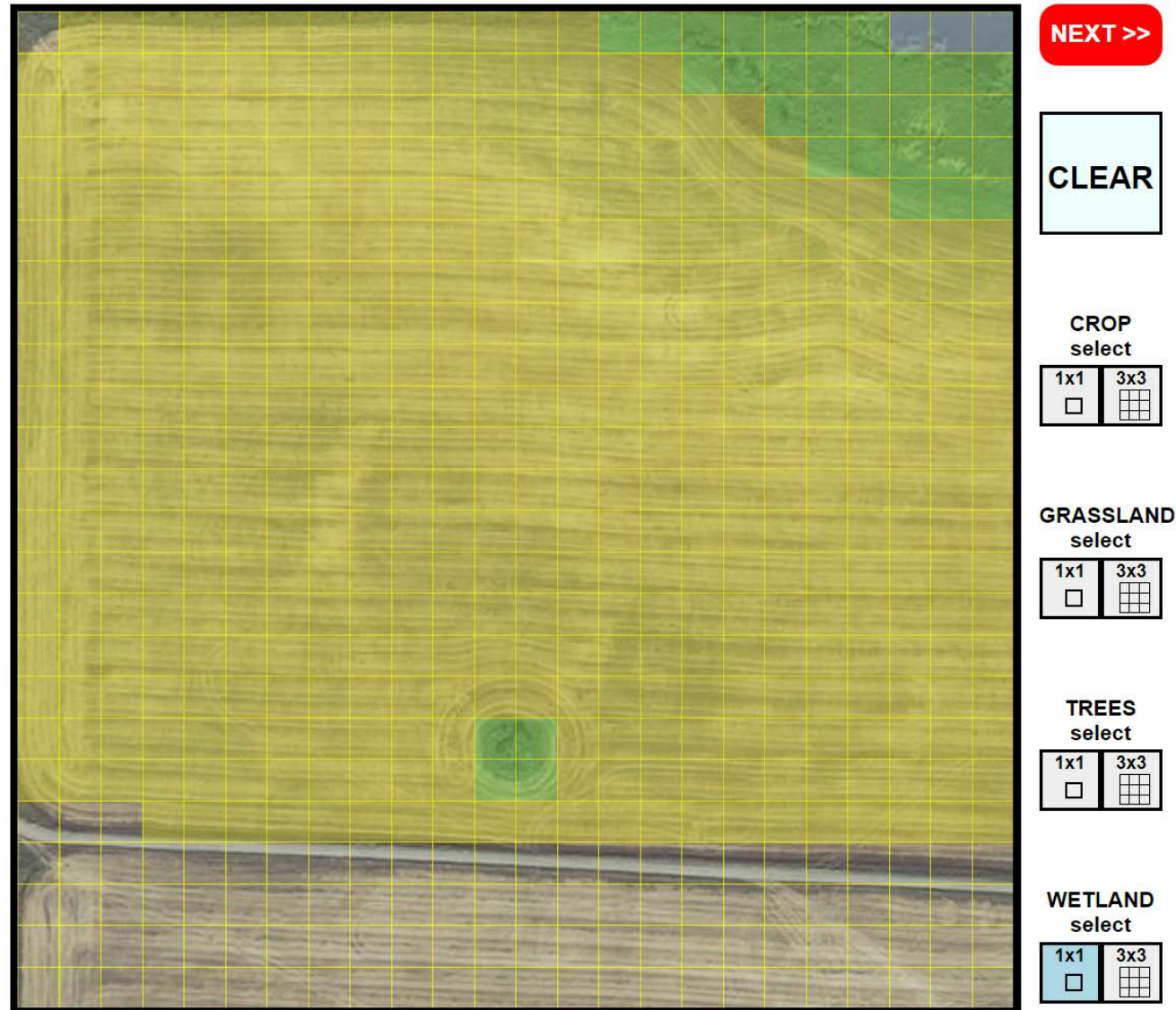
- Ask survey respondents to classify land cover from air photos
- Many “eyes” on each image
 - Platform such as Amazon m-Turk provides a pool of willing participants
 - Volunteers with conservation agencies

Funding: SSHRC Partnership Development Grant (with Charles Towe)

Crowdsourced image classification



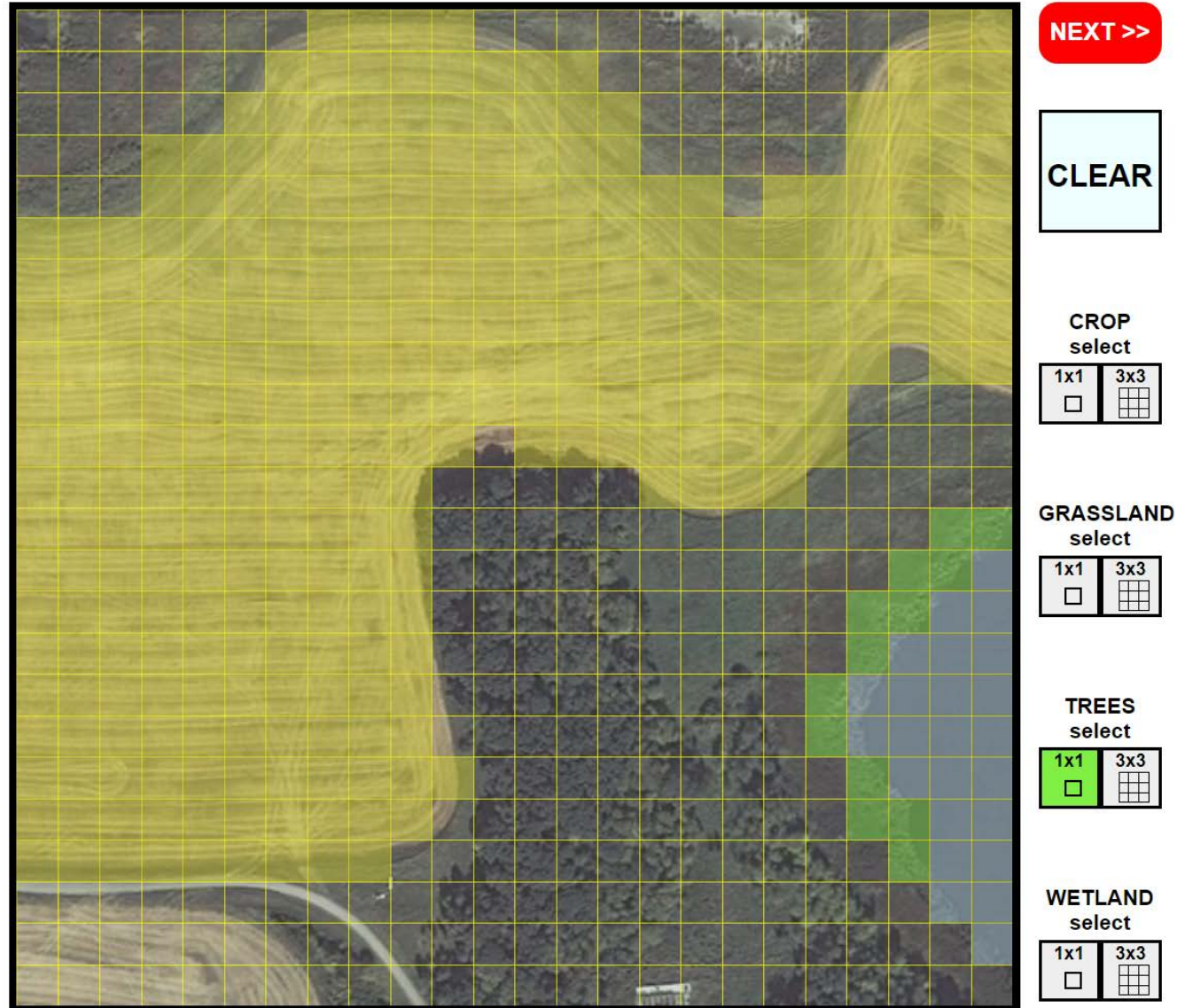
Crowdsourced image classification



Crowdsourced image classification



Crowdsourced image classification



NEXT >>

CLEAR

CROP
select

1x1 3x3
☐ ☐

GRASSLAND
select

1x1 3x3
☐ ☐

TREES
select

1x1 3x3
☒ ☐

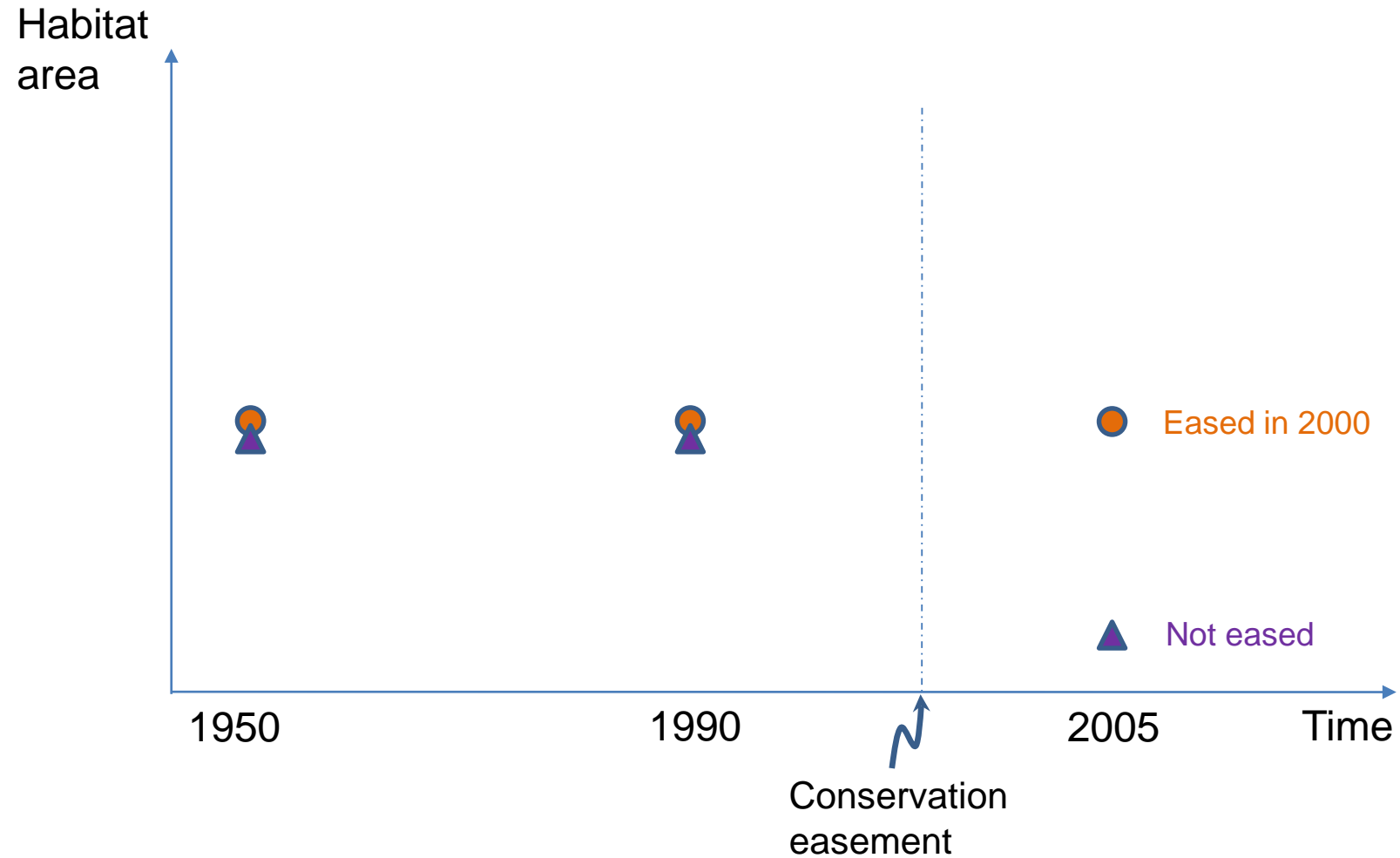
WETLAND
select

1x1 3x3
☐ ☐

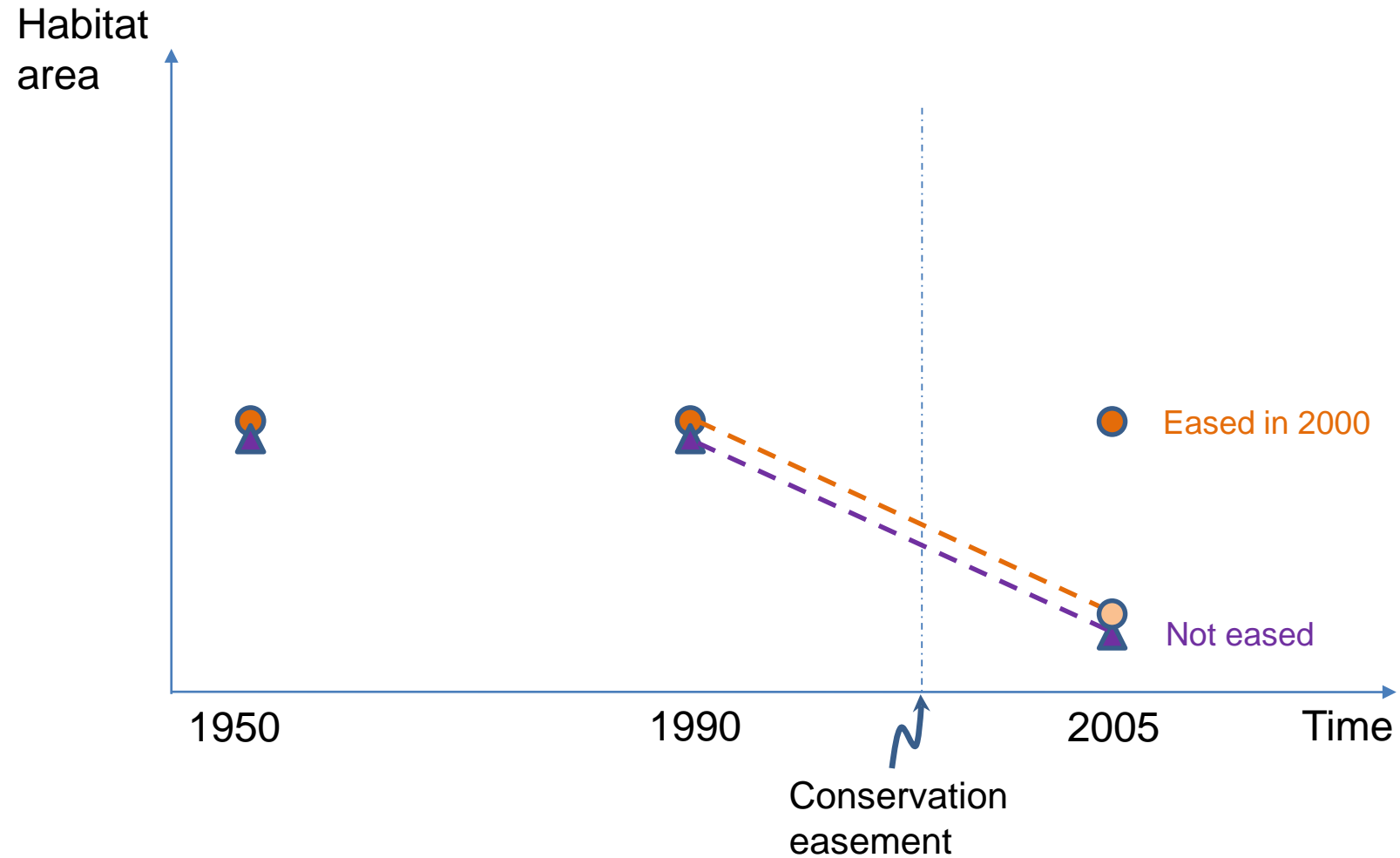
Crowdsourced image classification



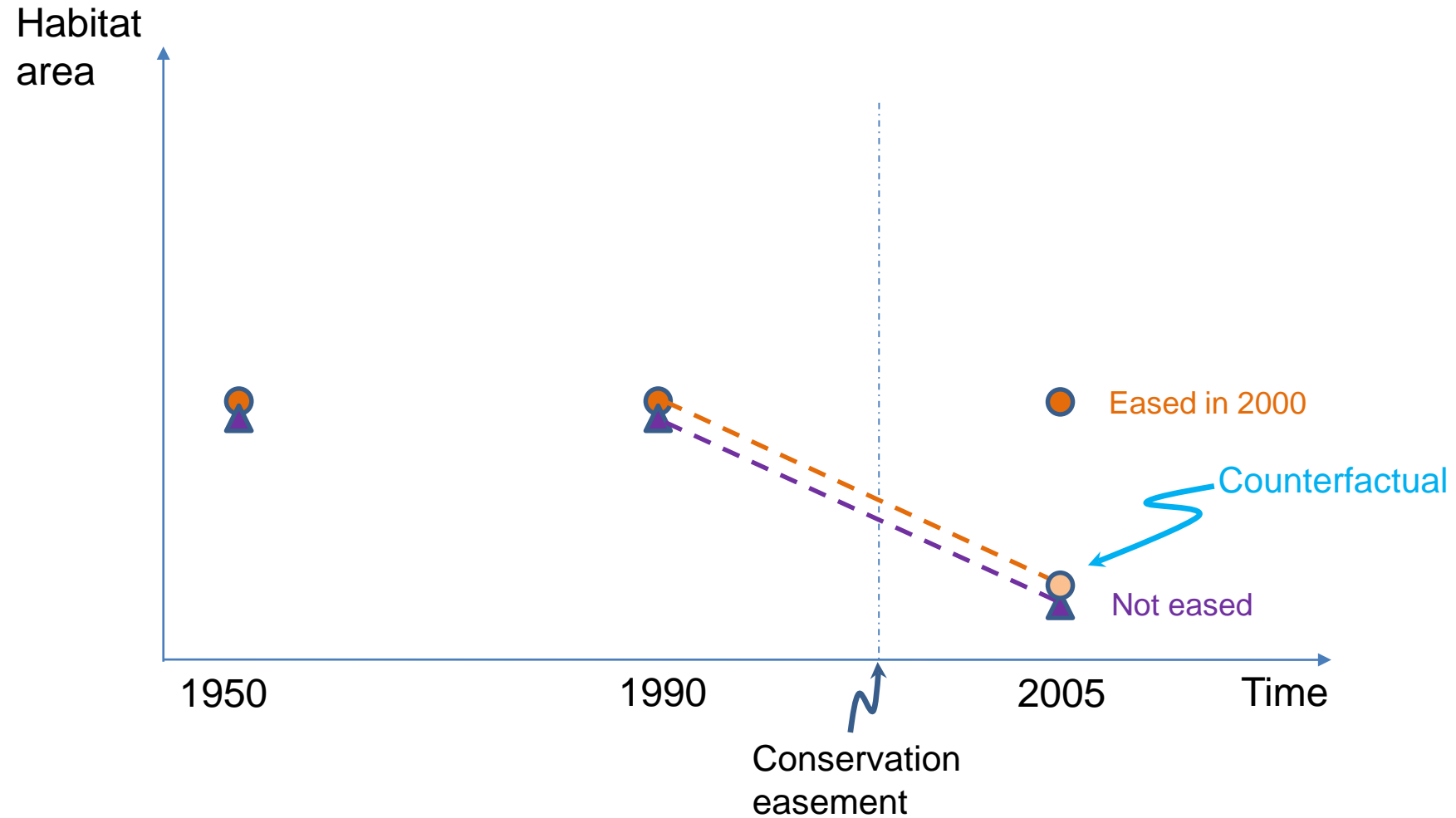
Using the crowdsourced images



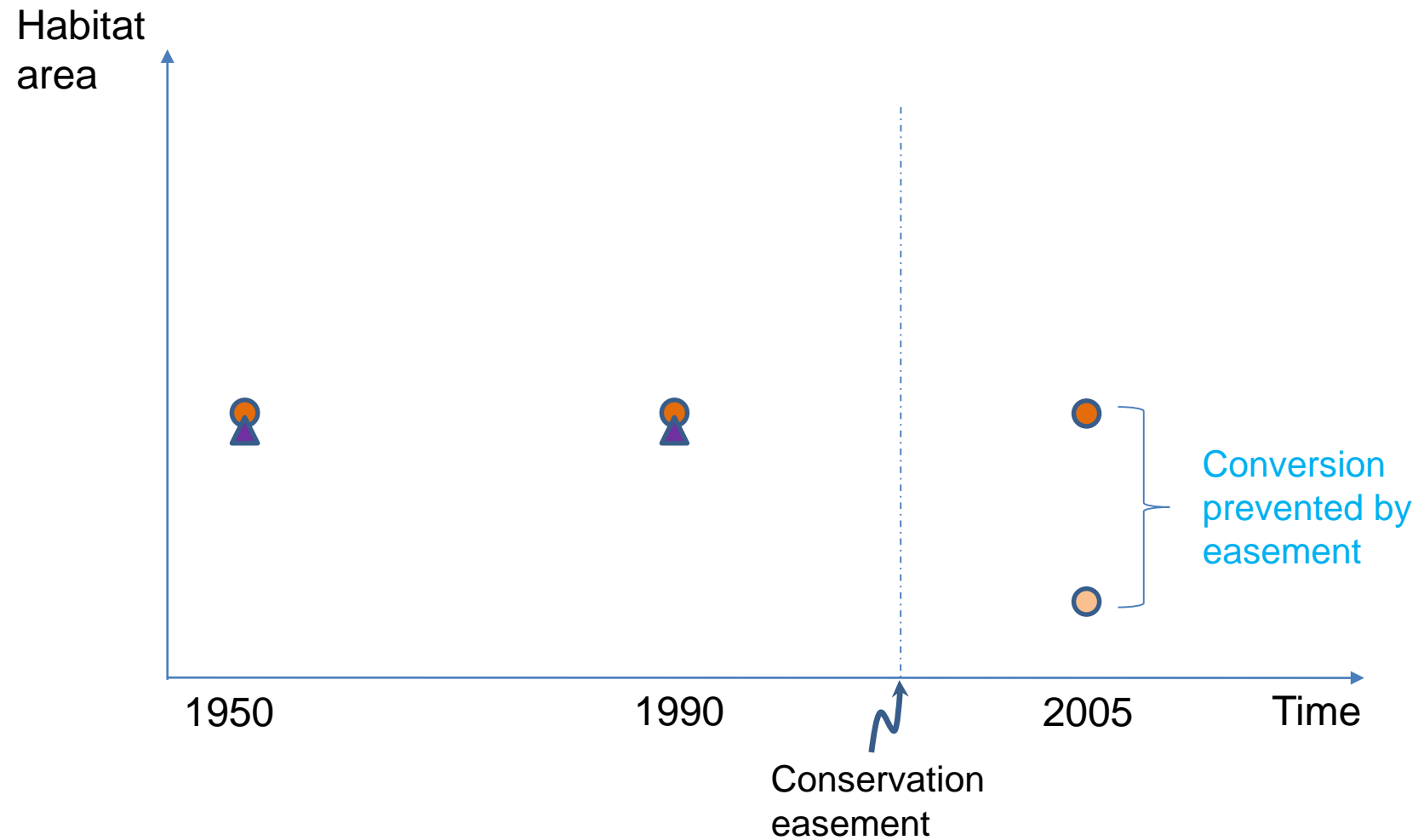
Using the crowdsourced images



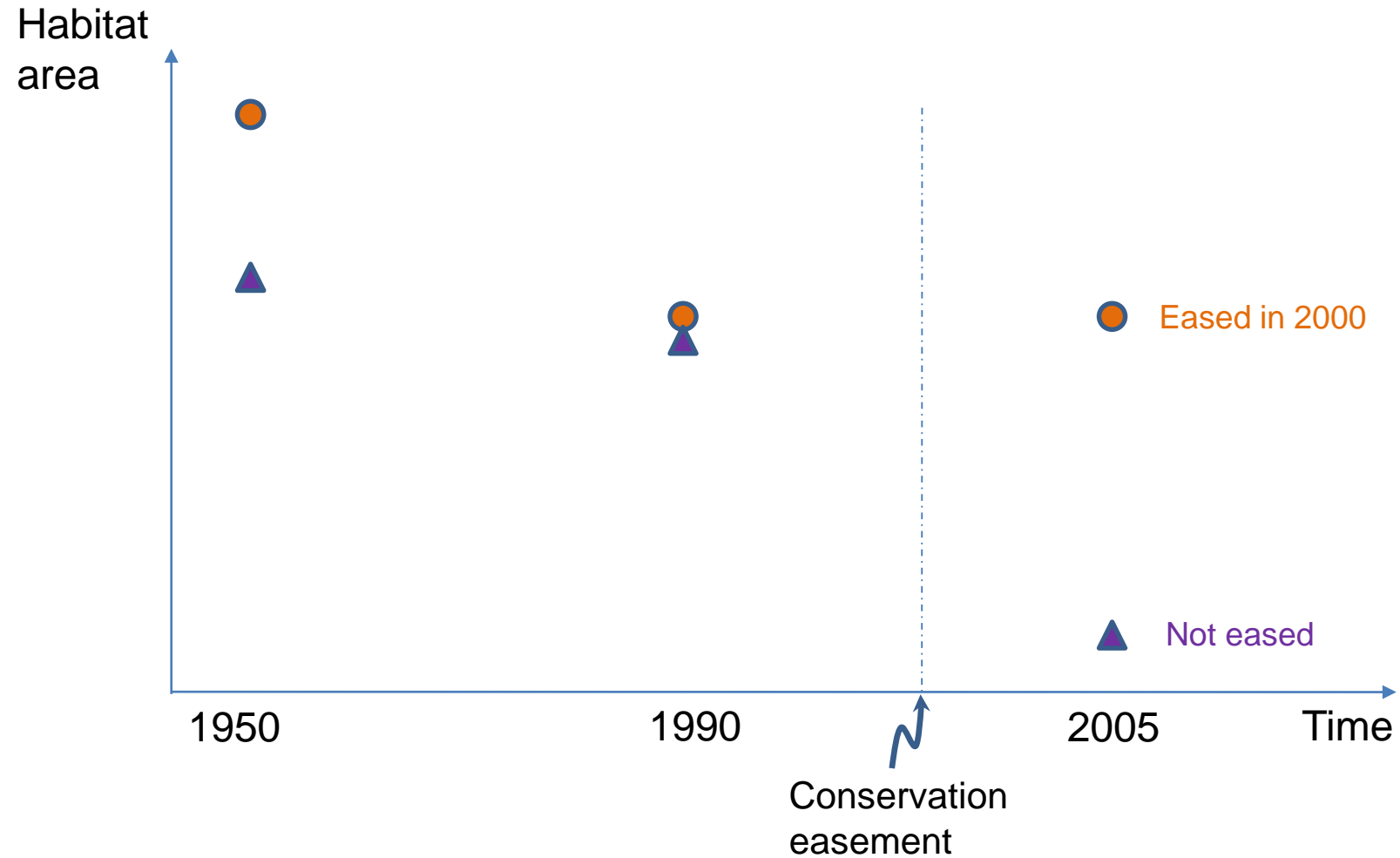
Using the crowdsourced images



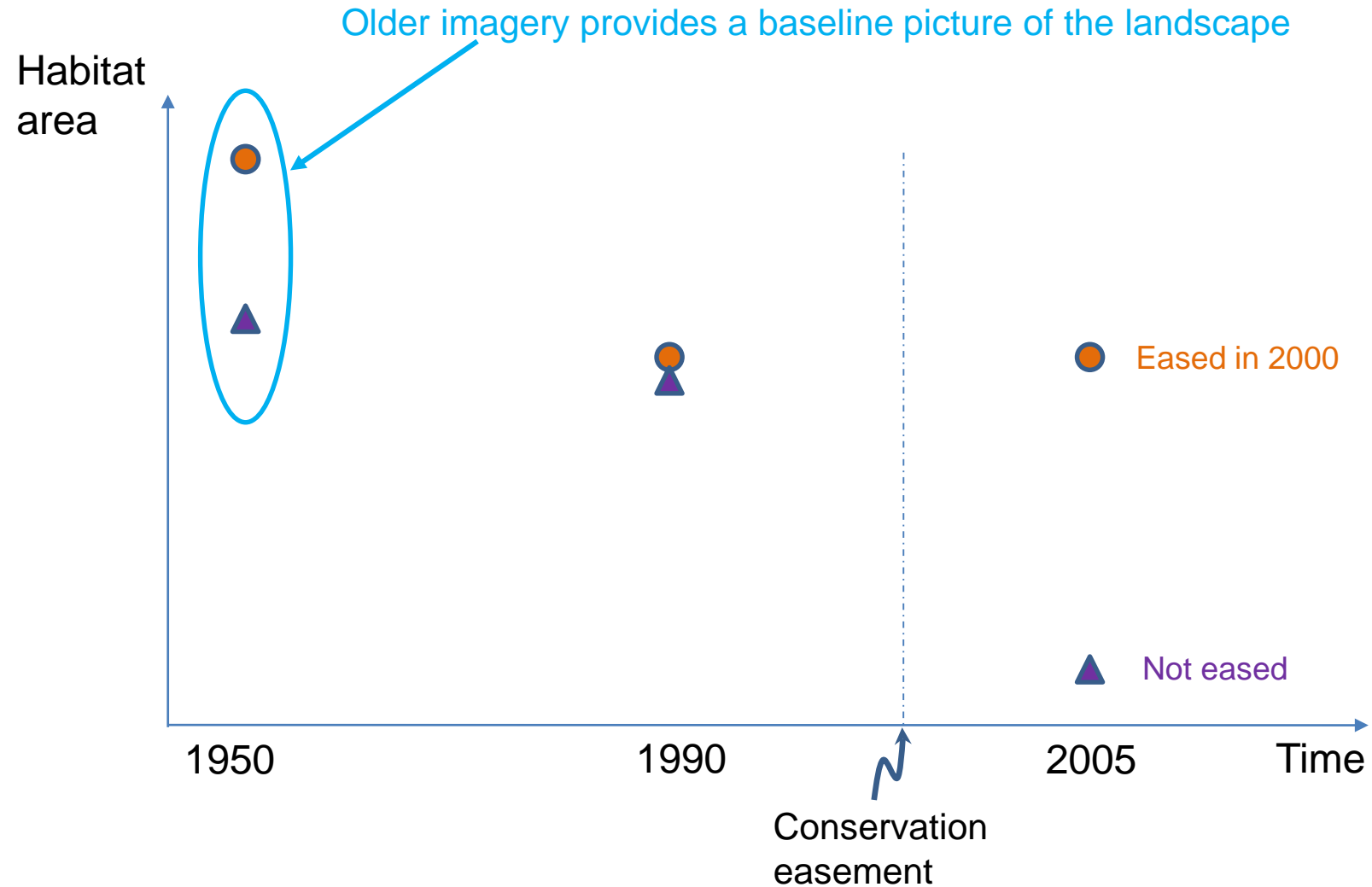
Using the crowdsourced images



Using the crowdsourced images



Using the crowdsourced images



Spatial interactions in habitat conservation: Evidence from prairie pothole easements[☆]



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Prairie potholes

Land conservation

Conservation planning

Social interactions

Contiguous habitat

Spatial spillovers

ABSTRACT

We examine the role of spatial interactions in conservation easements placed on prairie pothole habitat in western Canada. One of the goals of the conservation easement program we study is to protect contiguous habitat. We identify endogenous spatial interactions among conservation easements and government protected land, independent of spatially correlated landscape features and local economic shocks that influence easement enrollment. We present evidence that easements increase the likelihood of subsequent easements on neighboring land. Government-protected land appears to have little effect on the location of conservation easements. These results imply that conservation agencies have leveraged past conservation investment to enroll more contiguous habitat in permanent easements through a combination of targeting and positive social interactions among neighboring landowners.

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Targeting and spatial interactions

Spatial configuration of conservation matters

- Benefits of contiguous habitat

Target parcels with:

- Habitat
- Neighboring habitat
- Neighboring protected habitat



Targeting and spatial interactions

Spatial configuration of conservation matters

- Benefits of contiguous habitat

Target parcels with:

- Habitat
- Neighboring habitat
- Neighboring protected habitat



Does previously protected land cause neighboring land to be protected in the future?

- Agencies target habitat adjacent to previously protected habitat
- Landowner observational learning and changing social norms

Targeting and spatial interactions

Spatial configuration of conservation matters

- Benefits of contiguous habitat

Target parcels with:

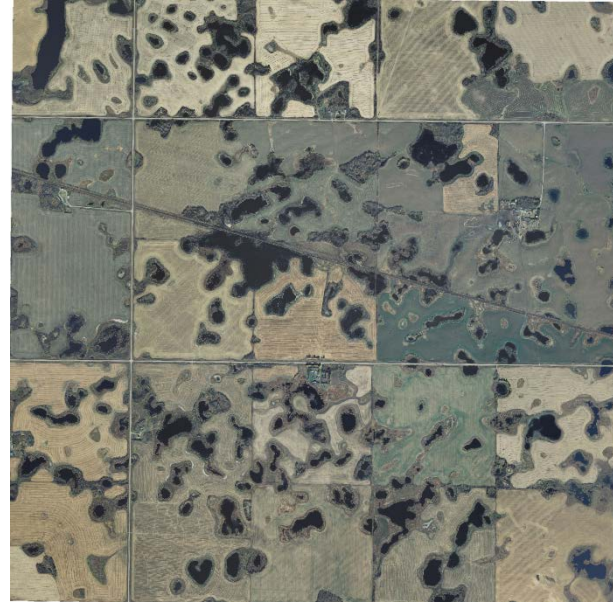
- Habitat
- Neighboring habitat
- Neighboring protected habitat



Path dependency—what is the impact of today's conservation investment on future conservation investment?

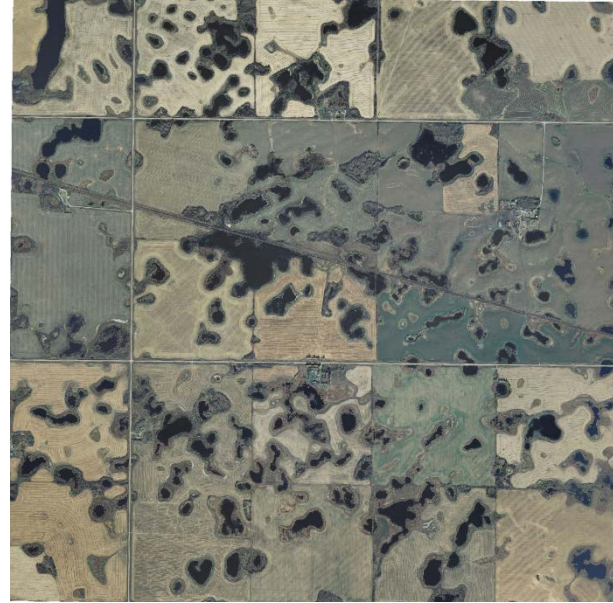
Targeting and spatial interactions

- Need micro-level data to identify contiguous land



Targeting and spatial interactions

- Need micro-level data to identify contiguous land
- Can't identify this effect by simply looking at spatial clustering of protected land



Targeting and spatial interactions

- Need micro-level data to identify contiguous land
- Can't identify this effect by simply looking at spatial clustering of protected land

Why not?

1. Landscape features spatially correlated



Targeting and spatial interactions

- Need micro-level data to identify contiguous land
- Can't identify this effect by simply looking at spatial clustering of protected land

Why not?

1. Landscape features spatially correlated
2. Agencies target habitat based on prevalence of neighboring habitat



Targeting and spatial interactions

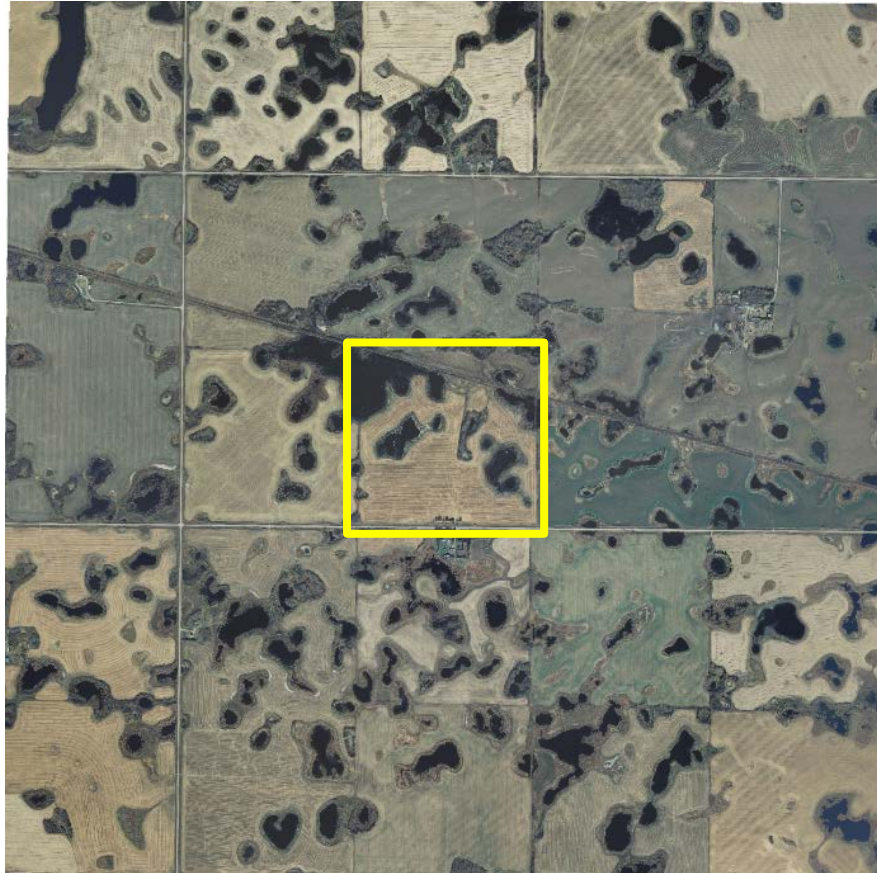
What is the counterfactual?

- Timing of easements



Repeated observations

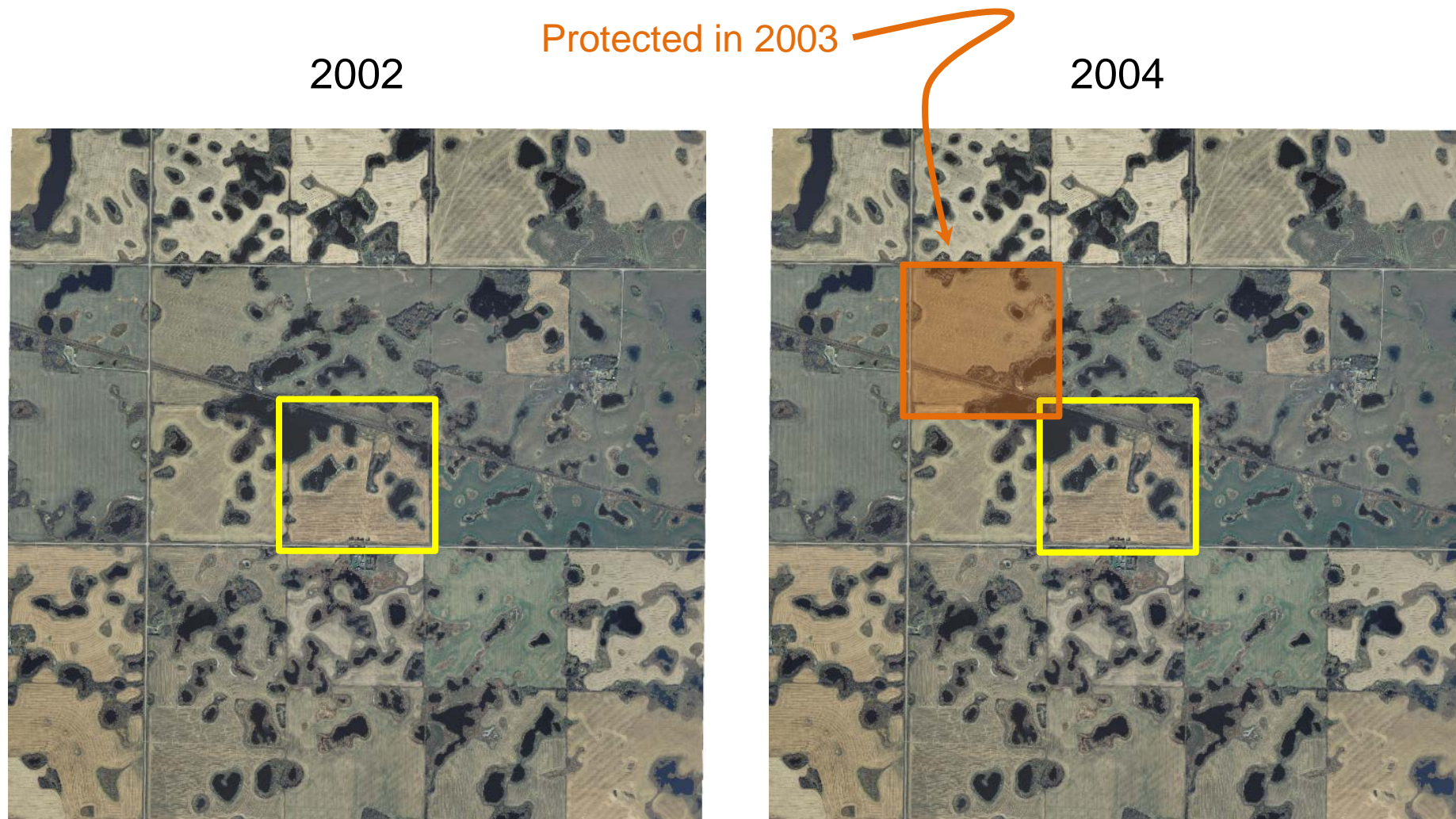
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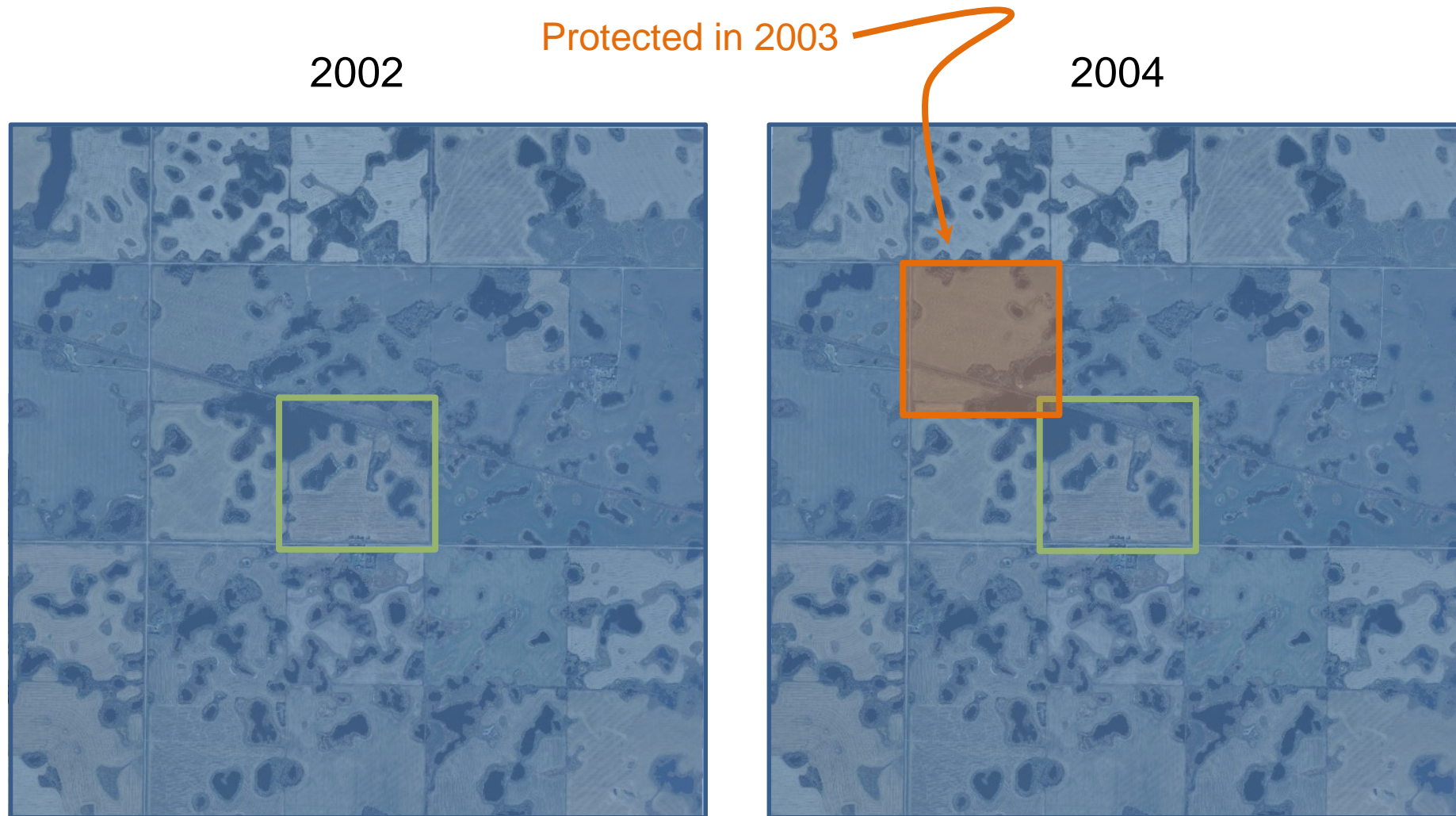
2004



Repeated observations



Repeated observations



How does likelihood of protection change in 2004, relative to 2002?

Some results

Are conservation agencies able to leverage past investment to protect more spatially contiguous habitat?

- Additional easement within 1 mile doubles the likelihood of an easement over the course of 10 years

Evidence of path dependency in conservation easement investment

- Targeting today has implications for future habitat protection

Important data sources:

- Manitoba Habitat Heritage Corporation and Ducks Unlimited Canada

Funding: SSHRC Insight Development Grant (with Wanhong Yang)

How much green for the buck? Estimating additional and windfall effects of French agro-environmental schemes by DID-matching



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Organic farming

ABSTRACT

Agro-environmental schemes (AES), which pay farmers to adopt greener practices, are increasingly important components of environmental and agricultural policies both in the US and the EU. Here we study the French implementation of the EU AES program. We estimate additional and windfall effects of five AESs for a representative sample of individual farmers using difference-in-difference (DID) matching. We derive the statistical assumptions underlying DID-matching from a structural household model and we argue that the economics of the program make it likely that these assumptions hold in our data. We test the implications of the identifying assumptions, provide a lower bound using triple-difference matching, test for crossover effects and insert our estimates of both additionality and windfall effects into a cost-benefit framework. We find that the AESs promoting crop diversity have inserted one new crop into the rotation but on a small part of the cropped area. We also find that the AES subsidizing the planting of cover crops has increased cover crops by 10 ha on the average recipient farm at the expense of almost 7 ha of windfall effect. This AES does not appear to be cost effective. In contrast, we find that the AES subsidizing grass buffer strips could be socially efficient despite large windfall effects. We finally estimate that the AES subsidizing conversion to organic farming has low windfall effects and high additionality.

Additionality in agriculture cost share programs

Additionality effects

- If program encourages farmers to adopt environmentally friendly practices

Windfall effects

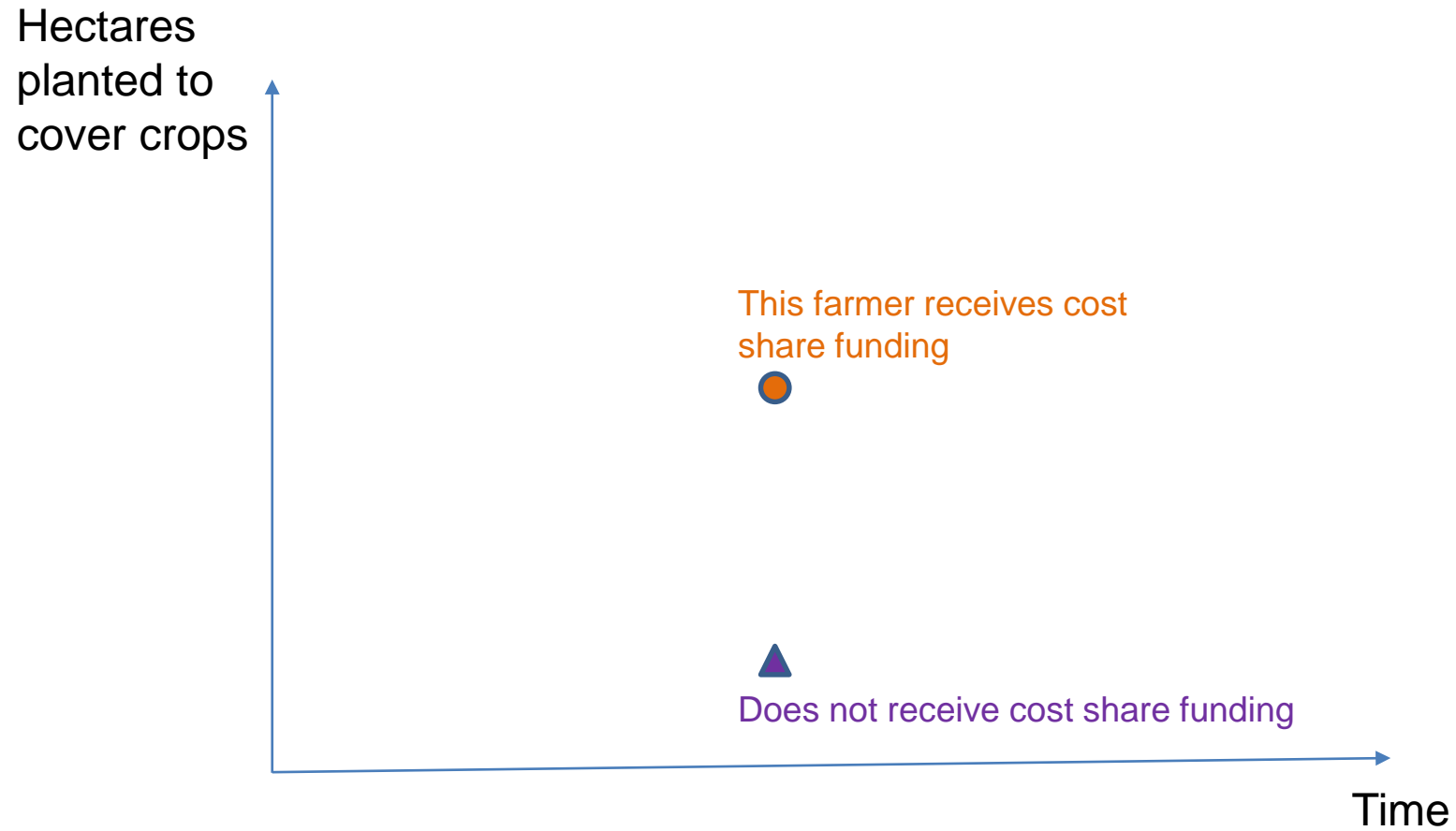
- If pays for practices that would have been adopted in programs absence

Cost-benefit of program depends on these two effects

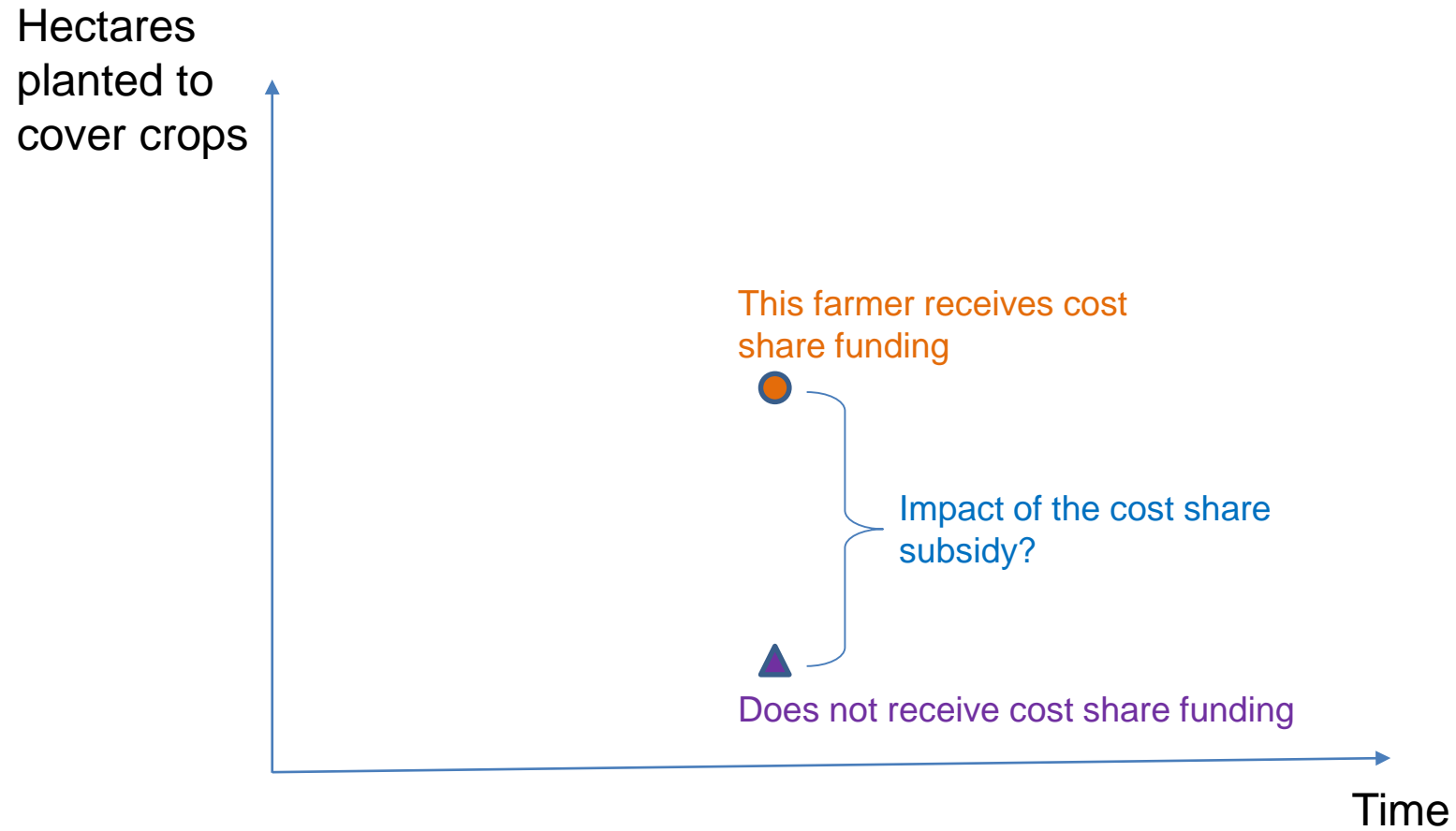
Cost share programs are voluntary

- Farmers with lowest compliance costs are most likely to sign up

Additionality in cost share programs

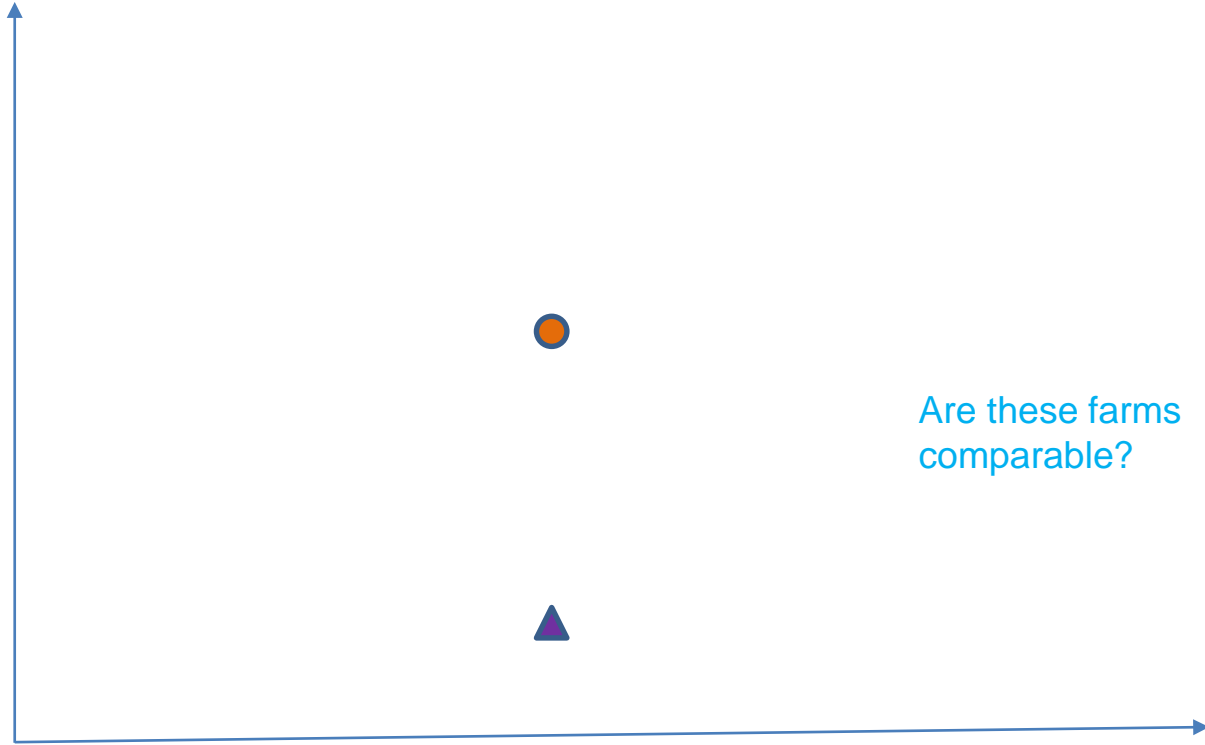


Additionality in cost share programs



Additionality in cost share programs

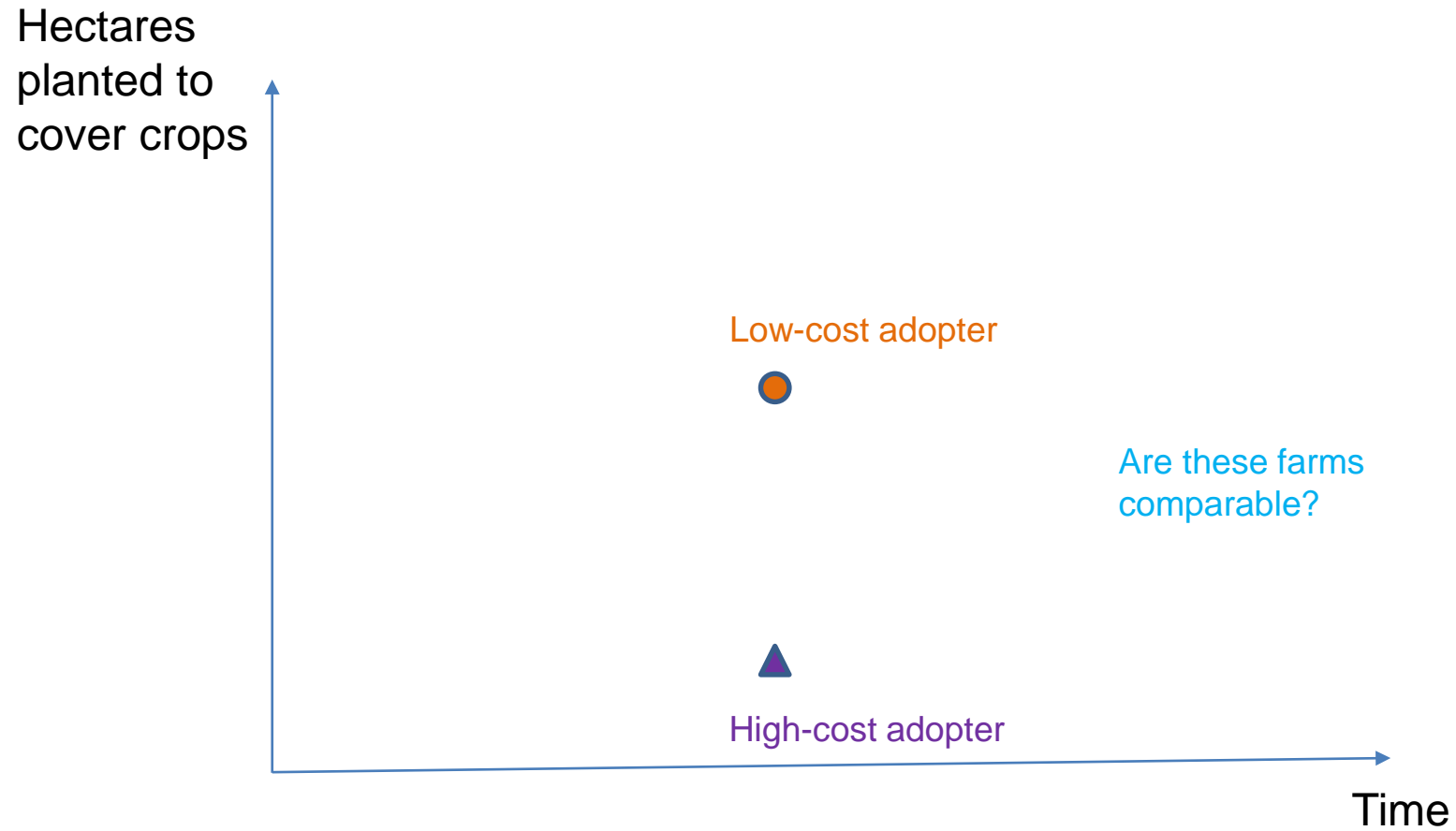
Hectares
planted to
cover crops



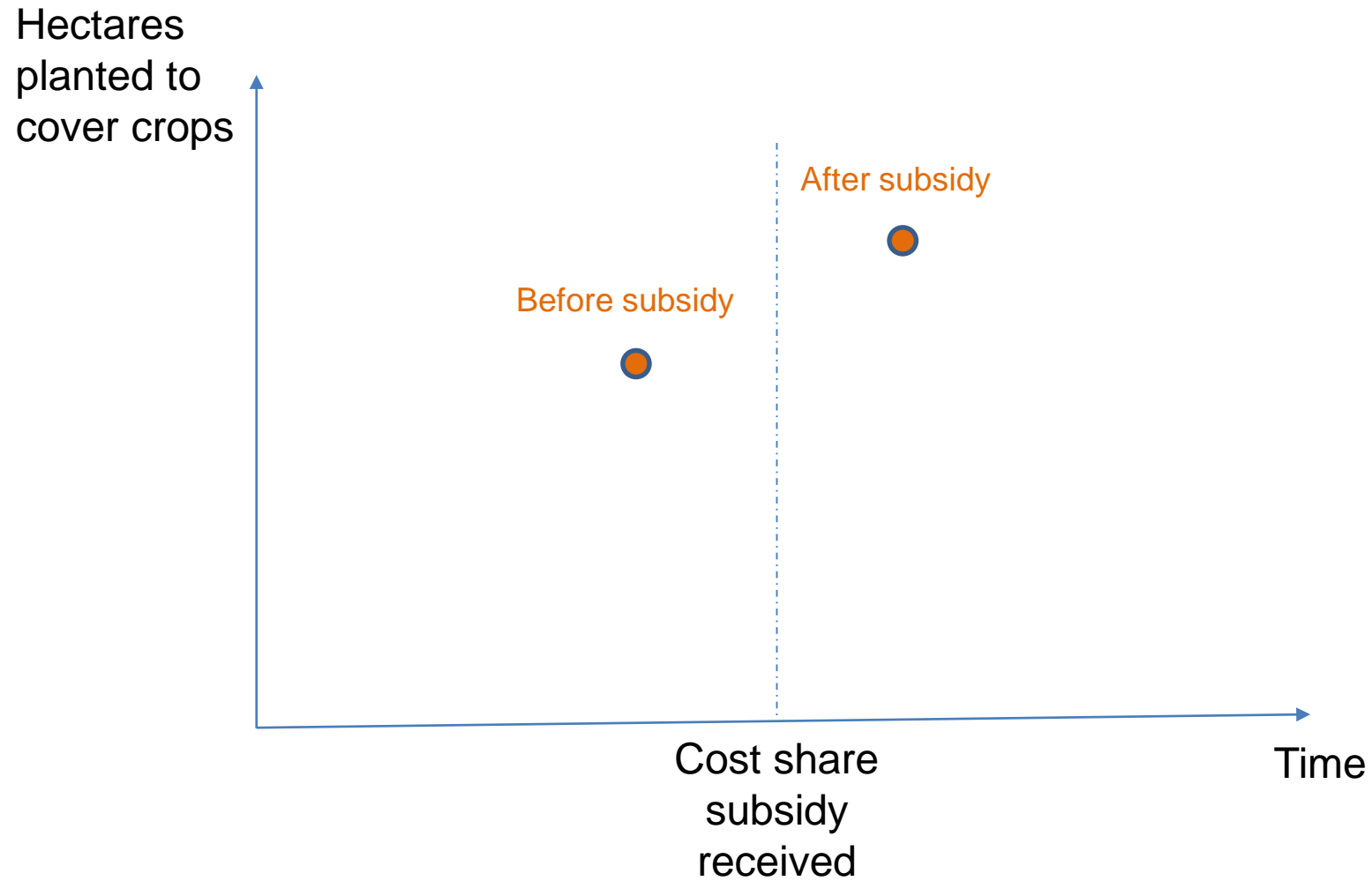
Are these farms
comparable?

Time

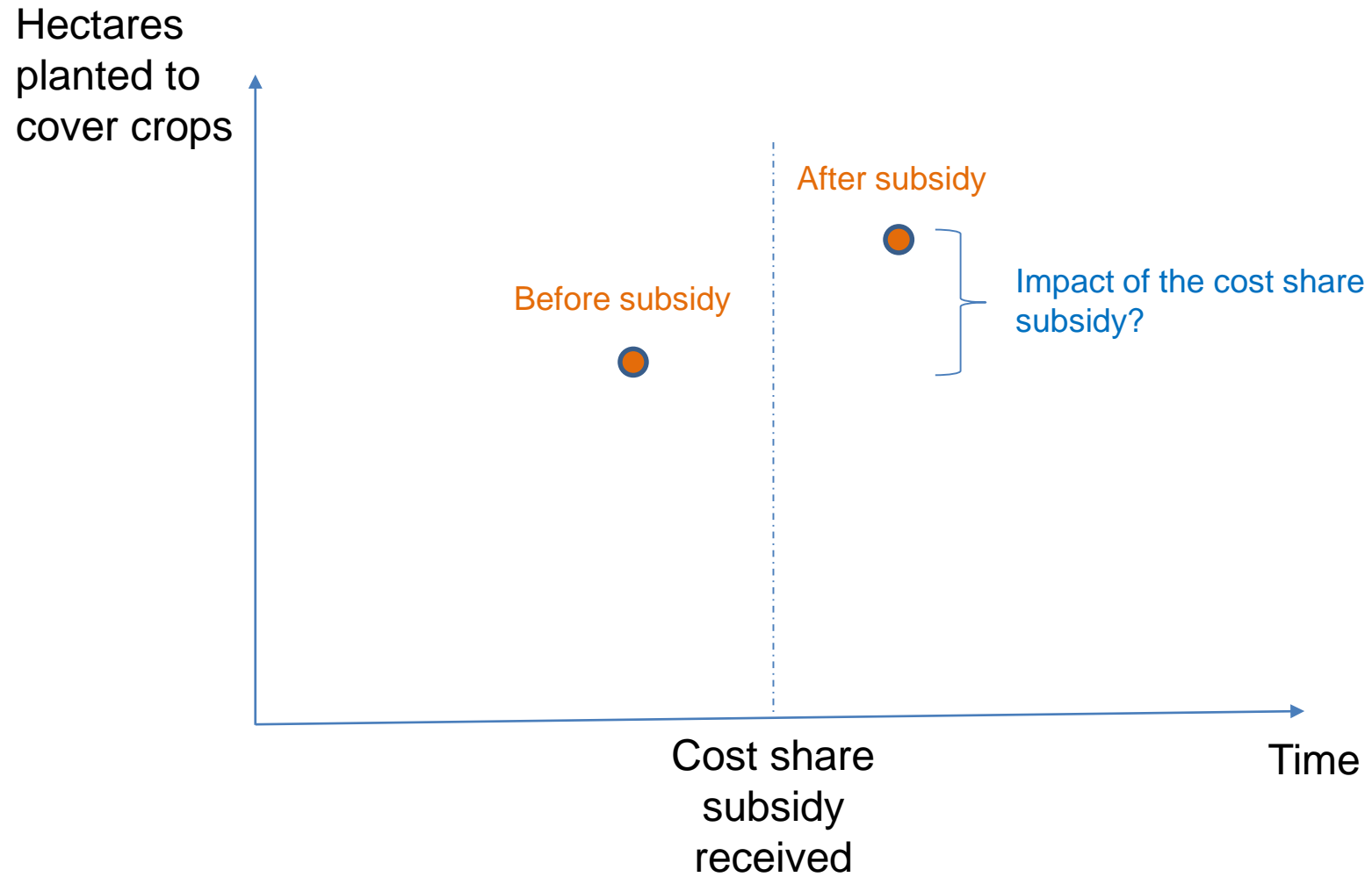
Additionality in cost share programs



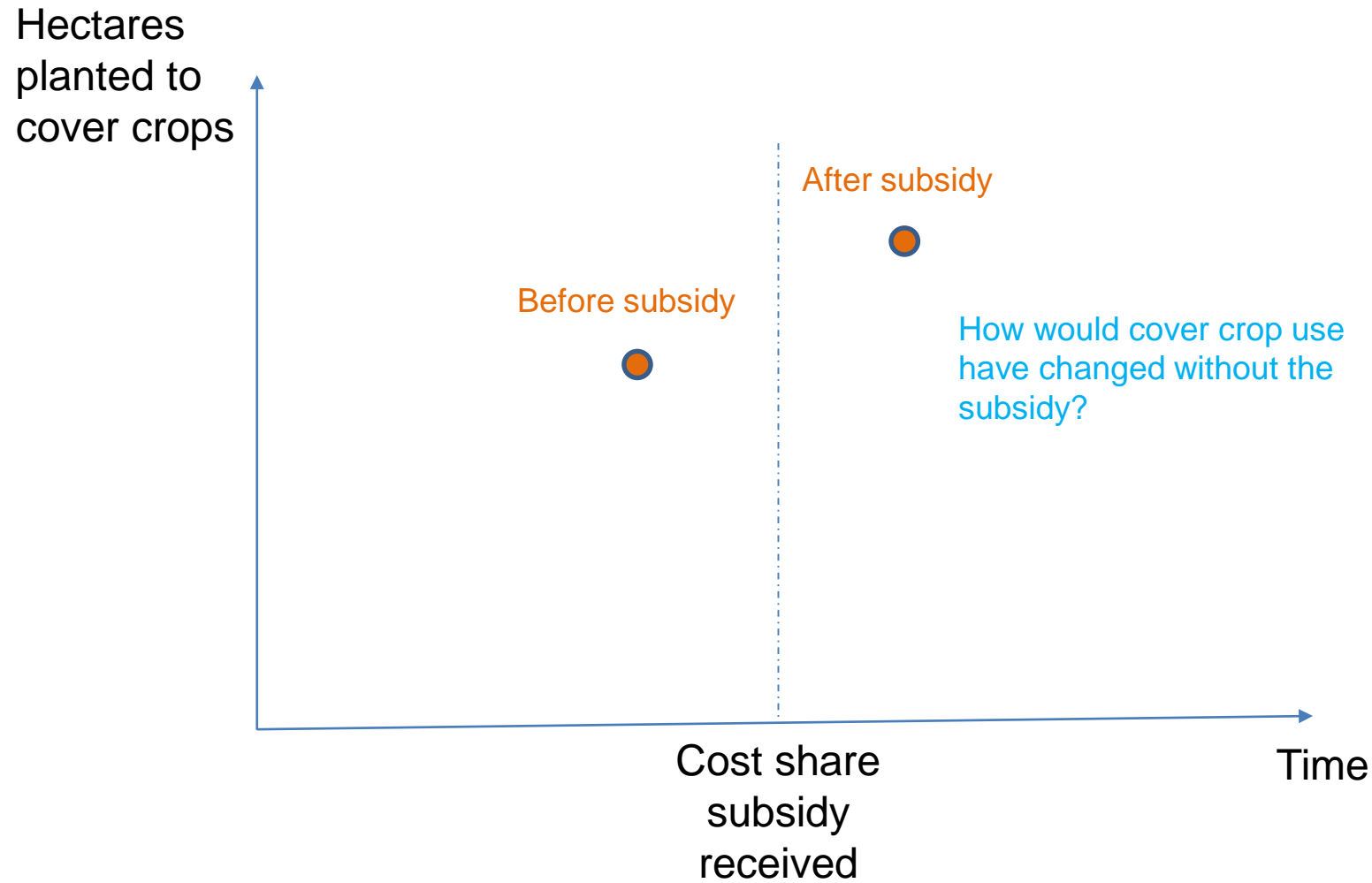
Additionality in cost share programs



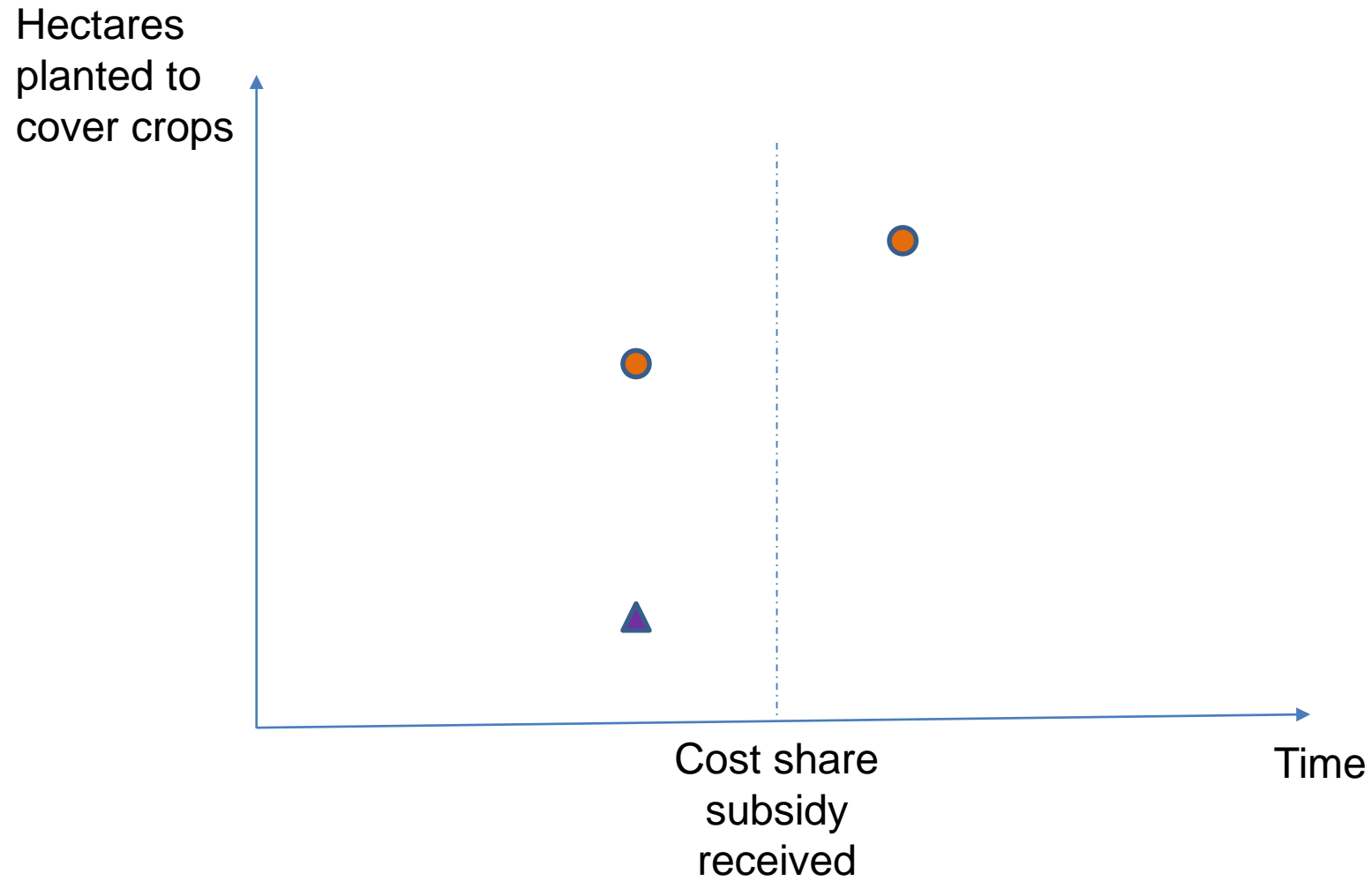
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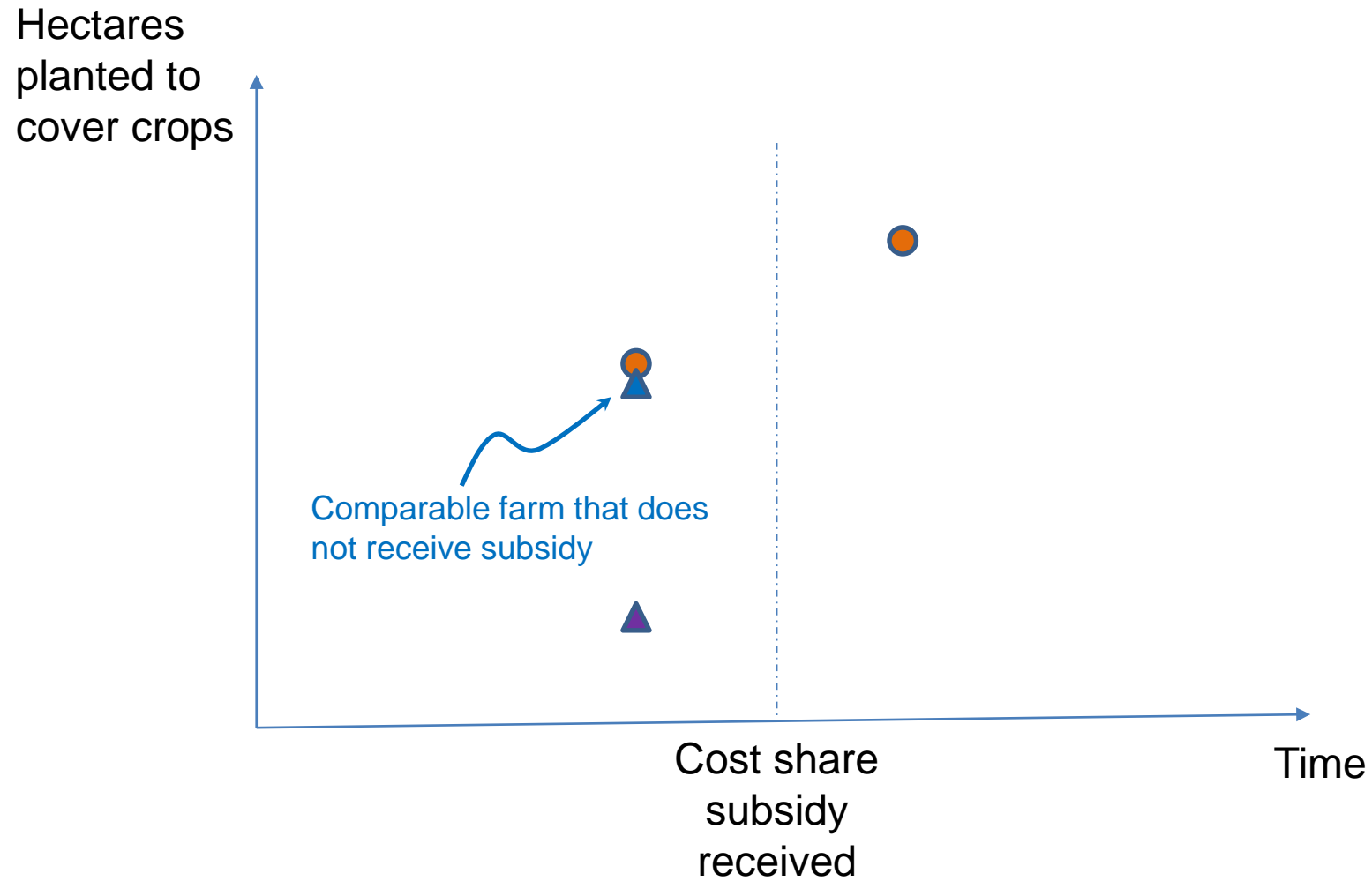
Additionality in cost share programs



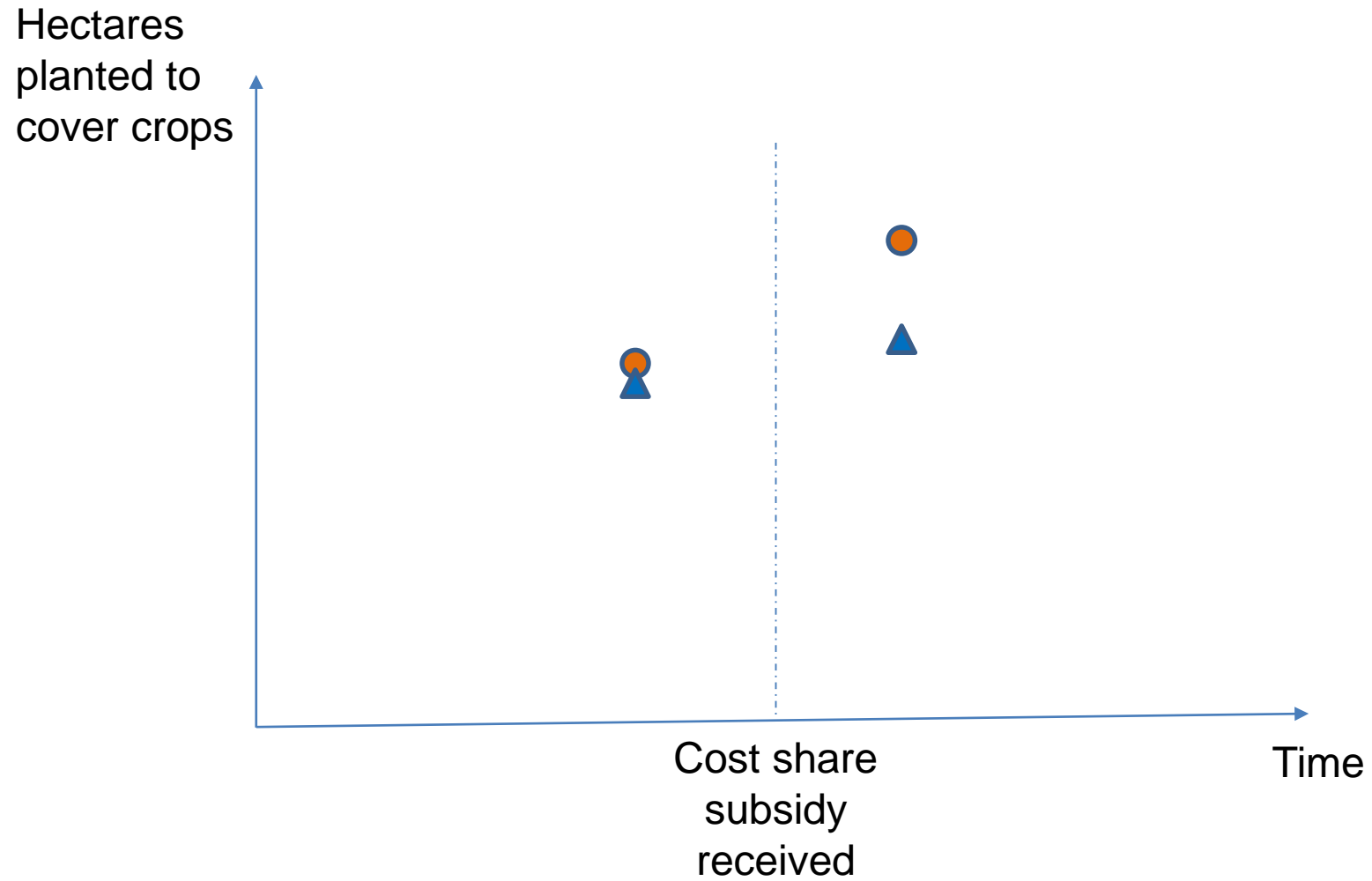
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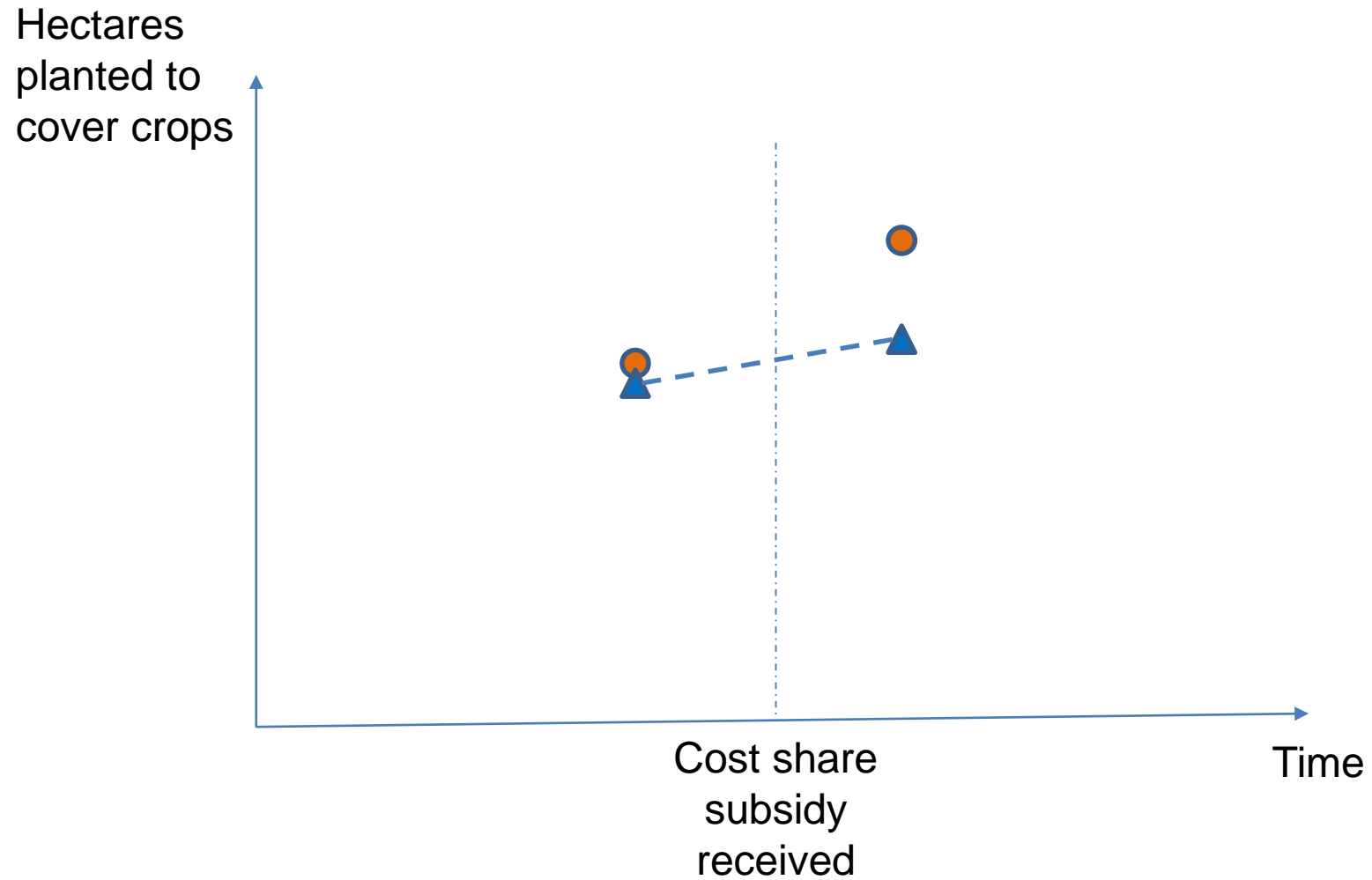
Additionality in cost share programs



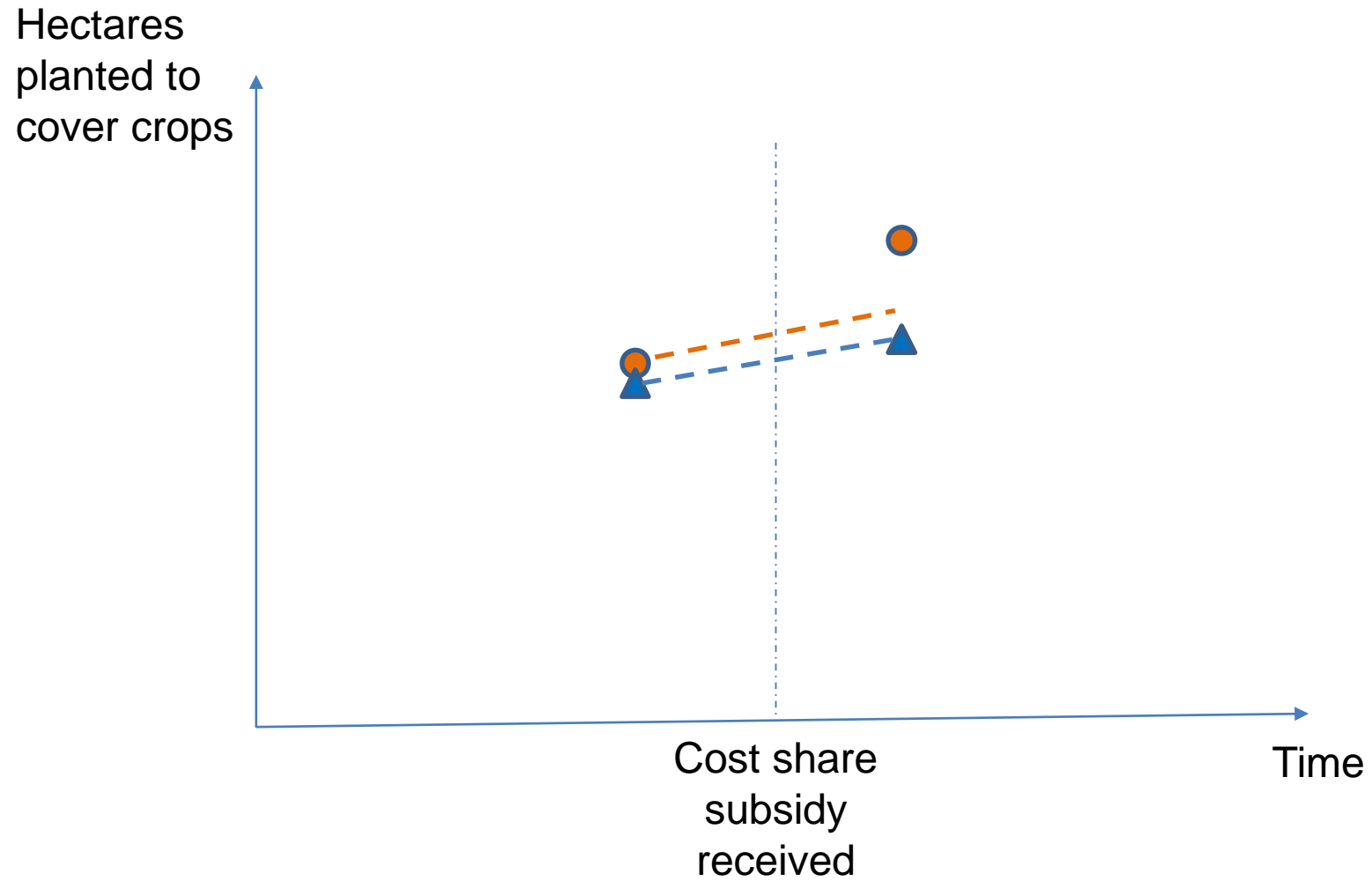
Additionality in cost share programs



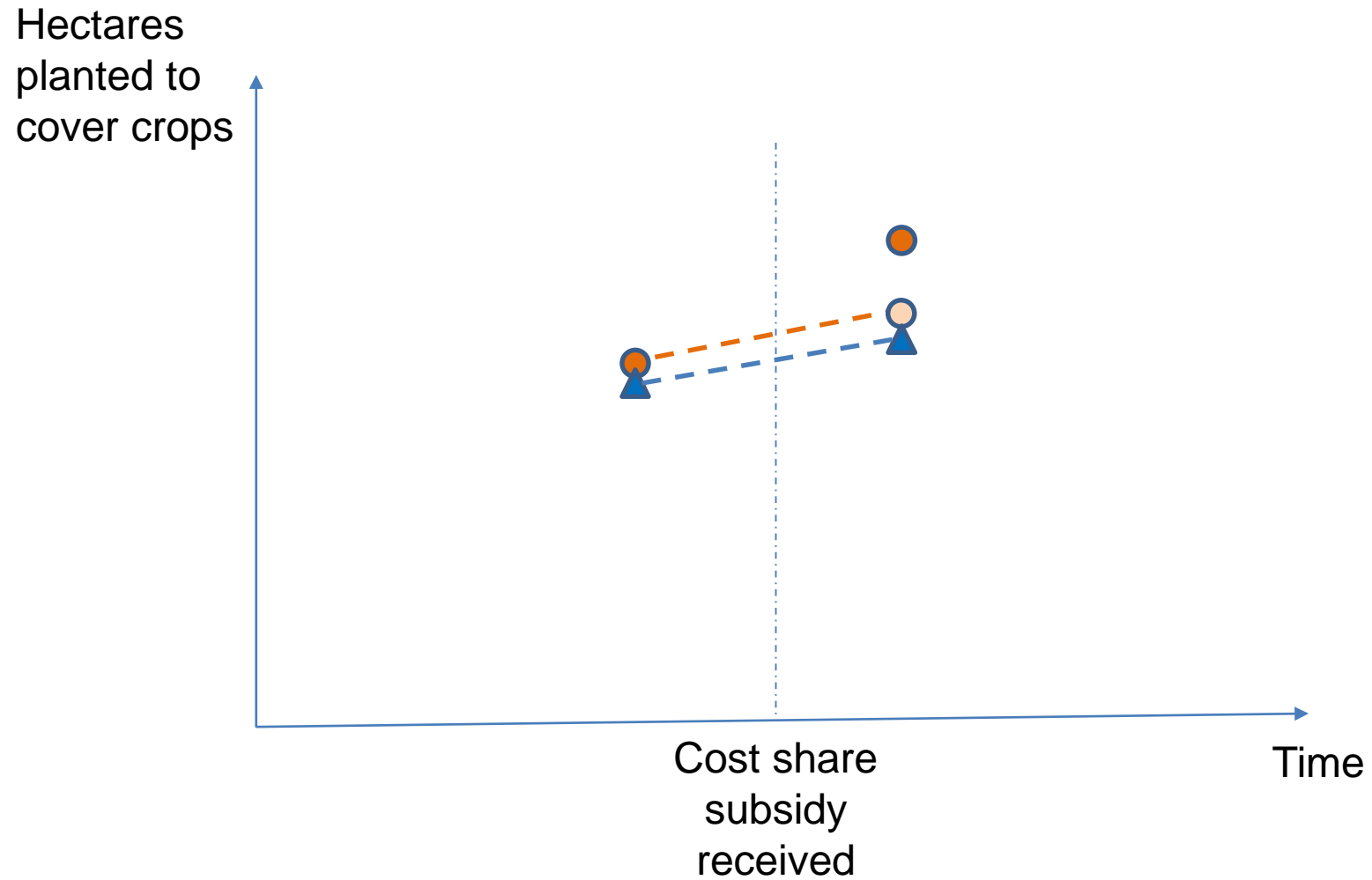
Additionality in cost share programs



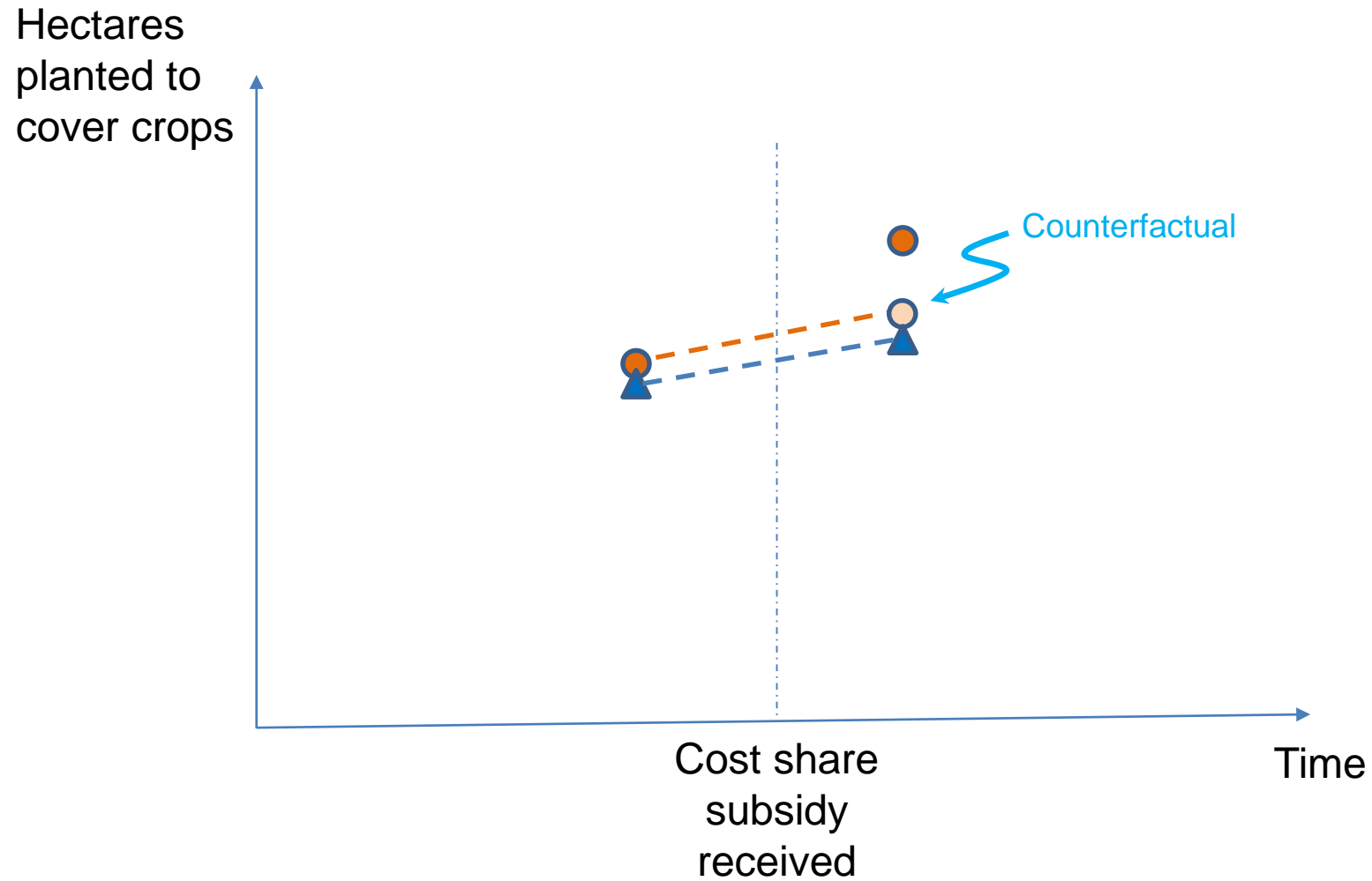
Additionality in cost share programs



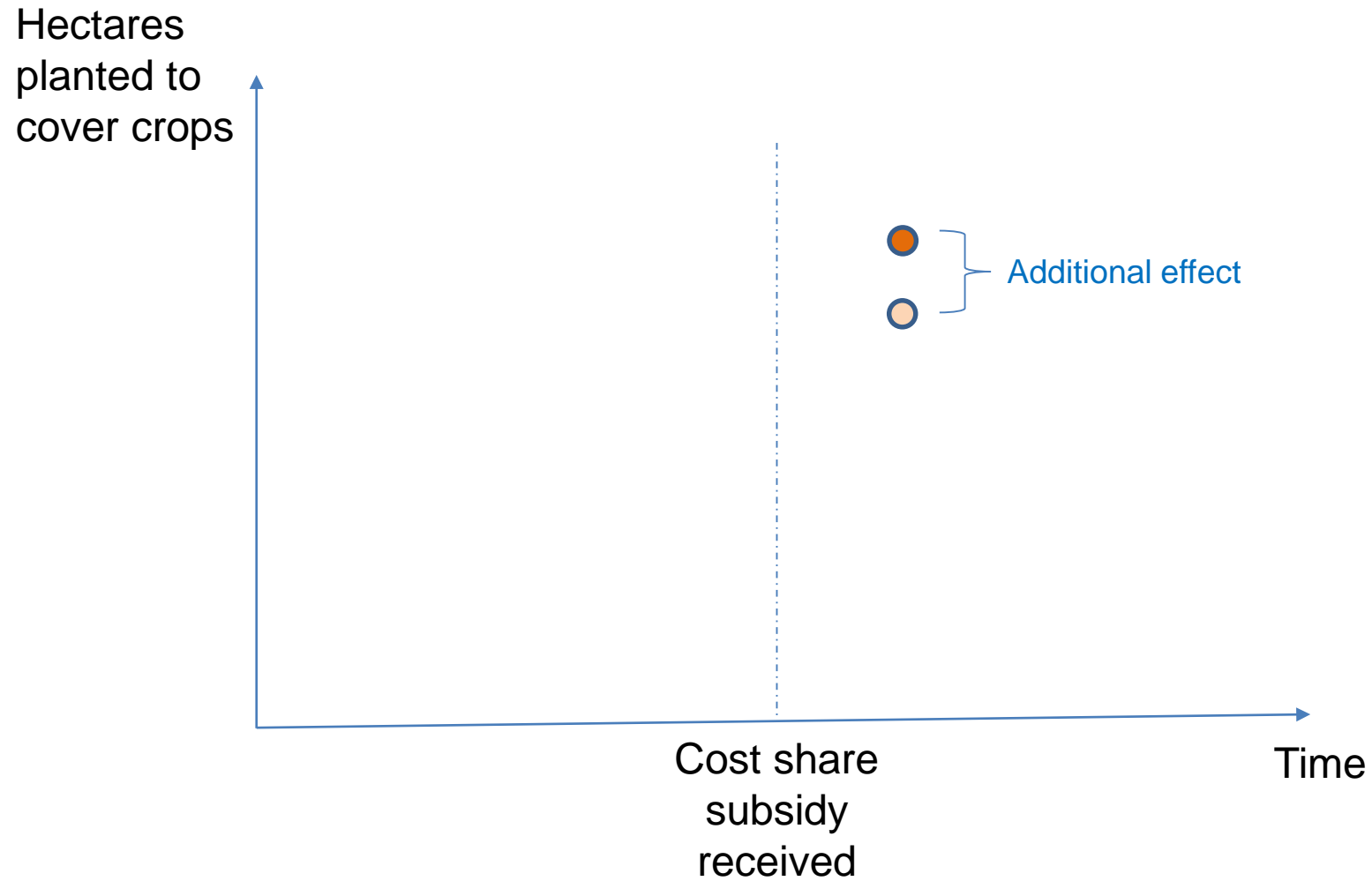
Additionality in cost share programs



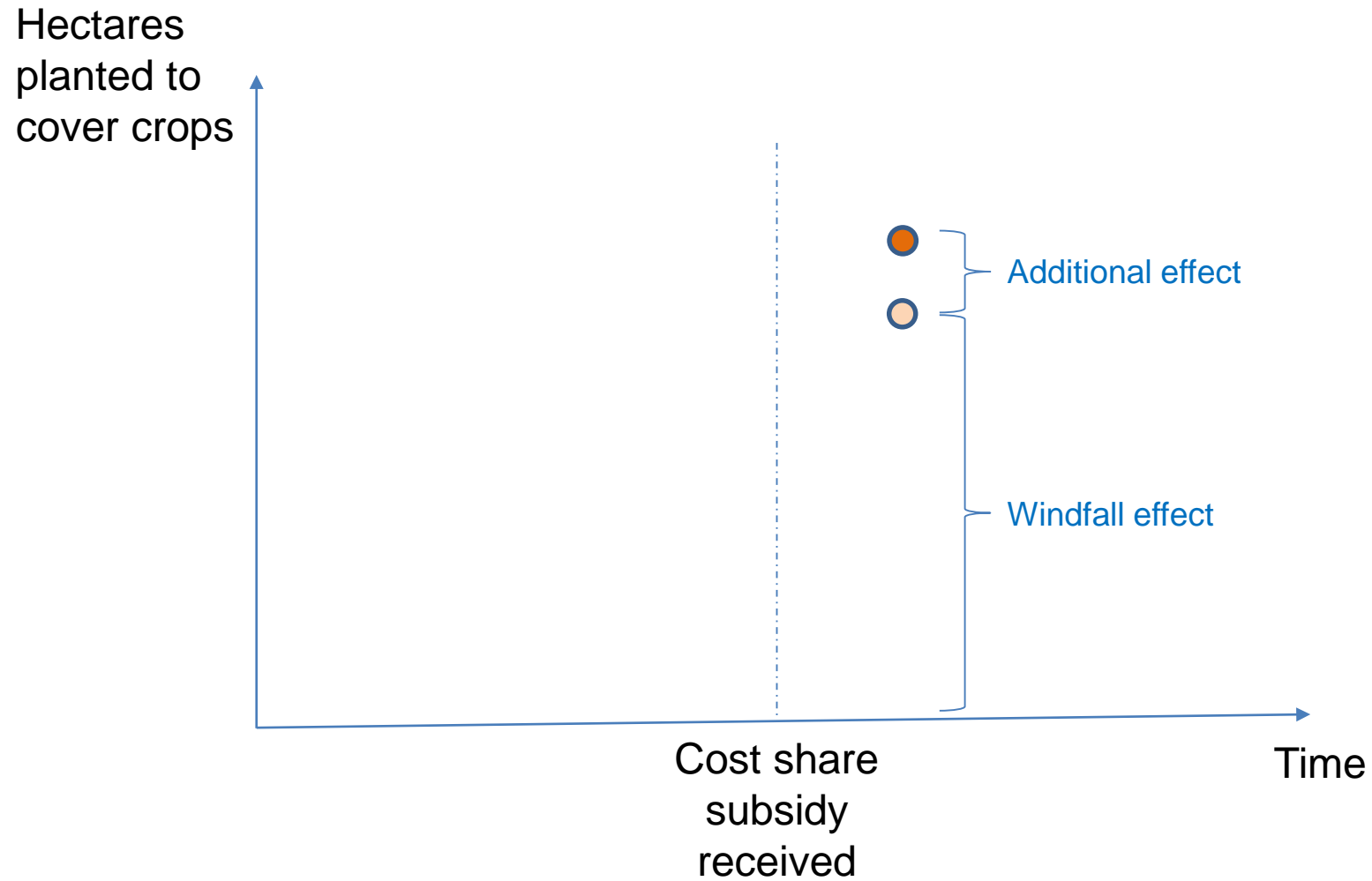
Additionality in cost share programs



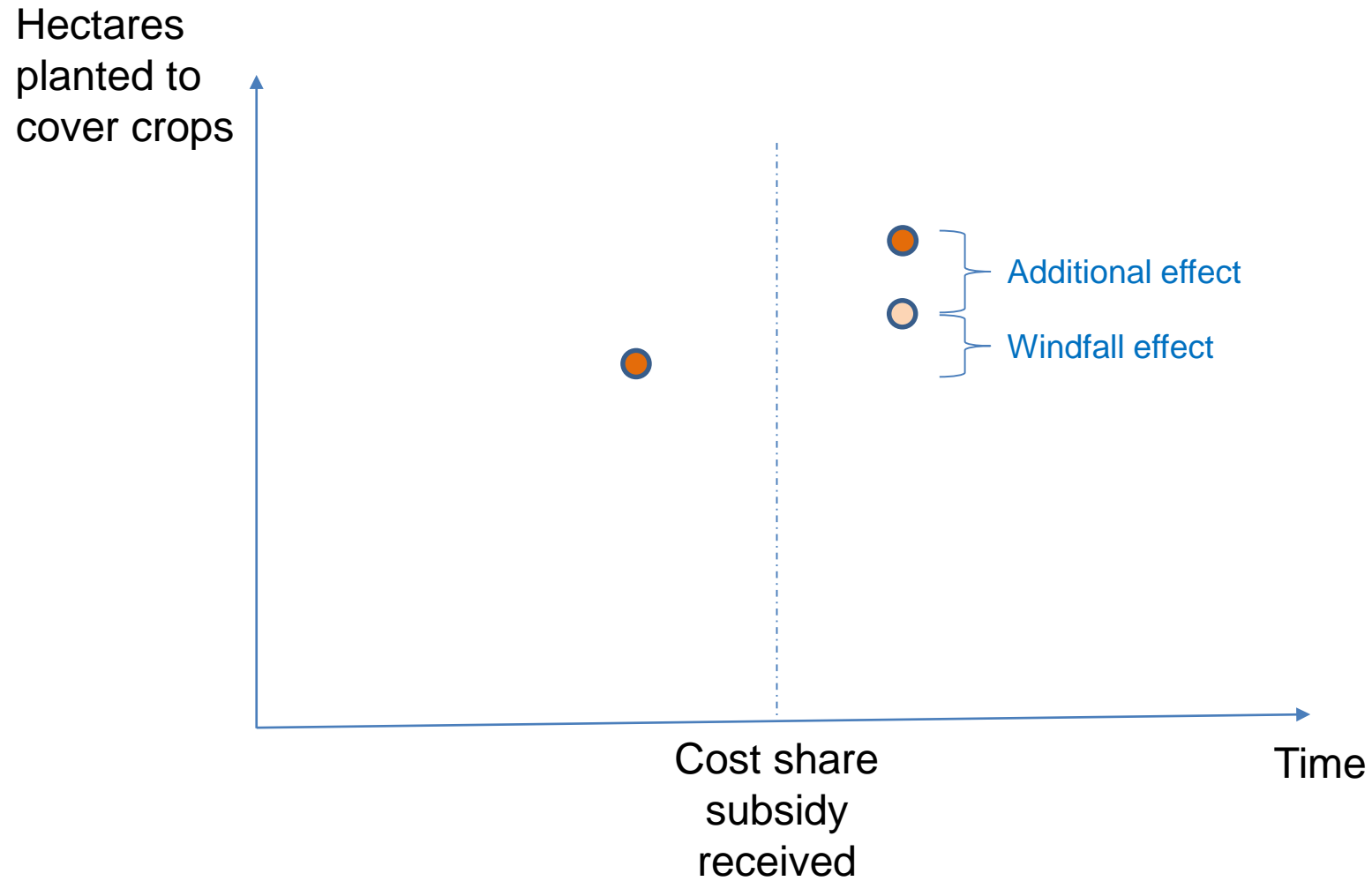
Additionality in cost share programs



Additionality in cost share programs



Additionality in cost share programs



Data

Dataset used

- Repeated observations of French farmers
- Statistical survey of agricultural conservation practices (2003 & 2005)
- Paired to:
 - 2000 Agriculture Census
 - Administrative files on cost share participation

Cost share data

- Up to 3,000 farmers per cost share practice
- 60,000 non-participant farmers

Outcomes

- Farmer-level adoption of conservation practices

Some results

Cover crop subsidy:

- Additional 10 hectares; windfall 7 hectares
- Not a cost effective subsidy

Grass buffer strips

- Large windfall effects
- Effective at curbing runoff (in this setting)
- Cost effective subsidy

Transition to organic farming

- High additionality
- Low cost of payments relative to estimated social benefits

Canadian agri-environmental policy

Agricultural Policy Framework (2003-2008)

- Environmental Farm Plan (EFP)
 - Identify farm-level environmental risks
- National Farm Stewardship Program (NFSP)
 - Provide cost sharing for adoption of beneficial management practices
- National Agri-Health Analysis and Reporting Program (NAHARP)
 - Track changes in agri-environmental indicators
- Subsequent policy frameworks have extended these programs
 - Growing Forward 1 and 2
 - CAP

Assurance: Beneficial Management Practices

Environmental farm planning helps improve the value and health of Manitoba farms. The continued adoption of environmental farm planning will enhance Canada's reputation as a supplier of safe, high-quality foods that are produced in an environmentally responsible manner.

Ag Action Manitoba will help farmers implement and adopt beneficial management practices (BMPs) on their farm identified in their **Environmental Farm Plan**. The BMPs eligible for cost shared funding to farmers are:

- **resource management planning**
- **establishment of a cover crop**
- **increasing frequency of perennials within annual crop rotations**
- **perennial cover for sensitive lands**
- **improved pasture and forage quality**
- **intercropping**
- **liquid manure storage odour reduction**
- **barn odour reduction**
- **farmyard runoff control**
- **relocation of confined livestock areas**
- **managing livestock access to riparian areas**
- **sub-surface drainage water management**
- **utilization of drainage water**
- **pesticide storage**
- **secondary containment for liquid fertilizer storage**

More detailed information on each BMP is provided in the next sections.

Environmental Farm Plans

Environmental Farm Plans (EFP) are designed to address priority issues and help farmers:

- identify existing environmental assets on their farm
- raise awareness of environmental risks on their farm
- identify actions to reduce risks
- improve environmental sustainability
- improve production efficiency on the farm

How to get an EFP on your farm

- The process includes completion of an EFP workbook, facilitated workshops and a workbook review.
- The EFP program is administered and delivered by Manitoba Agriculture and EFP reviews are completed by a third party. In Manitoba, the review is done through the Keystone Agricultural Producers and is confidential.
- An EFP will need to be reviewed every five years to remain valid.

For more information, or to register for an EFP workshop, contact your local **Manitoba Agriculture** office.

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BMP: Establishment of a Cover Crop (201)

Cover crops protect soil, air and water by capturing nutrients, reducing soil erosion and runoff, increasing water uptake, and sequestering carbon in soil.

The purpose of this BMP is to use cover cropping as a means to target carbon loss, soil organic matter loss, erosion and nutrient loss, and to take up excess moisture. Priority will be given to projects that follow low residue crops and/or target areas of excess moisture.

Farmers may be required to direct seed their following crop into the cover crop stand.

Cost share ratio and funding cap

There is a cost share ratio of 25 per cent government, 75 per cent applicant. This BMP has a funding cap of \$10,000.

Eligible costs

- seed, equipment use and labour costs for seed-bed preparation and seeding
- options such as winter cover crops, relay crops, green fallow crops and biennial green manures, cover crop mixtures for grazing on stockless farms
- cover crop mixture must have a minimum of 3 species with varying growth habits and be chosen to target the risk being mitigated (e.g., erosion protection, water uptake, etc.)
- supplied seed compensated based on average seed costs
- personal labour (\$25 per hour) and personal equipment use (at set program rates)

Ineligible costs

- seeding of cash crops (e.g., winter wheat)

BMP specific questions

The following information will be required in the application:

- What cover crop species have you selected for your mixture and why were these particular species chosen?
- How will you establish your cover crop (e.g., in-season, post-harvest, planted vs. broadcast)?
- How many acres of cover crop will be seeded?
- What was the previous crop? What will be seeded following the cover crop?
- How will the cover crop be terminated?
- How will implementing this BMP change your current farm practice?
- If relevant, attach a drawing or aerial photo that highlights any sensitive areas that are being improved by the establishment of cover crops.

Reference materials

For more guidance in developing your application, visit:

- North Dakota State University: [Selecting a Cover Crop](#)
- University of Manitoba - Natural Systems Agriculture: [Cover Crops and Green Manures](#)

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BMP: Perennial Cover for Sensitive Lands (203)

Perennial cover on sensitive lands will minimize erosion and salinization, and help to sequester carbon in soil.

Cost share ratio and funding cap

There is a cost share ratio of 50:50 and a funding cap of \$10,000 for this BMP.

Eligible costs

- seed, equipment use and labour costs for seed-bed preparation and seeding, limited to a maximum of 40 acres per project (typically per quarter section).
- personal labour (\$25 per hour) and personal equipment use (at set program rates)

Ineligible costs

- annual crop seed (ex: nurse crop)

Notes

The objective of this BMP is to protect soil vulnerable to erosion and salinization. By establishing a perennial crop where the growth of annuals is otherwise poor, there should also be an increase in carbon sequestration and soil organic matter (SOM). An added benefit of flowering perennial cover is increased biodiversity and pollinator habitat. The intention is to maintain permanent perennial cover on sensitive land; therefore, the land should not be converted from perennial forages to annual crops as the environmental benefits would not be upheld.

BMP specific questions

The following information will be required in the application:

- What perennial species have you selected and why were these particular species chosen?
- Do you intend to leave the perennial permanently or will you terminate the stand in the future?
- What is the number of acres of perennials seeded?
- What crops have been growing in the project area in the last 5 years?
- How will implementing this BMP change your current farm practice?
- Attach a diagram or aerial photograph that identifies the field(s) on which this project will take place. Identify areas of risk (i.e. sensitive areas) and indicate where the perennial will be seeded.

Reference materials

For more guidance in developing your application, visit:

- Manitoba Agriculture: **Soil Management Guide** - Soil Salinity and Soil Erosion chapters
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BMP: Utilization of Drainage Water (602)

Utilizing tile drainage water by recycling it back onto the land is an alternative to discharging it downstream. In order to recycle drainage water to enhance crop production, the water has to be captured and then applied to a field via pumping (conventional irrigation) or the flow has to be reversed into the ground (sub-irrigation). The ability to use captured drainage water to meet crop demand during dry periods represents an adaptation to anticipated volatility in water availability due to climate change. This practice also enables recovery of nutrients by the crop, which may increase yield and reduce nutrient loss from the fields.

Cost share ratio and funding cap

There is a cost share ratio of 50:50 and a funding cap of \$15,000 for this BMP.

Eligible costs

- irrigation-specific equipment: pivots, travelling gun, sub-irrigation
- pumps, hoses, pipes, filtration systems, generators or other power source
- personal labour (\$25 per hour) and personal equipment use (at set program rates)

Ineligible costs

- conventional irrigation equipment used exclusively for non-drainage water

Notes

- Funding will be based on the percentage of drained tile water recycled. For example, if you wanted to irrigate from a retention structure that had a total capture of 75 per cent surface water and 25 per cent tile drained water, only 25 per cent of the eligible costs would be eligible for funding.
- Proponent must have a Licence to Construct Water Control Works before construction begins and a Licence to Use Water for Irrigation Purposes (if needed).
- Design-focused costs (e.g., site investigation by specialized consultants, design plans by tile installers, construction designs for retention structures) are eligible through BMP 101: Resource Management Planning.
- Water retention structures and control structures are eligible through BMP 601: Sub-Surface Drainage Water Management.

BMP specific questions

The following information will be required in the application:

- What is your current water management strategy?
- How prepared is your farm currently to contend with variability in moisture levels?
- Could a portion of water demand on your farm based on crop rotation be met by recycling surface or sub-surface drainage water?
- How are you planning to irrigate? Describe the distribution system (pivot, lateral, drip irrigation, sub-irrigation, etc.).
- What is the amount of water per acre you will be applying?

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Farm Environmental Management Survey

Impressive survey

- Large sample of farmers
- Repeated over time
- Information on various aspects of crop and livestock production, including crop types, acreage, practices adopted, wetland drainage, tile drainage, etc.
- Appears to have information on adoption of Environmental Farm Plan
- Appears to track which farms receive financial assistance for BMPs

Evaluating Canadian agri-environmental policy

Which cost share practices are yielding the greatest returns?

How much of the cost share is going to “additional” conservation?

What is the role of social networks in adoption patterns?

How do cost share subsidies interact with land tenure?

- Deaton, Lawley, and Nadella (2018) identify cases where renters are less likely to adopt cover crops

Acknowledgements

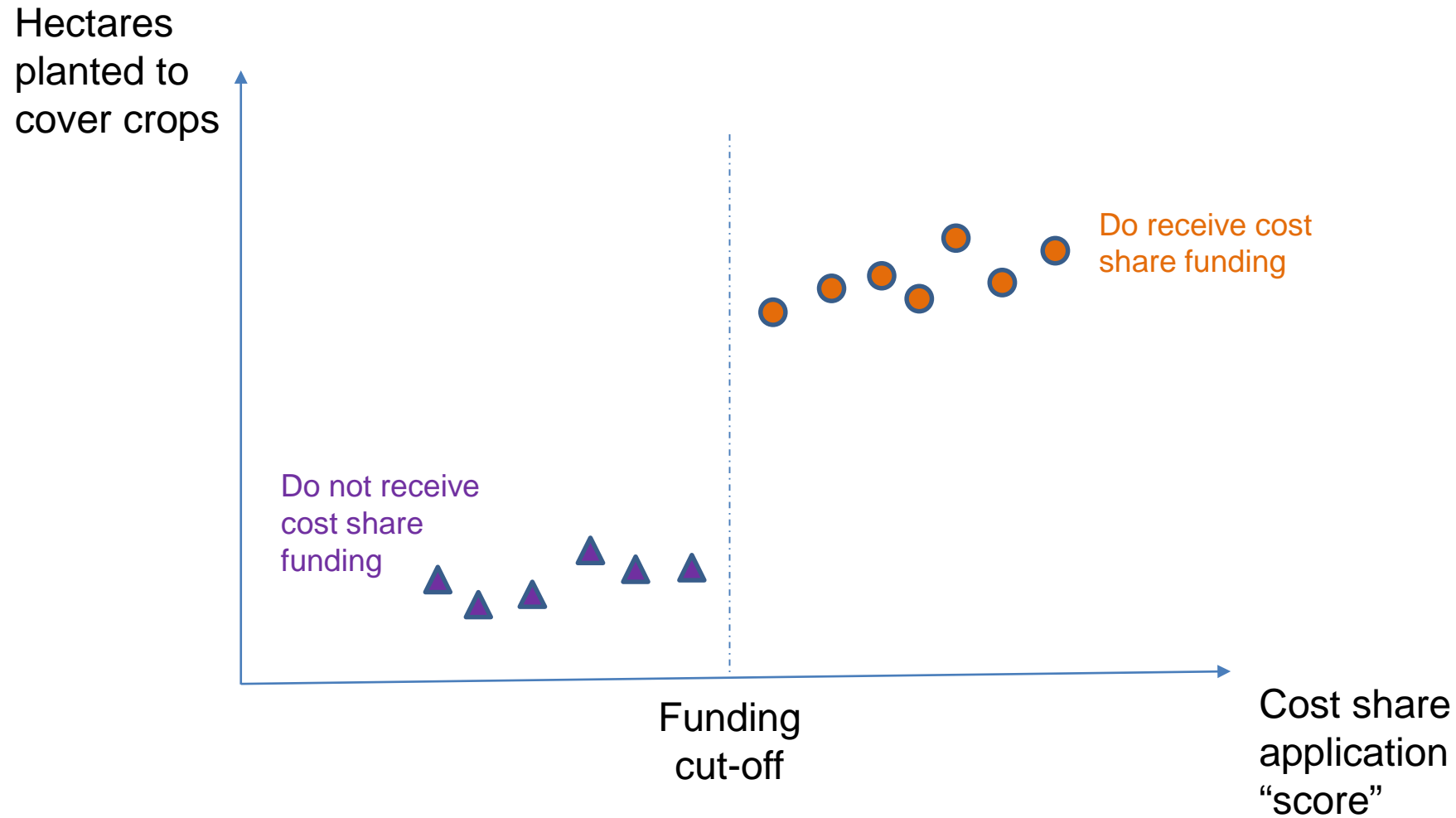
Funding:

Linking Environment and Agriculture Research Network
Social Science and Humanities Research Council

Data obtained from:

- Manitoba Provincial Assessor
- Manitoba Habitat Heritage Corporation
- Ducks Unlimited Canada
- Nature Conservancy Canada
- AAFC
- Manitoba Land Initiative

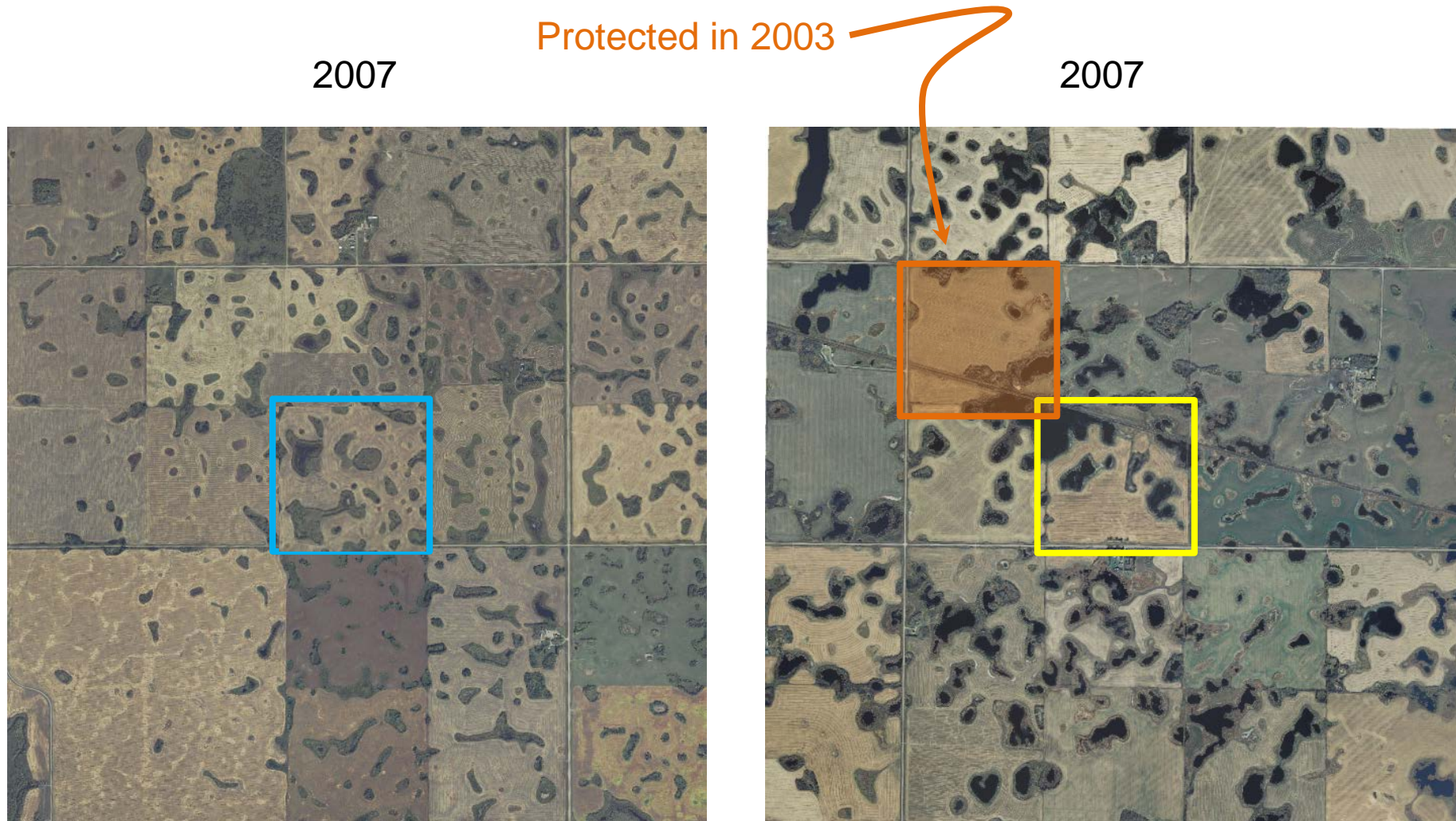
Identifying additionality in cost share programs



What goes into building evidence?

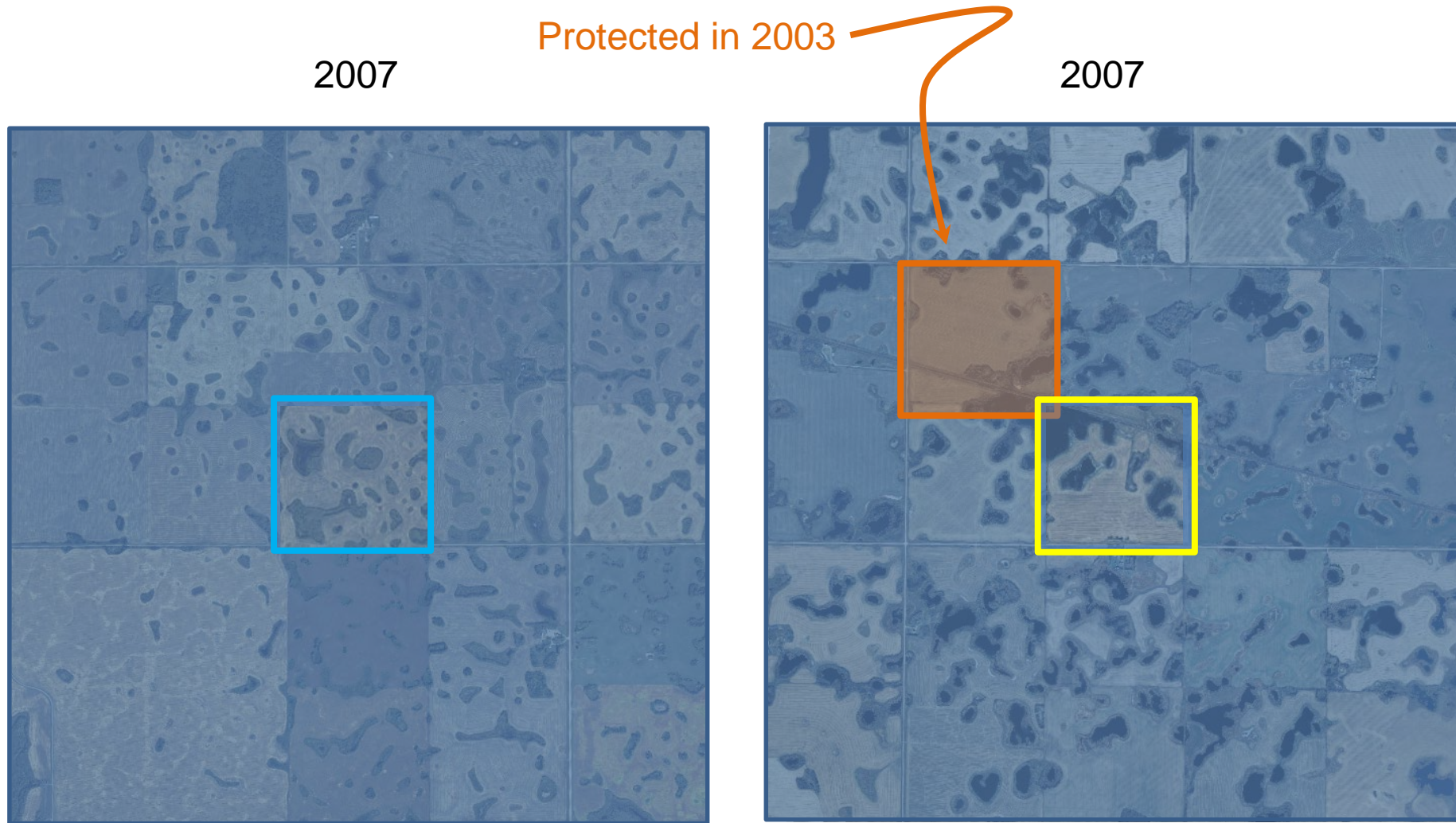
1. Micro-level data (farmers, households, land parcels, etc.)
 - Administrative (property transactions, tax returns, etc.)
 - Survey-based (Ag Census, FEMS, etc.)
2. Policy data
 - Who was targeted?
 - Who adopted/responded/received support?
 - Timing of policy
3. Outcomes
 - What outcomes are important?
 - Need data to identify change over time for different observational units (farmers, households, land parcels, etc.)

Observations of different parcels in same year



How does likelihood of protection differ across parcels in the same year?

Observations of different parcels in same year



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