

Water Quality Trading and Wetland Sinks Economic Considerations

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Wetlands and Global Climate Change, Portland
September 15th - 18th, 2008

Outline

1. Background

- *Watersheds in the US*
- *Research question*

2. Water Quality Trading

3. Water Quality Trading and Wetlands:

- *Method: economic modeling*

4. Main result

5. Conclusion and final remarks

Background

Two large scale problems in US watersheds:

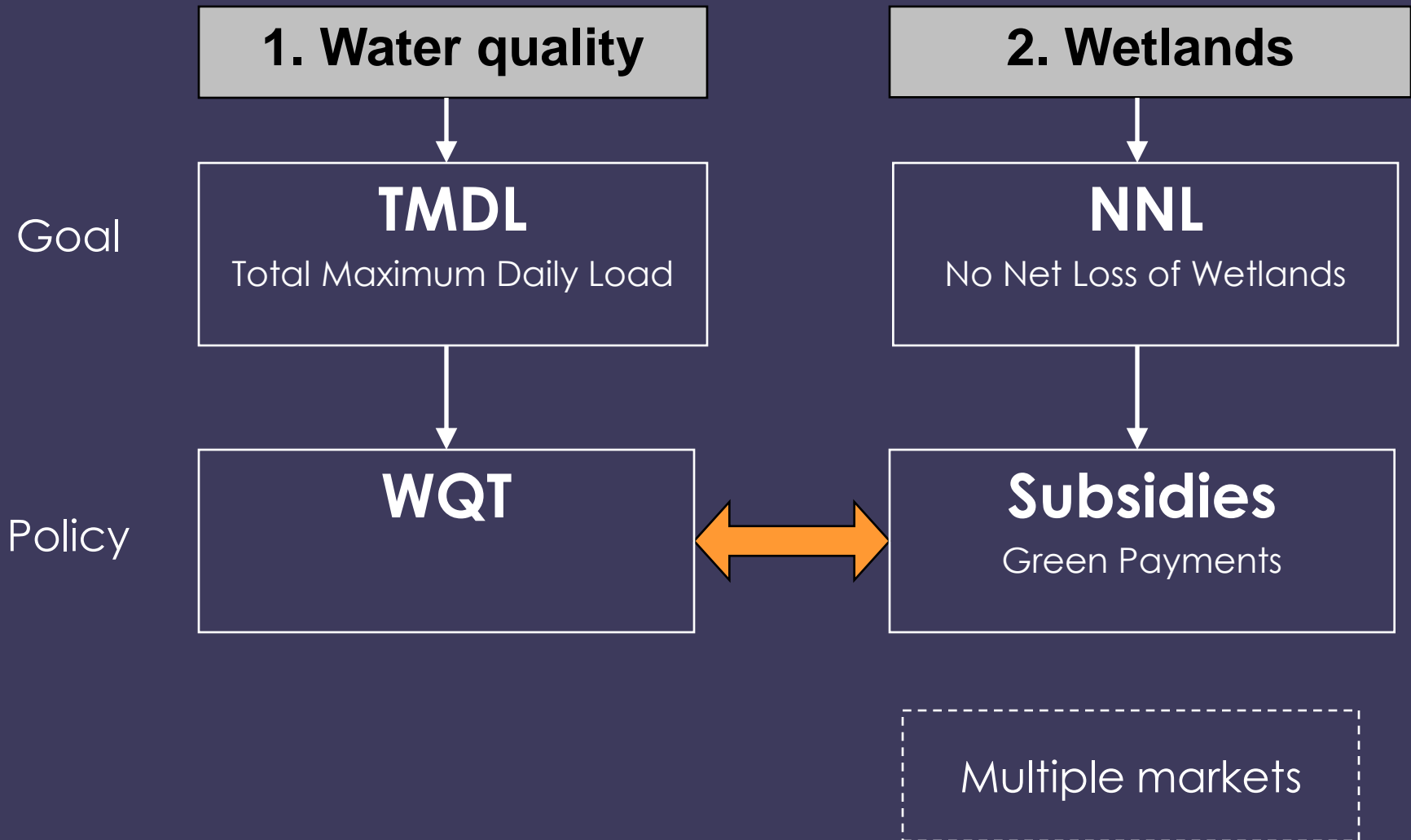
1. Impaired waterways

- ✓ Industrial pollution under control
- ✓ Agricultural runoff (and WWTP) still a problem

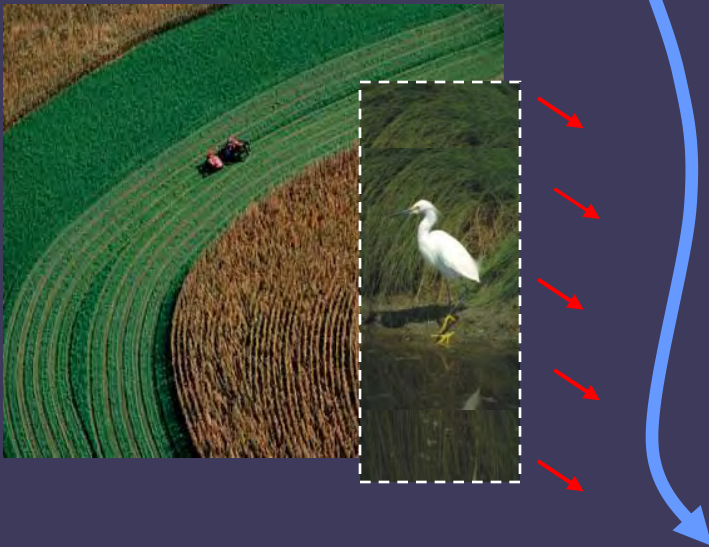
2. Wetland loss

- ✓ 50% WL → other uses by 70s
 - Ecosystems (Wildlife Habitat)
 - Flood control
 - Wetlands can act as Water Treatment Plants

Background



Wetlands



1. Ecosystems

Habitat

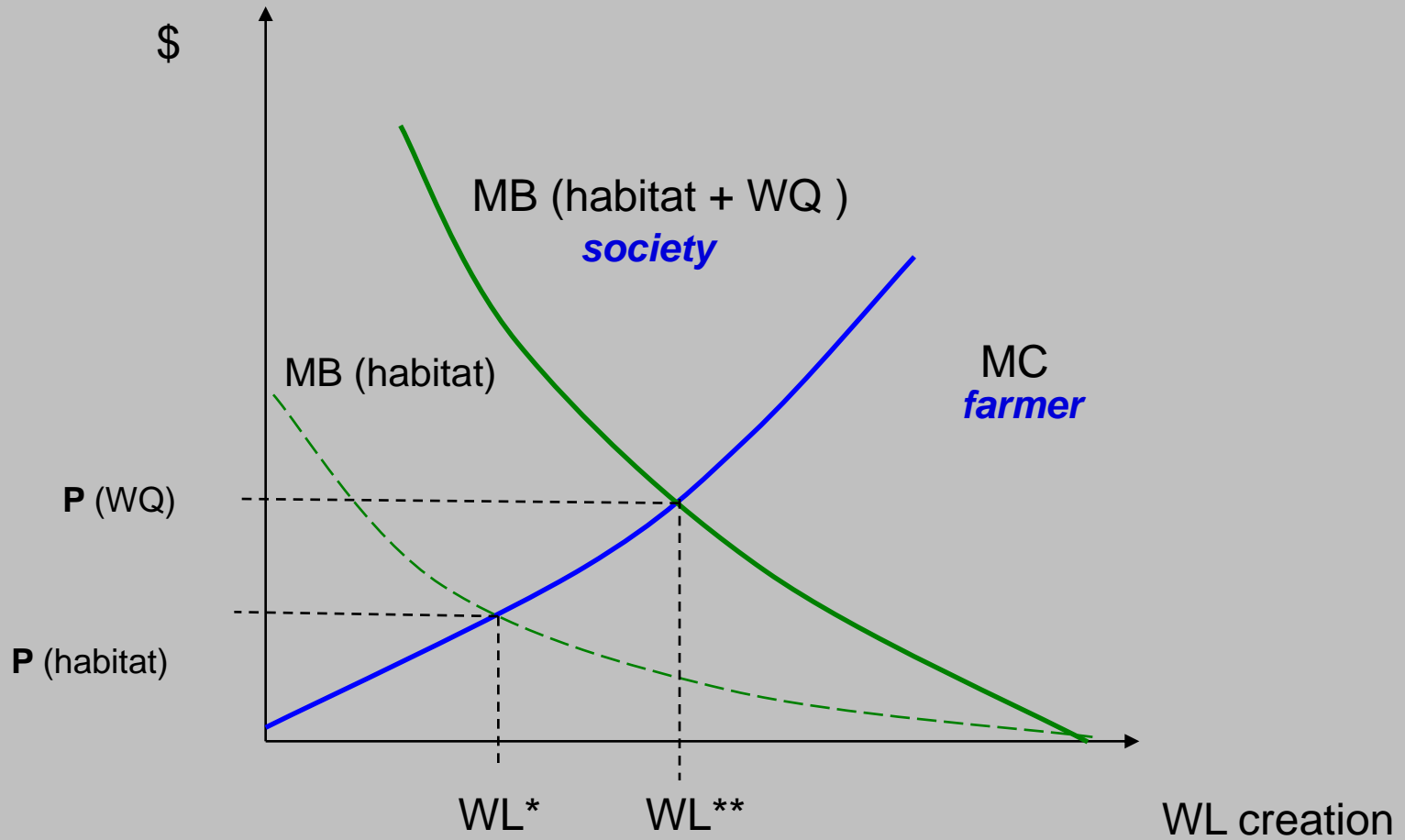
2. WQ enhancement

Nutrient sinks

Land abandonment

“DOUBLE-DIPPING” SHOULD BE ALLOWED (?)

Wetland provision



Background

- Within ORD/USEPA there is a nascent large scale research effort to investigate the use of wetlands to reduce nutrient loading.
- A wetland subsidy could also help develop existing WQT programs (thin markets)

Research question

General

What are the economic considerations of incorporating Wetlands in an efficient WQT program ?

Particular

Can a Wetland subsidy help meet NNL goal and expand WQT markets?

A Developed Watershed

Nonpoint Sources



Agriculture



Point Sources

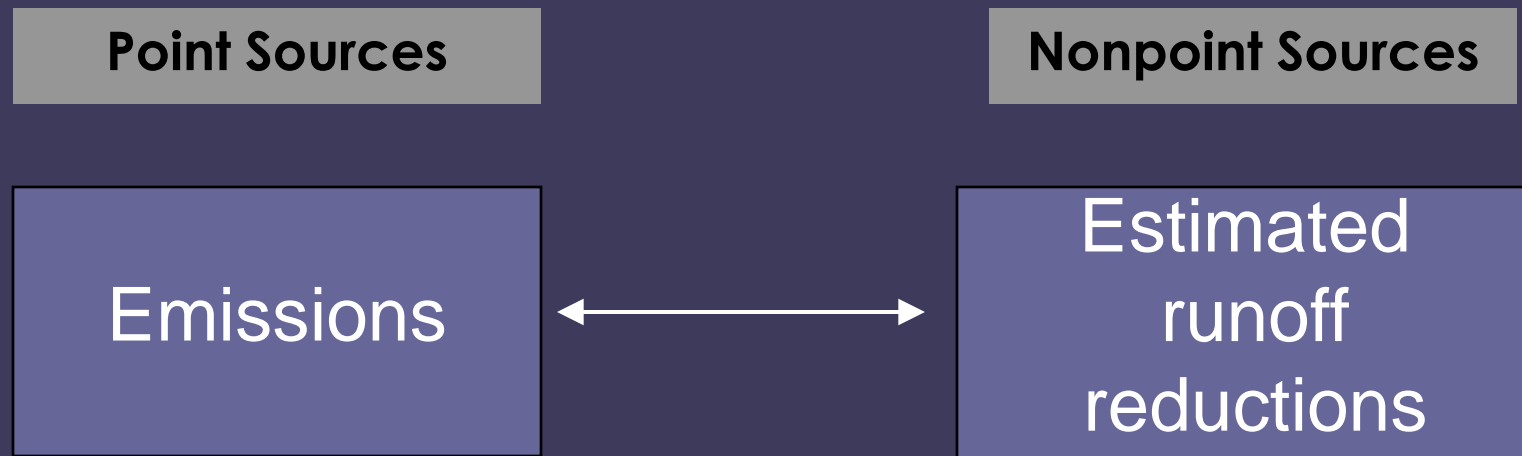


Industry - WWTP



TMDL

Water Quality Trading



RUNOFF = F (fertilizer, till, Buffer-strips,
Wetlands, Weather)

Literature

✓ Ecology

*Focuses on efficiency of wetlands as WWTP
(Býstrom et al 2000; Mitsch & Gosselink 2000)*

✓ Trading & Multiple markets

*Markets for multiple pollutants
(Woodward & Han 2004; Montero 2001; Austin 1997)*

✓ Trading & NPS

*Wetland is just one more input (BMP)
(Horan & Shortle 2005; Horan et al 2004)*

Method

- ✓ Economic Modelling (*Lankoski & Ollikainen, 2003*)
- ✓ Partial equilibrium analysis (*Horan & Shortle, 2005*)
1 PS (farm) - 1 NPS (firms)
- ✓ New features:
 - NPS in “multiple markets”: Y, WQT, WL
 - Wetlands as N-WWTP
 - Land as an allocable input (short / long run)

The farm's problem

Farms' cost function

$$G = g(x, z_2) + p_l[r(x, z_2) - \hat{r}_{nps}^0] - sz_2$$

Y

WQ

WL

Demand for Inputs

$$x(p_y, p_l, w_x, w_{z_2}, s)$$

$$z_2(p_y, p_l, w_x, w_{z_2}, s)$$

Runoff abatement supply in WQ

$$r(x(p_y, p_l, w_x, w_{z_2}, s), z_2(p_y, p_l, w_x, w_{z_2}, s))$$

$$\frac{\partial r}{\partial s} = r_x \frac{\partial x(p_y, p_l, w_x, w_{z_2}, s)}{\partial s} + r_{z_2} \frac{\partial z_2(p_y, p_l, w_x, w_{z_2}, s)}{\partial s}$$

change in abatement supply due to change in s

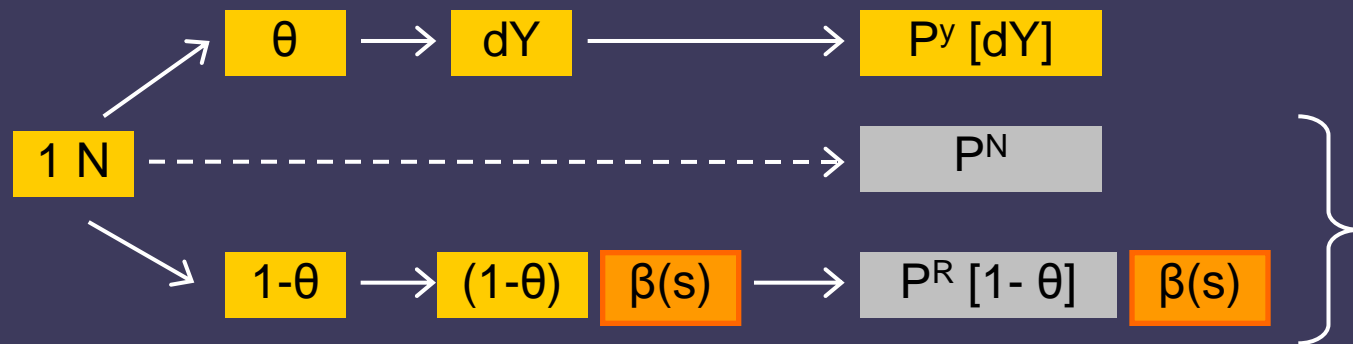
$$\frac{\partial x(p_y, p_l, w_x, w_{z_2}, s)}{\partial s} = \begin{vmatrix} 0 & g_{xz_2} + p_l r_{xz_2} \\ 1 & g_{z_2 z_2} + p_l r_{z_2 z_2} \end{vmatrix} \div \begin{vmatrix} g_{xx} + p_l r_{xx} & g_{xz_2} + p_l r_{xz_2} \\ g_{z_2 x} + p_l r_{z_2 x} & g_{z_2 z_2} + p_l r_{z_2 z_2} \end{vmatrix}$$

$$\frac{\partial z_2(p_y, p_l, w_x, w_{z_2}, s)}{\partial s} = \begin{vmatrix} g_{xx} + p_l r_{xx} & 0 \\ g_{z_2 x} + p_l r_{z_2 x} & 1 \end{vmatrix} \div \begin{vmatrix} g_{xx} + p_l r_{xx} & g_{xz_2} + p_l r_{xz_2} \\ g_{z_2 x} + p_l r_{z_2 x} & g_{z_2 z_2} + p_l r_{z_2 z_2} \end{vmatrix}$$

Results

A wetland subsidy

- ✓ Increases wetlands
- ✓ It also changes relative prices



- ✓ WL subsidy acts like subsidy on polluting inputs!
- ✓ WL subsidy makes farming a better business

Results

Constrained Land

Environmental
Impact

Wetland area z_2^*



increases

positive

Cropland area z_1^*



decreases

positive

Fertilizer use x^*



ambiguous

ambiguous

Abatement supply
in WQT market a^*



ambiguous

ambiguous

Results

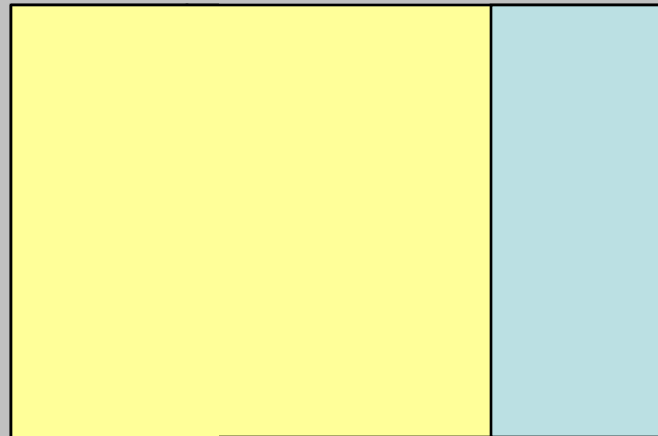
Unconstrained Land

		Environmental Impact
Wetland area z_2^*	increases	positive
Cropland area z_1^*	increases	negative
Fertilizer use x^*	increases	negative
Abatement supply in WQT market a^*	ambiguous	ambiguous

Results

Unconstrained Land

-  Cropland
-  Forested land
-  Wetland



Conclusion

Can a Wetland subsidy help NNL goal
AND expand WQT markets ?

Two preconditions

- ✓ land area is constrained (IN, Illi / Michigan)
- ✓ wetlands actually do the job (science not clear)

Final remarks

Still work in progress:

- a) Simplified model
- b) How important are the effects in real world
- c) Simulations / empirics
- d) Input from ecology / hydrology

Thank you !