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The Political Economy of Conservation Targeting Strategies

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The Political Economy of Conservation Targeting Strategies

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The presentation Is Based on

- Wu, J., D. Zilberman, and B.A. Babcock. “Environmental and Distributional Impacts of Conservation Targeting Strategies." *Journal of Environmental Economics and Management* 41(May 2001): 333-350.
- Wu, J., and W.G. Boggess. "The Optimal Allocation of Conservation Funds." *Journal of Environmental Economics and Management* 37(November 1999): 302-321.

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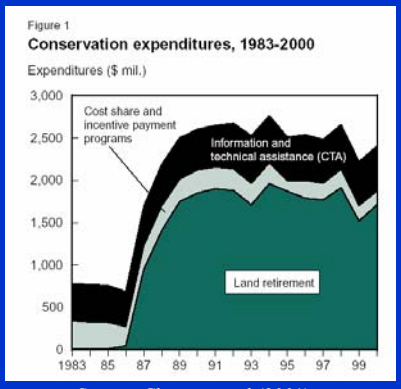
Increasing Expenditure on Agri-Environmental Programs in the U.S.



Source: Claassen et al (2001)

The Trend Is Likely to Continue

- Interest groups view agri-environmental programs as a viable alternative, although for different reasons.
  - New way of delivering farm income supports.
  - New way of encouraging resource conservation and environmental management.
  - New way of preserving the status quo.

Issues

- How should conservation funds be allocated among geographic areas?
  - Should funds be concentrated on fewer watersheds or distributed over a wider geographic area?
  - Should funding priorities be given to areas with the worst environmental problems or areas that have made some environmental improvements?

Issues-cont.

- What criteria should be used to target resources for conservation?
  - Should we target least productive resources or resources that are most vulnerable to environmental problem?
  - What payments should be based on? Should we pay for adoption of certain conservation practices or some measures of environmental benefits?

Issues – cont.

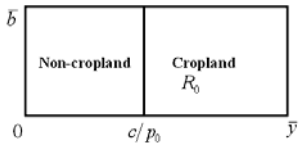
- What are the economic, environmental and distributional implications of alternative targeting criteria?

Outline

- Present an economic model to evaluate the economic, environmental, distributional effects of alternative conservation targeting criteria.
- Discuss how alternative targeting criteria would affect different interest groups, including consumers, producers, farmers, and environmentalists.

A Model of Conservation Targeting Strategies

Suppose a resource manager with a given budget want to target some resources (e.g., land) for conservation in a region.



y = per-acre output
b = per-acre environmental benefit if the land is retired
$s(y, b)$ = probability distribution function of (y,b)
c = per-acre production cost.

The Optimal Land Use

$$\max_{(\delta(y,b))} \quad CS + PS + V(B) = \int_0^Y D^{-1}(z)dz - cQ + V(B),$$

where

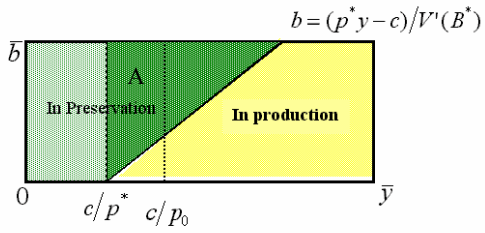
$$Q = \int_0^{\bar{b}} \int_0^{y} \delta(y,b)s(y,b)dydb$$

$$Y = \int_0^{\bar{b}} \int_0^{y} y\delta(y,b)s(y,b)\,dydb$$

$$B = \int_0^{\bar{b}} \int_0^{y} b[1-\delta(y,b)]s(y,b)dydb.$$

$\overline{\delta(y,b)}$ = the share of land with (y, b) in production,
$V(B)$ = the social value of environmental benefits.

An Illustration of the Optimal Targeting Criterion

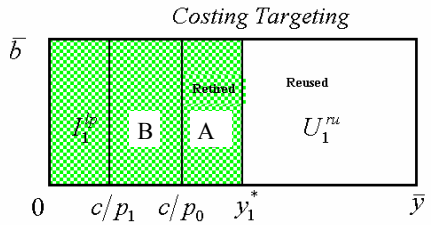


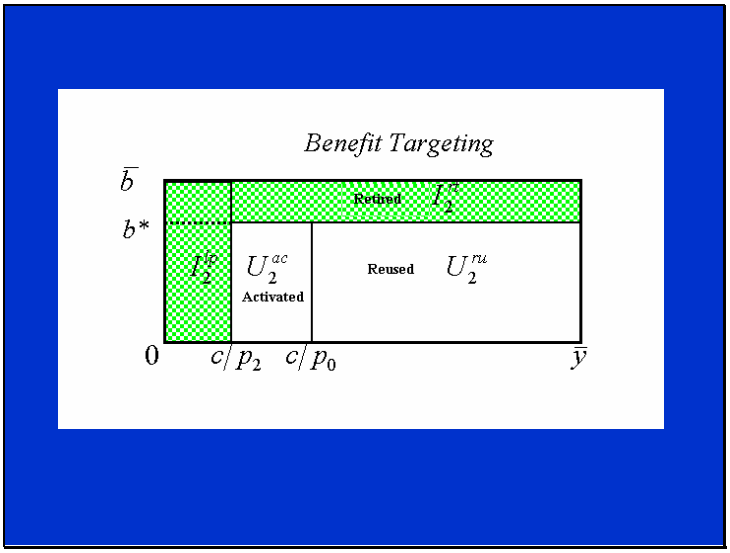
The optimal conservation budget = $B^* V'(B^*)$,

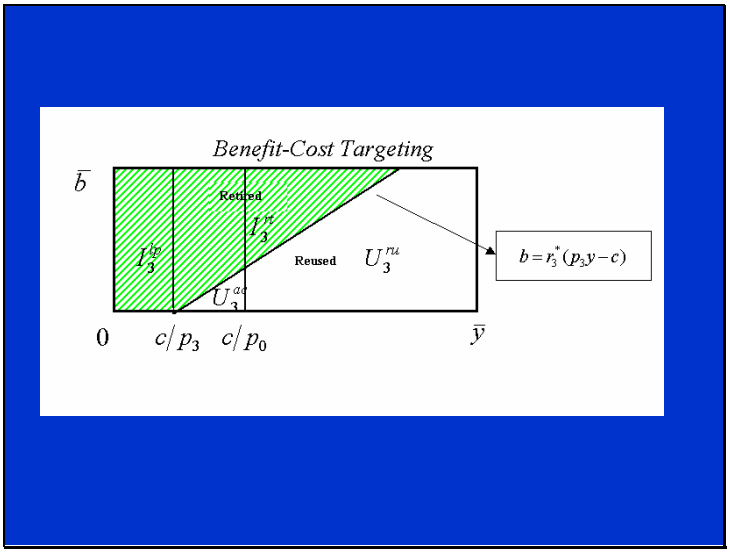
Conservation Targeting Criteria

- Cost targeting – to target resources that are the least expensive (e.g., the CRP before 1990).
- Benefit targeting – to target resources that provide the highest environmental benefit per resource unit (e.g., the U.S. Fishery and Wildlife Service).
- Benefit-cost targeting – to target resources that provide the highest benefit per dollar expended (e.g., the CRP after 1992).
- Benefit-maximizing targeting – to target resources that provide the largest environmental benefit for a given budget (e.g., EQIP and CREP).

An Illustration of Alternative Targeting Criteria




Benefit Targeting
$\bar{b}$
b^*
Retired
I_2^r
I_2^{ic}
U_2^{ac}
Activated
Reused
U_2^{ru}
0
c/p_2
c/p_0
$\bar{y}$


Benefit-Cost Targeting
$\bar{b}$
Retired
Reused
U_3^{ru}
$b = r_3^*(p_3 y - c)$
0
c/p_3
c/p_0
$\bar{y}$

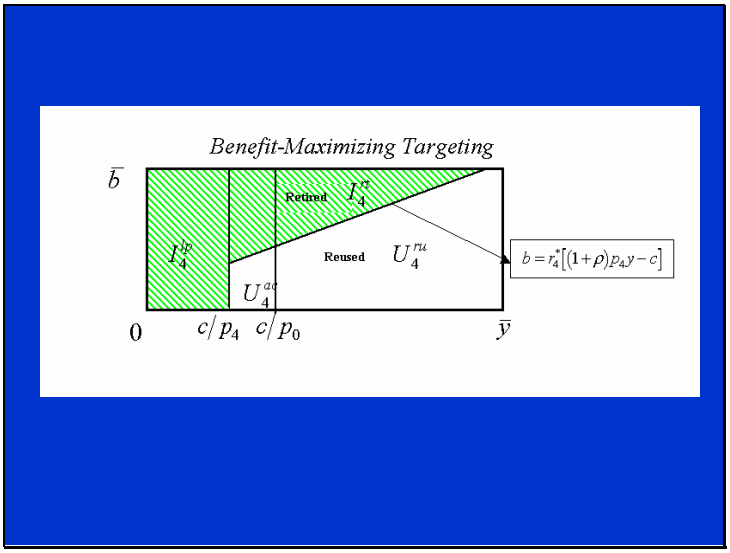
Proposition 2 (Wu, Zilberman, and Babcock, 2001):

i. If output demand is not perfectly elastic, the benefit-cost targeting is no longer maximizing total environmental benefits.

ii. A benefit-maximizing strategy ranks resources from high to low according to

$$\frac{b}{(1+\rho)p_A y - c},$$

where $\rho > 0$ if $\eta < \infty$ and $\rho = 0$ if $\eta = \infty$.


Benefit-Maximizing Targeting
$\bar{b}$
Retired
I_4^{re}
I_4^{ip}
Reused
U_4^{ru}
$b = r_4^*[(1+\rho)p_4 y - c]$
U_4^{ac}
0
c/p_4
c/p_0
$\bar{y}$

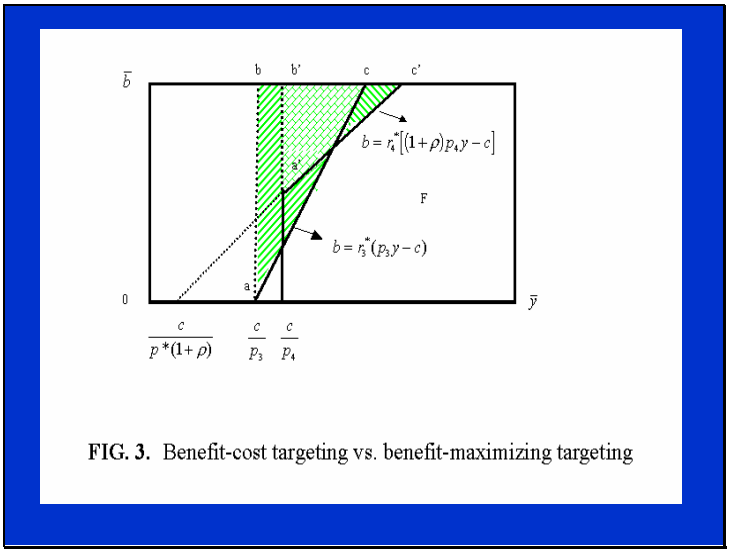


FIG. 3. Benefit-cost targeting vs. benefit-maximizing targeting

Key Performance Measures of Targeting Criteria

i) Total amount of resource in conservation

$$Q(I_i) = Q(I_i^{lp} + I_i^{nt}) = \iint_{I_i^{lp} + I_i^{nt}} s(y,b)dydb,.$$

ii) Total amount of resource in production

$$Q(U_i) = Q(U_i^{nu} + U_i^{ac}) = \iint_{U_i^{nu} + U_i^{ac}} s(y,b)dydb,$$

iii) Total output

$$Y_i = Y(U_i^{nu} + U_i^{ac}) = \iint_{U_i^{nu} + U_i^{ac}} ys(y,b)dydb$$

iv) Producer surplus

$$PS_i = [D^{-1}(Y_i)Y_i - cQ_i] + M,$$

v) Consumer surplus

$$CS_i = \int_0^{Y_i} D^{-1}(\delta)d\delta - D^{-1}(Y_i)Y_i.$$

vi) Total environmental benefit

$$B_i = B(I_i^{lp} + I_i^{nt} - U_i^{ac}) = \iint_{I_i^{lp} + I_i^{nt} - U_i^{ac}} bs(y,b)dydb,;$$

vii) Net gain in environmental benefit

$$\Delta B_i = B(I_i^{nt} - U_i^{ac}) = \iint_{I_i^{nt} - U_i^{ac}} bs(y,b)dydb,$$

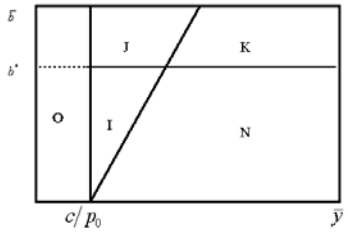
If $\Delta B_i < 0$, the program is counterproductive.

Proposition 3 (*Wu, Zilberman, and Babcock, 2001*):

i) $Q(I_1) \geq Q(I_3) \geq Q(I_4) \geq Q(I_2)$,
ii) $Q(U_2) \geq Q(U_4) \geq Q(U_3) \geq Q(U_1)$
iii) $Y_2 \geq Y_4 \geq Y_3 \geq Y_1$,
iv) $p_1 \geq p_3 \geq p_4 \geq p_2$,
v) $CS_2 \geq CS_4 \geq CS_3 \geq CS_1$,
vi) $PS_1 \geq PS_3 \geq PS_4 \geq PS_2$,
vii) $B_4 \geq B_3 \geq B_1$, $B_4 \geq B_2$.

where
1 - cost targeting
2 - benefit targeting
3 - benefit-cost targeting
4 - benefit-maximizing targeting

An Illustration of Results for the Perfectly Elastic Demand



Resource in Conservation:

$$I_2 = O + J + K$$
$$I_3 = O + J + I$$
$$\Rightarrow \quad Q(I_2) - Q(I_3) = Q(K) - Q(I) \le 0.$$
$$Y_2 - Y_3 = Y(I+N) - Y(K+N)$$
$$= Y(I) - Y(K) \ge 0$$

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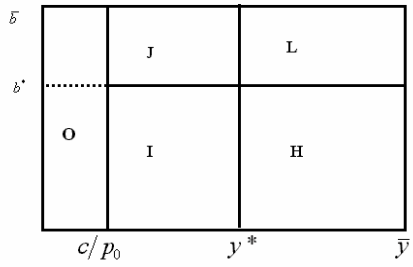
An Illustration of Proposition 1 - Cont.



- Cannot sign $B_1 - B_2 = B(I) - B(L)$??.
- The difference depends on the variation and correlation between productivity and environmental benefits.

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Proposition 3 (Wu, Zilberman, and Babcock, 2001):

i) $Q(I_1) \geq Q(I_3) \geq Q(I_4) \geq Q(I_2)$,
ii) $Q(U_2) \geq Q(U_4) \geq Q(U_3) \geq Q(U_1)$
iii) $Y_2 \geq Y_4 \geq Y_3 \geq Y_1$,
iv) $p_1 \geq p_3 \geq p_4 \geq p_2$,
v) $CS_2 \geq CS_4 \geq CS_3 \geq CS_1$,
vi) $PS_1 \geq PS_3 \geq PS_4 \geq PS_2$,
vii) $B_4 \geq B_3 \geq B_1$, $B_4 \geq B_2$.

where
1 - cost targeting
2 - benefit targeting
3 - benefit-cost targeting
4 - benefit-maximizing targeting

Implications

Benefit targeting:

- Largest amount of resource in production
- Highest output and lowest output price
- Largest consumer surplus
- Should be the most preferred strategy of consumers
- Other groups that may support benefit targeting are labor and input suppliers.
- Least preferred strategy of the resource owners

Implications – Cont.

Cost targeting

- The largest reduction in production
- The largest output price increase
- Landowners' most favored strategy

Coincidentally?

The Conservation Reserve Program, which aims to provide environmental benefit and farm income supports, used cost targeting before 1990.

Implications – Cont.

Benefit-cost targeting

- Maximizes total environmental benefit for a given budget when the output price is fixed.
- An efficient strategy
- When the output demand is not perfectly elastic, it is no longer maximizing total environmental benefit for a given budget.
- Should not be the most preferred strategy of any group.

Implications – Cont.

Benefit-maximizing targeting

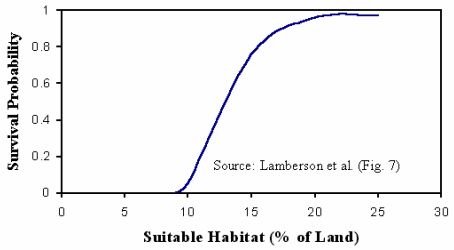
- The price feedback must be considered
- Ignoring the price feedback effect reduces environmental gains of a conservation program, and may make a conservation program counter productive.
  - ✓ Wu (2000) found significantly slippage effects in the CRP.

Implications – cont.

- Threshold effects must be considered.
- A threshold effect is present when a significant environmental improvement can be achieved only after conservation efforts reach a certain threshold.
- Threshold effects have been found in many conservation efforts, particularly those involving fish and wildlife.

An example of Cumulative Effects

Figure 1. Suitable Habitat and Northern Spotted Owl Survival



Implications – cont.

- Targeting based on on-site physical criterion, such as soil erosion rate or riparian conditions, could result in substantial efficiency loss if thresholds effects are present.
- Political pressure to spread money more evenly among interest groups or Congressional Districts may also lead to large efficiency loss.

Historically,

- U.S. conservation programs have been designed to
  - protect specific resources,
  - managed by different agencies, and
  - targeted on the basis of onsite, productivity related criteria.
- Conservation funds are often allocated based on political considerations or are keyed to specific, on-site characteristics.
- They tend to ignore threshold effects, ecosystem linkages, and spatial connections between ecosystems.

Concluding Comments

- In most conservation investments, there are likely some strong non-linearities and ecosystem linkages that militate against the politically palatable funding criteria.
- The design of agri-environmental programs must recognize these complexities of ecosystems.
- Formulas or guidelines based on political consideration, or keyed to a specific on-site physical criterion, are likely to result in substantial efficiency losses.
- While challenges are daunting, payoff is potentially high when sciences are used in the design agri-environmental programs.

Central Message

- Targeting is necessary to achieve economic efficiency, but not sufficient.
- Targeting based on on-site physical criteria will result in substantial benefit loss if threshold effects are present.

This presentation is based on

1. Wu, J., and W.G. Boggess. "The Optimal Allocation of Conservation Funds." *Journal of Environmental Economics and Management* 37(November 1999): 302-321.

2. Wu, J., R.M. Adams, and W.G. Boggess. "Cumulative Effects and Optimal Targeting of Conservation Efforts: Steelhead Trout Habitat Enhancement in Oregon." *American Journal of Agricultural Economics*, 82(May 2000): 400-413.

3. Wu, J., D. Zilberman, B.A. Babcock. "Environmental and Distributional Effects of Conservation Targeting Strtegies." *Journal of Environmental Economics and Management* 41(May 2001): 333-350.

4. Wu, J., and K. Skelton. "Targeting Conservation Efforts in the Presence of Threshold Effects and Ecosystem Linkages." *Ecological Economics* 42(August 2002): 313-331.

5. Wu, J., K. Skelton, W.G. Boggess, and Richard M. Adams. "Pacific Salmon Restoration: Tradeoffs Between Economic Efficiency And Political Acceptance." *Contemporary Economic Policy*. 21(1) (January 2003): 78-89.

6. Watanabe, M., R.M. Adams, J. Wu. "A Spatially Explicit Model for Allocating Conservation Efforts: The Grande Ronde River Basin, Oregon." Presented in the 2003 Workshop of the Association of Environmental and Resource Economists, Madison, Wisconsin, June 15-17, 2003.

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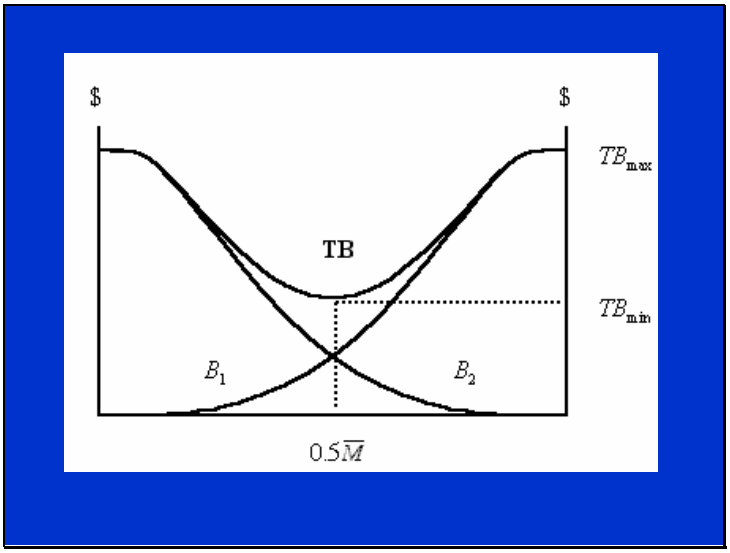

Three Challenges for the Design of Conservation Policies

- Threshold effects
- Ecosystem linkages
- Spatial connections

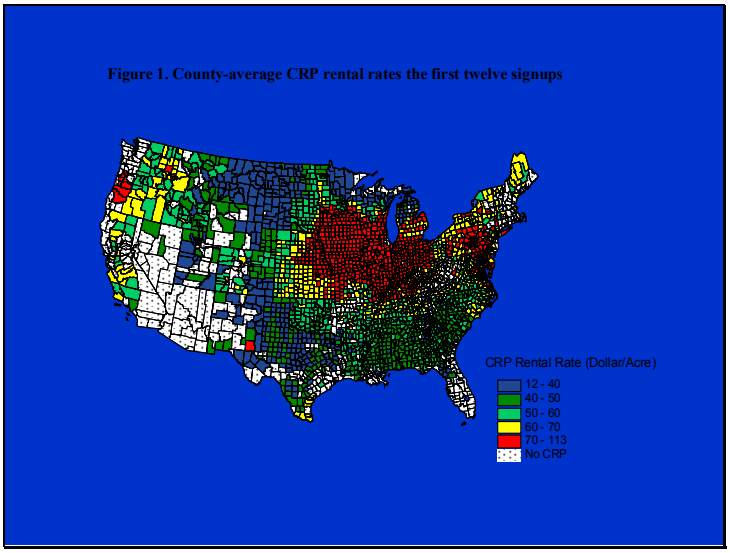
Figure 1. County-average CRP rental rates the first twelve signups
CRP Rental Rate (Dollar/Acre)
12 - 40
40 - 50
50 - 60
60 - 70
70 - 113
No CRP

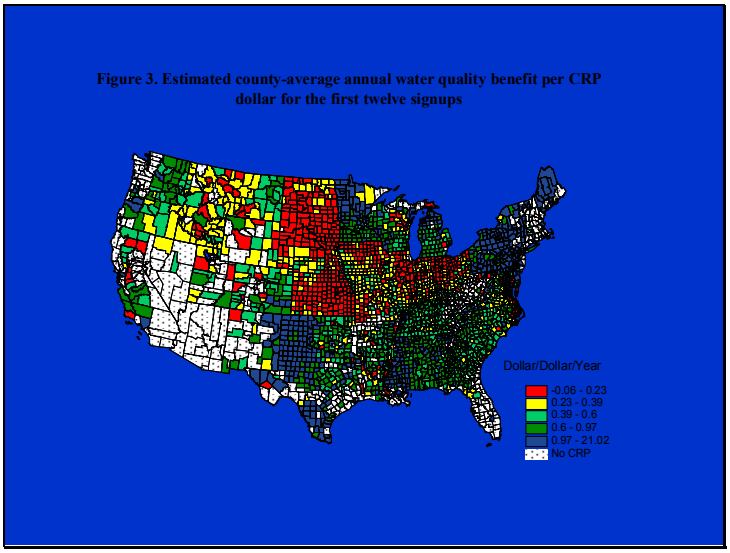
Figure 3. Estimated county-average annual water quality benefit per CRP dollar for the first twelve signups
Dollar/Dollar/Year
-0.06 - 0.23
0.23 - 0.39
0.39 - 0.6
0.6 - 0.97
0.97 - 21.02
No CRP