Hedonic pricing approach

OLS Model

$$lnP_{ijt} = \beta_0 + \beta_X X_i + \beta_N N_j + \beta_P Pond_{ij} + \beta_R RingPond_i + \gamma_Y Year_t + \gamma_S Subd_j + \varepsilon_{ijt}$$

Spatial autoregressive (SAR) model*

$$lnP_{ijt} = \rho W_{ij} lnP_j + \beta_0 + \beta_X X_i + \beta_N N_j + \beta_P Pond_{ij} + \beta_R RingPond_i + \gamma_Y Year_t + \varepsilon_{ijt}$$

Hierarchical Spatial Autoregressive (HSAR) model*

$$lnP_{ijt} = \rho W_{ij} lnP_j + \beta_0 + \beta_X X_i + \beta_N N_j + \beta_P Pond_{ij} + \beta_R RingPond_i + \gamma_Y Year_t + \delta\theta + \varepsilon_{ijt},$$
$$\theta = \lambda M\theta + u$$

where

lnP_{ijt}= log price of house *i* sold in year *t* located in subdivision *j*

X_i= vector of structural characteristics

N_j= neighborhood characteristics

$Pond_{ij}$= pond-related characteristics

$RingPond_i$= buffer rings from the pond

$Year_t$= selling year of house *i*

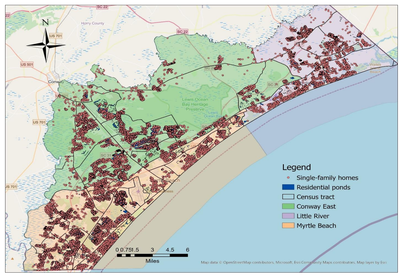
$Subd_j$= spatial fixed effect by subdivision

ε_{ijt}= error term

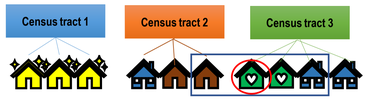
*Additional spatial variables for SAR and HSAR

$W_{ij} lnP_j$= spatial weight matrix at the property-level

Mθ= spatial weight matrix at the census tract-level



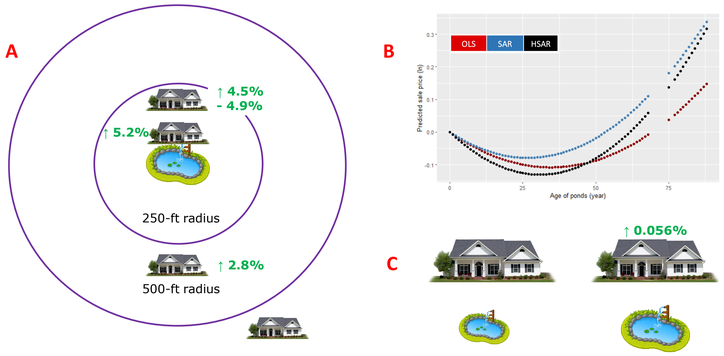
Census tract (adjacent)



Property-level (1.55 miles)

The study covers 29,669 single-family homes sold from 2010 to 2018 in the three coastal districts of Horry County.

Highlights



A. Distance to ponds

- ✓ **Houses adjacent to a pond** are **5.2%** more expensive than a similar house which is 500-ft away from the pond. Given an average home, this would translate to an economic benefit of **$13,355** ($256,833.77 * .052 ~ $13,355).
- ✓ **Houses within 250-ft buffer from the pond** are **4.5% to 4.9%** more expensive than a similar house which is 500-ft away from the pond. Given an average home, this would translate to an economic benefit of **$12,071** ($256,833.77 * .047 ~ $12,071).
- ✓ **Houses within 500-ft buffer from the pond** are **2.8%** more expensive than a similar house which is 500-ft away from the pond. Given an average home, this would translate to an economic benefit of **$7,191** ($256,833.77 * .028 ~ $7,191).
- ✓ When the distance variables were interacted with 'post-pond construction' (whether the nearest pond was constructed or not at the time of transaction), the relationship with sale price became negative indicating a cost of stormwater basins to proximate households.

B. Pond age

- ✓ As the pond becomes older by a year, the sale price falls until it reaches the turning point of either 35 years (OLS), 27 years (SAR), or 31 years (HSAR).

C. Pond size

- ✓ A one-acre increase in the size of the nearest pond would increase the sale price by **0.056%**. Given an average home, this would translate to an economic benefit of **$144** ($256,833.77 * .00056 ~ $144).

Stormwater ponds provide multiple ecosystem services, & SC coastal residents value them.

ABSTRACT

Stormwater practices are mainly built to reduce flooding, but they could generate a wide array of ecosystem services depending on their type and design. In coastal South Carolina (SC), wet detention ponds are the most widely adopted stormwater practice, and they became important features of urban landscape over the years. These ponds are mostly located at residential areas and are typically managed by the respective homeowners' association. Using hedonic pricing approach, we found that single-family homes adjacent to a pond or at a distance not less than 500-ft tend to be more expensive by 3% to 5% compared to those located farther away. Moreover, the results of another valuation technique – a choice experiment approach, revealed that the coastal residents were willing to pay a premium on top of their current stormwater fee to improve the environmental benefits of the nearest ponds — flooding reduction, water quality improvement, wildlife habitat, recreation, and scenic beauty. Depending on the county of residence, survey participants are willing to pay a premium of 30% to 50% for a 50% improvement in pollutant removal efficiencies of the nearest ponds. Also, they are likely to pay a premium of 28% to 51% for the nearest pond to have buffer vegetation and serve as a home for wildlife. Residents would also be willing to pay 11% to 27% premium for the nearest pond to contribute to scenic beauty of their neighborhood. Findings from this work could help stormwater professionals in designing stormwater management strategies that are desirable to local communities.

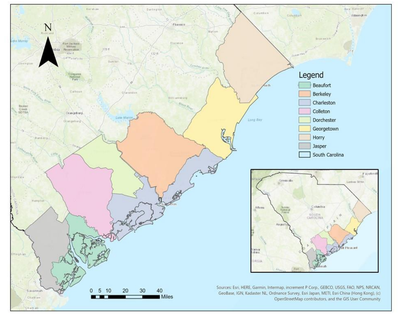
Choice experiment approach

- ✓ Surveyed 1,159 residents from 5 coastal counties
- ✓ 5 ecosystem services and 1 bid amount
- ✓ Econometric model

$$P_{ij} = \int \frac{\exp(x'_{ij}\beta)}{\sum_{j=1}^{J} \exp(x'_{ik}\beta)} f(\beta|\theta) d\beta$$

$$E(WTP^k) = -\frac{E(\beta^k)}{\beta^{price}}$$

- ✓ Data analysis: Mixed logit model



Attributes		Current situation	Benefits of new program
Number of floods in lawn/ backyard		73% of the coastal residents experience ankle-deep flooding in their lawns after strong rainfall events*	25%, 50%, or 75% less frequent than current
Capacity to reduce water pollution		Median pollutant removal rates for wet ponds range from 17 to 96%, depending on the pollutant type	25%, 50%, or 75% more efficient than current
Home for wildlife (buffer vegetation, fish, waterfowl, alligators)			With or without buffer vegetation and wildlife
Aesthetic value/ Scenic beauty			With or without aesthetic value
Recreational value (Canoeing and catch-and-release fishing)		Some well-maintained ponds with boat ramps are used for canoeing and catch-release-fishing	With or without recreational value
Additional stormwater fee per month		Current monthly stormwater fee ranges from $2.66 - $12.50 per month	25%, 50%, or 75% of the current stormwater fee

Attributes and levels of choice experiment model

Given the set of wet pond attributes with corresponding effects to the ecosystem services, which option will you choose?

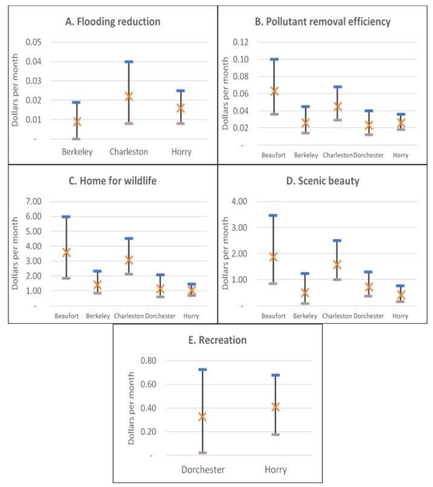
Attributes		Option A	Option B	Current situation
Number of floods in lawn/ backyard		50% less frequent than current	25% less frequent than current	No change
Capacity to reduce water pollution[1]		50% more efficient than current	25% more efficient than current	
Home for wildlife (buffer vegetation, fish, waterfowl, alligators)		Yes	Yes	
Aesthetic value/ Scenic beauty		No	Yes	
Recreational value[2] (Canoeing and catch-and-release fishing)		No	No	
Additional stormwater fee per month		$ 2.2	$ 4.4	$ 0

[1]Median pollutant removal rates for wet pond range from 17% to 96%, depending on the pollutant type (Vulava et al., 2018).
[2]Disclaimer: Certain WATER QUALITY STANDARDS should be met before using ponds for recreational activities.

Option A | Option B | Current situation

Sample choice set in Beaufort County

Highlights



Marginal willingness-to-pay for changes in ecosystem services

A. Depending on the county of residence, residents would be willing to pay an average of 1 to 2 cents per month or **10 to 26 cents annually** for 1% reduction in flooding frequency. This implies 15% to 21% premium above their current stormwater fee.

B. Residents from five counties are willing to pay **27 to 75 cents annually** for a 1% improvement in pollutant removal efficiencies of ponds.

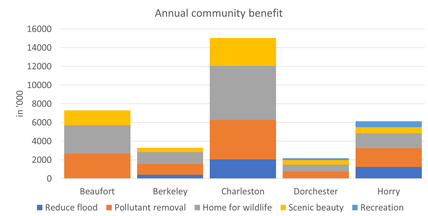
C. When it comes to biodiversity enhancement, residents are willing to pay **$12 to $43 annually** for ponds to serve as wildlife habitat.

D. Residents are willing to pay **$5 to $23 annually** for ponds to contribute to the scenic beauty of their neighborhood.

E. Only the samples from Dorchester and Horry counties were willing to pay **$4 to $5 annually** for ponds to provide recreational benefits.

Annual community benefit

Given the total household population per county, the improvement in the benefits of ponds would translate to an annual community benefit ranging from $2 million to $15 million per county.



Published materials related to this work

Valuing stakeholder preferences for environmental benefits of stormwater ponds: Evidence from choice experiment

Understanding the public behavior in adopting green stormwater infrastructure

VALUING THE ECOSYSTEM SERVICES OF STORMWATER PONDS IN COASTAL SOUTH CAROLINA

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