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# Economic Analysis of Spatial Preferences Heterogeneity of Water Quality

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## 1 INTRODUCTION & OBJECTIVE

The assessment of non-market benefits from the improvement of water quality is a necessary precondition to the implementation of the European Water Framework Directive (WFD).

The impacts of the policy will be geographically uneven. Variation in the physical and socio-economic context involve spatially differentiated perceptions of the benefits.

**The objective** of this study is to account for spatial preference variability in the valuation of water quality improvements in the river basin (RB) context. This contributes to designing accurate rules of aggregation of environmental benefits.

## 2 CONCEPTUAL FRAMEWORK & HYPOTHESIS

$$H_0 : -\frac{\partial V_{ij\tau}}{\partial V_{ij\tau}} \frac{\partial Q_{\tau}}{\partial P} \geq -\frac{\partial V_{ijv}}{\partial V_{ijv}} \frac{\partial Q_v}{\partial P}$$

$V_{ij\tau}$  = utility of respondent  $i$  living in sub-basin  $\tau$   
 $Q_{\tau}$  = water quality change in sub-basin  $\tau$   
 $Q_v$  = in sub-basin  $v$

Stated preferences techniques are applied to the estimation of non-market values for environmental changes.

Valuation rarely includes spatial attributes, while they are relevant for accurate welfare estimation.

**HYPOTHESIS**  
**PEOPLE VALUE WATER QUALITY IMPROVEMENTS HIGHER WHEN IT OCCURS WHERE THEY LIVE (SPATIAL HETEROGENEITY OF PREFERENCES).**

## 3 CASE STUDY & SURVEY DESIGN

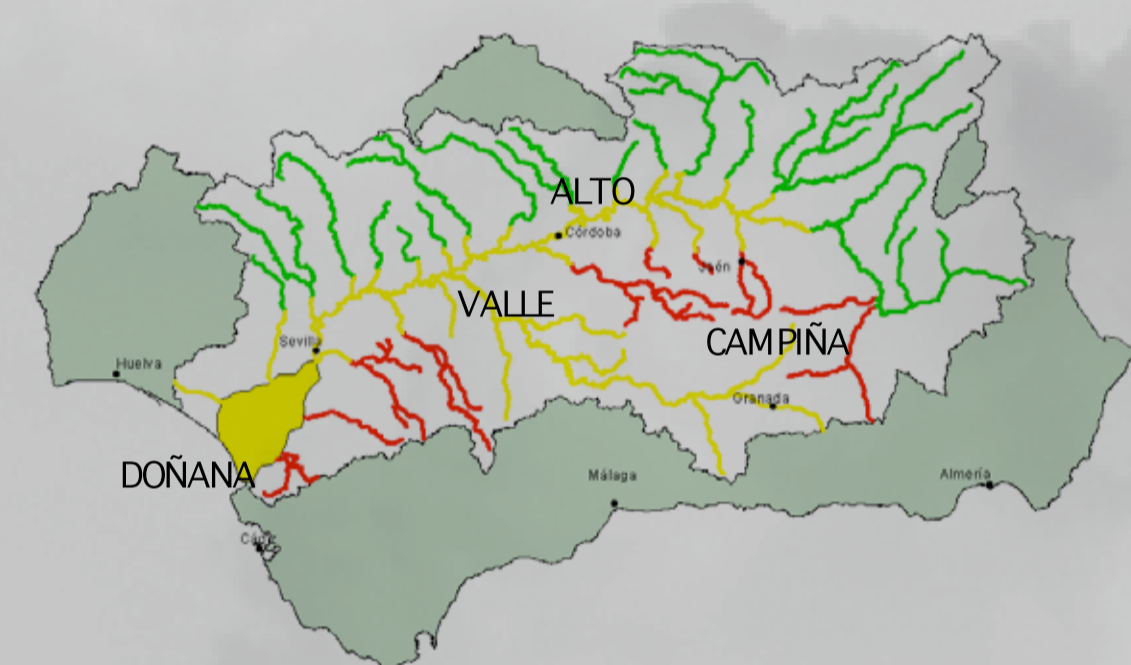
Guadalquivir River Basin (GRB) is the largest in South of Spain (> 4 million people, 57 thousands km<sup>2</sup>).



The GRB is divided in 4 zones of study: Alto, Valle, Campiña and Doñana.

The water quality is defined based on a Quality Ladder of water uses (Resources For the Future Approach).

CURRENT WATER QUALITY LEVELS



WATER QUALITY LADDER

VERY GOOD	→	Suitable for drinking and high ecological status
GOOD	→	Suitable for recreation, such as swimming and fishing
MODERATE	→	Suitable for sprinkling gardens and irrigation
POOR	→	Not suitable for any of the above uses

## 4 METHODOLOGY

Choice experiment, based on Value Theory and Random Utility Theory.

Main effects fractional factorial design presenting 4 choice cards to a cross-section of the RB population. 619 interviews (October 2006).

Willingness to pay for Water Quality changes in the different zones (situations A & B), representing an improvement in relation to the current situation.

Payment vehicle: annual increase on water bill.

“Which situation do you prefer?”

<b>SITUATION A</b> € 50 PER YEAR	<b>SITUATION B</b> € 150 PER YEAR	<b>CURRENT SITUATION</b> NO INCREASE IN WATER BILL

## 5 MODELLING & RESULTS

Testing for spatial heterogeneity of preferences in relation to the place of residence:

TWO MODELS:

**Multinomial Logit Model 1:**

Only attributes, not accounting for spatial heterogeneity of preferences.

**Multinomial Logit Model 2:**

Interactions of attributes with zone of residence. Example:

1) Specific value of local residents: Inhabitant of zone Valle \* Water Quality increase of Zone Valle to the Very Good level.

2) Value of non-local residents: Inhabitant of zone Valle \* Water Quality increase of zone Campiña to the Very Good level.

Good Water Quality - MEAN WTP €/ household per year					
Accounting for spatial heterogeneity	Whole basin sample	Sub-basin sample			
		Alto	Valle	Campiña	
No (MNL 1)	133.9	-	-	-	
Yes (MNL 2)	143.1	143.1	143.1	143.1	

Very Good Water Quality - MEAN WTP €/ household per year					
Accounting for spatial heterogeneity	Whole basin sample	Sub-basin sample			
		Alto	Valle	Campiña	
No (MNL 1)	194.5	-	-	-	
Yes (MNL 2)	256.8	202.2	196.9	228.8	

## 6 CONCLUSIONS

MAIN RESULTS:

**MNL 1:**

All attributes significant with expected signs: the public derives a significant benefit from the improvement of RB water quality.

**MNL 2:**

- At the good level, interaction terms are not significant: the public values the water quality improvement equally in the whole RB regardless where they live.

- At the very good level, interaction terms are significant only for local residents: they place an additional value to the improvement of water quality in their zone of residence.

Not accounting for the extra value of local residents at the very good levels leads to underestimation of the total welfare estimate (32%).

**RESPONDENTS ARE EXPECTED TO VALUE CHANGES IN ENVIRONMENTAL GOOD PROVISION DIFFERENTLY DEPENDING ON SPATIAL CONDITIONS:**

The population values the improvement of the water quality in the whole RB but local residents place an additional value than non-residents for reaching the high ecological status.

**IMPLICATIONS FOR THE AGGREGATION OF WELFARE MEASURES:**

Not accounting for spatial heterogeneity of preferences may yield to underestimation of the welfare measures.

**POLICY RELEVANCE:**

Social and agricultural non-market economic benefits need to be estimated at the RB scale, involving spatial variability. Accurate aggregation rules are crucial.

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