



PREFERENCES FOR NATURE-BASED SOLUTIONS AIMING AT REDUCING FLOOD RISKS

Results of a Discrete Choice Experiment in the Lez catchment (France)

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NATURE-BASED SOLUTIONS FOR REDUCING FLOOD RISK

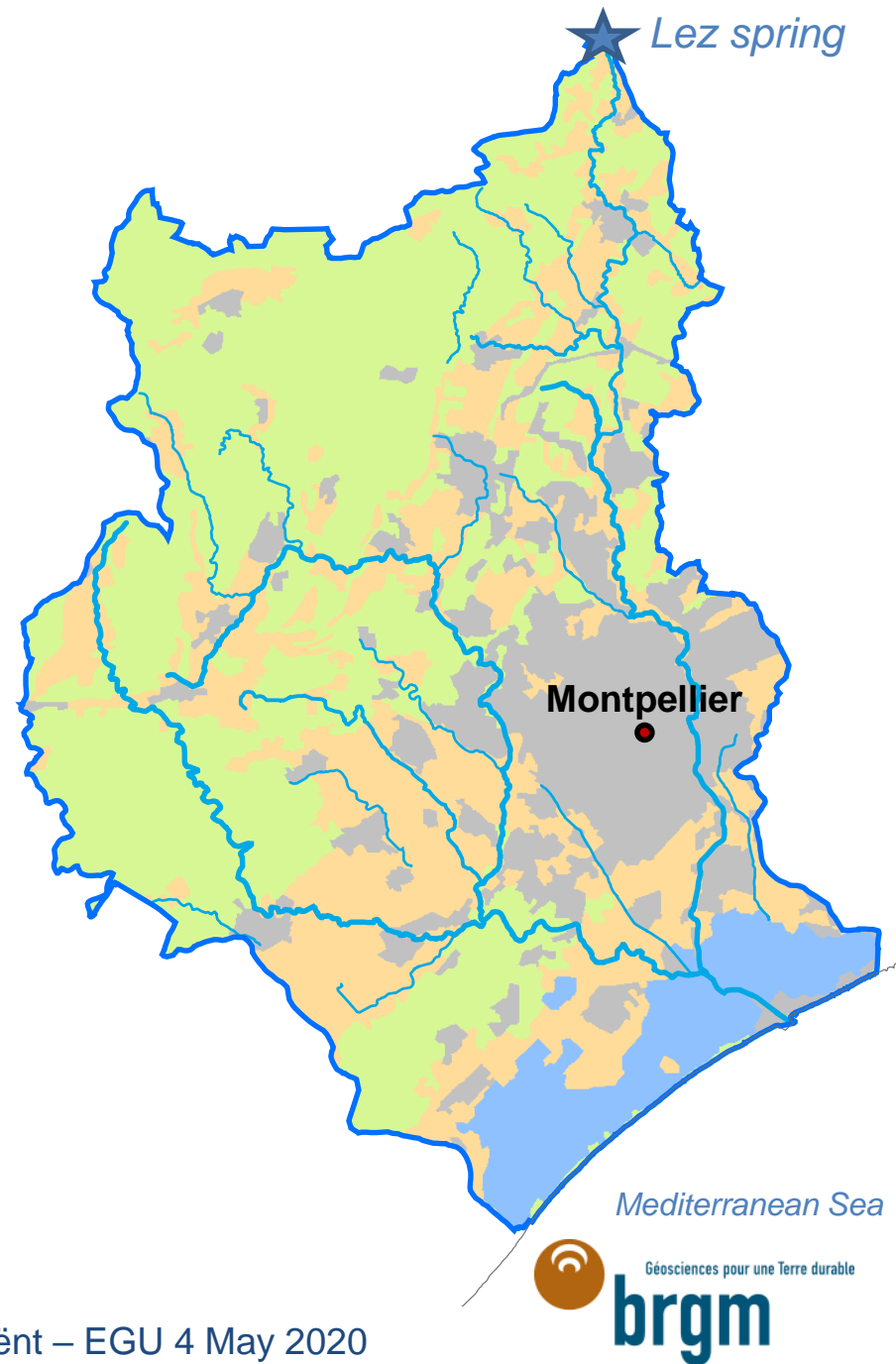
- **Nature Based Solutions (NBS)** are increasingly promoted as innovative solutions to address water risks, especially flood risk reduction
- Their specificity, in comparison to grey solutions, is their capacity to produce a multiplicity of co-benefits
- **Assessing these co-benefits** is therefore fundamental to evaluate properly the opportunity for local authorities to invest in NBS

Do people attach an economic value to the co-benefits associated to NBS aiming at reducing flood risk, and how much?

- Conservation of natural and agricultural areas *versus* green infrastructure: what are the population's preferences?
- Is there some heterogeneity in preferences ? What are the factors explaining this heterogeneity?

THE LEZ CATCHMENT

- 640 km², 460 000 inhabitants
- Rapid urbanisation in the plain
+2920 ha from 1990 to 2012
(+1,2%/year)
- Typical Mediterranean weather →
Flash floods of the Lez and its
tributaries + runoff flooding in urban
areas
- 2014: 65 million € damages for private
housing and businesses
- 78% due to runoff



THE LEZ CATCHMENT

Flood risk & future urban development

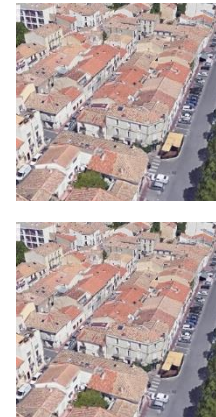
- Population growth
- Challenge to manage urban development with flood risk management in the future

TODAY
 + 140 000 inh.
 (+75 000 housing)
 ↓
2040
 If urban sprawl continues

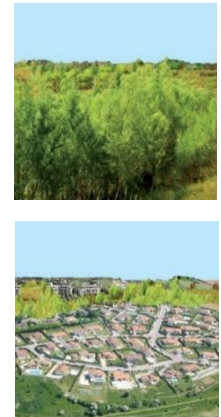
Example 1
urban area
 (historic centre)



Exemple 2
urban area
 (centre periphery)



Example natural
and agricultural
area



3200 ha
waterproofed

3 types of solutions to manage flood risk in the future

NBS



Grey infrastructures



Conservation of natural and agricultural land



Introduction of green infrastructure



METHOD: DISCRETE CHOICE EXPERIMENT (DCE)

Preliminary workshops

- Organisation of 2 workshops with local stakeholders (June 2018 and February 2019)
- Evolution of the Lez catchment by 2040
- Selection of relevant NBS,
- Identification of expected co-benefits, implementation level and barriers
- Presentation of the CE method



DCE survey

- February – July 2019: preparation
- August 2019: face-to-face interviews with 29 respondents (pre-test survey)
- September 2019: on-line survey

Des solutions fondées sur la nature pour diminuer le risque inondation sur le bassin versant du Lez (34)?

Préambule

Ce questionnaire a été développé par le BRGM* dans le cadre d'un projet de recherche européen. Son objectif est de connaître votre opinion sur la place de la nature en ville et le risque inondation. Cette enquête présente différents scénarios de développement urbain. Ces scénarios sont issus de travaux de recherche et non des projets des collectivités territoriales en charge de l'urbanisme et du développement du territoire. Ils serviront toutefois à alimenter les réflexions pour la réalisation de futurs projets d'urbanisme et de développement du territoire.

* Le Bureau de recherches géologiques et minières (BRGM) est un établissement public de recherche dans le domaine de l'eau, de l'environnement et des risques naturels (<https://www.brgm.fr>)

Avant de commencer, nous souhaitons nous assurer que vous habitez bien sur le bassin versant du Lez.

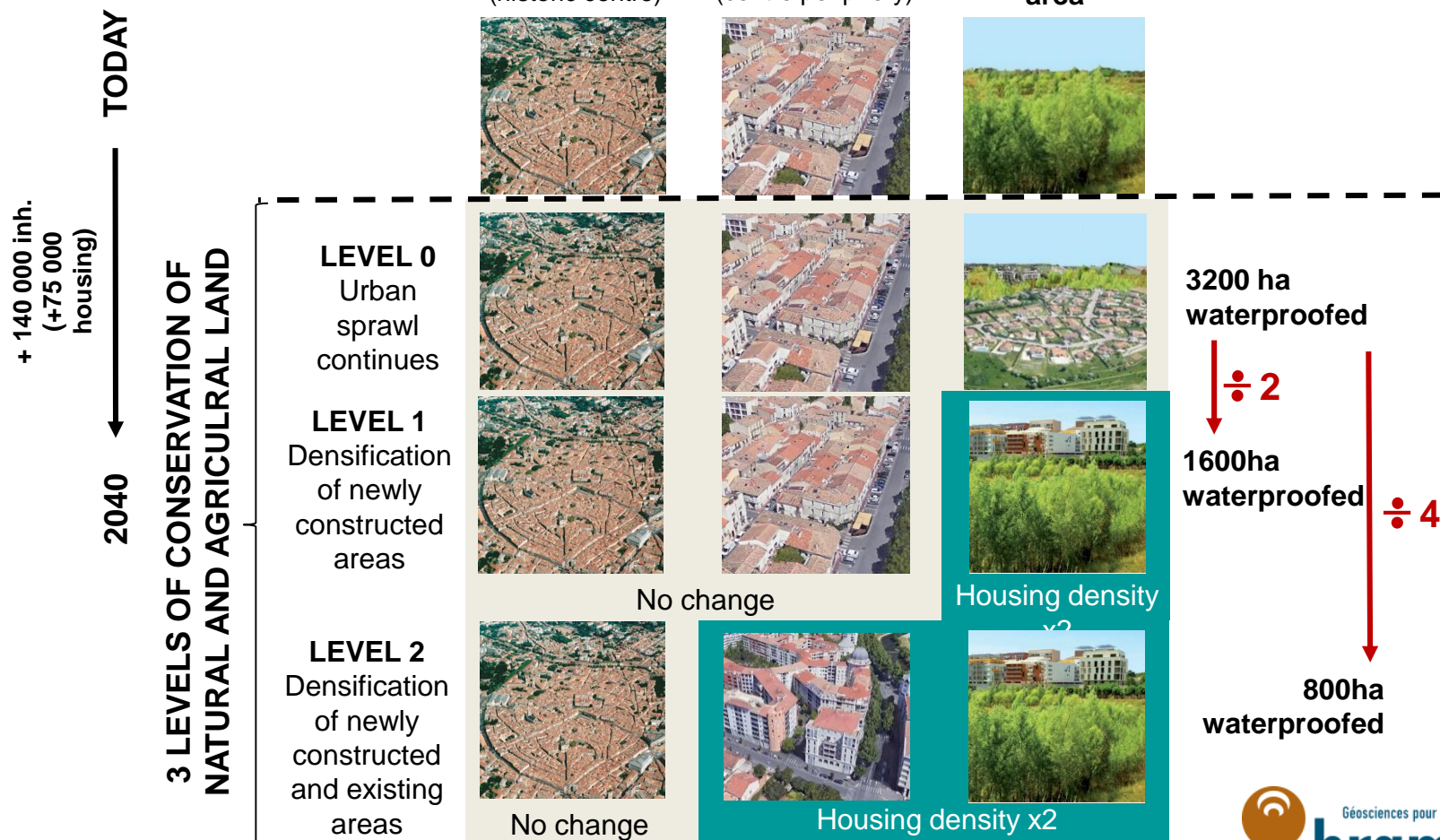
Quelle est votre commune de résidence?

Répondre →

NATURE-BASED SOLUTIONS



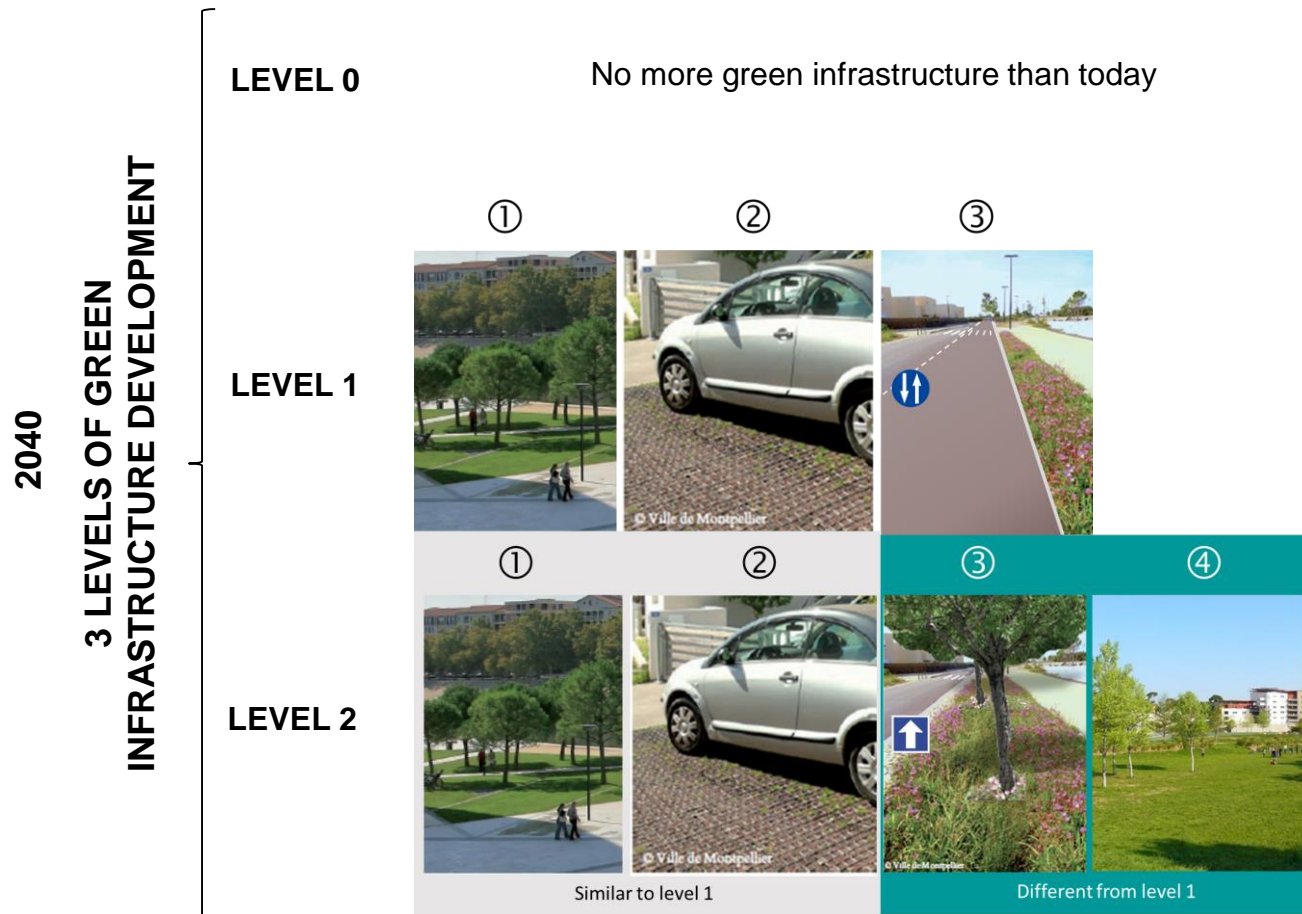
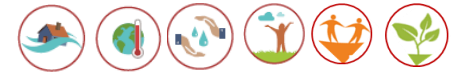
Conservation of natural and agricultural land



NATURE-BASED SOLUTIONS


















Introduction of green infrastructure



CHOICE EXPERIMENT







Attributes and levels

ATTRIBUTE 1 Conservation of natural and agricultural land	LEVEL 0 Continued urban sprawl 	OR LEVEL 1 1600 ha of preserved natural and agricultural areas <div>    </div> <div> No change Housing density x 2 </div>	OR LEVEL 2 2400 ha of preserved natural and agricultural areas <div>    </div> <div> No change Housing density x2 </div>
ATTRIBUTE 2 Green infrastructure	LEVEL 0 No more green infrastructure 	OR LEVEL 1 <div>    </div>	OR LEVEL 2 <div>     </div> <div> Similar to level 1 Different from level 1 </div>
ATTRIBUTE 3 Contribution to local taxes	20, 40, 60, 80, 100 or 120 €/household/year		

CHOICE EXPERIMENT

Choice sets

- Relative preference between attribute levels inferred from the statistical analysis of choices in several choice sets
- Experimental design elaborated with the NGENE software (D-efficient design)
- 2 blocks with 6 choice sets each → respondents randomly respond to 1 block

Conservation of natural and agricultural land	Alternative A LEVEL 2 2400 ha of preserved natural and agricultural areas  <div> No change <div>Housing density x2</div> </div>	Alternative B LEVEL 1 1600 ha of preserved natural and agricultural areas  <div> No change <div>Housing density x 2</div> </div>	None of the 2 strategies
	LEVEL 1  <div> ① ② ③ </div>	LEVEL 2  <div> ① ② ③ ④ </div>	
Green infrastructure			
Contribution to local taxes	60€/household/year	60€/household/year	

Tick your preferred option

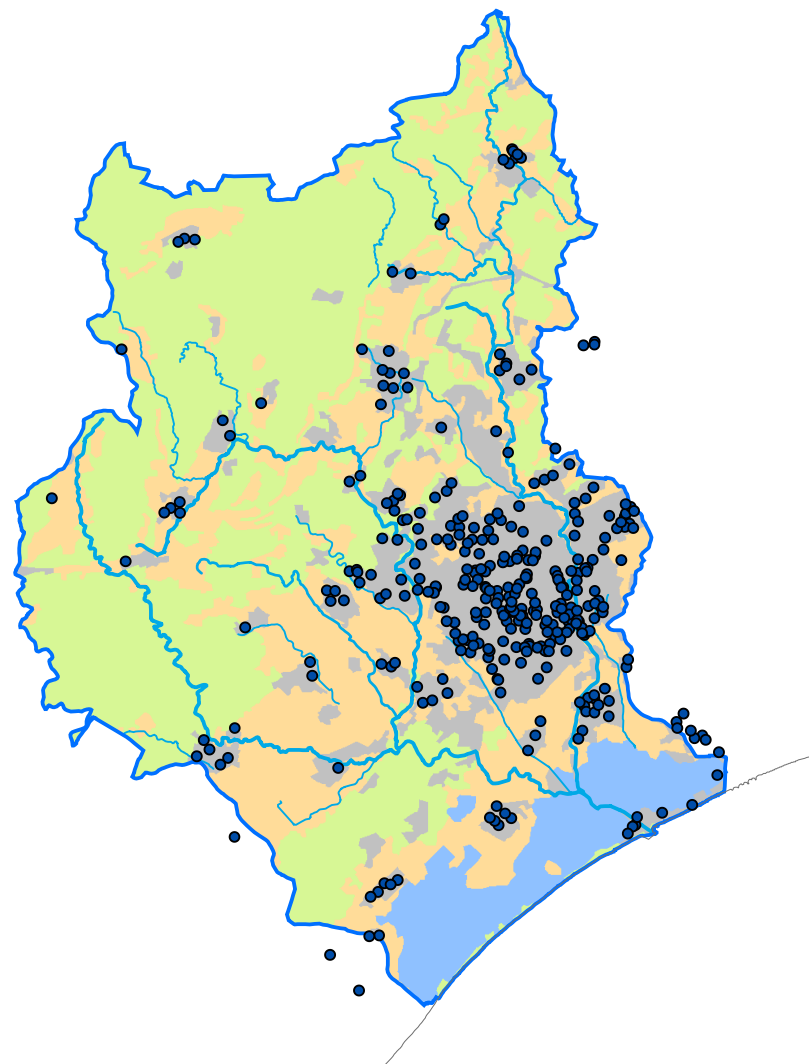
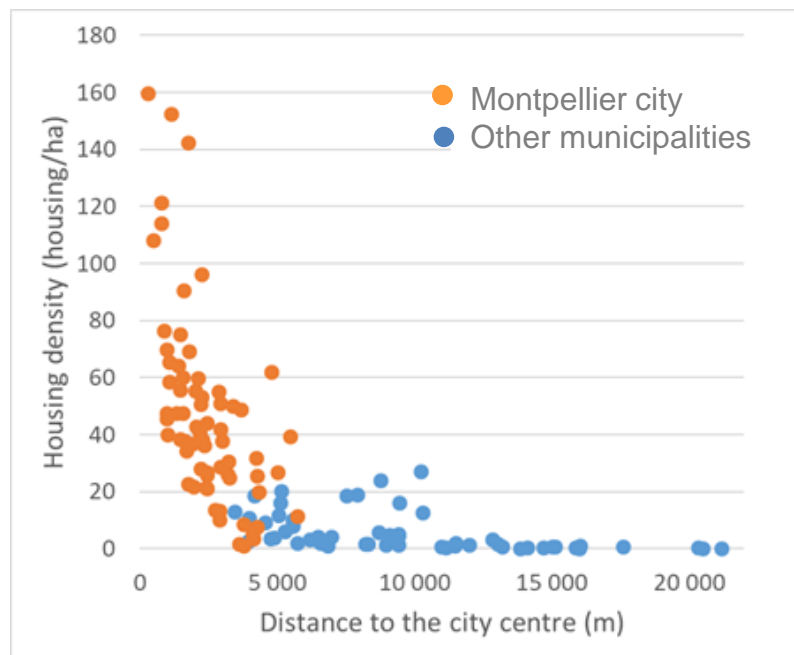
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DATA DESCRIPTION

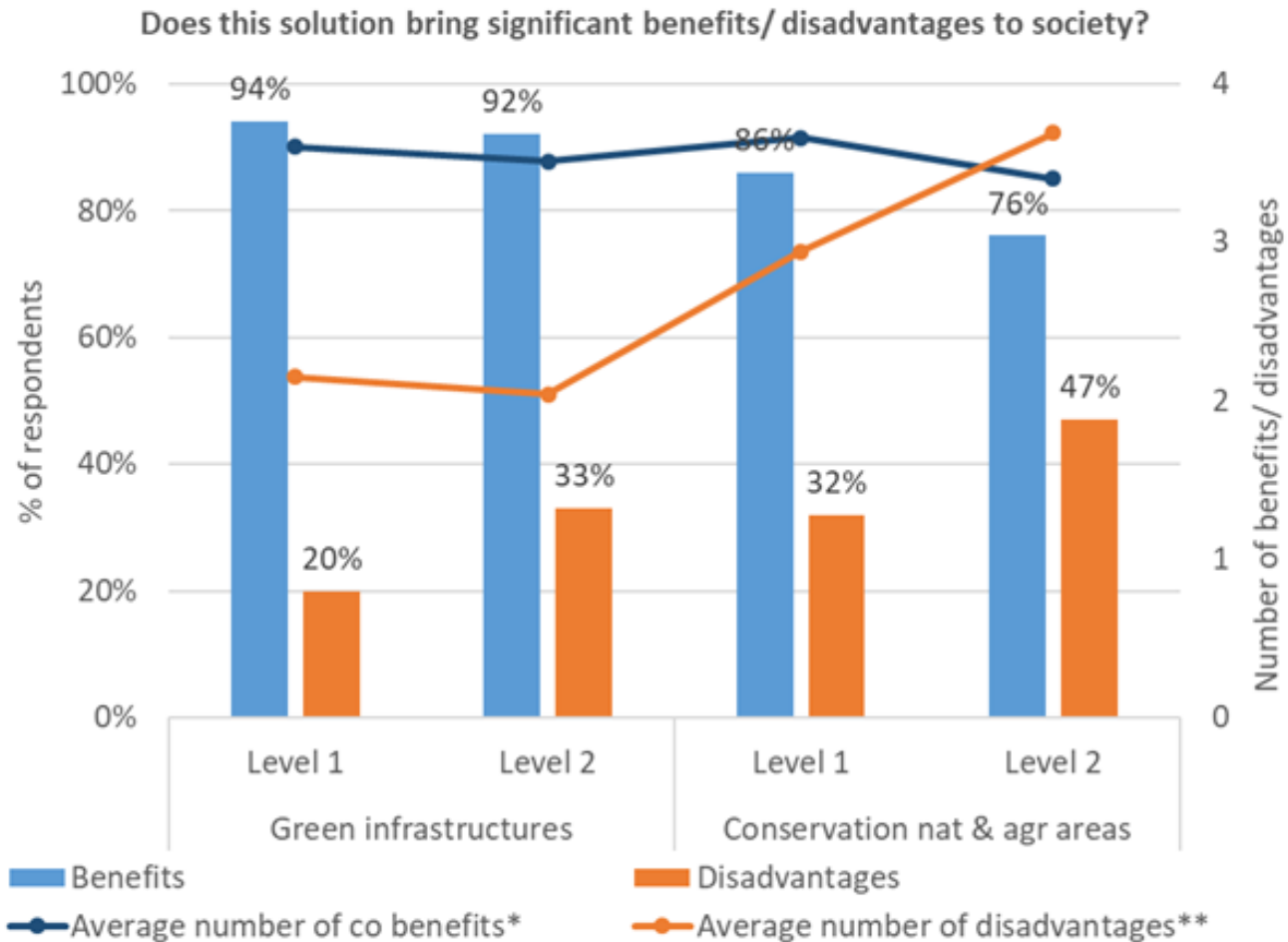
400 respondents living on the Lez catchment

Characteristics	Sample	Lez catchment
Sample size	400	460 000
Sex (% of women)	67%	53%
Employment (% employed)	65%	48%
Mean net income (€/household/month)	2,714	
Mean household size	2,24	2,06
% living in Montpellier city	56%	60%

... along a rural-urban gradient

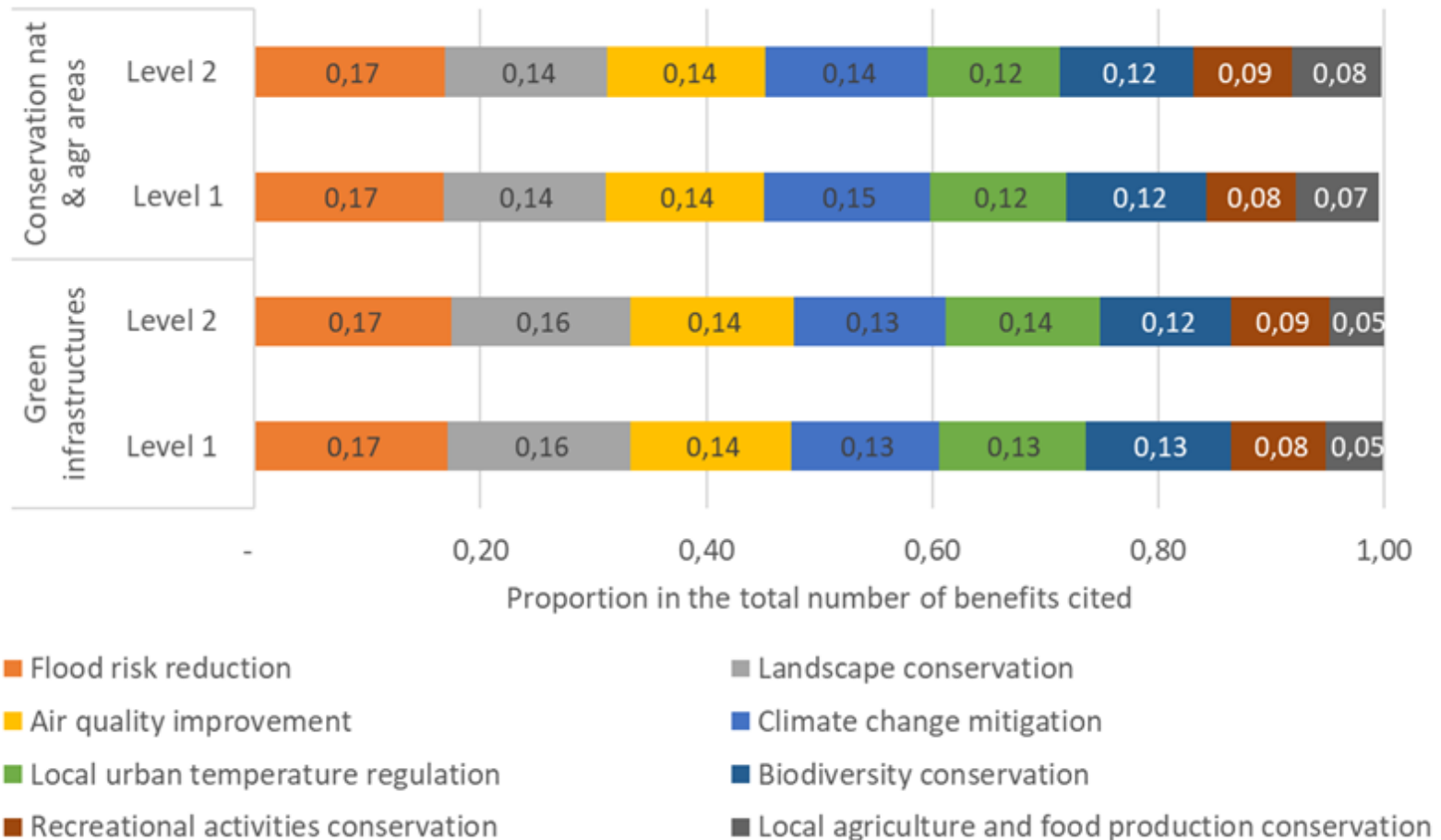


SIGNIFICANT BENEFITS AND DISADVANTAGES ASSOCIATED TO NBS (1)

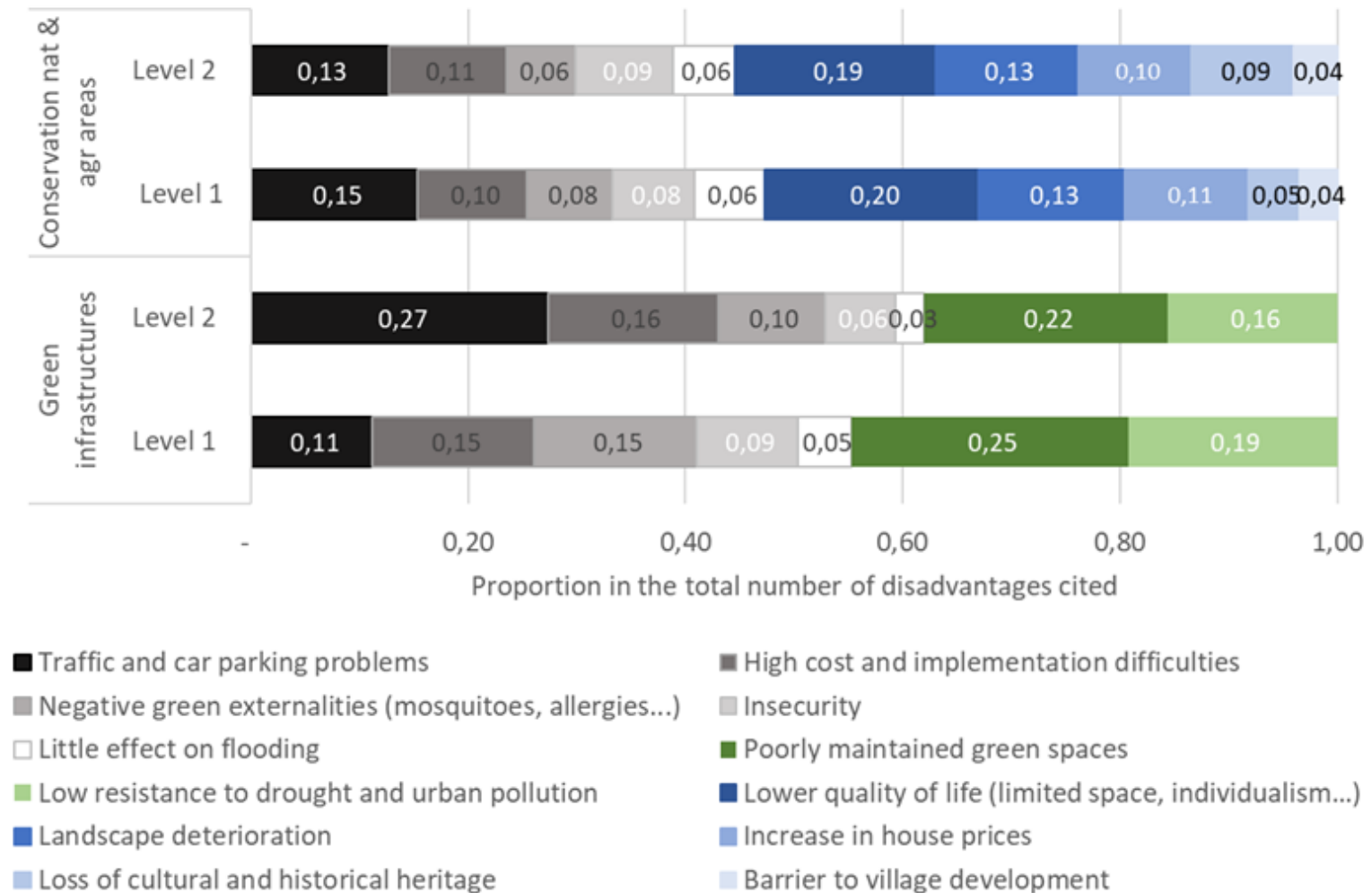


Note: quoted by those who consider that there are significant benefits (*) disadvantages (**)

SIGNIFICANT BENEFITS AND DISADVANTAGES ASSOCIATED TO NBS (2)



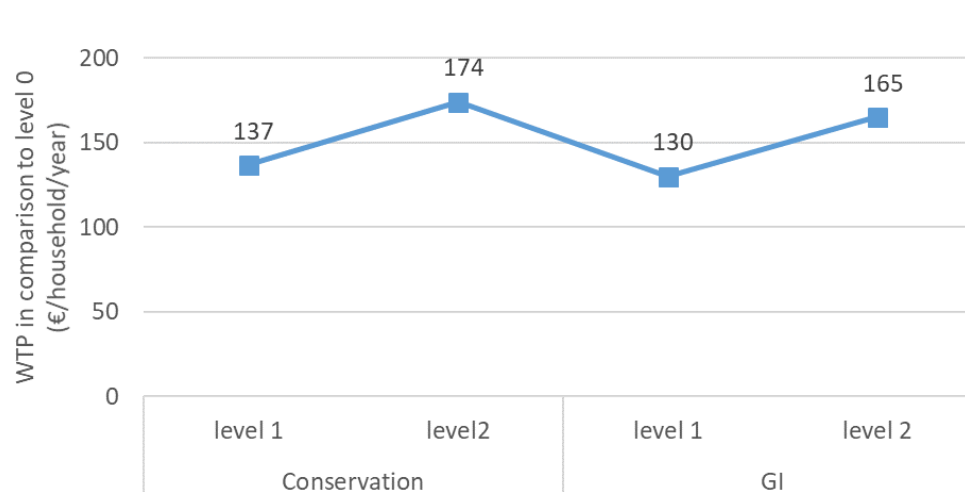
SIGNIFICANT BENEFITS AND DISADVANTAGES ASSOCIATED TO NBS (3)



WTP FOR NBS (1)

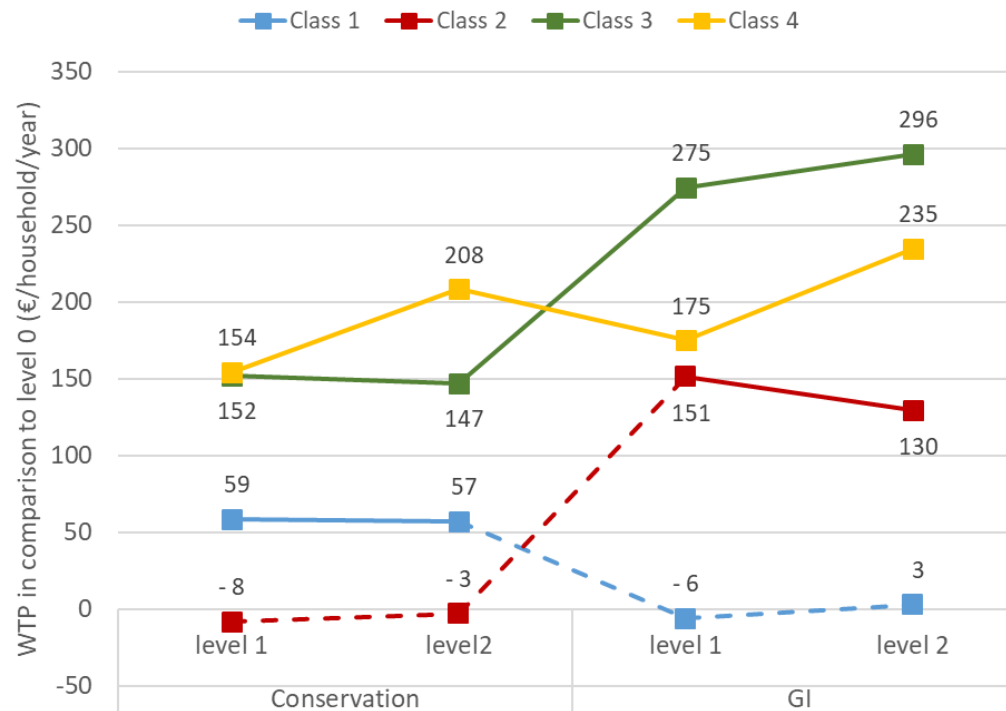
The sign of SD is irrelevant,
must be interpreted as
positive
** p<0.05
*** p<0.01

	Conditional logit model	Mixed logit model
Mean		
Conserv_L1	0.319***	0.598***
Conserv_L2	0.755***	1.268***
GI_L1	0.327***	0.569***
GI_L2	0.728***	1.201***
BAU	-1.142***	-2.330***
Payment	-0.010***	-0.018***
SD		
Conserv_L1		-0.383***
Conserv_L2		0.923***
GI_L1		0.640***
GI_L2		0.793***
BAU		2.510***
Payment		-0.018***
Log likelihood	-2271.3637	-2004.7714
AIC	4554.727	4035.299
BIC	4596.018	4117,881



WTP FOR NBS (2)

	Latent class logit model					
	Class1	Class2	Class3	Class4	Class5	
share	0,146	0,102	0,239	0,314	0,198	
Conserv_L1	0,7356304 ***	-0,0700386	0,5717595 ***	0,4485255 ***	0,7719042 ***	** p<0.05
Conserv_L2	0,6792717 ***	0,0138486	0,5154286 ***	1,168559 ***	2,620024 ***	*** p<0.01
GI_L1	-0,1831882	0,9064748 ***	0,9175432 ***	0,5133191 ***	0,3989903 **	
GI_L2	0,1453021	0,5645751 *	1,153366 ***	1,315174 ***	1,613025 **	
BAU	-3,143992 ***	1,150489 **	-3,348362 ***	-0,337902	-4,043191 ***	
Payment	-0,036677 ***	-0,0156981 ***	-0,0108835 ***	-0,0133727 ***	-0,0063523	
AIC			4066.445			
BIC			4383.009			

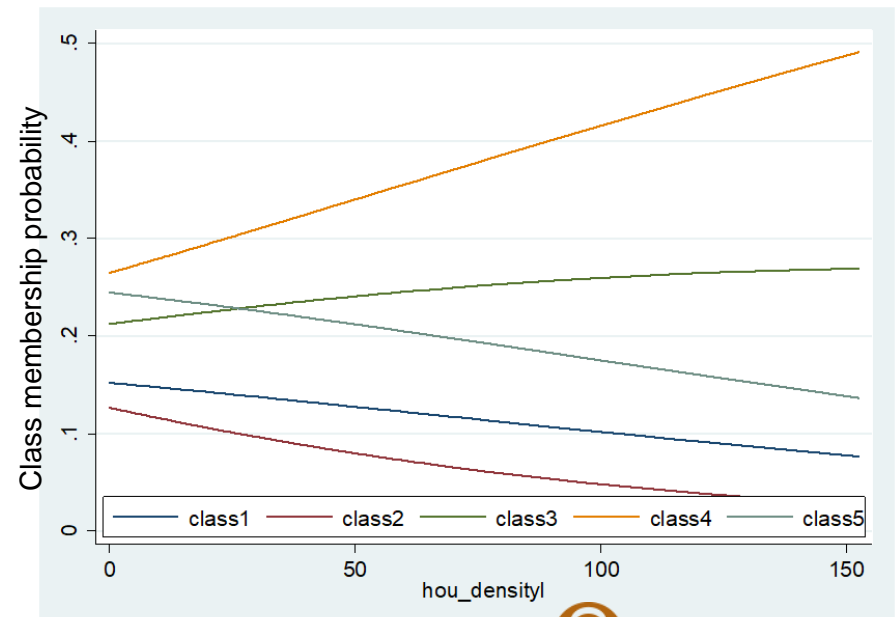
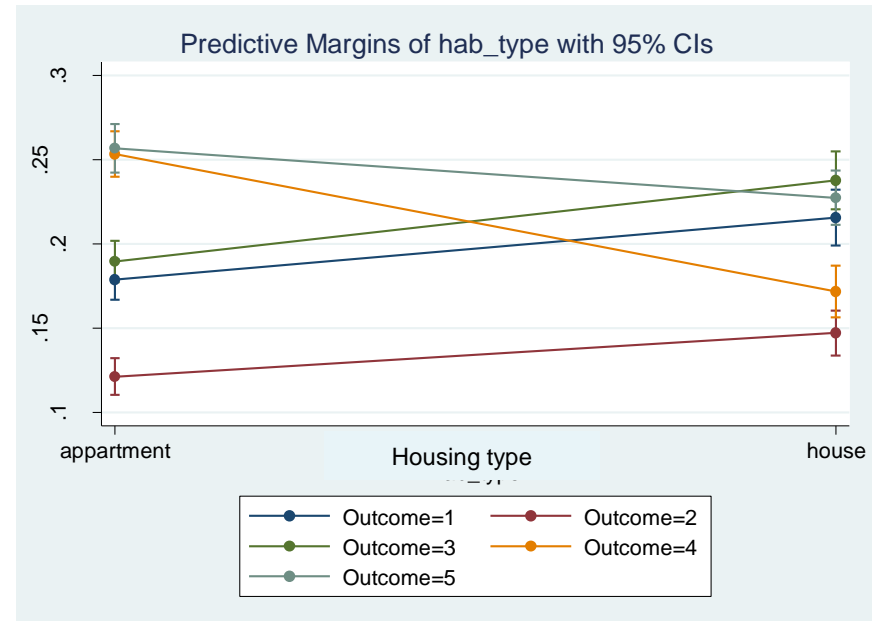
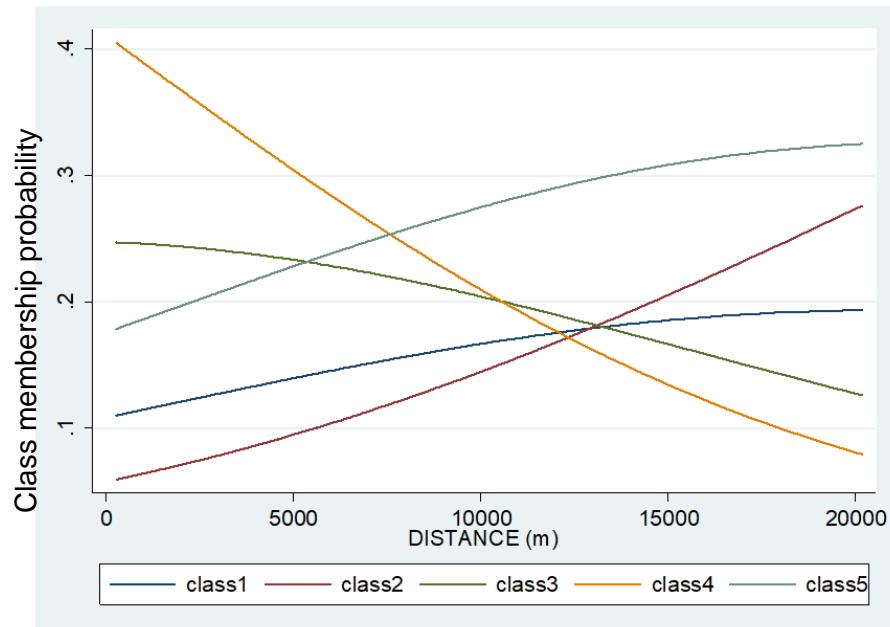


FACTORS INFLUENCING PREFERENCES HETEROGENEITY (1)

Housing environment

- Distance to city center***
- Housing type***
- Housing density***

*** Significance of the overall effect of each variable on class membership $p < 0,01$

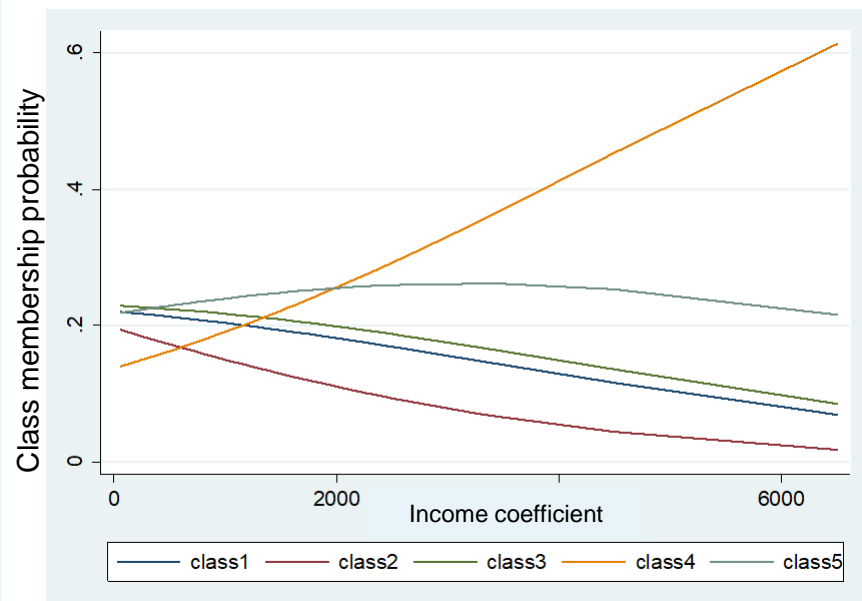
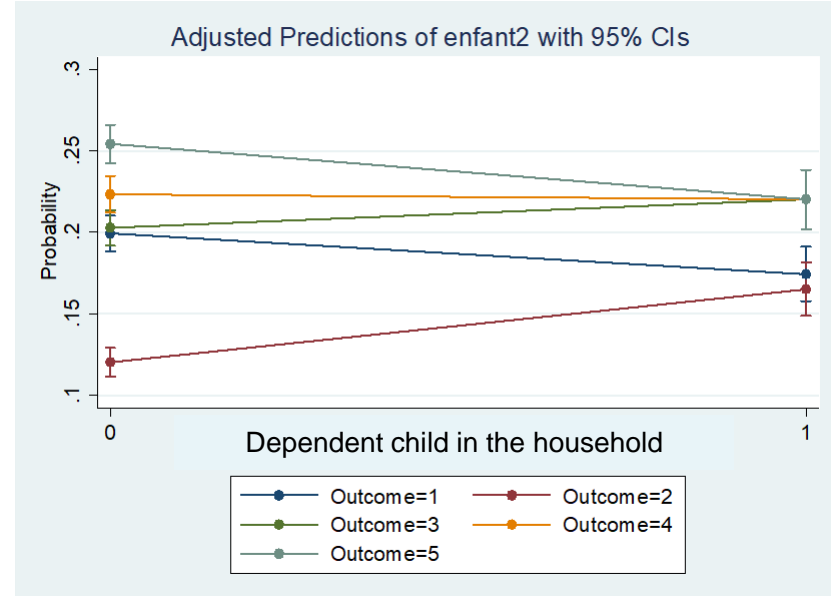
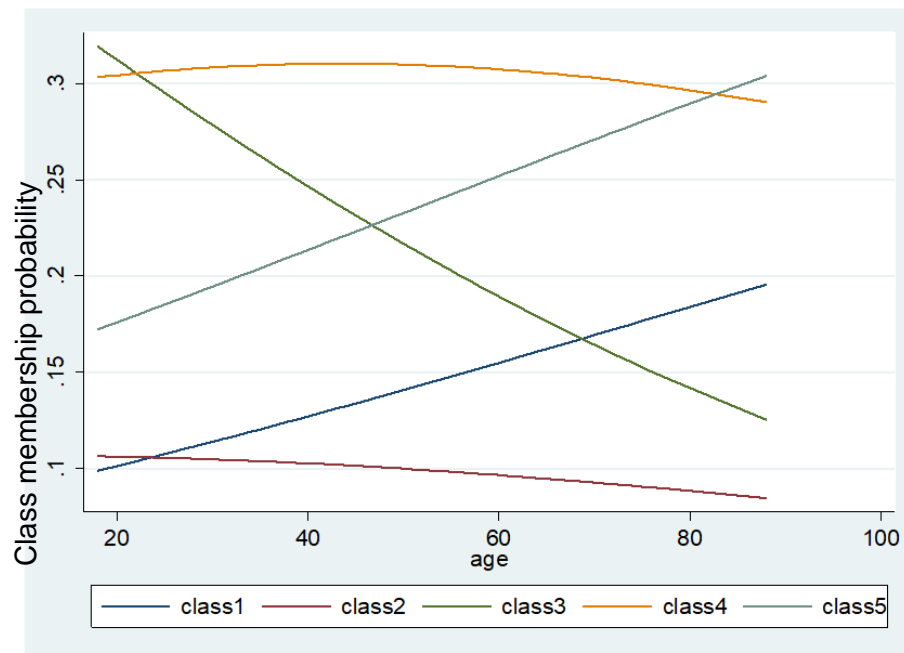


FACTORS INFLUENCING PREFERENCES HETEROGENEITY (2)

Household characteristics

- Age***
- Dependent child in the household***
- Income coefficient***

*** Significance of the overall effect of each variable on class membership $p < 0,01$



CONCLUSION AND PERSPECTIVES

- Positive WTP for co-benefits associated to NBS implementation
- First study that studies explicitly the conservation of natural and agricultural land as a NBS
- We highlight resident's perception of tradeoffs entailed by the development of NBS in cities
- We analyse the heterogeneity of preferences for NBS among the population and show significant influence of housing environment (distance to city centre, housing density, housing type) and household characteristics (age, income coefficient, dependent child in the household)