FONDAZIONE ENI ENRICO MATTEI

Biodiversity benefits from alternative rice cultivation practices:

a Choice Experiment approach

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Milan, 03 December 2009

Outline

Measuring biodiversity services

- What's biodiversity
- Why to protect it
- Why and how to monetize it

The survey

- A Choice Experiment approach on rice cultivation
- Method

Preliminary results

- RPL model estimates
- Conclusions

1.1 What’s biodiversity

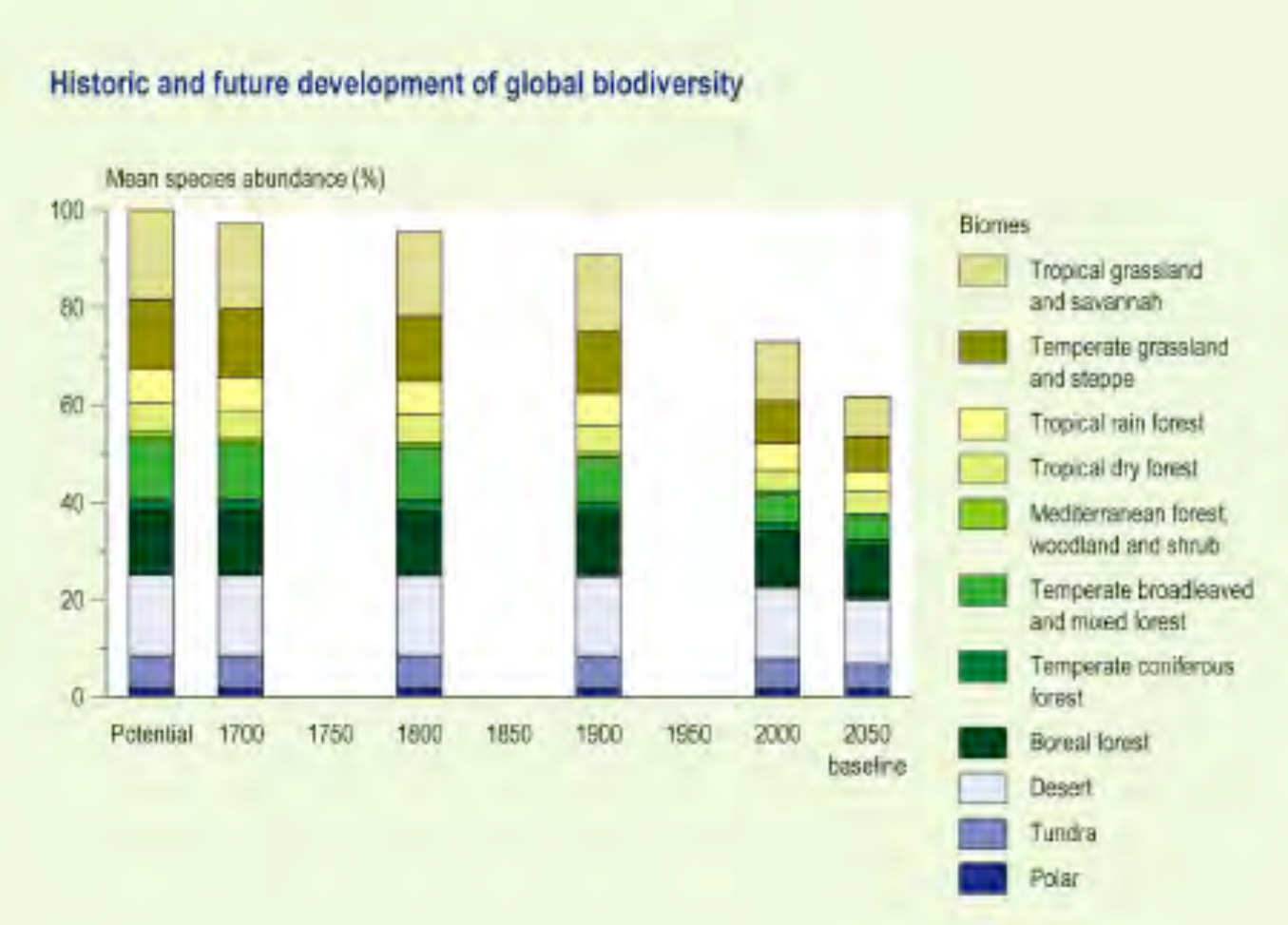
- Biodiversity is the diversity of species, populations, genes but also communities, and ecosystems.
- It is both a factor in and an indicator of the health of all ecosystem processes. These processes form the environment on which organisms, including people, depend.

1.2 Why to protect biodiversity

- Direct benefits of ecosystems to humans such as food, timber, clean water, protection against floods, and aesthetic pleasures all depend on biodiversity, as does the productivity and stability of natural systems.
- The majority of ecosystems in the world have been seriously modified by humans.
- Increased loss of biodiversity driven by landuse changes (COPI, 2008)

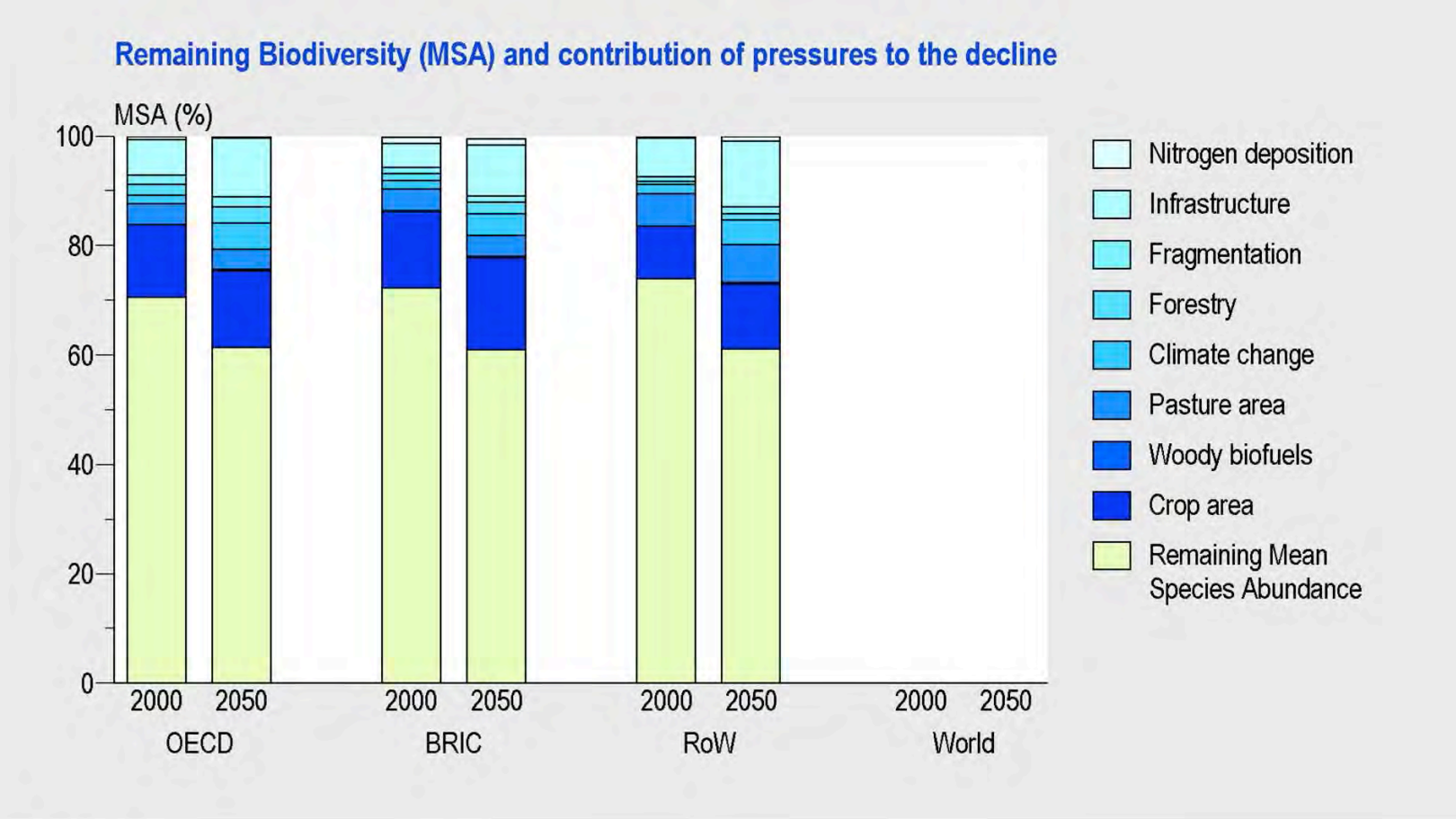
1.2

Why to protect biodiversity



1.2

Why to protect biodiversity



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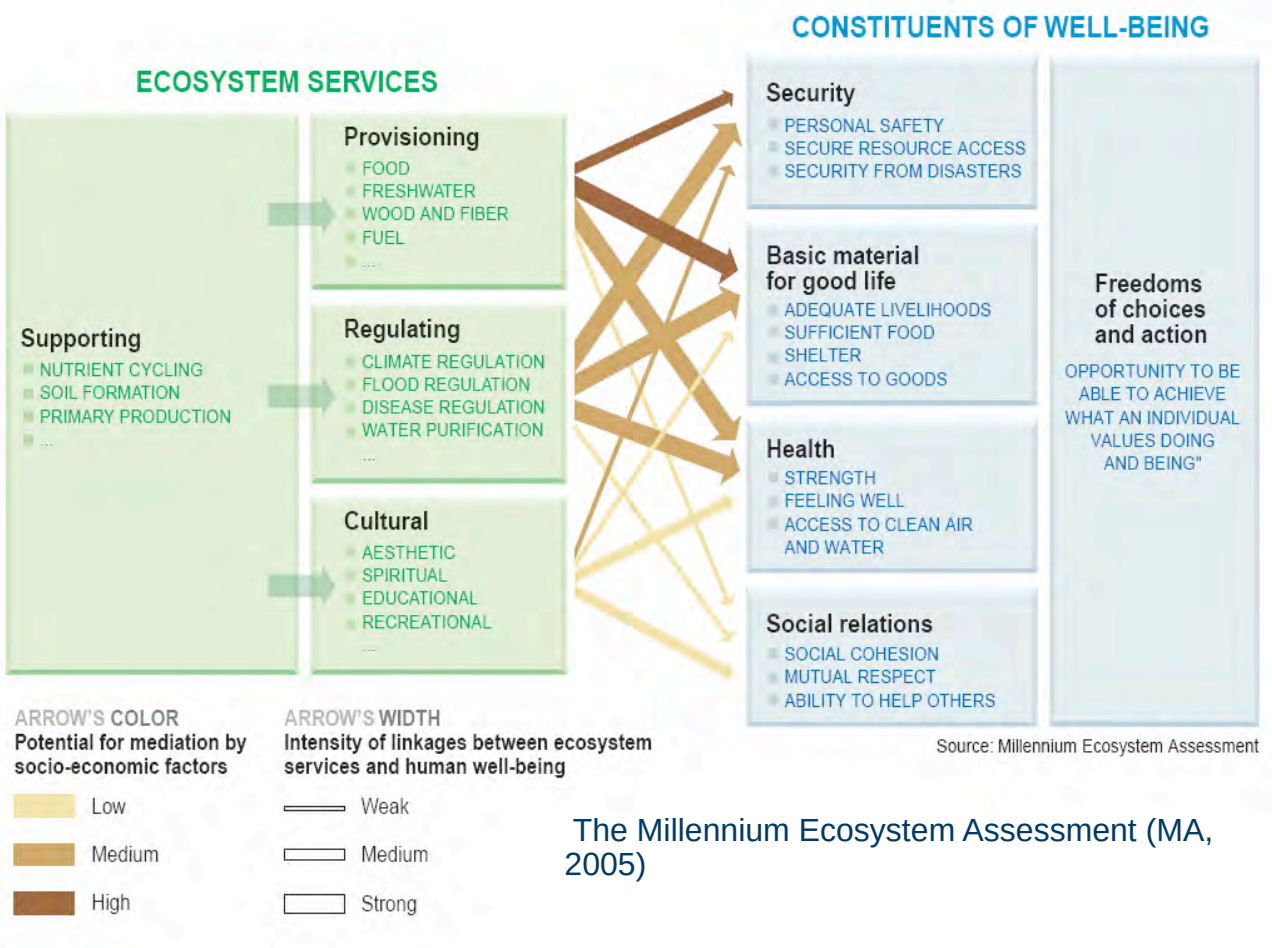
1.3

Why and how to monetize biodiversity

- Conversions of natural ecosystems to other forms of land use alter the total flow of Ecosystem Services.
- Different Ecosystem Services are often in competition between each other, and choices about conversion and tradeoffs are often the wrong choices
  - The changes often bring short-term economic benefits at the expense of longer-term costs.
  - Many ecosystem services are not fully understood, there is a lack of information so they are ignored
  - Sometimes choices are made to the benefit of a restricted number of individuals, and at the expense of wider communities.
  - To produce food, timber and fuel, pristine ecosystems are often converted to single purpose land uses with great loss of biodiversity and risk of total degradation.

1.3 Why and how to monetize biodiversity

- The Millennium Ecosystem Assessment framework is widely used to assess and value the interdependency between human well-being and the natural environment through the economic concept of ecosystem services.



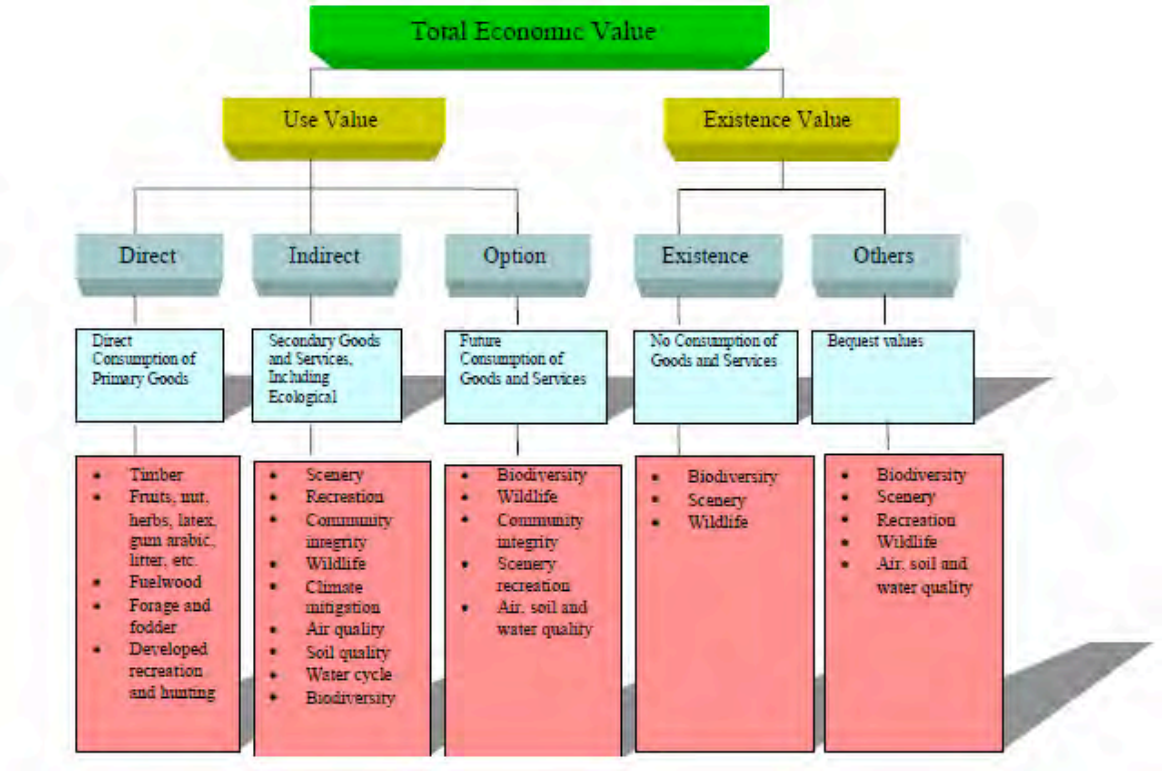
The Millennium Ecosystem Assessment (MA, 2005)

1.3 Why and how to monetize biodiversity

The notion of Total Economic Value (TEV) is used to set a theoretical framework for the monetization of the ecosystem services since the early 1990s (Costanza et al., 1997).

Stated choice methods are able to capture the TEV of biodiversity services

Survey-based method: relies on what people say they would do under hypothetical circumstances



2.1

A Choice Experiment (CE) survey

Aim

- To assess people's preferences for alternative scenarios of rice production methods which lead to habitat enhancement and biodiversity protection, by focusing on the biodiversity services and economic effects they generate
- Developed within the EXIOPOL project in collaboration with University of Pavia and WWF Italy

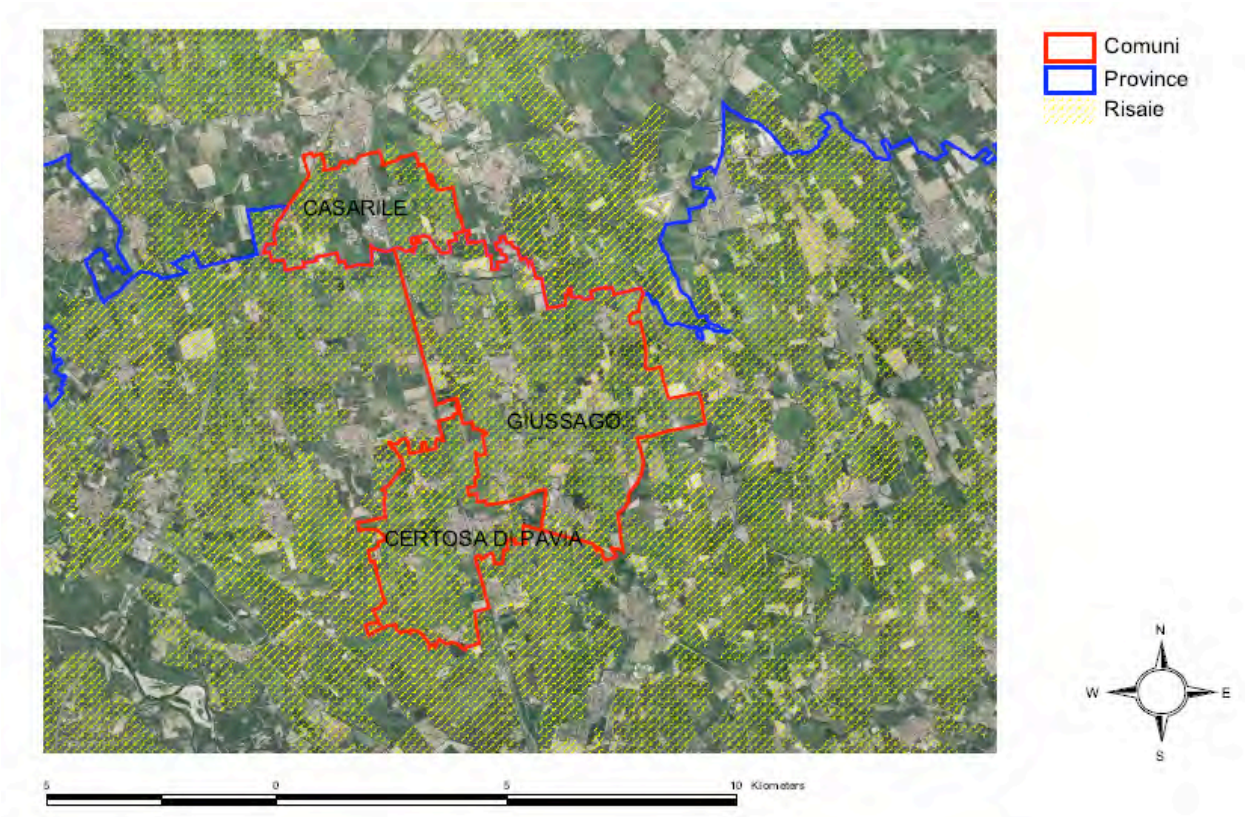
Choice Experiment survey

- Captures different dimensions (i.e. services) embedded in the concept of biodiversity, and the related tradeoffs
- Respondents are asked to choose among two or more policy scenarios described in terms of different attributes set at various levels

2.2

Study area

- 3 Municipalities in the most rice productive area in Italy: province of Milan and Pavia, Lombardy
- The survey questionnaire was administered with face-to-face interviews to a selected sample of 300 households



2.3 Questionnaire

Section1:

- Introduces the concept of biodiversity and its related services; explains how they can be affected by agricultural practices.
- Focuses on rice production. By using a cost-benefit perspective, possible methods to produce rice, while minimizing threats to biodiversity are presented. In particular, the traditional rice production method is employed as point of reference to depict rice production strategies able to be more in harmony with the environment.

2.3 Questionnaire

TRADITIONAL	TODAY - MODERN
• Small fields	• Large fields
• Limited use of fertilizers	• Massive use of fertilizers and chemicals
• Paddies are dry for short periods of time	• Paddies are dry for long and frequent periods of time
• Presence of hedges and trees between paddies	• Absence of hedges and trees between paddies

The **NEGATIVE ASPECTS** of modern rice cultivation include:

1. The paddies, large and often dry, create a monotonous and arid landscape.
2. The use of fertilizers and chemicals pollutes the water and soil harming plants and wild animals.
3. The paddies act as “ecological traps”. During the spring, when they are flooded, they attract many aquatic organisms (frogs, tree frog and other amphibians) which will then reproduce. When the water is removed the eggs, larvae and tadpoles are unable to survive.
4. The absence of water favors the proliferation of mosquitoes because of the absence of the insects (dragonflies) and aquatic organisms (frogs, tree frogs etc) that prey on mosquitoes
5. The lack of shrubs and trees between the cultivated fields removes natural environment for plants (flowers, shrubs and trees), insects (butterflies, bees), birds and small mammals (hares, porcupines).

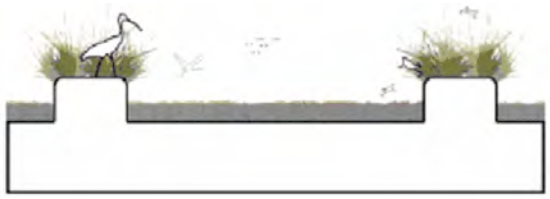
2.3 Questionnaire

Section 2:

- Explains that by changing the modern methods of rice cultivation it is possible to protect biodiversity.
- Three alternative techniques of rice cultivation able to protect biodiversity are presented. These are in line with those recently studied and tested by the University of Pavia in the study area:

1. Spontaneous vegetation along the levees
2. Canals in the rice paddy
3. Re-naturalization of the paddy

2.3 Questionnaire

Spontaneous vegetation along the levees 	Canals in the rice paddy 
Re-naturalization of the paddy – a Before 	After 
Re-naturalization of the paddy – b 	

2.4 Attributes and levels

Attributes	Levels
Extension of the cultivated area to be transformed into natural reserves	-2%; 8%; 15%
Type of landscaping amelioration for the area (land or water landscape engineering ***(cultural service)***	-Landscape engineering: hedges, trees, woods
Birds' biodiversity ***(biodiversity as "diversity")***	The financing of new public environmental goods is to be paid for by a decrease in the amount of a household's taxation money that was previously spent on other government-funded goods. Respondents were thus informed that, in order to meet the financial obligations for the protection of biodiversity, the regional administration would use a part of the funds earmarked for administrative expenses and for promotional/entertainment expenses.
Mosquitoes reduction ***(regulating service)***	
Cost per family (in terms of ***tax-reallocation***)	-0€ (status quo) -40€; 80€; 110€; 160€; 200€

2.5

Stated Choice question

- Using orthogonal fractional factorial design, we generated 25 profiles, five of which were eliminated due to inconsistencies among attributes levels.
- A cyclical design was applied to create 20 choice sets, each consisting of three alternative profiles.
- The first one was fixed and corresponded to the status quo scenario, i.e. the conventional scenario of rice cultivation practices, priced at zero cost, and characterized by the current biodiversity services' levels. The other two profiles varied from card to card and corresponded to rice cultivation scenarios that employ more traditional practices, resulting into an enhancement of the selected biodiversity services.
- Internal coherence was verified. All combinations were asked in roughly equal frequencies across the three selected Municipalities.

2.5

Stated Choice question

EFFECTS	Status quo	Intervention A	Intervention B
Cultivated area in your Municipality to be transformed into natural reserve	None, as today	2%	8 %
Type of landscaping for the area	As today	Waterscape engineering: canals, pools, lakes	Landscape engineering: hedges, trees, woods
Biodiversity (variety of species)	As today	The presence of many bird species is facilitated (10-15 species protected)	The presence of few bird species is facilitated (3-5 species protected)
Mosquitoes	As today, no decrease	Decrease in mosquitoes	As today, no decrease
Cost per family [€/year2009]	0€	110€	80€

I prefer: ❑ Status quo ☒A ❑B ❑ No preference: indifferent

3.1

Basic statistics

Individual characteristics	Mean or %
Age	43.7
Female	50.6
Household size	3.0
Yearly household taxation money (in Euros in 2007)	7,545.7
Yearly net personal income (in Euros)	17,936.9
Yearly net household income (in Euros)	32,112.8
Work in the public sector	45.4
Work in the manufacturing sector	21.2
Work in the agricultural sector	6.1
Attitudinal characteristics	
Believe that public investment for environmental safety is very important	10.6
Believe that public investment for public health is very important	41.4
Believe that public investment for education is very important	24.0

3.2 Model specification (RUM)

- The model is estimated with a Random Parameter Logit (for more details, see Louviere et al., 2000; Green, 2002), which relaxes the Independence of Irrelevant Alternatives (IIA) assumption

Model 1

$$V = \beta_1 COST + \beta_2 AREA + \beta_3 LAND + \beta_4 BIODIV + \beta_5 MOSQ$$

Model 2

$$V = \beta_1 COST + \beta_2 AREA + \beta_3 LAND + \beta_4 BIODIV + \beta_5 MOSQ + \beta_6 MOSQ \times GENDER + \beta_7 LAND \times FINCOME$$

3.3 Variables

Variable	
COST	*una tantum* cost per family: 40; 80; 110; 160; 200 €/year2009
AREA	categorical variable; takes on value 0, 2, 8, 15 percent
LAND	‘as today’: takes on value ‘0’ ‘landscape engineering’: takes on value ‘1’ ‘waterscape engineering’: takes on value ‘-1’
BIODIV	‘as today’ takes on value ‘0’ ‘presence of few bird species facilitated (5 to 10): takes on value the median value ‘7,5’ ‘presence of many bird species facilitated (10 to 15): takes on the median value ‘12,5’
MOSQ	‘as today’: takes on value ‘0’ ‘mosquitoes reduction’: takes on value ‘1’
GENDER	‘male’ takes on value ‘1’ ‘female’ takes on value ‘2’
FINCOME	categorical variable

3.4 RPL model estimation results

	Model 1	*Model 2*
PRICE	-0.003 *** (0.145^{-03})	-0.001 (0.001)
AREA	0.048*** (0.021)	0.046** (0.162)
LAND	-0.441*** (0.205)	-0. 533** (0. 176)
BIODIV	0.157*** (0.029)	0. 098** (0. 045)
MOSQ	1.70*** (0.339)	0.281 (0.524)
MOSQ $_X$ GENDER		0. 953** (0.368)
LAND $_X$ FINCOME		0.017* (0.011)
SAMPLE	1401	1401
Log-likelihood	-370.786	-407.743
Pseudo-R^2	0.261	0.228
LR test of significance of all coefficients		73.914 (p > 0.001)

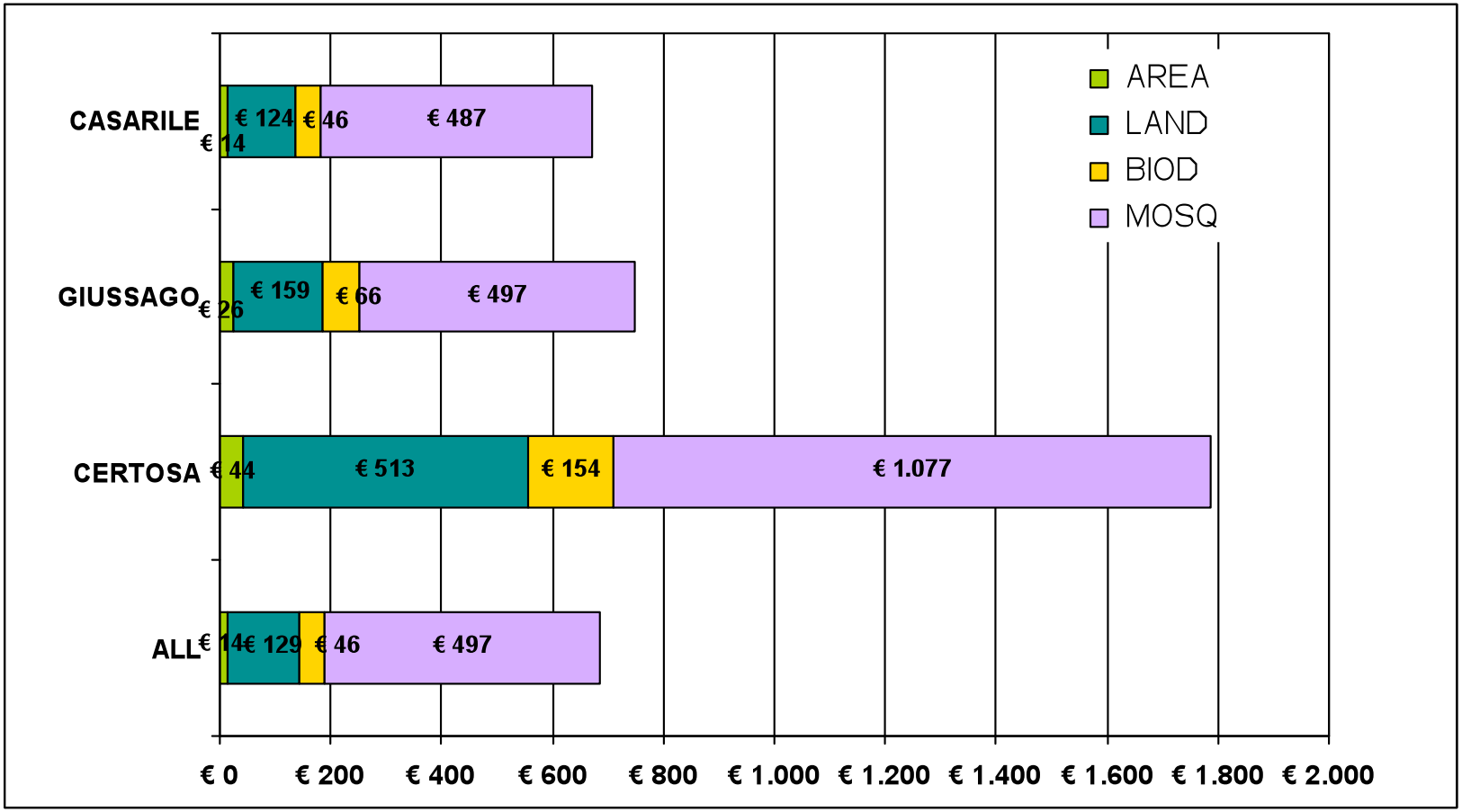
3.5 Implicit prices under the RPL models

	Mean [€/household year 2009]
AREA	€ 14.22
LAND	€ 129.03
BIODIV	€ 45.96
MOSQ	€ 496.73

	CERTOSA	GIUSSAGO	CASARILE
Nobs	479	465	457
AREA	€ 43.64	€ 26.05	€ 13.68
LAND	€ 512.87	€ 158.71	€ 123.75
BIOD	€ 154.38	€ 66.23	€ 45.65
MOSQ	€ 1,076.88	€ 496.54	€ 487.38

3.5

Implicit prices under the RPL models



3.6 Conclusions

- All the attributes are statistically significant. This signals that respondents are able to understand the relationship between the proposed changes in rice cultivation practices and what this would bring in terms of enhancing both biodiversity as such (i.e. species diversity), and its related services (i.e. regulating and aesthetic ones).
- Mosquitoes reduction represents the most important service for respondents (€496.73household/year2009), who were therefore able to understand that an amelioration of the rice-field ecosystem would lead to a reduction of mosquitoes' proliferation.
- Similarly, respondents showed to appreciate the renaturalization of a part of cultivated area (€14.22/household/year2009 for the conversion of 1% of rice cultivated area into natural), and its effects in terms of landscape improvement, which is raked as the second important service (€129.03household/year2009).

3.6 Conclusions

- Biodiversity protection in terms of species diversity is also relevant for respondents, but it shows a lower unit WTP (€45.96/household/year2009 for the protection of one additional bird specie population). However, if we consider the average proposed protection of 7.5 and 12.5 birds' species, such as those proposed the CE scenarios, the WTP ranges from about 344.7 to 574.5. In addition, in principle, we might suppose to observe different WTP values for a different indicator of species diversity; but this issue lays out of the purposes of the present study.
- Results based on a municipality-based sampling show that WTPs are higher for respondents leaving where the density of rice fields is higher

3.6 Conclusions

- These estimates all call attention to the feasibility of implementing an agri-environmental policy aimed at protecting biodiversity services in the future.
- More importantly, there are further implications about enhancing the applicability of biodiversity protection policies when we consider the results obtained for different biodiversity services. For example, the highest value attached to mosquitoes reduction would imply, for policy makers, that stressing more direct-use anthropocentric-related benefits in the biodiversity policies may encourage greater support from people with different environmental attitudes

Thanks!

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