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Willingness to pay for alternative features of land-use policies: the case of the lake Garda region

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ABSTRACT

In urban contexts land-use planning can play a central role to promote adaptation and mitigation strategies to climate change. Limiting soil consumption, improving urban greening and restoring abandoned areas are three of the most important strategies towards a sustainable land use. . The extent to which these three actions can be effectively implemented depends on the specific biophysical and cultural characteristics of the local context as well as on the preferences of residents . We conducted a Choice Experiment (CE) on a sample of 500 people living in four municipalities of the lake Garda western coastal strip, in Italy, to assess the willingness to pay (WTP) towards these three planning strategies based on alternative land-use . The proposed land use strategies are presented as a feasible way to improve the mitigation and adaptation capacity of the local context. Our results suggest that the local community perceives the growth rate of sealed areas as the most pressing issue, and people are in favour of measures aimed at containing the phenomenon. Efforts in this direction are needed and should inform the current policy debate on local land-use planning.

1. Introduction

Robust adaptation strategies to prevent and minimise the effects of climate change are required when no mitigation policies pursuing significant emissions reduction and temperatures increase are in place. Among the many possible adaptation strategies, policies aimed at optimising and guaranteeing the supply of soil functions play a crucial role (UN Rio + 20 Summit, European Unions 7th Environment Action Programme).

The soil is responsible for multiple functions and services (agricultural productivity, water purification and regulation, carbon sequestration and regulation, provision of functional and intrinsic biodiversity, provision and cycling of nutrients), but its ability to deliver ecosystem services and to fulfil its functions is under increasing pressure due to phenomena such as soil sealing, erosion, contamination and decline in organic matter (Pena et al., 2020; Lilburne et al., 2020). Due to the complexity and the sheer amount of soil functions, there is not only one approach for preserving them and reducing climate-risk valid across all settings, but soil policies have to be place- and context-specific. Even if well-planned soil management proves to be essential at all levels of administration, from the local to the international, most adaptation initiatives in Europe are taken at the regional or local scale, based on the heterogeneity in the severity and nature of climate impacts between and within regions (Turpin et al., 2017). The lack of a common EU directive on soil preservation has led each Member State to implement different regulations, and the results are highly heterogeneous measures on soil conservation in the EU (Ronchi et al., 2019). Recently, Grunewald et al. (2019) developed a set of indicators to evaluate the sustainability of urban development, considering both the access to green spaces and the anthropogenic component of a city.

Most adaptation policies regarding land preservation are devoted to avoiding and contrasting soil consumption, intended as the phenomenon in which environmental resources are lost because of the occupation of originally agricultural, natural, or semi-natural land. Soil consumption is therefore defined as the variation from a non-artificial land cover (non-consumed land) to an artificial land cover (consumed land). The phenomenon happens in particular as a consequence of infrastructural or urban expansion. Soil sealing, intended as the act of permanently covering the soil with artificial materials, represents to date the prevalent cause of soil degradation in Europe (ISPRA, 2018). The net soil consumption is calculated as the ratio between soil consumption and agricultural, natural and semi-natural land (European

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Commission, 2012). According to the European Commission's objective of zero soil consumption by 2050, any sealing of agricultural and natural land should be avoided, and the other types of soil degradation should be offset through land restoration of equal or larger areas that can provide the same ecosystem services as the natural soil lost (European Commission, 2012).

Soil consumption is a phenomenon that involves both large metropolitan cities and small municipalities but in different manners (Guastella et al., 2017). Although large cities account for the greatest part of soil transformation, land use there is more efficient because the population density is higher, both on average and at the margins. In contrast, small cities account for only a minor fraction of total soil transformation, but this transformation is largely inefficient as it involves land development at very low densities. Thus, the decoupling of land development and demographic change that takes place at the European level (Kasanko et al., 2006; Guastella et al., 2019) is specifically relevant in small towns and the touristic areas such as in the surrounding of Garda Lake, in Italy, which is the object of investigation of the present paper. Geographically located in the neighbouring of relevant national and European infrastructures and in close connection with highly urbanised metropolitan areas, the Garda Lake area shows a significant share of artificially covered land, almost twice the national average, notwithstanding the biophysical characteristics of a typical sub-alpine area. Characterised by the presence of small and very small municipalities, the whole area has undergone rapid transformation in recent years thanks also to the contribution of the tourism sector, that also significantly pulled the residential demand and, in turn, land development.

The adverse effects of land use on the environment and ecosystems have been widely documented in the empirical literature (Ewing, 2008; Hartig and Kahn, 2016; Johnson, 2001; Gaigne et al., 2012; Song et al., 2020) and yet the dispute about the opportunity of urban sprawl, the primary cause of land-use change, is still controversial (Brueckner, 2000; González-García et al., 2020; Yuan et al., 2019; Shoemaker et al., 2019). Urban sprawl, the low-density and spatially discontinuous expansion of cities, brings positive effects and is expected to improve the utility of household that can buy larger and more affordable houses, possibly with private parking and garden, at the price of commuting (Glaeser and Kahn, 2004). Low-density urban development is also associated to residential sorting and zoning (Ehrlich et al., 2018) and, hence, to the possibility for households to choose where to live according to the characteristics of the neighbourhood that best correspond to their demand (Mockrin et al., 2019). As a result, land-use policies towards a more sustainable urban development lacks a shared agreement .

Against this background, understanding the perception and preferences of households for locally implemented land-use policies appears a prerequisite for their successful implementation. This was the objective of the CLIC-PLAN project, which started in 2017. The project intended to raise awareness on the potentially catastrophic effects of climate change in the very fragile and vulnerable area of the Garda lake, located in the sub-alpine space. Its ultimate goal was to produce a local adaptation plan with a bottom-up approach. The project benefited of the contribution of scientists from several disciplines: economists, mathematicians, pedagogists, and psychologists and used a variety of different methods stemming from the modelling to statistical analysis of questionnaire data to direct interviews and focus groups. The need to combine such a variety of methods required the choice to refine the geographical extent of the study area, under the constraint of having areas representative of the variety of environments in the Garda lake in order for the project results to be upscalable. This choice resulted in the selection of four municipalities, two (Desenzano and Manerba) located in the southern part of the lake, the most connected with the urban network and characterised by a substantial agricultural vocation to the largest extent, and two (Tignale and Tremosine) located in the northern part, closer to the alpine space and characterised by a naturalistic and forest landscape.

As part of the project, this study investigates the preferences of citizens living in the municipalities of the Garda Lake area toward different planning strategies based on alternative uses of land by means of a Discrete Choice Experiment. This method has been used to evaluate landscape preferences[2] for land-use planning (Hanley et al., 1998; Rambonilaza and Dachary-Bernard, 2007) and to investigate the willingness to pay (WTP) for land-use policies aimed at reducing the impact of climate change in rural and agricultural areas (Pröbstl-Haider et al., 2016) or increasing the environmental sustainability of urban areas (Fruth et al., 2019). We contribute to this literature by explicitly considering the reduction of soil consumption as a challenge to address climate change and promote sustainable development. We take the viewpoint of citizens and ask them to consider three types of land-use policies, consistent with the package of potential measures to reduce soil consumption and improve urban natural ecosystems set out at the regional level. The first policy consists in the reduction of the growth rate of the share of the sealed area over the total urbanised area. The second is the creation or expansion of gardens and natural parks within the urban boundaries. The third is the re-naturalisation of green spaces that are currently unused and non-vegetated.

The first objective of the paper is understanding the level of public awareness regarding the need for local adaptation strategies. Specifically, we measure the extent to which soil consumption is considered an issue and the residents preferences towards three land-use adaptation actions. The second objective is providing some policy suggestions for sustainable soil management in the site by identifying what interventions are perceived as most important and pressing by local communities.

The remainder of the paper is organised as follows. Section 2 describes the area where the study has been conducted and provides some data about the current scenario in terms of land use and policies. Section 3 introduces the theoretical model, describes the experimental design adopted, and the type of data collected for the study. Section 4 presents the results. Section 5 discusses these results and concludes.

2. Case study

Soil consumption is steadily growing in Italy. In 2017, 54 additional km^2 of soil had been sealed, which averages to 15 ha per day. Fifteen regions (on a total of twenty) exceeded 5% of soil consumption, with the highest share in Lombardy (12.99 %) (ISPRA, 2018). The Lombardy region is also among the most artificially covered in Europe (Regione Lombardia, 2010).

The Lombardy region, which is the region the study area belongs to, introduced new land governance regulations (regional law 31/2014) (Regione Lombardia, 2014) aimed at reducing soil consumption and favouring the restoration of urbanised areas. These regulations modify the land governance regional law 12/2005 (Regione Lombardia, 2005) and foresee the adjustment of all land planning instruments to new regulations for the reduction of soil consumption and the restoration of degraded soil: the regional land plan (Piano Territoriale Regionale), the provincial and metropolitan city land plans (Piani Territoriali delle Province e delle Città Metropolitane), and the territorial governance plans (Piani di Governo del Territorio). On the premise that soil is a non-renewable resource, the primary objective of reducing soil consumption and of realising the goal planned by the European Commission of achieving, by 2050, a zero net land occupation is put into effect by steering the city planning and building activities toward already anthropised areas, deteriorated or fallen into disuse. The Lombardy regional land plan (which was approved by the Regional Council with Decree 1523, on May 23, 2017) has the task of measuring the soil

[2] For an overview and a discussion of the different landscape evaluation techniques and models see Arriaza et al (2004).

consumption index, dividing the territory into 10 consistent areas. The first planned step is to achieve a reduction of soil consumption of 25 % for residential areas, and 20 % for productive areas, by the end of 2020. Given that the new regional land plan and the provincial and metropolitan city land plan have not been adjusted so far to the regional law 31/2014, the legitimacy of the city council regulations aimed at reducing soil consumption by re-devising the forecasts has been put into question. The recent approval of the regional law 16/2017 introduced possible variations from the previous plans, which would still ensure a negative or zero soil ecological balance. The law 31/2014 is still under examination by the Italian Constitutional Court.

According to the data from the regional system of land monitoring available in the DUSAF (Destinazione d'Uso dei Suoli Agricoli e Forestali)[3] database, in the Lombardy region, sealed areas account for 86.31 % of the total urbanised surface, green urban areas (gardens and natural parks) account for 4.42 %, and unused and non-vegetated areas are equal to 1.80 %[4] . The remaining share of the urbanised area is composed of building sites and infrastructures. The percentage increase in the sealed area in the period 2000–2015 in the entire region amounts to 13.56 %.

The study area we consider includes municipalities located in the Garda Lake coastal strip (Figs. 1 and 2). The lake serves as a boundary between the Lombardy and Veneto regions, but we only consider municipalities in the Lombardy side of the lake, being the other municipalities subject to a different jurisdiction. This case-study area mimics pretty well the regional trend with a share of 81.45 % of sealed areas, 4.65 % of gardens and natural parks, and 1.75 % of unused and non-vegetated areas. Over fifteen years the sealed area in the municipalities of interest increased by 14.21 % against an increase by 89.28 % of gardens and natural parks and 412.45 % of unused and non-vegetated areas.

In particular, we considered four municipalities: Desenzano, Manerba, Tignale, and Tremosine. The selection of these four cities responds to the need to have a sample that is representative of the whole lake area, at least of the Lombardy side. In addition to providing a representative example of soil consumption dynamics in the region, this area is also among the most naturalistic places of Lombardy, due to the presence of both the lake and the neighbourhood with the natural Alpine territories. The good accessibility of the area from the wealthiest part of the region, together with its naturalistic appeal, explains the great interest for tourists and visitors. Also, the increasing demand for non-residential housing has pushed urban development up and threatened the already fragile ecological equilibria. The presence of relatively small municipalities and the tradeoff between tourism, economy, ecosystem services preservation and climate change vulnerability makes the area extremely interesting as a case study.

3. Methodology

3.1. Theoretical model

The preferences and the willingness to pay of residents towards land-use based climate change adaptation measures have been elicited by a stated preferences approach, namely a choice experiment (CE). Stated preferences methods are grounded in the Random Utility Theory (McFadden, 1974) which decomposes the utility an individual gains from a good (U_n) into a deterministic component observable by the researcher (V_n) and an unobserved stochastic component (ε_n). Formally:

$$U_n = V_n + \varepsilon_n \quad (1)$$

The deterministic component of the utility (V_n) depends on attributes levels of the good considered, while the stochastic term is assumed to be a random variable with an extreme value Gumbel distribution with location parameter 0 and scale parameter 1. In addition, CEs borrow from Lancaster theory (Lancaster, 1966) the idea that the utility an individual gains from a good depends on the utility gained from each good attribute such that V_n is a linear function of attribute levels weighted by the individual's preference for each attribute. In a choice experiment, respondents are asked to repeatedly tradeoff among alternatives in experimentally designed sets where each alternative represents a different combination of attributes levels. The respondent choice identifies the alternative in the set providing him the highest utility. If the random component of utility ε_n is assumed to be extreme value distributed, then the logit probability of individual n to choose alternative j in the choice set t can be computed as:

$$P_{njt} = \frac{e^{\beta_n' x_{njt}}}{\sum_i e^{\beta_n' x_{nit}}} \quad (2)$$

where β are the utility parameters to be estimated, which represent the weight given to each attribute in determining the utility. The Random Parameter Logit (RPL) model is a case of mixed logit models where parameters associated to each attribute are assumed to vary among individuals reflecting preferences heterogeneity. In a RPL model, the preference for an attribute is represented by a parameter distribution (Train, 2009). Hence, the probability for an individual of making the sequence of choice he actually does is:

$$P_{njt} = \int_\beta \prod_t \frac{\exp(\beta_n' x_{njt})}{\sum_i \exp(\beta_n' x_{nit})} f(\beta, \delta^2) d\beta \quad (3)$$

Where β_n is the vector of individual-specific parameters with expected value vector β and with variance-covariance matrix δ . The probability in a RPL model is the integral of the logit probability over the parameter space. The integral does not have a closed-form solution but can be approximated by simulations (Train, 2009). The simulations take a set of R draws from the distribution of the parameters and at each draw, the logit probability is calculated.

When the status quo is one of the alternatives in the choice sets, the literature (Herriges and Phaneuf, 2002; Scarpa et al., 2007) shows a potential correlation in the error structure among alternatives different from the status quo. Indeed, while respondents experience the status quo, the other alternatives in the choice sets are just hypothetical alternatives, and hence they may carry larger variance in the stochastic component, and there may be a correlation in this component. To account for this, we apply an error component model where the random component of the alternatives different from the status quo shares a zero-mean random variable whose variance must be estimated. An error-component RPL model is:

$U_{njt} = B_n X_{njt} + u_{njt} + \varepsilon_{njt}$ $u_{njt} \sim N(0, \delta)$ for the alternatives different from the status quo

$U_{njt} = B_n X_{njt} + \varepsilon_{njt}$ for the status quo alternative

We apply a RPL model with error component where each non-monetary attribute coefficient is assumed to be normally distributed while the monetary attribute coefficient is kept fixed. This setup is rather typical in a RPL framework as discussed by Bliemer and Rose (2013). Assuming the monetary attribute coefficient to be non-random prevents the shortcomings of computing the WTP as the ratio of two distributions. Indeed, in a RPL model, WTP must be computed by

[3] Based on the analysis carried out in the 1990s in the framework of the European Program Corine Land Cover, the Lombardy region developed an analytical and monitoring tool on soil use named DUSAF. The tool divides the land data in 3 main levels, according to Corine Land Cover, the first of which includes the 5 major cover categories (artificial areas, rural areas, wooded and semi-natural areas, wetlands, water bodies), progressively detailed in the second and third levels. Two further levels (4 and 5) represent the specifities of the Lombardy territory. Data are available at https://www.dati.lombardia.it/Territorio/Dusaf-5-0-Uso-del-suolo-2015/iq6r-u7y2.

[4] The reference DUSAF codes for the construction of these categories are the following. Total urbanised area: 1; sealed area: 11 + 12; gardens and natural parks: 1411; unused and non-vegetated areas: 1412.

Fig. 1. Location of the case study area.

randomly drawing from the distributions of the non-monetary coefficients and of the cost coefficient and taking the ratio of each draw. The estimated WTP is hence the average of these ratios. Daly et al. (2012) show that when the cost coefficient has a density in proximity to zero, the WTP distribution does not have finite moments. The authors also show which distributions can be used for the cost coefficient and which boundaries must be imposed to guarantee the WTP distribution to exist. Despite guarantying the existence of the resulting WTP distribution, randomly drawing from the distribution of the cost attribute coefficient may results in very small values in some draws and consequently very large values of the computed WTP in that draw. These draws would inflate the variance of the WTP and may artificially result in a large share of the population with a negative WTP. Despite being counter-intuitive, the use of a non-random cost coefficient prevents these drawbacks.

When the main interest is to estimate the WTP of individuals, a more elegant approach overcoming the drawbacks above is proposed by Train and Weeks (2005). They suggest to reparametrise the utility model such that the parameter associated with each attribute already represents the attribute WTP. A model so specified is called WTP-space model (opposite to the preference-space model) and it directly estimates the WTP associated with each attribute. The re-parameterisation is carried out by dividing each element of the utility function by the monetary attribute and directly estimating the model in this form. A RPL model estimated in WTP-space requires to specify the distribution of the directly-estimated WTP coefficients. In our study, we estimate our RPL model with error component both in preference space and in WTP space assuming a normal distribution for the random coefficients also in the WTP-space model. As the WTP estimates are scale-free parameters, we compare the WTP from both models.

3.1.1. Estimating WTP and confidence intervals in preference-space RPL model

When the model is parametrised in preference space, several procedures exist for computing the confidence interval of the simulation-derived WTP. Two of the most used procedures are the Delta method (Oehlert, 1992) which derives confidence interval analytically and the Krinsky and Robb (1986) which uses the variance-covariance matrix of the coefficients to simulate the confidence intervals of the WTP. Noteworthy, obtaining the standard errors of the WTP within a RPL framework is not trivial. As outlined by Bliemer and Rose (2013) when computing the WTP in a RPL model, there are four sources of uncertainty: there is uncertainty about the mean and the standard deviation of the non-monetary attribute, and there is uncertainty about the mean and the standard deviation of the monetary attribute. Consequently, when computing the WTP measure, the uncertainty of the attribute coefficients translates into uncertainty in the mean and standard deviation of the WTP. Therefore, the computation of the confidence interval around the WTP requires to use the whole variance-covariance matrix of the attribute coefficients. Several studies either ignore the standard errors associated to each estimate and use the information on the mean and standard deviation of each attribute (Campbell, 2007) or ignore the standard deviation related to each coefficient treating the model as a MNL model (Amador et al., 2005). Hensher and Greene (2003) adapt the Krinsky and Robb procedure to the case of a RPL model, while Bliemer and Rose (2013) propose a way to apply the Delta method to a RPL model. We compute the confidence interval around the estimated WTP following Hensher and Green

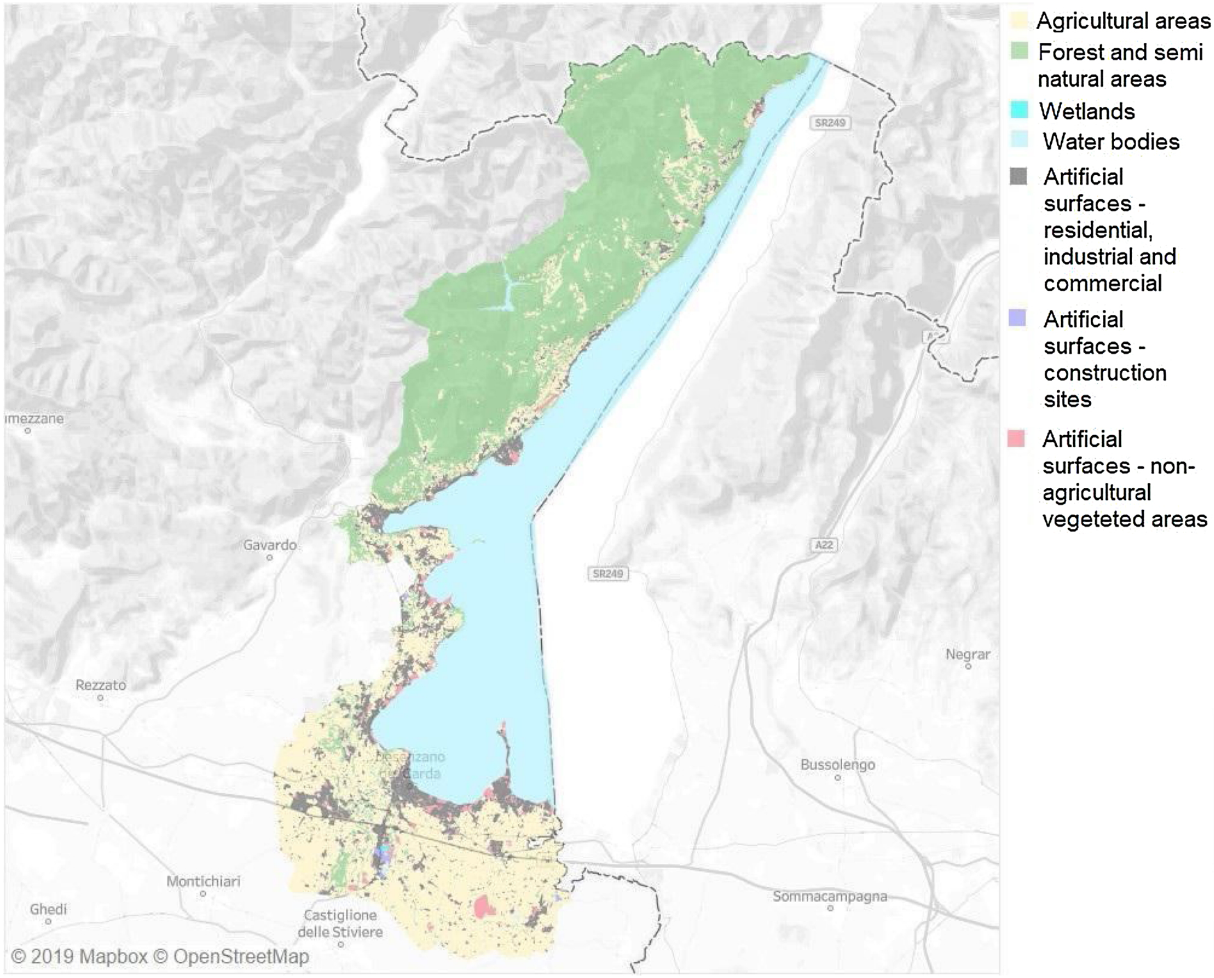

Fig. 2. Land cover map of the case study area.
Source: Land cover database of the Lombardy region (DUSAF), year 2015

(2003). More precisely, we obtain the standard errors for the mean and for the standard deviation of WTP of a non-monetary attribute by randomly drawing from the mean and the standard deviation of the attribute coefficients ($\beta_{no-\cos t}$ and $\delta_{no-\cos t}$ respectively) and from the mean of the cost coefficient[5] ($\beta_{\cos t}$). Each draw accounts for the variance-covariance matrix of the coefficients. For each draw, we calculate the ratio $\beta_{no-\cos t}/\beta_{\cos t}$ and $\delta_{no-\cos t}/\beta_{\cos t}$ which represent the mean WTP and the standard deviation WTP implied by that draw. The mean and the standard deviation of $\beta_{no-\cos t}/\beta_{\cos t}$ over the draws represents the estimated WTP mean and the related standard error. The mean and the standard deviation of $\delta_{no-\cos t}/\beta_{\cos t}$ over the draws represents the estimated WTP standard deviation and the related standard error.

3.2. Experimental design and data

In the study, we consider three attributes which describe potential land-use climate change adaptation actions. The first attribute consists of the reduction of the growth rate of the sealed area within the boundaries of the four municipalities considered. In the last 15 years, the sealed area has increased by 14 % in the Lombardy region and the municipalities of the Garda lake are in line with this trend. We propose the respondents a reduction in the growth of the sealed area in the next 15 years to 7% and to 3% if proper policy actions were taken. Another attribute considered in our study is the share of green area over the total area within the municipality borders. Currently, this share is around 5% and we draw an increase to 7% and even to 9% with suitable policy decisions. The last non-monetary attribute concerns the share of urban areas that are unused. These areas currently account for 2% of the urban surface but can be reduced to 1% and even to 0% by proper actions. The experimentally designed shares for the increase in green areas and for the decrease in unused areas have been set after a discussion with local policy makers to have realistic and plausible values.

Table 1 provides an overview of the attributes and levels adopted in the study. Before introducing the attributes, the questionnaire explains what is climate change and what are the soil functions that improve the adaptation and mitigation capacity. It is also pointed out how some land-use decrease (increase) the ability of the soil to carry out its functions and as a consequence how they negatively (positively) contribute (halt) to climate change. Respondents are explained how policy actions can decrease improper land use (the sealed area growth) and increase proper land use (green area within municipality borders and the conversion of non-vegetated areas). Then each attribute is introduced and carefully explained and it is pointed out that an improvement in any of the attributes compared to the current level can be pursued only by the introduction of a yearly municipality tax on each citizen older than 18 years. Regarding the reduction in the growth rate of the sealed area, the tax would replace the revenues lostfrom the missed urbanisation fees, while in the other two cases the tax would be used to enhance the interventions targeted to create new green spaces

[5] The cost attribute is represented by the mean only as it is treated as a not random parameter in our study. The example provided by Hensher and Greene (2003) makes the same assumption.

Table 1
Description of the attributes and relative levels.

Attributes	Levels (status quo in bold)
Growth in the sealed area in the next 15 years	**+14 %**, +7%, +3%
Share of green area within municipality boundaries	**+5%**, +7%, +9%
Share of unused area within municipality boundaries	**+2%**, +1%, 0%
Tax (euro/person/year)	**0**, 5, 15, 30, 50

or re-naturalise unused areas. The proposed hypothetical tax levels are set at 5, 15, 30 and 50 euro/person/year. These levels have been set after focus groups discussions and after checking the range suitability through a pilot study. If the status quo is chosen, no additional tax is required. Beyond checking the proper range for the tax, the pilot study has allowed checking the wording and the length of the questionnaire as well as getting prior values for parameter estimates to be used in the setup of the final design.

The design for the pilot study is an optimal orthogonal in the difference (OOD) fractional factorial design. An OOD design aims at maximising the differences in the attribute levels over the experiment such that the respondent is forced to tradeoff on all attributes, while orthogonality guarantees the influence of each attribute on the choice to be determined. The coefficient estimates from the pilot study have been used as prior values in the construction of the final Bayesian efficient design. Our Bayesian design aims at minimising the D-error derived from the variance-covariance matrix, which ultimately results from the model estimation (Hensher et al., 2015). As the parameter estimates and the related variance-covariance matrix are unknown when the design is constructed, an efficient design requires the use of prior information on the parameter estimates. When prior information is lacking, it is common practice to use the estimates from a pilot study as priors. The uncertainty about the true parameter estimates is accounted for by the Bayesian setting, which considers the prior values as random, carrying a specific distribution (Scarpa and Rose, 2008). As we finally estimate a RPL model, in the design generation process we specified priors for both the expected value and the variance of each parameter.

The final design is composed of 30 choice sets divided into five blocks, such that each respondent faces six choice sets. An example of a choice set is provided in Table 2. To prevent systematic order effects, a randomisation of the order of the choice sets in the same block is performed such that respondents facing the same block receive the choice sets in a different order.

The questionnaire was distributed to 500 respondents whose residence and domicile is in one of the four Garda lake municipalities considered: Desenzano, Manerba, Tignale, Tremosine. Interviews were conducted using computer-assisted techniques: 200 interviews were Computer-Assisted Person Interview (CAPI), with 50 interviewed per municipality, and other 300 interviews were conducted using Computer-Assisted Web Interviews (CAWI) methods to complement the first set. The combination of the two approaches was necessary to guarantee the representativeness of the sample with respect to population characteristics such as age, gender and municipality of residence. 109 respondents were not willing to trade-off as they chose the status quo in all the six choice sets. It is common practice to leave these respondents out as they do not add any information in the analysis. Thus, the final number of responses included in the estimation sample is 391 and each is given six choice sets, so the total number of observations used to estimate the model is equal to 2,346. The average age in the sample is 41, and around half of the respondents are male; 66 % declare to have a job, while 15 % are students; finally, 38 % of the interviewed has a degree (see Table 3). At the end of the questionnaire, we asked people to score the difficulty in choosing the preferred alternative in each choice set by using a Likert scale from 1 (=very easy) to 5 (=very difficult). The average score is 2.8, indicating that the effort required to respondents was not unmanageable.

Table 3
Descriptive statistics of the model variables (mean and SD).

Variable	Mean	SD
Age	41.07	14.70
Male	0.48	0.50
Occupied	0.66	0.47
Student	0.15	0.36
Degree	0.38	0.49
Married	0.55	0.50

4. Results

The results of the empirical analysis are presented in Table 4 for the preference space and WTP space approaches. As the socio-demographic variables do not vary across choice sets for the same respondent, they have been interacted with the alternative specific constant related to the status quo in order for their parameters to be estimated. Hence, their parameters indicate the increase or decrease in utility by sticking with the status quo alternative.

Results using the preference-space approach (Model 1) show that alternative land uses compared to the status quo increase the utility for male respondents as well as for married respondents as their associated parameters display a negative sign. These results are confirmed by the WTP-space model (Model 2) where also unemployed people raise their utility moving away from the status quo. The attribute levels are modelled as dummy variables, such that it is possible to catch non-linear behaviour in utility with respect to attribute levels. The respondents show preference heterogeneity with respect to the highest level of each of the three attributes, while the standard deviations of the coefficients for the middle level of each attribute are not statistically significant indicating in this case no differences in the preferences among respondents. The error component is significant at 1% indicating that respondents perceive the two proposed alternatives as different from the status quo and these experimentally designed alternatives carry a higher variance in the random component.

The fixed tax coefficient presents the expected negative sign and it is statistically significant. Respondents show on average a preference for halting the increase in the sealed area within municipality boundaries. The preferences are higher for the high level of this attribute, namely limiting the increase of the sealed area in the next 15 years to 3%, compared to the medium level which prospects an increase of 7%. This preference behaviour is consistent with the theory of increasing utility and decreasing marginal utility. Results of the preference space model show that respondents are not interested in a rise in the share of green

Table 2
Example of a choice set.

Attributes	Alternative 1	Alternative 2	Status quo
Growth in the sealed area in the next 15 years	+3%	+7%	+14 %
Share of green area within municipality boundaries	+9%	+7%	+5%
Share of unused area within municipality boundaries	+2%	0%	+2%
Tax (euro/person/year)	15	30	0

Table 4
Summary of the estimation results using the Preference Space (model 1) and the WTP space (model 2) approaches.

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	*	

Notes to table: ***, **, * indicate 1%, 5% and 10 % confidence level respectively. The socio-demographic variables modelled as dummy variables are Male (= 1 for male respondent), Degree (= 1 for respondent holding a university degree), Student (= 1 for student), Unemployed (= 1, if the respondent was unemployed at the time of the questionnaire), Married (= 1, if respondent is married).

area within municipalities. Instead, the WTP space model shows a positive and significant coefficient for an increase of the share of green area to 7%. This model indicates that on average dwellers of the four municipalities are willing to pay 6.7 euro for this action. This WTP, however, is much smaller compared to the WTP for reducing the sealed area growth (16.9 euro and 25.3 euro for a reduced growth rate of 7% and 3% respectively). The lack of interest of the citizens towards having more green area may be explained by the location of the four municipalities under study. They are surrounded by a highly naturalistic area, and consequently, the dwellers may not feel the need to increase the green areas inside the cities. Respondents result to be indifferent about the reduction in the unused area from 2% (status quo level) to 1%, while they appear to experience a decrease in utility if the unused area drops to zero. Although this disutility is unexpected, this may be explained by the interest of people to see some areas in a natural state.

Table 5 shows the WTP, and related standard errors for the preference space model computed according to the procedure explained in Section 3.1. For comparison, we also report the WTP of the WTP space model that are the same values shown in Table 4. As the tax coefficient is kept fixed, the significance of the mean and the standard deviation of the WTP is in line with the significance of the corresponding preference-space attribute coefficients (Table 4). The average WTP for having a moderate decrease in the level of sealed area growth (+7%) is 17.7 euro/person/year while it is 26.7 euro/person/year for having the highest proposed decrease in the growth. Both these measures are statistically significant, and only the second WTP is found to be heterogeneous across respondents. The other attribute for which the WTP is significant is the decrease in the unused area to 0%. As in the corresponding preference-space parameters, the sign is unexpected, as

Table 5
Mean and standard deviation of WTP and related standard errors.

	Model 1		Model 2	
	Estimate	Std error	Estimate	Std error
Expected value of WTP				
7% increase in sealed area	17.749	3.072***	16.861	1.862***
3% increase in sealed area	26.721	4.370***	25.352	2.308***
share green area equals to 7%	3.732	3.131	6.731	2.049***
share green area equals to 9%	1.820	3.260	0.094	2.066
share of unused area equals to 1%	−0.896	2.958	−0.324	1.937
share of unused area equals to 0%	−10.282	3.460***	−9.411	2.225***
Standard deviation of WTP				
7% increase in sealed area	12.246	10.446	20.911	2.747***
3% increase in sealed area	56.532	6.717***	50.653	4.618***
share green area equals to 7%	0.266	5.172	1.943	1.866
share green area equals to 9%	21.972	5.152***	16.478	2.492***
share of unused area equals to 1%	0.553	5.524	3.507	2.331
share of unused area equals to 0%	21.495	6.442***	21.008	2.260***

Notes to table: ***, ** and * indicate 1%, 5% and 10 % significance level respectively.

dwellers indicate a negative WTP associated with this action. The values of the WTP for the WTP space model are in line, both in sign and magnitude, with the ones of the preference space model. The only two differences concern a statistical significance recorded only in the WTP-space model for increasing the share of green area to 7% and the heterogeneity in WTP (significant standard deviation) for having an increase in the sealed area of only 7%.

The strong overlapping between the results of the two models helps to confirm the robustness of the estimation. To compare the two models and consider the slight differences in the results between the two, we have applied the AIC and BIC measures. While the AIC and BIC measures are similar between the two models, both are slightly lower in the case of the WTP-space model. Therefore, we may conclude that the significance found in WTP-space model for two parameters and not in the preference-space model is worth to be considered.

5. Discussion and conclusions

The empirical evidence presented in the previous section provides a clear picture of the preference set of local communities living in the coastal strip of the Garda lake. In this section we contextualise our results in the frame of the existing literature and provide a non-technical summary of our findings, highlighting their relevance for policy-makers.

The first evidence arising from our analysis is that, on average, people are willing to pay for policy actions aiming at limiting soil consumption and moderately increasing the greening of cities. Previous studies based on contingent valuation and hedonic pricing, the most widely used methods to assess the WTP for urban open spaces, find a positive and significant relationship between value of urban open spaces and population density (see e.g. Brander and Koetse, 2011). Evidences in the same direction are provided by different CE conducted to elicit the WTP for green areas and urban greening interventions. The CE conducted by Neuts and Vanneste (2020) shows that residents of the densely populated city of Amsterdam attach a high value to green urban areas and this accompanies concerns on the overcrowding of the city. Fruth et al. (2019) compare the preferences toward different types of urban greening measures of people living in a central neighbourhood of Berlin. They provide evidence that, even without considering urban parks or large areas, the WTP for interventions aimed at improving the sustainability of densely urban areas are, on average, well perceived. They find that street greening, which consists of trees, sidewalk gardens, and natural vegetation along the streets, is the preferred measure among those analysed in the study. This leads us to believe that the high density of the areas we consider may be a major factor contributing to the explanation of the positive WTP for reducing soil consumption and moderately increasing green areas.

Although general evidence exists suggesting that people are willing to pay for ecosystem services provided by green urban areas, to our knowledge none of the previous studies investigate the economic valuation of actions to limit soil consumption nor compared the preferences for urban green areas increase with preferences for reducing the sealed area growth rate. This study adopts, in this sense, an original perspective. In our analysis, the link with the urban greening is both direct and indirect. The direct link consists of the valuation of an increase in the percentage of green areas and a decrease of non-vegetated areas through partial reconversion of these abandoned spaces to vegetated ones. The indirect link consists in assessing the preference towards the reduction of the growth rate of the sealed area. We find evidence that such a reduction is preferred to an increase in the green area within municipality borders. Different preferences for different management of open spaces have to be interpreted looking at the characteristics of the study area. WTP estimates are sensitive to geospatial factors, including resource scale and the presence of complements and substitutes, as shown by Johnston et al. (2017), as well as to regional-specific cultural influences and perceptions of natural and open spaces, as suggested by Brander and Koetse (2011). The area under study, like many others in Europe and especially in the sub-alpine area, is characterised by substantial urbanisation pressures in conjunction with a naturalistic vocation, due to the proximity to natural areas. In line with these characteristics, the evidence in this paper points to the necessity of strengthening actions aimed at significantly reducing soil sealing. This result is not surprising: Tyrväinen (2001) measures the WTP for urban forests in two medium-sized towns in Finland. In addition to be willing to pay for the recreational use of the forests, half of the respondents are also willing to pay for preventing construction in urban forests. New constructions often take place in natural areas with an increasing pressure on land use. Growing urbanisation reflects on residents' preferences, as shown by our results. The lower WTP associated with the increase of green areas that we found in our CE can be attributed to the presence of natural areas in the surroundings of the Garda lake. Sirina et al. (2017) find a similar result: they develop a contingent valuation study in the urban park Parc des Moulins, in the Troyes conurbation (France). They find that the probability of the subjects being willing to pay is lower when they highly value contact with nature and reach the park to enjoy the natural surroundings.

The second evidence provided by our analysis is that the empirical results are largely heterogeneous across respondents. Among others, we found that subjects' preferences and WTP for moving away from the staus quo option depend on gender, marital status, and employment status as well as on unobserved heterogeneity (captured by the significant standard deviation for some of the attribute levels). Even if some previous studies find a positive correlation between income and WTP for urban green areas (see e.g. del Saz-Salazar and Rausell-Köster, 2008) there is no clear consensus in the literature on the significance and direction of the effect of socio-demographic variables on the WTP. The heterogeneity across respondents is strictly linked with the perception and the use-value of the different areas. Urban green spaces often provide the possibility for locals to engage in recreational activities or to build up social capital by responding to psychological, social, and physical needs, as remarked by Tyrväinen et al. (2007). Several studies tackle this heterogeneity focusing on identifying cognitive and motivational factors affecting individual behaviour and the perception of natural areas (see Sauer and Fischer, 2010 and López-Mosquera and Sánchez, 2014 among others).

A final evidence we report concerns households' preferences against the re-naturalisation of unvegetated and abandoned areas. Our results suggest that people are not willing to pay for re-naturalisation actions and these, instead, are perceived as a cause of disutility. However, the result needs to be interpreted carefully. In fact, unvegetated and abandoned areas in this study are mostly located close to large network infrastructures and, looking at their location, their abandonment is the result of being former construction sites, not in use anymore. More specifically, these sites are not located close to the core residential areas, but rather in proximity of road and rail infrastructure networks with limited residential fabric and it is likely that, due to their marginal location, residents do not perceive a direct utility from their reconversion. Previous literature shows that rehabilitation benefits are often overlooked and underestimated. Damigos and Kaliampakos (2003), through a contingent valuation study, estimate the economic value of rehabilitation of a urban quarry in the center of Athens, mostly conducted through reforestation interventions. They find that, even if three quarters of the respondents believe that their municipality lacks green space, only 56 % are willing to pay for rehabilitation actions. Studies focusing on river rehabilitation in urban areas provide further insights in this direction. Junker and Buchecker (2008) show that rehabilitation interventions are directly related to the improvement of the landscape perceived by citizens. Deason et al. (2010) remark that there is often disagreement over the significance of problems, the need for rehabilitation interventions, and their scale. In our case, the general underestimate of rehabilitation actions seems to be reinforced, in the perception of the residents, by the lack of proximity to the unused areas. This last point raises the question of whether or not WTP should be considered in relation to the distance between the site valued and the respondents' residence or workplace. Unfortunately, we have not been able to address this issue in our research, because sites (i.e. areas with a potential for reconversion) are not evenly distributed across the study area, being concentrated in the Desenzano city, close to highways and railways. The relevance of proximity would be a valuable topic to be explored in future research involving site reconvertion and revegetation policies. Some evidence about the relevance of proximity on the WTP comes from the literature on urban parks. del Saz-Salazar and Ménendez (2007) study the WTP for a new planned urban park in the city of Valencia. They find that people living closer to the area identified for the park have a WTP considerably higher than the others.

To conclude, we can summarise our results and generalise them to provide a few insights that may be useful to inform policies. In the municipalities considered in this study, measures limiting the sealing of soil increases local residents' utility more than measures improving the greening of the cities. This is an important message for policymakers, who might usually prefer investments in green infrastructure over those limiting soil consumption with the belief that increasing the first may bring a direct return from voters' consensus while the second would not. Local residents may have multiple incentives for limiting the soil consumption, not strictly related to the environmental benefits generated by such limits. Among others, keeping soil transformation low is the preferred channel of local communities for limiting the supply of housing, thus keeping property values high. Our empirical analysis cannot fully disentangle the multiple determinants of residents' preferences. We were however able to measure them, showing that limiting soil consumption to the desired level is more important than improving the urban greening a. We find a great heterogeneity of results across respondents, based on socio-demographics characteristics. Accordingly, when designing urban planning actions, the local composition of the population and the socio-demographic traits of people living within the spatial scope of the action is relevant and should be properly taken into account. Finally, we find that people are not willing to pay for re-naturalisation actions. As stressed above, this result might be driven by the location of unused areas, mainly located in peripheries. To conclude, it is worth noting that soil protection in areas under rapid urbanisation is among the most important objectives in the agendas of policymakers, primarily on the local scale. Actions to prevent soil consumption and preserve the functioning of the ecosystem services it provides are required. Both the costs and the benefits of these actions target specific geographical contexts and, hence, in order for them to be effective, they must be accepted by the local population. In other words, these actions should be designed following a bottom-up approach. Results of this study show, as a topical example, that dwellers in the municipalities of Garda lake, contrary to the expectations, are overall satisfied with the current situation and departures it are only partially perceived as positive and desirable.

Many urban planning decisions still do not properly account for environmental impacts and do not engage in active discussion with citizens. Our results reinforce the call from more conservative land-use policies advocated by European and international institutions, EEA (2016a, 2016b) and the OECD (2018) among others, to make urbanisation more sustainable by highlighting that soil-containment and urban greening policies, when carefully designed involving local communities, have also the potential to increase residents utility, a basis to be socially acceptable.

Authors statement

Linda Arata set the experimental design and analysed the results of the experiment

Francesca Diluiso carried out the literature review and contributed to find the attribute and attribute levels

Gianni Guastella defined the attribute and the attribute levels, checked the quality of data collected and contributed to perform the pilot study and draw the discussion and conclusions.

Stefano Pareglio monitored the development of the entire study

Paolo Sckokai monitored the development of the entire study and contributed by giving tips and suggestions relative to the attribute and attribute levels and to the design of the experiment.

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