Received: 21 July 2023 | Accepted: 3 February 2024

DOI: 10.1111/ajae.12467

ARTICLE

Who should benefit from environmental policies? Social preferences and nonmarket values for the distribution of environmental improvements

Michela Faccioli[1,2] | Diana M. Tingley[2] | Mattia C. Mancini[2] | Ian J. Bateman[2]

[1]School of International Studies, and Department of Economics and Management, University of Trento, Trento, Italy

[2]Land, Environment, Economics and Policy (LEEP) Institute, Business School, Department of Economics, University of Exeter, Exeter, UK

Correspondence
Michela Faccioli, School of International Studies, and Department of Economics and Management, University of Trento, Trento, Italy.
Email: michela.faccioli-1@unitn.it

Funding information
Natural Environment Research Council (NERC) through the SWEEP project, Grant/Award Number: NE/P011217/1; UKRI-BBSRC through the NetZeroPlus (NZ+) project, Grant/Award Number: BB/V011588/1; Esmée Fairbairn Foundation, Grant/Award Number: 22-0827; Exeter Business School's International Advisory Board Research Fund

Abstract

The literature is replete with valuations of the costs and benefits of environmental change, yet the issue of where those impacts fall across society is rarely considered. This is a significant knowledge gap given clear evidence of social preferences regarding distributional effects reflected in both policy and protest. As an initial contribution, we examine preferences regarding projects designed to more than offset the biodiversity impacts of housing developments in England, as mandated under the UK's Net Gain legislation. Employing a nationally representative sample, a Discrete Choice Experiment values options for alternative characteristics and location of both development and offset sites, including their situation relative to both the respondent's home and neighborhoods of different socioeconomic status. This defines sets of "winners" and "losers" varying across wealth levels. Results show that respondents did not necessarily prefer that the communities losing biodiversity due to development must also be the beneficiaries of the biodiversity enhancement under Net Gain rules. This is particularly the case where the communities losing biodiversity are located far from the respondent and are high wealth. Instead, our findings show that respondents are willing to pay more for Net

M.F. conceptualized the overarching research goals and aims and developed the overall methodology for the research, with the help from all co-authors. M.F. and D.M.T. designed and tested the survey, with support from all co-authors. M.F. analysed the data and curated the data visualization, with help from M.C.M.. M.F., with support from D.M.T., coordinated and managed the project. I.J.B. provided supervisory support. M.F., D.M.T. and I.J.B. secured the funding. M.F. wrote the first draft of the paper and all co-authors contributed with edits and revisions. All authors approved the submitted version of the manuscript.

Gain policies delivering biodiversity improvements to low or average (rather than high) wealth communities. These results highlight the importance of considering distributional concerns when measuring the welfare impacts of environmental policies and the potential role of such policies as redistributive tools to reduce social inequalities.

KEYWORDS

biodiversity, distribution, environmental benefits, equity, Net Gain, nonmarket valuation

JEL CLASSIFICATION

Q51, Q56, D63, Q57, I31

1 | INTRODUCTION

The environment (i.e., natural capital) supplies numerous goods and services (e.g., food, timber, recreation etc.) that are of great value to society and contribute to people's welfare (Costanza et al., 2017). Natural capital can, however, be more or less abundant in different areas and therefore provide differing levels of benefits to different people depending on their proximity to nature. The skewness in the distribution of nature and the benefits it provides to people can also be exacerbated by the application of environmental (or other) policies (Circle Economy, 2022). This paper focuses on if and how policy-driven changes in the distribution of the benefits of nature, affecting different groups of people in different locations, influence the economic value attached to the environment.

There is evidence that disadvantaged communities have fewer possibilities to enjoy the environment (Mullin et al., 2018). In particular, lower income households and individuals of minority ethnic backgrounds tend to live in more densely populated areas with fewer opportunities to enjoy and access a good quality environment, compared to their counterpart (Banzhaf et al., 2019; Hausman & Stolper, 2021; Hsiang et al., 2019; Vona, 2021). This implies that these more disadvantaged households tend to enjoy fewer benefits from the environment, which further decreases their already lower living standards and quality of life, with negative repercussions in terms of their welfare (Bruegge et al., 2019; Holland et al., 2019; Vona, 2021). Given the increasing gap worldwide between the richer and the poorer (i.e., social inequality) (Stiglitz et al., 2010), the question of how different segments of society benefit from the environment is consequently starting to attract increasing political attention (see e.g., the UK Government [HM Government, 2018]; the USA Government [OMB, 2003, 2023]; Dauwalter & Harris, 2023).

Despite the significance of the problem (Meya, 2020), distributional issues have largely been neglected in the nonmarket environmental valuation literature, concerned with estimating the welfare impacts of environmental changes. This literature has generally focused on efficiency, namely on maximizing the total net social welfare from alternative environmental policies, while treating as a second-order question the distribution of the benefits and costs of these policies across different social groups, and the resulting equity or fairness issues. This is so despite social welfare depending on both efficiency and distributional aspects (Drupp et al., 2018; Flores & Strong, 2007). According to Cai et al. (2010) the economic value of (and overall support for) an environmental policy cannot be estimated without considering the policy's distributional impacts. Recent evidence (Bergquist et al., 2022) based on public opinion surveys shows that perceived fairness is the most important driver of the public acceptance of climate policies. Ignoring distributional issues may therefore

undermine the success (and effectiveness) of any environmental intervention, given that people will likely oppose any measure that they do not view as fair (Povitkina et al., 2021).

To date, only a minority of environmental valuation studies have explicitly accounted for the distribution of the benefits and costs of policies across different people. These studies have typically relied on a simple approach (Adler, 2016; Nyborg, 2014) based on adjusting the estimated welfare measures by applying some predetermined "distributional or equity weights" that tend to give more importance to the views of those with a low compared to a high level of income (Nurmi & Ahtiainen, 2018). Although simple, this approach has been heavily criticized for taking a strong normative stance and using some out-of-context and often arbitrary weights (Drupp et al., 2018) and applying them, only in a second step, to the calculation of social preferences, as if preference formation and distributional considerations were independent.[1] As argued in Cai et al. (2010), distributional considerations cannot be applied *ex post* to the estimated economic values. Instead, people's preferences for the distribution of environmental costs and benefits need to be explicitly explored.

Only a handful of environmental valuation studies have so far followed this latter approach. Among these, the focus has generally been on preferences for alternative rules to share the costs of environmental policies (Ajzen et al., 2000; Andor et al., 2018, 2022; Atkinson et al., 2000; Bartczak et al., 2023; Börger et al., 2023; Cai et al., 2010; Dietz & Atkinson, 2010; Johnson, 2006). Results of these studies, carried out mostly in the context of climate change policies, indicate that social preferences and Willingness To Pay (WTP) are generally higher when: (1) the cost-sharing rule requires polluters (rather than the beneficiaries) to bear the costs of environmental restoration (i.e., "polluter-pays-principle"); (2) when costs are adjusted based on different abilities to pay, which is perceived as a "fairer" approach; and (3) in case of uncertainty regarding who is responsible for the environmental problem, when an equal split of payments is proposed.

To the best of the authors' knowledge, the valuation literature has to date not yet explored the social preferences for the distribution of the benefits of environmental policies and decisions (Dauwalter & Harris, 2023; Hsiang et al., 2019). This is a major knowledge gap because the question of who should benefit from an environmental policy is as important as the question of who should pay for it (Drupp et al., 2018) to correctly measure welfare impacts and better inform policy making. Expectations (based on e.g., Baumgärtner et al., 2017, drawing on Frank & Schlenker, 2016) are that preferences and WTP should be higher for environmental policies that achieve a more equitable distribution of nature. It is in fact possible to manage natural capital such that environmental policies become a tool to re-distribute environmental benefits and, in the long-run, contribute to reducing inequalities and improve the quality of life of the less advantaged members of society (Mullin et al., 2018). Managing the environment in a way that allows for the redistribution of welfare is, however, only being considered by a minority of governments around the globe. An example is the UK, which aims to address environmental inequalities by promoting a more even distribution of environmental benefits and resources, as conveyed in the UK government's 25-Year Environment Plan (HM Government, 2018). This requires understanding how environmental planning and policy affects different groups of people, and what would be society's willingness to redistribute environmental benefits, such that natural capital is managed for all.

To provide evidence on social preferences for the distribution of environmental benefits, we designed and conducted a Discrete Choice Experiment (DCE) survey. Our empirical application focused on Net Gain policies in the context of housing development plans in England (UK). These policies, which came into effect mid-February 2024, mandate developers to deliver an equivalent amount of biodiversity lost due to house-building works and to go beyond by enhancing it further. Net Gain policies should, according to legislation, be delivered as close as possible to the communities affected by the loss of nature due to development, but they could also be designed in a way such

[1]Arguably, spatially explicit valuation studies (e.g., Bateman et al., 2006; Bateman et al., 2016; Bateman et al., 2019) should also be mentioned in our literature review, as their results can have distributional implications. However, no valuation study so far focusing on spatial aspects has explicitly controlled for distributional and justice issues, such that no conclusions can be drawn based on that literature regarding the role of distributional considerations.

that other communities will benefit. Given the significantly different distributional implications that these alternative approaches could have, the example of Net Gain policies represents an ideal case study for us. Methodologically, to pursue our research objectives, we included a specific attribute (neighborhood wealth) in our DCE to measure the general public's preferences for the distribution of policy benefits (i.e., which wealth group should gain), while introducing some exogenous variation (through split sample treatments) in the distribution of the environmental losses (i.e., which wealth group would lose and where). This study design (as explained in more details in Section 3) allowed us to collect the necessary information to answer several research questions on the role of distributional preferences and perceived fairness in the nonmarket valuation of the environment. The exact questions, and the literature motivating them, will be outlined in Section 2.1.

Our study contributes to the literature in several ways. As mentioned above, and to the best of our knowledge, this is the first study to shed light on the role of the distribution of environmental benefits on WTP. More knowledge on this matter is important to correctly measure welfare impacts, guide better environmental policy making and to anticipate the potential public acceptability of policies with different distributional repercussions. Importantly, ours also represents the first valuation study to explore distributional issues in the context of biodiversity loss and conservation. The (few) previous valuation studies focusing on distributional preferences explored the general public's support for alternative cost-sharing rules in the context of climate policies. The only exception in this literature is Börger et al. (2023), which focused on marine plastic pollution policies. Given rising problems of biodiversity loss worldwide and increasing efforts to save species and habitats (IPBES, 2019), understanding how biodiversity conservation policies should be designed, and for whom, is therefore both timely and relevant (Drupp et al., 2023).

As we will present in Section 4, and explain in Section 5, our findings show that respondents did not necessarily prefer that the communities losing biodiversity due to development must also be the beneficiaries of the biodiversity enhancement proposed under Net Gain. This is especially the case when the communities losing biodiversity are located far from the respondent and are "high wealth." Instead, our findings show that respondents are willing to pay more for Net Gain policies that will deliver biodiversity improvements to different people, especially to the "low" or "average" (rather than "high") wealth communities. These results highlight the importance of considering distributional concerns when measuring the welfare impacts of environmental policies. In addition to having economic significance, these findings have also policy relevance by highlighting the potential role of environmental policies as a tool to redistribute the allocation of environmental resources and to reduce social inequalities.

2 | BACKGROUND ON CASE STUDY

To investigate social preferences for the distribution of the benefits of environmental policies, we consider recent policy developments in England (UK), focusing on promoting a sustainable approach in the building and development sector.[2] This is a good case study because different policy design options are being discussed and, depending on how measures will be implemented, there will be different distributional implications in terms of who benefits and who loses from these policies (Bateman & Zonneveld, 2019).

Due to housing shortages and an increasing population, the UK government has committed to building 300,000 new homes in England each year by the mid-2020s (Bramley, 2019; Wilson & Barton, 2023). Despite efforts to avoid using new land, about half of the new homes will have to be built on sites that have not yet been developed, mostly farmland, at the edges of existing residential

[2]Given that environmental policies are a devolved matter in the UK, and considering the differences in the policy approaches to sustainable building across England, Scotland, Wales, and Northern Ireland, it is important to clarify at this point that the focus of our case study will be England (UK).

areas. As a result, natural environment and wildlife species will be lost due to the building of new houses.

Under the Environment Act 2021,[3] and officially from mid-February 2024, developers are required to minimize damages to the natural environment from building works; restore the nature and biodiversity lost due to the development; and, additionally, as a Minimum Legal Requirement, achieve the so-called Biodiversity Net Gain principle, whereby a 10% overall increase in natural environment and wildlife species will be delivered (as measured through the Statutory Biodiversity Metric (DEFRA, 2024), building on the Biodiversity Metric 4.0 developed by Natural England 2023). The new Net Gain legislation will focus only on biodiversity enhancement and will aim to leave nature in a better overall state than it was before the development.

As set out in the UK government's 25 Year Environment Plan (HM Government, 2018), discussions are also underway to expand upon Biodiversity Net Gain approaches to include wider natural capital benefits (e.g., recreation, flood protection etc.) to not only help nature thrive but also to provide additional benefits for people.

A number of Local Planning Authorities in England are proposing more ambitious biodiversity improvement targets beyond the 10% uplift legislated as the Minimum Legal Requirement (Carter Jonas, 2023). In addition, it is being discussed whether public access to Net Gain sites should also be promoted to give people more opportunities to enjoy nature, which would improve their health and well-being (Natural England, 2022). The new legislation recommends that Net Gain projects are created as close as possible to, or on, the development site, but, where this is not possible, they can also be delivered in different locations.[4] Varying the location of the Net Gain project does not only have ecological implications (habitats and their suitability for biodiversity are different across space) but, as socioeconomic circumstances also vary spatially, it additionally raises questions in terms of the populations losing versus gaining biodiversity. If the Net Gain project is delivered on, or close to, the development site, the same people losing greenspace and biodiversity due to the development would stand to benefit the most from the Net Gain improvements. Otherwise, where Net Gain projects are located elsewhere, the people losing biodiversity from the development and those benefiting from Net Gain improvements will be different groups of individuals. If nature is enhanced close to lower wealth neighborhoods, for example, which tend to be the most disadvantaged groups in terms of access to nature, their well-being and quality of life might be especially improved. Thus, depending on where the loss of nature takes place and where the Net Gain improvements are delivered, issues are raised concerning the distributional effects of Net Gain policies (and thus their social justice aspects).

Policy makers have no clear guidance at the moment regarding how, where and especially for whom Net Gain projects should be designed to maximize social benefits. Lacking any clear guidance from the valuation literature, information on the social preferences for alternative Net Gain project configurations is therefore both timely and urgently needed; not only by public decision makers in England, as they have entered the enforcement phase of Net Gain policies, but also by public decision makers and conservation organizations in other parts of the world. In fact, the Biodiversity Net Gain policy in England is the most wide ranging of a particular class of "no net loss" or "net positive" biodiversity programs that are emerging globally to address the problem of infrastructure-driven biodiversity loss (zu Ermgassen et al., 2021). Issues such as those raised around the implementation of Net Gain (who should benefit, where and how) are also very common to other environmental policies. The results of our valuation study may therefore be relevant to better guide the

[3]Environment Act 2021, UK Public General Acts, 2021 c. 30, schedule 14 available at: https://www.legislation.gov.uk/ukpga/2021/30/schedule/14/enacted.

[4]The official guidance documents (The Statutory Biodiversity Metric: User Guide, building upon the Biodiversity Metric 4.0: User Guide) report that the biodiversity units delivered by Net Gain projects should be weighted by a *spatial risk* multiplier that penalizes projects that deliver habitat at a distance from the impact site (i.e. off-site). Further justification in favor of on-site compensation comes from programmatic documents as well as "best practice" recommendation and implementation documents (CIEEM, 2021; DEFRA, 2023; DLUHC, 2023; LGA, 2023).

design and implementation of all those environmental policies where distributional considerations play a role.

2.1 | Conceptual framework

Before presenting the empirical experiment conducted, we first provide an overview of some of the theories and findings from the literature to motivate the hypotheses tested in this study on the role of distributional issues on preferences.

Most of the literature on Net Gain and the related topic of "no net loss" have typically argued in favor of "on-site" compensation, based on (among other things) justice reasons. According to this principle, it is fairer that those affected by the environmental damage (i.e., the "victims") also benefit from the environmental compensation (Cole et al., 2021; Griffiths et al., 2019; Gurney et al., 2021), such that no one is made significantly worse off as a result of the Net Gain policy.

A different perspective, developed within the (non-environmental) economic literature mostly, in turn argues that people also favor policies that benefit especially those that are less well-off in society (Gurney et al., 2021; Mengel & Weidenholzer, 2022). According to this idea, which reflects support for a more equitable distribution of resources and wealth, a marginal environmental improvement benefiting particularly the most disadvantaged in society should be preferred. A more extreme conceptualization of these preferences was presented by Rawls (1971), according to whom society should *only* care about enhancing the well-being of those individuals with the lowest level of welfare, who otherwise suffer the costs of any losses more than proportionally. Members of society however tend to display limited degrees of altruism when it comes to public goods' provision (Ritz & Hahn, 2014). Based on this, it is therefore also possible that individuals just value the provision of the resource or benefit, no matter who will receive it, which reflects no specific underlying distributional concerns.

Evidence from the economic and psychology literature outside the environmental domain has also shown that individuals' distributional considerations can be context specific and depend on the social environment (Levitt & List, 2007; Sircar et al., 2018). In particular, the salience (relevance or closeness) of the social context can affect distributional and altruistic sentiments (Li et al., 2020). In this framework, *in-group biases* can emerge, whereby individuals take distributive decisions that tend to favor fellow group members with similar socioeconomic background, geographical location, or common social ties (Dietz & Atkinson, 2005; Dorin et al., 2021).

Drawing on this literature, this article seeks to answer three central questions concerning the social preferences for the distribution of environmental benefits to fill an important gap in the non-market valuation literature, as highlighted in Section 1. What we test in relation to each question is briefly reported below, with more details presented in Section 3.

First, we ask the question: *Should the same communities who lose environmental quality be the beneficiaries of the environmental improvement delivered via Net Gain*? As part of this research question, we test the extent to which our respondents endorse a policy approach where the "victims" of the environmental losses are compensated with nature improvements or if, instead, there is support for the environmental benefits going to other communities.

The second research question is: *If the people who lose nature should not necessarily be the beneficiaries of Net Gain, who should benefit from the environmental improvements*? As part of this research question, we investigate whether respondents are indifferent to, or rather display specific preferences for, who else (excluding those experiencing the environmental loss) should receive the environmental benefits.

Third, we ask the question: *Are preferences for the distribution of environmental benefits sensitive to the socio-economic background of the respondent*? As part of this research question, we are interested in testing whether there is evidence for *in-group bias* in distributional choices in environmental settings.

Importantly, each of the above research questions were explored across a range of scenarios to test if preferences for the distribution of environmental benefits are sensitive to the specific settings being considered, varying in terms of "who" loses nature due to development and "where."

3 | METHOD: DISCRETE CHOICE EXPERIMENT SURVEY

3.1 | Experimental design

For the purposes of this study, we designed and conducted a DCE survey asking members of the general public in England (UK) to choose their most preferred option among a set of different hypothetical (but realistic) Net Gain policy alternatives. Each time, three Net Gain options were presented: one being fixed across the choice situations and reflecting the Minimum Legal Requirement for Net Gain (based on the new legislation); and two alternatives varying across the choice situations, following an experimental design, and reflecting Net Gain policies extending beyond the Minimum Legal Requirement. Each option was defined in terms of five attributes, taking different levels, as described in the following paragraphs and as summarized in Table 1.

One attribute described the level of biodiversity improvement that could be achieved by the policy. Following the new legislation on Net Gain, the Minimum Legal Requirement option will mandate developers to achieve a 10% biodiversity improvement over the predevelopment level–meaning that all species expected to be lost due to the housing development will have to be replaced and some more added, following specific habitat interventions. Policy alternatives to the Minimum Legal Requirement option presented in the DCE could, in turn, also be associated with more significant ("moderate" or "high") levels of biodiversity improvements. Levels of biodiversity were conveyed in the choice cards by means of illustrations showing realistic variations in farmland ecological features and associated wildlife species.[5,6]

The second attribute considered in the DCE referred to the location of the Net Gain site. For each alternative, information was provided on the distance (in miles and equivalent driving time) of the Net Gain project from both the housing development and the respondent. In the Minimum Legal Requirement option displayed in the choice cards, the Net Gain site was presented in the same location as the development or directly adjacent to it (at a fixed distance from the respondent) because the new legislation recommends that, where possible, the Net Gain is delivered "on-site," where the development takes place. In the other policy alternatives presented in the DCE, the Net Gain site was instead offered in locations that could be different from the development site (i.e., "offsite"), at set distances ranging from 1 to 100 miles from the respondent.[7] To allow respondents to consider the widest range of credible scenarios, the direction of the distance vector was not specified. This way, two Net Gain sites presented at the same distance could still be located in different places.

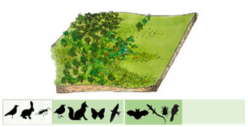
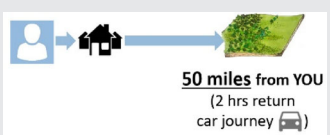
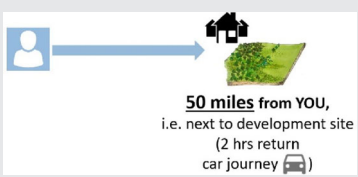
A third attribute displayed in the DCE referred to the possibility to access the Net Gain site for recreational purposes. Based on current legislation, in the Minimum Legal Requirement option developers are not obliged to provide any additional benefits (including recreational access) beyond

[5]In the choice cards, respondents were informed (using a visual illustration) that both the area that would be lost due to the development and the area where Net Gain would be delivered are (predevelopment and pre-intervention) grassland habitats with a few common farmland species. For consistency, this information was kept constant across the alternatives presented in all choice cards.

[6]To come up with the illustrations showing the different levels of biodiversity change, we referred to the published literature (European Court of Auditors, 2020) and consulted with biologists and ecologists (Dr. Ben Balmford and Dr. Gemma Delafield) to identify a plausible list of wildlife species that can be found in agricultural habitats with different ecological features. We opted for this approach over the use of the Statutory Biodiversity Metric - the official measure of biodiversity under Net Gain, which builds on the Biodiversity Metric 4.0 - for several reasons. The metric rests on context-specific assumptions and doesn't allow to formulate realistic biodiversity levels that can be applied to a variety of scenarios (as needed in our survey). In addition, the metric fails to capture the correlation between habitat-based scores and species of conservation priority (e.g., Hawkins, 2022; Hawkins et al., 2022). Given the inherent complexity of biodiversity, which makes it challenging to unequivocally interpret its traits especially when it comes to value elicitation (Balmford et al., 2022; Dasgupta, 2021), we therefore opted for a less specific but more encompassing measure, informed by available studies and expert knowledge.

[7]Reasons for delivering Net Gain in locations that are not close to the development site include the possibility of achieving further social benefits and especially greater environmental improvements. As the Lawton (2010) report highlights, to achieve a significant reversal in the trend of biodiversity loss it is crucial to focus on the restoration of joined up networks of ecologically relevant ecosystems rather than on the restoration of fragmented local sites where losses take place. Recent evidence (Rampling et al., 2023), in fact, shows that on-site Net Gain restoration is often exposed to high risks of not being able to deliver the promised biodiversity improvements, and it represents an inadequate tool to reverse the loss of critically endangered species.

TABLE 1 Attributes and their levels for each split sample.

Attributes	Split samples					
	Development close (i.e., 2 miles from the respondent)			Development far (i.e., 50 miles from the respondent)		
	Population losing nature: low wealth	Population losing nature: average wealth	Population losing nature: high wealth	Population losing nature: low wealth	Population losing nature: average wealth	Population losing nature: high wealth
Biodiversity improvement delivered from Net Gain	 Minimum Legal Requirement		 Moderate Enhancement		 High Enhancement	
Location of Net Gain site	1, 2, 5, 10, 25, 50, 75, 100 miles from respondent For example, 			For example 		
Recreational access to the Net Gain site	 No public access allowed			 Public access allowed		
Neighborhood benefiting from Net Gain	 Low wealth neighborhood		 Average wealth neighborhood		 High wealth neighborhood	
Cost	£ 2, 4, 8, 16, 32, 48, 64, 96 per household per annum, for 5 years					

Note: in the visual display of the location attribute, the icon with the stylized person indicates the respondent and the picture with the houses refers to the development site.

biodiversity improvements, unless the greenspace lost due to the development was also used for recreation prior to the housebuilding. In our DCE, in the Net Gain policy options presented as alternatives to the Minimum Legal Requirement, we however sometimes considered offering recreational access to the site. This was to estimate the value that respondents would assign to the possibility (for themselves or others) to visit the Net Gain site.[8]

Importantly for the purposes of our research, a fourth attribute included in the DCE focused on the type of neighborhood located closest to the Net Gain project site that would therefore benefit the most from the improvement(s). To describe the type of neighborhood, the level of wealth of the community ("low," "average," or "high") was used as an indicator.[9] In our choice cards, in the Minimum Legal Requirement option displayed, where the Net Gain project is delivered "on-site" (as close as possible to the development), the same individuals losing the greenspace due to housing are also the ones benefiting the most from the Net Gain project. In the other Net Gain policy alternatives of the DCE, where the location of Net Gain is not necessarily at (or close to) the development site, the neighborhood benefiting from Net Gain could be different from the one losing the greenspace due to the development and be either "low," "average," or "high wealth."[10] When providing the background information to respondents in the survey, it was explained that lower wealth households tend to have less opportunities to see and enjoy nature (relative to more affluent households) and that enhancing nature close to lower wealth neighborhoods could help improve their well-being and quality of life.

Finally, a monetary attribute was included in the study design. This attribute reflected the amount of money that the respondent would be required to pay in the form of a new tax to contribute to the funding (initial investment and maintenance costs for 30 years) of any Net Gain project going beyond the Minimum Legal Requirement option. The legislation in fact requires developers to bear the full costs of restoring nature and wildlife lost due to the development and to deliver the required 10% uplift. Given that, in our DCE, the Minimum Legal Requirement option was presented at "no cost" to households. The other policy alternatives in the DCE, showing additional changes or improvements beyond the Minimum Legal Requirement, were instead associated with a payment from the general public, ranging from £2 to £96 per household per year, for 5 years.

For the purposes of our research, namely to test the role of distributional considerations around the allocation of environmental benefits and their effect on preferences and WTP, we created different scenarios. Each scenario, varying in terms of the type of population losing the greenspace due to the development (i.e., "low," "average," or "high wealth") was randomly presented to a separate group of study participants, following a split sample approach.[11] Adding exogenous variation over the wealth profile of the population losing nature was motivated by the willingness to explore whether respondents' preferences were context dependent and, in particular, sensitive to information about the socioeconomic group being damaged from the loss of environmental quality.

If respondents are supportive of the idea that the same people losing nature should also be those benefiting from Net Gain, we anticipate that the Minimum Legal Requirement option would be their preferred alternative, as this is the only scenario in which the same individuals losing nature can be directly compensated with Net Gain. Furthermore, our study participants might also be concerned with distributing Net Gain benefits to the people losing nature, especially when these are lower

[8]In the survey, respondents were informed that no recreational access was allowed to the greenspace that would be lost due to the development (prior to housebuilding) and to the area where Net Gain would be delivered (prior to project implementation).

[9]Annual income is generally used as a socioeconomic measure when studying the distribution of economic resources. However, annual income provides only a one-off (circumstantial) picture, which can change year after year, thereby not giving a realistic idea of the actual means and belongings of a person, which are instead better represented by a wealth measure (Drupp et al., 2018).

[10]In our survey, the Minimum Legal Requirement is the only scenario in which the same individuals losing the greenspace due to the development are also the beneficiaries of Net Gain improvements. In all other scenarios presented, the beneficiaries would be different from the losers. Even when two Net Gain sites are presented at the same distance from the respondent (e.g., 2 miles), they could still be located in different places (in different directions from the respondent) and therefore concern different people.

[11]This approach is inspired by Cai et al. (2010) who state in their paper that choice scenarios should explicitly include information about the policy distributional consequences, possibly randomized across respondents, to test for the effect of a systematic variation in the distribution of resources on WTP.

(rather than higher) wealth communities. In such cases, we would expect the rate of choice (and of perceived fairness) of the Minimum Legal Requirement option to increase when the lower (rather than higher) wealth communities lose nature, keeping everything else constant.

Analogously, we anticipate that respondents who prefer Net Gain policies that benefit different communities, other than those losing nature due to development, would prioritize scenarios in which the beneficiaries are the "less affluent" (rather than the "more affluent") communities, if they are concerned about the redistribution of resources in favor of the less advantaged.

In our DCE, for each scenario (where a "low," "average," or "high wealth" neighborhood loses greenspace due to the development) the location of the development site was additionally varied, with the possibility of it being either close (2 miles) or further away (50 miles) from the respondent. The location of the development site (and therefore of the population affected by the loss of greenspace) was varied to learn if preferences for the distribution of Net Gain project benefits changed depending on the salience of the scenarios for the respondent. Indeed, expectations were that respondents are more likely to care about an environmental loss (and benefit) occurring in a neighborhood close to them (rather than far away), unless they have prevailing other-regarding preferences (Drupp et al., 2018). Anticipating a proportionally higher degree of concern for the "local" (i.e., local Net Gain to compensate for local environmental losses), we would therefore expect that respondents, on average, should support the Minimum Legal Requirement option (compensating the same neighborhoods suffering the loss of greenspace), especially when the loss takes place close to them.

Altogether, six scenarios or split samples were considered in our study, showing all the possible combinations of neighborhood wealth and relative location of the population affected by the loss of greenspace due to the development. This design is unique and allowed us to experimentally introduce some exogenous variation when exploring preferences for distributional aspects in a way that is otherwise hard to achieve in the real world (due to endogeneity problems). It is in fact acknowledged that in reality a household's place of residence, their socioeconomic status and environmental quality are highly correlated (due to a phenomenon known as sorting), which makes the identification of the separate effect of income distribution on the valuation of the environment hard to model using observed data (Kuminoff et al., 2013).

The different attribute levels were combined into policy options using a D-efficient Bayesian experimental design, optimized for the multinomial logit (MNL) model, using priors based on the MNL model coefficients estimated from responses collected at the pilot stage ($N = 330$). The final design comprised 24 choice tasks, allocated to three blocks, such that eight choice tasks were presented to each respondent. Importantly, given the purposes of our study, a single experimental design was created for all split samples in order to avoid difficulties comparing across the treatments due to the way that choice cards are combined. For illustrative purposes, Figure A1 in the online supplementary appendix shows an example choice card for two split sample treatments in our experiment (choice card examples from the other split samples can be made available from the corresponding author upon request).

3.2 | Survey administration and sample

The DCE study was administered online between May and June 2022[12] via a professional market research company, which delivered a sample of just over 3600 respondents who were representative

[12]To create a sufficiently reliable survey instrument (available to the interested reader in the online supplementary appendix), several steps were taken before data collection. To start developing the questionnaire, we ran focus group sessions with experts and then members of the public to sense-check their overall level of understanding of the subject matter and framing of the issues, and to refine the choice of the attributes. Following that, pretesting interviews were run to improve and clarify the survey instrument. After programming the questionnaire online, two rounds of piloting took place to exclude any remaining confusion around the understanding of the survey messages and (as customary) to update the experimental design.

TABLE 2 Summary of the sociodemographic characteristics of the population and study respondents by split sample.

		Development close (2 miles)			Development far (50 miles)		
Variable	**Population**	**Population losing nature: low wealth**	**Population losing nature: average wealth**	**Population losing nature: high wealth**	**Population losing nature: low wealth**	**Population losing nature: average wealth**	**Population losing nature: high wealth**
Gender							
Male	48.99%	49.09%	48.83%	49.00%	48.75%	48.83%	48.84%
Female	51.01%	50.75%	51.17%	50.66%	51.08%	51.00%	51.00%
Age							
18–29	19.00%	18.57%	16.33%	18.60%	18.64%	19.50%	19.44%
30–44	25.00%	25.70%	26.33%	25.75%	25.79%	24.33%	24.75%
45–64	33.00%	36.48%	36.17%	33.89%	35.61%	36.33%	35.22%
≥65	23.00%	19.24%	21.17%	21.76%	19.97%	19.83%	20.60%
Region of residence							
North West	13.04%	12.94%	13.00%	13.12%	13.14%	13.00%	12.96%
North East	4.83%	4.81%	5.00%	4.98%	4.83%	4.83%	4.82%
Yorkshire & the Humber	9.79%	9.78%	9.67%	9.80%	9.82%	9.67%	9.80%
West Midlands	10.47%	10.45%	10.50%	10.47%	10.48%	10.50%	10.47%
East Midlands	8.68%	8.29%	8.67%	8.64%	8.65%	8.83%	8.64%
East of England	11.05%	11.28%	11.00%	11.46%	10.98%	11.00%	11.13%
London and Greater London	15.64%	15.75%	15.67%	15.45%	15.64%	15.67%	15.61%
South East	16.27%	16.58%	16.33%	16.11%	16.31%	16.33%	16.45%
South West	10.23%	10.12%	10.17%	9.97%	10.15%	10.17%	10.13%
Socioeconomic group							
AB	27.00%	31.34%	30.50%	30.23%	30.78%	30.50%	30.56%
C1, C2	48.00%	50.08%	50.67%	50.66%	50.58%	50.67%	50.83%
DE	25.00%	18.57%	18.83%	19.10%	18.63%	18.83%	18.60%

Note: in the UK, a letter-based system (Social grade: A, B, C1/C2, D, E) is generally used to classify people based on their socioeconomic situation. "AB" corresponds to "higher and intermediate managerial, administrative and professional occupations"; "C1" and "C2" respectively refer to "supervisory, clerical and junior managerial, administrative and professional occupations" and "skilled manual occupations"; and "DE" refers to "semi-skilled and unskilled manual occupations, unemployed and lowest grade occupations" (Office for National Statistics, 2023). For the population data, statistics on gender, age, and region of residence come from the Office for National Statistics and refer to mid-2020 data for the adult population in England (Office for National Statistics, 2021), whereas the statistics on the socioeconomic groups are based on 2016 data from the National Readership Survey (2016).

of the population of England (UK) in terms of age and gender (as hard quotas), and region of residence and socioeconomic group (as soft quotas). Table 2 summarizes the main sociodemographic characteristics of the respondents by split sample group and shows these alongside the corresponding population statistics.

3.3 | Statistical modeling

Responses to the DCE are modeled based on the random utility maximization (RUM) framework (McFadden, 1974). In each choice set, respondents are assumed to choose the alternative that yields the highest utility, after considering the alternative's bundle of attributes (including the neighborhood wealth of the beneficiaries). The utility that respondent n obtains from a given Net Gain program j can therefore be specified as follows:

$$U_{nj} = \boldsymbol{\beta}'^{\boldsymbol{m}}_{\boldsymbol{n}} \left(\boldsymbol{X}^{\boldsymbol{m}}_{\boldsymbol{nj}} + \boldsymbol{\beta}'^{-\boldsymbol{m}}_{\boldsymbol{n}} \boldsymbol{X}^{-\boldsymbol{m}}_{\boldsymbol{nj}} \right) + \varepsilon_{nj} \tag{1}$$

where $\boldsymbol{X}^{\boldsymbol{m}}_{\boldsymbol{nj}}$ is the level of the monetary attribute and $\boldsymbol{X}^{-\boldsymbol{m}}_{\boldsymbol{nj}}$ the vector of nonmonetary attributes (such as the level of biodiversity achieved under Net Gain and the type of beneficiary receiving Net Gain benefits) describing alternative j faced by respondent n; ε_{nj} is the error term that captures factors unobserved by the econometrician—this term follows a Gumbel distribution and has variance equal to α_n^2 ($\pi^2/6$), where α_n is the scale parameter, which reflects the variance of the error term in relation to the magnitude of all coefficients; $\boldsymbol{\beta}'^{\boldsymbol{m}}_{\boldsymbol{n}}$ is the parameter associated with the monetary attribute; $\boldsymbol{\beta}'^{-\boldsymbol{m}}_{\boldsymbol{n}}$ is the vector of parameters that express individuals' preferences for the nonmonetary characteristics of the Net Gain program (including preferences for the type of beneficiary receiving Net Gain benefits, which can incorporate distributive considerations).[13] To account for preference heterogeneity, both $\boldsymbol{\beta}'^{\boldsymbol{m}}_{\boldsymbol{n}}$ and $\boldsymbol{\beta}'^{-\boldsymbol{m}}_{\boldsymbol{n}}$ are assumed to be individual-specific random coefficients that follow a given parametric distribution specified by the researcher. In our case, a normal distribution, with mean b and standard deviation σ, is used for all parameters, excepted for cost, which is assumed to be log-normally distributed to restrict the sign of this coefficient to be the same for all respondents. For this reason, the negative of the cost variable is considered in the utility function. The multiplication of all attributes by the parameter of the monetary variable ($\boldsymbol{\beta}'^{\boldsymbol{m}}_{\boldsymbol{n}}$) allows us to directly interpret the vector of preference parameters ($\boldsymbol{\beta}'^{-\boldsymbol{m}}_{\boldsymbol{n}}$) as a vector of implicit prices (marginal WTPs) and therefore to specify the model in WTP-space. Our model additionally allows for full correlation of the random parameters, thus representing a mixed logit model (MXL; McFadden & Train, 2000; Train, 2009) in WTP-space with correlation.

By econometrically analyzing the responses to our DCE (as specified above), information was obtained on respondents' preferences concerning where (whether "on-site" or elsewhere), how (with "low," "moderate," or "high biodiversity improvements" and/or "recreational access"), and especially to whom ("low," "average," or "high wealth" neighborhoods) Net Gain should be delivered. For the purposes of our research, we considered the choices of respondents from all six split samples described in Section 3.1, and we applied the same model specification to each treatment data to ensure comparability.

[13]In our choice experiment, respondents express their preferences over a bundle of goods, described in terms of changes in biodiversity, changes in landscape appearance, distance of the site from the respondent, recreational accessibility of the site, the socioeconomic profile of the communities benefiting from the proposed improvements, and the cost of the project. Given this, the parameter associated with the type of population benefiting from Net Gain should be interpreted (if positive) as a *premium* that respondents might be willing to face for a given bundle of Net Gain attributes (as specified above) to be distributed to a specific wealth group.

4 | RESULTS

4.1 | Overall preferences for Net Gain projects

The results of the DCE models are summarized in Tables 5 and 6. Before focusing on the findings that are specific to the research questions of this paper, it is worth reporting some common overall patterns (valid across all split samples) regarding respondents' preferences for Net Gain projects.

We found that respondents, on average, displayed preferences to move away from the Minimum Legal Requirement Biodiversity Net Gain option for reasons unexplained by the attributes. This is signaled in the model by the negative and significant mean coefficient for the Alternative Specific Constant (ASC), which we created for the Minimum Legal Requirement alternative.

We also found that preferences (and WTP) tend to increase with the level of biodiversity improvement offered, but at decreasing rates, showing sensitivity to the scope of the environmental change and diminishing marginal utility. This finding is reflected by the values of the coefficients associated with the dummy variables "*biodiversity: moderate enhancement*" and "*biodiversity: high enhancement*," taking value one (else zero) when the biodiversity improvement associated with the policy is either "moderate" or "high" (with "low," the Minimum Legal Requirement level, as the reference category).

WTP also gradually declines as environmental improvements are moved further away from the respondent, reflecting distance-decay effects, which is a relatively standard finding in spatially explicit environmental valuation studies (Bateman et al., 2006). In addition, we found that respondents display higher preferences for Net Gain policies that deliver biodiversity improvements that are also accessible to people for recreational purposes.

As expected, the coefficients of the negative cost attribute are significant and, by design, they are associated with positive log-normally distributed mean and standard deviation estimates (Tables 5 and 6 report the coefficients of the normal distribution underlying the log-normally distributed monetary coefficients). This is, again, in line with the results of other studies, which find that respondents dislike policy options that cost them money.

The preferences for the attribute focusing on the wealth type of the population benefitting from the environmental improvements will be the focus of the next subsection.

4.2 | Distributional considerations

Due to the design of our DCE, we were able to explore several questions and test different hypotheses regarding the role of distributional concerns on respondents' preferences.

The first research question that we wanted to answer is: S*hould the same communities who lose environmental quality be the beneficiaries of the environmental improvement delivered* via *Net Gain*? To answer this question, we focused on the choices made by respondents for the Minimum Legal Requirement option, which delivers Net Gain on, or adjacent to, the actual site of the development (i.e., Net Gain delivered "on-site"), as prioritized under the new legislation. In this option, the same communities losing greenspace due to the development will benefit from the biodiversity enhancement delivered via Net Gain. Overall, as shown in Table 3, we found that the Minimum Legal Requirement Net Gain alternative was chosen as the preferred option over the other alternatives only in a small number of cases (between 23% and 30% of all choices, depending on the split sample). These findings show that most respondents did not necessarily think that Net Gain compensation needs to happen "on-site" and that the individuals losing the greenspace should benefit from Net Gain. Overall, the rate of preference for the Minimum Legal Requirement option was comparable across the different split samples, but it tended to be significantly lower when the loss of greenspace due to the development was far away from the respondent and/or when it mostly affected "high wealth" communities (see Table A1 in the online supplementary appendix).

To those respondents choosing the Minimum Legal Requirement option as their preferred alternative at least half of the times, we asked a follow up question (with a list of possible responses to pick from) to find out the main reason behind the respondent's support for the Minimum Legal Requirement option. Among other things, we wanted to understand the extent to which respondents favored (and considered as "fair") the new legislative approach to Net Gain, "compensating" with more nature those communities directly affected by the loss of habitat. Based on the responses obtained (see Table A2 in the online supplementary appendix), respondents chose the Minimum Legal Requirement option mainly for reasons associated with: responsibility ("*I should not be the one*

TABLE 3 Relative preference for the Minimum Legal Requirement (MLR) option.

	Development close (2 miles)			Development far (50 miles)		
Variable	**Population losing nature: low wealth**	**Population losing nature: average wealth**	**Population losing nature: high wealth**	**Population losing nature: low wealth**	**Population losing nature: average wealth**	**Population losing nature: high wealth**
Number of times when the MLR option is preferred	1176	1141	1109	1074	1002	953
Total choices across respondents	3952	3792	3960	4088	4080	4080
Share (%) of all choices when MLR is preferred	29.76%	30.09%	28.01%	26.27%	24.56%	23.36%

TABLE 4 Percentage of respondents choosing the Minimum Legal Requirement (MLR) option for reasons related to "fairness."

	Development close (2 miles)			Development far (50 miles)		
Variable	**Population losing nature: low wealth**	**Population losing nature: average wealth**	**Population losing nature: high wealth**	**Population losing nature: low wealth**	**Population losing nature: average wealth**	**Population losing nature: high wealth**
Respondents choosing the MLR option because of "fairness" reasons	39	27	33	31	20	9
Share (%) of respondents choosing MLR due to fairness reasons	28.68%	21.43%	25.98%	28.44%	20.00%	9.89%

Note: This table shows the frequency of choice of the statement: "It is fair that Net Gain projects are delivered as close as possible to the housing development, following the Minimum Legal Requirement for Net Gain" that respondents could select as the reason for choosing the Minimum Legal Requirement option as their preferred alternative.

paying for nature enhancement which goes beyond the Minimum Legal Requirement; housing developers should pay.")[14] and affordability ("*I cannot afford the extra cost*"), followed by reasons related with perceived fairness ("*It is fair that Net Gain projects are delivered as close as possible to the housing development, following the Minimum Legal Requirement for Net Gain*").

As shown in Table 4, between 10% and 29% of our respondents (depending on the split sample) chose the Minimum Legal Requirement option most of the time for reasons of perceived fairness. In particular, as indicated in Table A3 in the online supplementary appendix, the importance of perceived fairness when choosing the Minimum Legal Requirement option is significantly lower when the community that would lose the greenspace (and benefit from Net Gain if it was delivered "on-site") is "high wealth" and far away from the respondent.

In short, to answer our first research question, it is possible to overall conclude that that only a small fraction of our respondents believe that it would be "fair" and necessary that Net Gain benefits those households negatively affected by the loss of greenspace. Based on our findings, there is a majority belief that people not losing nature locally due to the development could and should benefit from the environmental improvements generated by Net Gain projects.

This leads us to the second research question: *If the people who lose nature should not necessarily be the beneficiaries of Net Gain, who should benefit from the environmental improvements*? To answer this question, we focused on the respondents' preferences for the attribute capturing the type of neighborhood ("low," "average," or "high wealth") that would benefit from Net Gain. The purpose was to explore whether respondents are indifferent to who receives the environmental benefits when "off-site" Net Gain compensation is implemented or if respondents have rather specific preferences in terms of which type of community should be the beneficiaries of Net Gain. Respondents might prefer that the communities from a similar wealth group as the neighborhood losing the greenspace are compensated with Net Gain, or they may be especially concerned for certain wealth groups (i.e., the lower rather than higher wealth). Preferences for the attribute describing the type of neighborhood benefiting from Net Gain were modeled in our MXL models using dummy variables, given the qualitative nature of the attribute. To ease interpretation, the omitted (reference) category for this variable corresponded to the wealth group of the population losing the greenspace due to the development—which was different, depending on the split sample.

As indicated by the choice model results reported in Table 5, on average, respondents do not generally display strong preferences regarding which wealth groups should be the beneficiaries of "off-site" Net Gain projects. There are however a few specific exceptions worth noting, where the coefficients of the dummy variables indicating the type of neighborhood benefiting from Net Gain are significant. Based on our results, which are also summarized in visual form in Figure 1, when the population losing greenspace is "high wealth" and located close to where the respondent lives, our respondents preferred that "lower wealth" neighborhoods are the recipients of Net Gain benefits. In turn, when the communities losing greenspace due to the development are "high wealth" but located far away, respondents prefer that "average wealth" neighborhoods benefit from Net Gain. Analogously, when the population losing greenspace is "low wealth" and far away, respondents prefer that "average wealth" neighborhoods benefit from Net Gain, while disliking Net Gain projects that benefit "high wealth" communities. In turn, when the communities losing greenspace are "low wealth" and located close to the respondent, respondents display positive preferences for Net Gain benefits going to the "average wealth" groups. These findings indicate that, on average, our survey respondents do not believe that "off-site" Net Gain benefits should necessarily accrue to the same

[14]Following the standard approach suggested in the literature (Mariel et al., 2021), those respondents motivating their choice for the Minimum Legal Requirement option by selecting the following statements, were classified as protesters and dropped from the analysis reported in our Results' section:

- I should not be the one paying for nature enhancement which goes beyond the Minimum Legal Requirement; housing developers should pay;
- I don't think it is important to pay for nature enhancements beyond the Minimum Legal Requirement: I would rather spend my money in other ways;
- and I don't trust that the extra money paid would actually be used to improve nature.

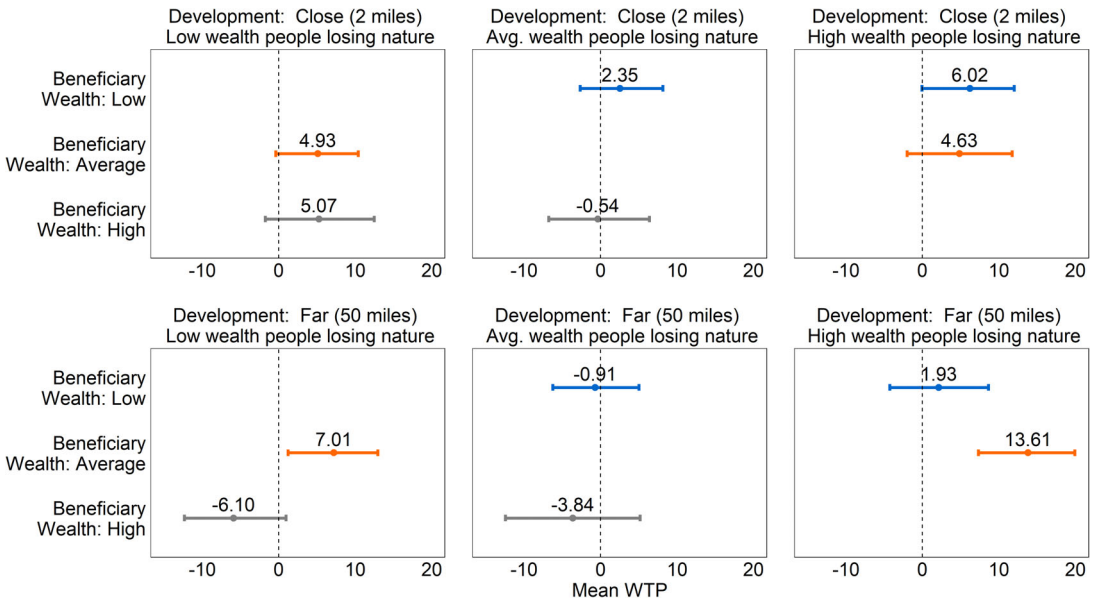


FIGURE 1 Mean willingness to pay (WTP) (with 95% confidence interval) for different wealth groups benefiting from Net Gain, by split sample (based on the results of Table 5). For each split sample, the omitted (reference) wealth category against which the above mean marginal WTP estimates need to be assessed is the wealth category of the population losing the greenspace due to the development. The results of the complete combinatorial Poe et al. (2005) test over the significance of the differences between the WTP estimates are reported in the online supplementary appendix, Table A4.

socioeconomic class of people that lost nature. Instead, they are in favor of Net Gain benefits going especially to the "average wealth" and "low wealth" groups (rather than the "high wealth"). These findings point to the opportunity to use environmental policies (in this case Net Gain) as a tool to redistribute welfare across different segments of society and, in line with expectations, suggest the existence of preferences for a more equitable distribution of benefits (in favor of the less rich in society).

More insights on these findings can be obtained by focusing on a specific example. Starting from the coefficient estimates in Table 5, Figure 2 visually represents the distribution of average WTP for a Net Gain policy delivering a "moderate enhancement" of biodiversity. It also shows findings under different assumptions concerning both the distance of the Net Gain site from the respondent and the wealth of the communities that benefit from Net Gain and lose nature due to the development. Figure 2 only focuses on a couple of selected illustrative split samples, where the attribute describing the neighborhood benefiting from Net Gain has a nonzero (significant) effect on utility, based on Table 5.

In addition to confirming the general findings in response to our second research question, as previously described, the main result emerging from Figure 2 is that there is an interesting relationship between the preferences for the wealth group benefiting from Net Gain and the distance of the Net Gain site from the respondent. In order for two biodiversity-equivalent Net Gain projects to deliver the same welfare benefits (based on Figure 2), it is necessary that the biodiversity improvement is delivered closer to the respondent when the beneficiaries of Net Gain are "high wealth" rather than "lower wealth." This indicates the existence of trade-offs, with individuals being more willing to accept a policy that potentially delivers environmental benefits further away from them if the policy benefits mostly "lower wealth" groups.

The results presented so far focus on the average preferences. However, our model also indicates that there is heterogeneity in preferences, as shown by the significant standard deviation values in Table 5. This leads us to the third research question of this study: *Are preferences for the distribution of environmental benefits sensitive to the socioeconomic background of the respondent*? The goal was to see if, for example, respondents from a particular wealth group were more prone to vote in favor

TABLE 5 Mixed logit model results in Willingness To Pay (WTP)-space by split sample.

	Development close (2 miles)						Development far (50 miles)					
	Population losing nature: low wealth		Population losing nature: average wealth		Population losing nature: high wealth		Population losing nature: low wealth		Population losing nature: Average wealth		Population losing nature: high wealth	
Variables	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Minimum Legal Requirement (ASC)	−0.28*** (0.03)	0.57*** (0.07)	−0.12*** (0.03)	0.29*** (0.05)	−0.30*** (0.05)	0.29*** (0.07)	−0.09*** (0.03)	0.26*** (0.05)	−0.26*** (0.05)	0.49*** (0.07)	−0.27*** (0.05)	0.41*** (0.07)
Biodiversity: moderate enhancement	0.31*** (0.03)	0.33*** (0.04)	0.32*** (0.03)	0.28*** (0.03)	0.32*** (0.03)	0.32*** (0.04)	0.32*** (0.02)	0.37*** (0.03)	0.38*** (0.03)	0.36*** (0.04)	0.33*** (0.03)	0.34*** (0.04)
Biodiversity: high enhancement	0.50*** (0.04)	0.54*** (0.04)	0.54*** (0.03)	0.46*** (0.03)	0.57*** (0.04)	0.62*** (0.05)	0.61*** (0.04)	0.63*** (0.04)	0.61*** (0.04)	0.53*** (0.05)	0.54*** (0.04)	0.55*** (0.07)
Distance from respondent [divided by 100]	−0.46*** (0.04)	0.49*** (0.04)	−0.46*** (0.04)	0.42*** (0.03)	−0.35*** (0.04)	0.40*** (0.03)	−0.33*** (0.04)	0.33*** (0.03)	−0.24*** (0.03)	0.31*** (0.04)	−0.31*** (0.05)	0.35*** (0.05)
Public access provided	0.46*** (0.04)	0.50*** (0.03)	0.39*** (0.03)	0.44*** (0.02)	0.44*** (0.04)	0.49*** (0.04)	0.36*** (0.04)	0.50*** (0.03)	0.36*** (0.04)	0.52*** (0.03)	0.36*** (0.04)	0.40*** (0.04)
Beneficiary: low wealth neighborhood	-	-	**0.02** (0.03)	0.18*** (0.02)	**0.06*** (0.03)	0.17*** (0.03)	-	-	**−0.01** (0.03)	0.12*** (0.03)	**0.02** (0.03)	0.20*** (0.03)
Beneficiary: average wealth neighborhood	**0.05*** (0.03)	0.15*** (0.03)	-	-	**0.05** (0.04)	0.20*** (0.03)	**0.07**** (0.03)	0.20*** (0.03)	-	-	**0.14***** (0.03)	0.17*** (0.03)
Beneficiary: high wealth neighborhood	**0.05** (0.03)	0.20*** (0.02)	**−0.01** (0.03)	0.18*** (0.02)	-	-	**−0.06*** (0.03)	0.32*** (0.02)	**−0.04** (0.04)	0.29*** (0.04)	-	-
−Cost (£) [divided by 100]	1.13*** (0.09)	1.60*** (0.16)	1.38*** (0.09)	1.47*** (0.14)	1.19*** (0.08)	1.41*** (0.12)	1.39*** (0.08)	1.36*** (0.13)	1.15*** (0.08)	1.36*** (0.13)	1.43*** (0.09)	1.72*** (0.12)
Model diagnostics												
LL at convergence	−3451.45		−3272.99		−3420.32		−3462.81		−3564.25		−3339.26	
McFadden's pseudo-R^2	0.20		0.21		0.21		0.22		0.19		0.24	
Respondents	494		474		495		511		510		510	

Note: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. Std refers to the standard deviation parameter. Standard errors are provided in parentheses. All parameters are modeled as random and normally distributed except for the cost parameter, which is assumed to follow a log-normal distribution (the estimates of the underlying normal distribution are reported in this table). For modeling purposes, the cost and distance attributes were rescaled and divided by 100. Correlation parameters are available from the authors upon request. In this table, the coefficients in bold are those discussed in Section 4.2. The models were estimated using the simulated maximum likelihood method with 1000 Sobol draws with a random linear scramble and a random digital shift (Czajkowski & Budziński, 2019), using a discrete choice experiment (DCE) estimation package developed in Matlab and available from https://github.com/czaj/DCE.

TABLE 6 Mixed logit model results in WTP-space by split sample and respondents' wealth group.

	Development close (2 miles)						Development far (50 miles)					
	Population losing nature: low wealth		Population losing nature: average wealth		Population losing nature: high wealth		Population losing nature: low wealth		Population losing nature: average wealth		Population losing nature: high wealth	
Variables	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Minimum Legal Requirement (ASC)	−0.36*** (0.03)	0.59*** (0.05)	−0.08*** (0.01)	0.37*** (0.03)	−0.29*** (0.05)	0.40*** (0.06)	−0.13*** (0.03)	0.30*** (0.05)	−0.23*** (0.04)	0.50*** (0.05)	−0.37*** (0.05)	0.54*** (0.06)
Biodiversity: moderate enhancement	0.32*** (0.02)	0.36*** (0.03)	0.34*** (0.01)	0.25*** (0.02)	0.31*** (0.03)	0.27*** (0.04)	0.33*** (0.05)	0.37*** (0.03)	0.33*** (0.02)	0.30*** (0.03)	0.34*** (0.03)	0.37*** (0.04)
Biodiversity: high enhancement	0.44*** (0.03)	0.58*** (0.02)	0.56*** (0.02)	0.46*** (0.02)	0.53*** (0.04)	0.54*** (0.04)	0.60*** (0.05)	0.59*** (0.04)	0.56*** (0.03)	0.48*** (0.03)	0.58*** (0.03)	0.65*** (0.04)
Distance from respondent (divided by 100)	−0.46*** (0.03)	0.56*** (0.03)	−0.41*** (0.03)	0.41*** (0.03)	−0.35*** (0.03)	0.44*** (0.04)	−0.30*** (0.05)	0.33*** (0.03)	−0.23*** (0.02)	0.35*** (0.02)	−0.30*** (0.03)	0.36*** (0.02)
Public access provided	0.35*** (0.03)	0.51*** (0.02)	0.40*** (0.02)	0.43*** (0.01)	0.42*** (0.04)	0.46*** (0.03)	0.39*** (0.04)	0.49*** (0.07)	0.37*** (0.02)	0.54*** (0.02)	0.39*** (0.04)	0.36*** (0.03)
Beneficiary: low wealth neighborhood (below average wealth respondents)	-	-	**0.10**** (0.02)	0.21*** (0.02)	**0.07** (0.05)	0.27*** (0.04)	-	-	**−0.03** (0.03)	0.22*** (0.02)	**0.05** (0.05)	0.33*** (0.04)
Beneficiary: low wealth neighborhood (average wealth respondents)	-	-	**−0.01** (0.02)	0.18*** (0.02)	**−0.04** (0.05)	0.16*** (0.03)	-	-	**−0.05** (0.03)	0.17*** (0.02)	**0.08*** (0.05)	0.30*** (0.05)
Beneficiary: low wealth neighborhood (above average wealth respondents)	-	-	**0.09**** (0.03)	0.29*** (0.04)	**0.17**** (0.06)	0.47*** (0.07)	-	-	**0.13**** (0.04)	0.35*** (0.05)	**0.11*** (0.06)	0.17*** (0.03)
Beneficiary: average wealth neighborhood (below average wealth respondents)	**−0.11**** (0.03)	0.33*** (0.03)	-	-	**0.04** (0.06)	0.26*** (0.03)	**0.08** (0.05)	0.23*** (0.05)	-	-	**0.10**** (0.05)	0.19*** (0.04)
Beneficiary: average wealth neighborhood (average wealth respondents)	**−0.03** (0.04)	0.19*** (0.03)	-	-	**−0.02** (0.05)	0.20*** (0.03)	**0.01** (0.04)	0.18*** (0.02)	-	-	**0.16**** (0.05)	0.30*** (0.06)

TABLE 6 (Continued)

	Development close (2 miles)						Development far (50 miles)					
	Population losing nature: low wealth		Population losing nature: average wealth		Population losing nature: high wealth		Population losing nature: low wealth		Population losing nature: average wealth		Population losing nature: high wealth	
Variables	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Beneficiary: average wealth neighborhood (above average wealth respondents)	**0.03** (0.05)	0.38*** (0.05)	-	-	**0.18***** (0.07)	0.46***** (0.07)	**0.11**** (0.05)	0.18***** (0.04)	-	-	**0.26***** (0.07)	0.23***** (0.04)
Beneficiary: high wealth neighborhood (below average wealth respondents)	−**0.12***** (0.04)	0.28***** (0.03)	−**0.00** (0.04)	0.23***** (0.03)	-	-	−**0.06** (0.04)	0.16***** (0.03)	−**0.09**** (0.04)	0.36***** (0.04)	-	-
Beneficiary: high wealth neighborhood (average wealth respondents)	−**0.07*** (0.04)	0.39***** (0.03)	−**0.01** (0.03)	0.21***** (0.02)	-	-	−**0.10**** (0.04)	0.38***** (0.03)	−**0.05** (0.03)	0.25***** (0.03)	-	-
Beneficiary: high wealth neighborhood (above average wealth respondents)	**0.12**** (0.05)	0.50***** (0.04)	−**0.01** (0.04)	0.41***** (0.04)	-	-	−**0.00** (0.05)	0.33***** (0.04)	**0.17***** (0.05)	0.35***** (0.04)	-	-
−Cost (£) [divided by 100]	1.29***** (0.10)	1.86***** (0.15)	1.54***** (0.11)	1.98***** (0.18)	1.29***** (0.09)	1.51***** (0.13)	1.55***** (0.09)	1.75***** (0.18)	1.37***** (0.10)	1.77***** (0.16)	1.50***** (0.10)	2.24***** (0.18)

Note: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. Std refers to the standard deviation parameter. Standard errors are provided in parentheses. All parameters are modeled as random and normally distributed except for cost, whose parameter follows a log-normal distribution (the estimates of the underlying normal distribution are reported in this table). For modeling purposes, the cost and distance attributes were rescaled and divided by 100. Correlation parameters and model diagnostics are available from the authors upon request. In this table, the coefficients in bold are those discussed in Section 4.2. The models were estimated using the simulated maximum likelihood method with 1000 Sobol draws with a random linear scramble and a random digital shift (Czajkowski & Budziński, 2019) using a DCE estimation package developed in Matlab and available from https://github.com/czaj/DCE.

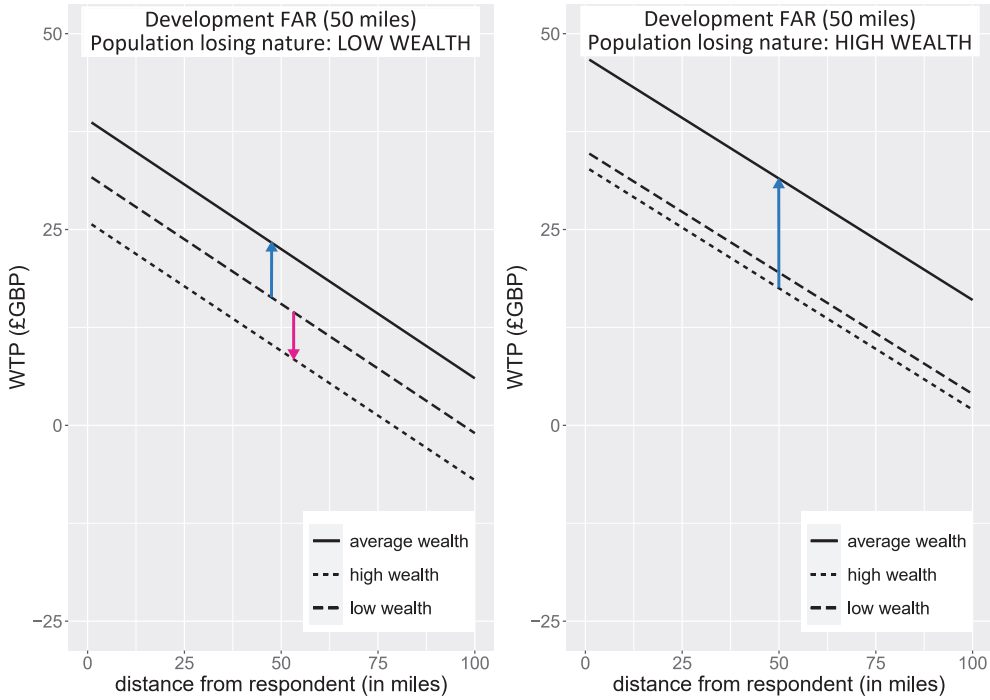


FIGURE 2 Change in average Willingness To Pay (WTP) when "moderate biodiversity enhancement" Net Gain is delivered, as a function of the distance of the Net Gain site from the respondent and assuming that different wealth groups are the beneficiaries (for selected split samples). The different line types in the figures refer to the WTP for Net Gain when benefits accrue to either "low," "average," or "high" wealth communities. Blue (upward-pointing) arrows indicate a statistically significant difference (i.e., increase) with respect to the reference category for the attribute describing the type of neighborhood benefiting from the Net Gain improvement; fuchsia (downward-pointing) arrows indicate a statistically significant difference (i.e., decrease) with respect to the reference category for the attribute describing the type of neighborhood benefiting from the Net Gain improvement. For each scenario considered in this example, the reference wealth category is the wealth group of the population losing the greenspace due to the development.

of a scenario where Net Gain benefits are distributed mostly to those individuals from the same-wealth category as them (indicating the presence of an *in-group bias effect*). To achieve that, we interacted each neighborhood wealth dummy variable in the model with data on the respondent's perceived own wealth. This latter information was obtained from one of the survey questions inviting respondents to self-classify as being part of a "low/below average," "average," or "above average/high" wealth household.

Based on our findings (reported in Table 6),[15] there are differences in preferences, depending on respondents' own wealth status, in terms of which type of wealth community should benefit from Net Gain. We found that "higher wealth" respondents are more likely to favor Net Gain projects benefiting either "low" or "average wealth" households. "Average wealth" respondents tended to especially dislike Net Gain projects that benefit "high wealth" groups. "Low wealth" respondents were mostly either indifferent to the socioeconomic group that should benefit from Net Gain compensation (likely because of their constrained ability to pay)[16] or averse to the wealthiest communities benefiting from Net Gain. Based on the results in Table 6, there is therefore only very weak evidence in favor of *in-group bias effects*.

[15]A visual summary of the results of Table 6 (along with the outcomes of the complete combinatorial Poe et al. (2005) test for the significance of the differences) are reported in Figure A2 (and Table A5) in the online supplementary appendix.
[16]It is well accepted within the environmental economics literature that the value and demand of environmental goods increase with income (Dietz & Atkinson, 2005).

Overall, despite the differences highlighted, these findings tell a consistent story, namely that there is a tendency to favor and support Net Gain projects that benefit "low wealth" or "average wealth" communities and opposition to those projects benefiting the wealthiest households. Our results also show that respondents do not generally think that the main beneficiaries of Net Gain projects should be households from the same wealth group as them.

5 | DISCUSSION

Taking Biodiversity Net Gain offsets relating to housing development in England as a case study, this research focuses on the general public's preferences and WTP for the distribution of environmental policy benefits across socioeconomic groups. Our findings reveal that respondents are prepared to trade losses to groups near to development sites for gains elsewhere that accrue to "low" or "average" (rather than "high") wealth groups; clearly there is a preference for modifying environmental policies in view of their distributional consequences. This result is ignored by current guidance regarding the implementation of Net Gain legislation, which strongly mitigates toward Net Gain projects being delivered on, or as close as possible to, development sites.

Our findings confirm expectations regarding positive preferences for higher biodiversity gains and recreational access, as well as a preference for offsetting close to the respondent *ceteris paribus*. However, this latter preference does trade-off against redistributional benefits where gains can be delivered to lower wealth groups. Study participants did not express clear preferences regarding the beneficiaries of Net Gain projects being from the same wealth group as either the people losing the greenspace or from the same wealth category as them. Instead, we found more support for Net Gain projects that would benefit "low wealth" or "average wealth" communities and less support for those projects that would benefit the wealthiest households. On average, our respondents were willing to pay up to £17 more (per household and year, for 5 years) if Net Gain policies were designed to benefit mostly "low wealth" (rather than "high wealth") communities; up to £26 more (per household and year, for 5 years) if Net Gain policies benefited mostly "average wealth" (rather than "high wealth") groups; and up to £12 less (per household and year, for 5 years) if Net Gain policies were designed to benefit mostly "high wealth" (rather than "low wealth") communities. These results provide decision makers with crucial value information needed to formulate optimized and utility-maximizing policy solutions. Importantly, our findings point to the fact that going beyond the Minimum Legal Requirements from Net Gain and freeing Net Gain policies from their local and on-site constraints would be desirable, as this would allow to achieve better outcomes for biodiversity (as found in zu Ermgassen et al., 2021) and to distribute the environmental benefits especially to the "least advantaged" and "average wealth" communities.

Despite our findings generally indicate a preference for redistributing environmental benefits from "higher" to "lower" wealth groups, reflecting a desire for a more equitable distribution of nature, some inconsistencies in the results are worth discussing. In some cases, in fact, we found preferences in favor of a redistribution toward the "average wealth," whereas in other cases in favor of the "low wealth." The existence of some degree of inconsistencies in the patterns identified across our split samples deserves further answers that our data cannot unfortunately provide. Part of the reason behind these inconsistencies, we think, could stem from our deliberate generality in the definition of our wealth groups, which might have led respondents to different interpretations. The choice to avoid prescriptive definitions of wealth was guided by evidence emphasizing the greater importance for people of a subjective perception of wealth over objective measures (Gasiorowska, 2014). Although we do not have a definite answer on the inconsistencies in some of our results on the redistribution of benefits, it is worth mentioning that the general understanding on altruism and income is itself inconclusive (see for example Chowdhury & Jeon, 2014; Holland et al., 2012). A lack of clarity around the causes of contradicting evidence on altruistic behaviors, and some suggestions that locally specific inequality levels might play a role (Dimick et al., 2017), could be confounding factors requiring additional testing.

Although there are patterns in the data that deserve further investigation, our overall findings are clear; people do not just care about the overall impact of the environmental policy, they also care about the distribution of the environmental losses and gains across society. This point is important because there is now evidence that many environmental policies (e.g., taxes and charges) have traditionally been regressive, that is, they have harmed less wealthy communities proportionally more than the richer ones (Mackie & Haščič, 2019; Mullin et al., 2018). Designing environmental policies that are redistributive toward the less well-off would therefore tackle the above problem while addressing public preferences. An increasing number of countries are beginning to specifically include distributional considerations in favor of the less advantaged within their environmental legislation (Mackie & Haščič, 2019). For example, as part of the EU Green Deal, Member States have approved a Just Transition Mechanism to support (with a €55 billion package, over the period 2021–2027) those communities that will be negatively affected by the green transition to make sure that no one is "left behind."[17] At the country level, the UK has recently committed to ensure that natural capital is managed for all (HM Government, 2018). Current plans for Net Gain policies in the UK do not however seem to be aligned with this overall objective of delivering a more equitable management of the environment. Given that new houses in the UK are mostly purchased by the relatively wealthy, it is anticipated that the delivery of "on-site" Net Gain environmental improvements relating to housing development will generally benefit the more affluent members of society (Bateman & Zonneveld, 2019), who already have more access opportunities to nature. Given this, the UK's Net Gain legislation as currently proposed is unlikely to contribute to a more equitable access to nature. To address this, the distributional preferences of society need to be identified and incorporated within environmental policy design and implementation.

If environmental policies are designed to match the distributional preferences of the relevant population, they are more likely to be accepted and, crucially, complied with by the public at large (OECD, 2017). This is important for policy uptake, suggesting that distributional concerns are not necessarily an obstacle for the implementation of more stringent policies, as commonly believed, but can be a tool to set more ambitious policy targets and accelerate their enforcement (Drupp et al., 2018). More equitable policies do not in fact need to come at the expenses of environmental effectiveness (i.e., the ability to achieve the desired outcome) or economic efficiency (i.e., the capacity to implement a policy to achieve maximum net benefit). It is in fact possible and desirable that environmental policies achieve the so-called "triple dividend"; namely they are effective, efficient, and equitable at the same time (Vona, 2021). More equitable Biodiversity Net Gain policies do not need to introduce trade-offs in terms of environmental effectiveness. In fact, the current legislation on the topic, tying offsets near to development sites, is already very unlikely to be effective and optimal for biodiversity (and seems more likely to be motivated by convenience for both planners and developers). Besides, in a real world of imperfect policy baselines, it is hardly the case that policies are designed to be efficient in the first place. As our study shows, there can be welfare gains from an appropriate redistribution of the expected policy outcomes.

6 | CONCLUSIONS

In this paper we explored the role of distributional concerns regarding the allocation of environmental benefits in the framework of the nonmarket valuation literature. Overall, there is a considerable knowledge gap in this area, probably also due to the greater attention that has been given to efficiency, rather than distributional and equity issues, in the environmental economics literature.

Our results show that respondents are sensitive to the socioeconomic distributions of gains and losses arising from environmental policies. We hope that this will encourage more and more

[17]See: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en.

researchers in the field of environmental valuation to explicitly account for distributional issues in their valuation studies, for example, by including specific information in the scenario description on who will gain (and lose) from a given policy or by using *ad hoc* attributes. Our findings specifically show that respondents would be willing to pay more for policies that preferentially benefit "low wealth" and "average wealth" communities, and pay less for policies benefitting richer groups. This reflects support for a redistribution of environmental improvements in favor of the less privileged in society.

The policy implications of our study are that environmental interventions need to be designed by carefully considering society's preferences regarding who should benefit. Distributional considerations in the management of the environment have only recently started to be discussed in a few countries, which have included these issues in their legislation. It is expected that more countries will follow suit in the future by actively involving and engaging relevant stakeholders in the design and implementation of policies to ensure that natural capital is managed for all. So far, there is evidence that environmental policies have tended to implicitly benefit the most well-off in society. Such an approach to policy making is challenged by our findings and potentially socially unsustainable in the long term as it exacerbates existing social inequalities. Unless society perceives that decisions are fair, it is likely that policies will be opposed, with the consequence being that interventions will be shorter-lived and less successful. Without society's long-term commitment to a policy and its implementation, interventions are at risk of failing to deliver against long term goals of nature conservation, thereby undermining the preservation of environmental resources for future generations.

Although offering some initial insights on the topic of social preferences and nonmarket values for the distribution of environmental benefits, the findings of this paper could however be expanded in different directions by future research.

First, for our empirical application, we focused on a developed country. Among advanced nations, the UK is one of the worst performing in terms of social inequality with growing income disparities and high public recognition that the income distribution is "unfair" and a cause for concern (Curtice et al., 2020). It would be insightful, however, to also study the case of developing countries, where inequalities are generally even more substantial in absolute terms and reliance on natural resources is more pronounced (Khan et al., 2022). Any redistribution of environmental assets in favor of the less well-off in developing countries could, therefore, potentially have a stronger impact on improving social welfare.

Second, in our study we explored distributional preferences across broad wealth classes, adopting a relatively simple approach. Focusing on the allocation of benefits within wealth classes would give us an extra layer of insight regarding, for example, which lower wealth communities should benefit the most from the proposed environmental improvements. This is important given the distinction between "vertical equity"—which we focused on and refers to the distributional effects across income groups—and "horizontal equity"—which has received much less attention from the literature and refers to achieving a more equitable distribution of resources within income groups (Fischer & Pizer, 2019). This topic also represents a very interesting and promising area of further research.

Third, more needs to be understood regarding the different factors affecting people's preferences for the distribution of environmental benefits. This can provide a more nuanced picture, which policy makers can consider when taking decisions regarding who should benefit from an environmental policy. For example, respondents might be less in favor of giving more nature to the lowest wealth group when this community represents a large (rather than small) share of households in society. The prevailing view might in fact be that a largely poor area needs primarily more jobs and economic opportunities, rather than nature, to prosper. Other context-specific factors that might play a role in driving attitudes toward redistribution, include: the circumstances driving poverty (with more positive attitudes toward the act of giving when poverty is the result of adverse life conditions rather than own agency); the ethnicity of the wealth group; or the crime rate in the area (with more honest communities in need generally being perceived as deserving more help). Individual-specific characteristics of the respondent might also be relevant, such as the political orientation (with left-wing respondents being expected to be more pro poor than pro rich) or gender (with women expected to be more altruistic).

ACKNOWLEDGMENTS

This research was funded by the Natural Environment Research Council (NERC) through the SWEEP project (grant number NE/P011217/1). The authors also gratefully acknowledge cofunding from the Exeter Business School's International Advisory Board Research Fund. M.F. and D.M.T. are thankful for the funding provided by the Esmée Fairbairn Foundation, and M.C.M. and I.J.B acknowledge the financial support received by the UKRI-BBSRC NetZeroPlus (NZ+) Award (Reference No. BB/V011588/1). The authors are grateful to two anonymous referees and the handling Editor for their comments to improve the paper, to prof. Brett Day, as well as to the attendees of the 2023 Summer Conference of the Association of Environmental and Resource Economists (AERE) and of the 28th Annual Conference of the European Association of Environmental and Resource Economists (EAERE) for constructive feedback and fruitful discussions on previous versions of this work.

REFERENCES

Adler, Matthew. 2016. "Benefit-Cost Analysis and Distributional Weights: An Overview." *Review of Environmental Economics and Policy* 10(2): 264–285. https://doi.org/10.1093/reep/rew005.

Ajzen, Icek, Lori H. Rosenthal, and Thomas C. Brown. 2000. "Effects of Perceived Fairness on Willingness to Pay." *Journal of Applied Social Psychology* 30(12): 2439–50. https://doi.org/10.1111/j.1559-1816.2000.tb02444.x.

Andor, Mark A., Manuel Frondel, and Stephan Sommer. 2018. "Equity and the Willingness to Pay for Green Electricity in Germany." *Nature Energy* 3: 876–881. https://doi.org/10.1038/s41560-018-0233-x.

Andor, Mark A., Andreas Lange, and Stephan Sommer. 2022. "Fairness and the Support of Redistributive Environmental Policies." *Journal of Environmental Economics and Management* 114: 102682. https://doi.org/10.1016/j.jeem.2022.102682.

Atkinson, Giles, Fernando Machado, and Susana Mourato. 2000. "Balancing Competing Principles of Environmental Equity." *Environment and Planning A: Economy and Space* 32(10): 1791–1806. https://doi.org/10.1068/a32106.

Balmford, Ben, Ian J. Bateman, Ben Groom, Mattia C. Mancini, and Sophus O. S. E. zu Ermgassen. 2022. Report for Project Entitled: Biodiversity Metrics, Public Preferences, and the Cost-Based Approach https://www.ukri.org/wp-content/uploads/2022/10/NERC-281022-BiodiversityMetricsPublicPreferencesCostBasedApproach-FullReport.pdf.

Banzhaf, Spencer, Lala Ma, and Christopher Timmins. 2019. "Environmental Justice: The Economics of Race, Place and Pollution." *Journal of Economic Perspective* 33(1): 185–208. https://doi.org/10.1257/jep.33.1.185.

Bartczak, Anna M., Wiktor Budzinski, Ulf Liebe, and Jürgen Meyerhoff. 2023. Distributive Justice in Payments for Air Quality Improvement a Study Combining Factorial Survey and Choice Experiment Data. Available at SSRN: https://doi.org/10.2139/ssrn.4359184.

Bateman, Ian J., Matthew Agarwala, Amy Binner, Emma Coombes, Brett H. Day, Silvia Ferrini, Carlo Fezzi, Michael Hutchins, Andrew A. Lovett, and Paulette Posen. 2016. "Spatially Explicit Integrated Modeling and Economic Valuation of Climate Driven Land Use Change and its Indirect Effects." *Journal of Environmental Management* 181: 172–184. https://doi.org/10.1016/j.jenvman.2016.06.020.

Bateman, Ian J., Amy Binner, Brett H. Day, Carlo Fezzi, Alex Rusby, Greg Smith, and Ruth Welters. 2019. "United Kingdom: Paying for Ecosystem Services in the Public and Private Sectors." In *Green Growth that Works: Natural Capital Policy and Finance Mechanisms around the World*, edited by Lisa Mandle, Zhiyun Ouyang, James Salzman, and Gretchen C. Daily, 237–254. Washington, DC: Island Press.

Bateman, Ian J., Brett H. Day, Stavros Georgiou, and Iain Lake. 2006. "The Aggregation of Environmental Benefit Values: Welfare Measures, Distance Decay and Total WTP." *Ecological Economics* 60(2): 450–460. https://doi.org/10.1016/j.ecolecon.2006.04.003.

Bateman, Ian J., and Sara Zonneveld. 2019. *Building a Better Society: Net Environmental Gain from Housing and Infrastructure Developments as a Driver for Improved Social Wellbeing*. Think Piece for the UK2070 Commission. https://uk2070.org.uk/wp-content/uploads/2019/10/BATEMAN_ZONNEVELD_Net_Env_Gain.pdf.

Baumgärtner, Stefan, Moritz A. Drupp, Jasper N. Meya, Jan M. Munz, and Martin F. Quaas. 2017. "Income Inequality and Willingness to Pay for Environmental Public Goods." *Journal of Environmental Economics and Management* 85: 35–61. https://doi.org/10.1016/j.jeem.2017.04.005.

Bergquist, Magnus, Andreas Nillson, Niklas Harring, and Sverker C. Jagers. 2022. "Meta-Analyses of Fifteen Determinants of Public Opinion about Climate Change Taxes and Laws." *Nature Climate Change* 12: 235–240. https://doi.org/10.1038/s41558-022-01297-6.

Börger, Tobias, Nick Hanley, Robert J. Johnston, Keila Meginnis, Tom Ndebele, Ghamz E. Ali Siyal, and de Vries Frans. 2023. "Equity Preferences and Abatement Cost Sharing in International Environmental Agreements." *American Journal of Agricultural Economics* 106(1): 416–441. https://doi.org/10.1111/ajae.12392.

Bramley, Glen. 2019. "Housing Supply Requirements across Great Britain for Low-Income Households and Homeless People. Research for Crisis and the National Housing Federation." In *Main Technical Report*. Edinburgh: School of Energy, Geosciences, Infrastructure and Society, Heriot-Watt University.

Bruegge, Chris, Tatyana Deryugina, and Erica Myers. 2019. "The Distributional Effects of Building Energy Codes." *Journal of the Association of Environmental and Resource Economists* 6(S1): S95–S127. https://doi.org/10.1086/701189.

Cai, Beilei, Trudy A. Cameron, and Geoffrey R. Gerdes. 2010. "Distributional Preferences and the Incidence of Costs and Benefits in Climate Change Policy." *Environmental and Resource Economics* 46: 429–458. https://doi.org/10.1007/s10640-010-9348-7.

Carter Jonas. 2023. Introduction of BNG to Local Plans in England. Spring 2023 Update. Available at: https://www.carterjonas.co.uk/research-and-insight/biodiversity-net-gain-local-plans-spring-2023-update.

Chowdhury, Subhasish M., and Joo Y. Jeon. 2014. "Impure Altruism or Inequality Aversion?: An Experimental Investigation Based on Income Effects." *Journal of Public Economics* 118: 143–150. https://doi.org/10.1016/j.jpubeco.2014.07.003.

CIEEM. 2021. Good Practice Requirements for Delivering Biodiversity Net Gain (on- and off-Site). Report https://cieem.net/wp-content/uploads/2021/07/CIEEM-Good-Practice-Requirements-for-Delivering-Biodiversity-Net-Gain-On-and-Off-Site-July2021.pdf

Circle Economy. 2022. Thinking beyond Borders to Achieve Social Justice in a Global Circular Economy. Actions for Governments and Multilateral Bodies. Report https://www.circle-economy.com/resources/thinking-beyond-borders-to-achieve-social-justice-in-a-global-circular-economy

Cole, Scott, Per-Olav Moksnes, Tore Söderqvist, Sofia A. Wikström, Göran Sundblad, Linus Hasselström, Ulf Bergström, Patrick Kraufvelin, and Lena Bergström. 2021. "Environmental Compensation for Biodiversity and Ecosystem Services: A Flexible Framework that Addresses Human Wellbeing." *Ecosystem Services* 50: 101319. https://doi.org/10.1016/j.ecoser.2021.101319.

Costanza, Robert, Rudolf de Groot, Leon Braat, Ida Kubiszewski, Lorenzo Fioramonti, Paul Sutton, Steve Farber, and Monica Grasso. 2017. "Twenty Years of Ecosystem Services: How Far Have we Come and how Far Do we Still Need to Go?" *Ecosystem Services* 28: 1–16. https://doi.org/10.1016/j.ecoser.2017.09.008.

Curtice, John, Nathan Hudson, and Ian Montagu. 2020. *British Social Attitudes: The 37th Report*. London: The National Centre for Social Research https://bsa.natcen.ac.uk/media/39400/bsa37_social-inequality-in-england-and-scotland.pdf.

Czajkowski, Mikolaj, and Wiktor Budziński. 2019. "Simulation Error in Maximum Likelihood Estimation of Discrete Choice Models." *Journal of Choice Modelling* 31: 73–85. https://doi.org/10.1016/j.jocm.2019.04.003.

Dasgupta, Partha. 2021. *The Economics of Biodiversity: The Dasgupta Review*. London: HM Treasury. Final Report.https://assets.publishing.service.gov.uk/media/602e92b2e90e07660f807b47/The_Economics_of_Biodiversity_The_Dasgupta_Review_Full_Report.pdf.

Dauwalter, Travis E., and Robert I. Harris. 2023. "Distributional Benefits of Rooftop Solar Capacity." *Journal of the Association of Environmental and Resource Economists* 10(2): 487–523. https://doi.org/10.1086/721604.

DEFRA. 2023. "Consultation Outcome-Government Response and Summary of Responses." https://www.gov.uk/government/consultations/consultation-on-biodiversity-net-gain-regulations-and-implementation/outcome/government-response-and-summary-of-responses.

DEFRA. 2024. "The Statutory Biodiversity Metric: User Guide" available at: https://assets.publishing.service.gov.uk/media/65c60e0514b83c000ca715f3/The_Statutory_Biodiversity_Metric_-_User_Guide_.pdf

Dietz, Simon, and Giles Atkinson. 2005. "Public Perceptions of Equity in Environmental Policy: Traffic Emissions Policy in an English Urban Area." *Local Environment: The International Journal of Justice and Sustainability* 10(4): 445–459. https://doi.org/10.1080/13549830500160982.

Dietz, Simon, and Giles Atkinson. 2010. "The Equity-Efficiency Trade-off in Environmental Policy: Evidence from Stated Preferences." *Land Economics* 86(3): 423–443.

Dimick, Matthew, David Rueda, and Daniel Stegmueller. 2017. "The Altruistic Rich? Inequality and Other-Regarding Preferences for Redistribution." *Quarterly Journal of Political Science* 11(4): 385–439. https://doi.org/10.1561/100.00015099.

DLUHC. 2023. National Planning Policy Framework https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1182995/NPPF_Sept_23.pdf.

Dorin, Camille, Marine Hainguerlot, Hélène Huber-Yahi, Jean-Christophe Vergnaud, and Vincent de Gardelle. 2021. "How Economic Success Shapes Redistribution: The Role of Self-Serving Beliefs, in-Group-Bias and Justice Principles." *Judgement and Decision Making* 16(4): 932–949. https://doi.org/10.1017/S1930297500008032.

Drupp, Moritz A., Jasper N. Meya, Stefan Baumgärtner, and Martin F. Quaas. 2018. "Economic Inequality and the Value of Nature." *Ecological Economics* 150: 340–45. https://doi.org/10.1016/j.ecolecon.2018.03.029.

Drupp, Moritz A., Jasper N. Meya, Martin F. Quaas, and Lutz Sager. 2023. "Inequality and the Environment: An Introduction to the Special Issue." *Journal of Environmental Economics and Management* 119: 102812. https://doi.org/10.1016/j.jeem.2023.102812.

European Court of Auditors. 2020. Biodiversity on Farmland: CAP Contribution Has Not Halted the Decline. Special Report 13/2020.https://www.eca.europa.eu/Lists/ECADocuments/SR20_13/SR_Biodiversity_on_farmland_EN.pdf.

Fischer, Carolyn, and William A. Pizer. 2019. "Horizontal Equity Effects in Energy Regulation." *Journal of the Association of Environmental and Resource Economists* 6(S1): S209–S237. https://doi.org/10.1086/701192.

Flores, Nicholas E., and Aaron Strong. 2007. "Cost Credibility and the Stated Preference Analysis of Public Goods." *Resource and Energy Economics* 29(3): 195–205. https://doi.org/10.1016/j.reseneeco.2006.09.001.

Frank, Eyal G., and Wolfram Schlenker. 2016. "Balancing Economic and Ecological Goals." *Science* 353(6300): 651–52. https://doi.org/10.1126/science.aaf9697.

Gasiorowska, Agata. 2014. "The Relationship between Objective and Subjective Wealth Is Moderated by Financial Control and Mediated by Money Anxiety." *Journal of Economic Psychology* 43: 64–74. https://doi.org/10.1016/j.joep.2014.04.007.

Griffiths, Victoria F., Joseph W. Bull, Julia Baker, and E. J. Milner-Gulland. 2019. "No Net Loss for People and Biodiversity." *Conservation Biology* 33(1): 76–87. https://doi.org/10.1111/cobi.13184.

Gurney, Georgina G., Sangeeta Mangubhai, Margaret Fox, Milena Kiatkoski Kim, and Arun Agrawal. 2021. "Equity in Environmental Governance: Perceived Fairness of Distributional Justice Principles in Marine co-Management." *Environmental Science and Policy* 124: 23–32. https://doi.org/10.1016/j.envsci.2021.05.022.

Hausman, Catherine, and Samuel Stolper. 2021. "Inequality, Information Failures, and Air Pollution." *Journal of Environmental Economics and Management* 110: 102552. https://doi.org/10.1016/j.jeem.2021.102552.

Hawkins, Isobel. 2022. Assessing the Performance of DEFRA's Biodiversity Metric. Master thesis, University of Oxford. http://iccsnew.wpengine.com/wp-content/uploads/2023/08/Dissertation-final_2.pdf.

Hawkins, Isobel, Sophus O. S. E. zu Ermgassen, Grub Henry, Treweek Jo, and E. J. Milner-Gulland. 2022. "No Consistent Relationship Found between Habitat Scores Determined Using the Biodiversity Metric and Presence of Species of Conservation Priority." *Practice* 118: 16–20.

HM Government. 2018. *A Green Future: Our 25 Year Plan to Improve the Environment*. London: Defra https://assets.publishing.service.gov.uk/media/5ab3a67840f0b65bb584297e/25-year-environment-plan.pdf.

Holland, Jo, Antonio S. Silva, and Ruth Mace. 2012. "Lost Letter Measure of Variation in Altruistic Behaviour in 20 Neighbourhoods." *PLoS ONE* 7(8): e43294. https://doi.org/10.1371/journal.pone.0043294.

Holland, Steven P., Erin T. Mansur, Nicholas Z. Muller, and Andrew J. Yates. 2019. "Distributional Effects of Air Pollution from Electric Vehicle Adoption." *Journal of the Association of Environmental and Resource Economists* 6(S1): S65–S94. https://doi.org/10.1086/701188.

Hsiang, Solomon, Paulina Oliva, and Reed Walker. 2019. "The Distribution of Environmental Damages." *Review of Environmental Economics and Policy* 13(1): 83–103. https://doi.org/10.1093/reep/rey024.

IPBES. 2019. In *Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*, edited by Sandra Díaz, Josef Settele, Eduardo S. Brondízio, Hien T. Ngo, Maximilien Guèze, John Agard, Almut Arneth, Patricia Balvanera, Kate Brauman, Stuart H. M. Butchart, Kai M. A. Chan, Lucas A. Garibaldi, Kazuhito Ichii, Jianguo Liu, Suneetha M. Subramanian, Guy F. Midgley, Patricia Miloslavich, Zsolt Molnár, David Obura, Alexander Pfaff, Stephen Polasky, Andy Purvis, Jona Razzaque, Belinda Reyers, Rinku Roy Chowdhury, Yunne-Jai Shin, Ingrid J. Visseren-Hamakers, Katherine J. Willis, and Cynthia N. Zayas. Bonn, Germany: IPBES Secretariat.

Johnson, Lourie T. 2006. "Distributional Preferences in Contingent Valuation Surveys." *Ecological Economics* 56(4): 475–487. https://doi.org/10.1016/j.ecolecon.2004.11.019.

Khan, Salim, Wang Yahong, and Asma Zeeshan. 2022. "Impact of Poverty and Income Inequality on the Ecological Footprint in Asian Developing Economies: Assessment of Sustainable Development Goals." *Energy Reports* 8: 670–79. https://doi.org/10.1016/j.egyr.2021.12.001.

Kuminoff, Nicolai V., V. Kerry Smith, and Christopher Timmins. 2013. "The New Economics of Equilibrium Sorting and Policy Evaluation Using Housing Markets." *Journal of Economic Literature* 51(4): 1007–62. https://doi.org/10.1257/jel.51.4.1007.

Lawton, John. 2010. "Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network." In *Report prepared for the Department for Environment, Food and Rural Affairs*. London: Department for Environment, Food and Rural Affairs. https://webarchive.nationalarchives.gov.uk/ukgwa/20130402151656/http:/archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf.

Levitt, Steven D., and John A. List. 2007. "What do Laboratory Experiments Measuring Social Preferences Reveal about the Real World?" *Journal of Economic Perspectives* 21(2): 153–174. https://doi.org/10.1257/jep.21.2.153.

LGA. 2023. Local Government Association Planning Advisory Service: Biodiversity net gain FAQs - Frequently Asked Questions https://www.local.gov.uk/pas/topics/environment/biodiversity-net-gain-local-authorities/biodiversity-net-gain-faqs.

Li, Jin, Yu Sun, Mei Li, Li Hui'e, Fan Wei, and Zhong Yiping. 2020. "Social Distance Modulates Prosocial Behaviour in the Gain and Loss Contexts: An Event-Related Potential (ERP) Study." *International Journal of Psychophysiology* 150: 83–91. https://doi.org/10.1016/j.ijpsycho.2020.02.003.

Mackie, Alexander, and Ivan Haščič. 2019. "The Distributional Aspects of Environmental Quality and Environmental Policies: Opportunities for Individuals and Households." In *OECD Green Growth Papers 2019-02*. Paris: OECD Publishing.

Mariel, Petr, David Hoyos, Jürgen Meyerhoff, Mikolaj Czajkowski, Thijs Dekker, Klaus Glenk, Jette Bredhal Jacobsen, et al. 2021. *Environmental Valuation with Discrete Choice Experiments. Guidance on Design, Implementation and Data Analysis*. Cham, Switzerland: Springer ISSN 2191-5512.

McFadden, Daniel. 1974. "Conditional Logit Analysis of Qualitative Choice Behavior." In *Frontiers in Econometrics*, edited by Paul Zarembka, 105–142. New York: Academic Press.

McFadden, Daniel, and Kenneth Train. 2000. "Mixed MNL Models for Discrete Response." *Journal of Applied Econometrics* 15(5): 447–470. https://doi.org/10.1002/1099-1255(200009/10)15:5<447::AID-JAE570>3.0.CO;2-1.

Mengel, Friederike, and Elke Weidenholzer. 2022. "Preferences for Redistribution." *Journal of Economic Surveys* 37(5): 1660–77. https://doi.org/10.1111/joes.12519.

Meya, Jasper N. 2020. "Environmental Inequality and Economic Valuation." *Environmental and Resource Economics* 76: 235–270. https://doi.org/10.1007/s10640-020-00423-2.

Mullin, Karen, N. Gordon Mitchell, Rizwan Nawaz, and Ruth D. Waters. 2018. "Natural Capital and the Poor in England: Towards an Environmental Justice Analysis of Ecosystem Services in a High Income Country." *Landscape and Urban Planning* 176: 10–21. https://doi.org/10.1016/j.landurbplan.2018.03.022.

National Readership Survey. 2016. Social Grade https://nrs.co.uk/nrs-print/lifestyle-and-classification-data/social-grade/.

Natural England. 2022. Biodiversity Net Gain. An Introduction to the Benefits https://naturalengland.blog.gov.uk/wp-content/uploads/sites/183/2022/04/BNG-Brochure_Final_Compressed-002.pdf.

Natural England. 2023. The Biodiversity Metric 4.0 (JP039) https://webarchive.nationalarchives.gov.uk/ukgwa/20230901111806/https://publications.naturalengland.org.uk/publication/6049804846366720.

Nurmi, Väinö, and Heini Ahtiainen. 2018. "Distributional Weights in Environmental Valuation and Cost-Benefit Analysis: Theory and Practice." *Ecological Economics* 150: 217–228. https://doi.org/10.1016/j.ecolecon.2018.04.021.

Nyborg, Karine. 2014. "Project Evaluation with Democratic Decision-Making: What Does Cost-Benefit Analysis Really Measure?" *Ecological Economics* 106: 124–131. https://doi.org/10.1016/j.ecolecon.2014.07.009.

OECD. 2017. "Trust and Public Policy: How Better Governance Can Help Rebuild Public Trust." In *OECD Public Governance Reviews*. Paris: OECD Publishing.

Office for National Statistics. 2021. "Estimates of the Population for the UK, England, Wales, Scotland and Northern Ireland." Dataset. https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland.

Office for National Statistics. 2023. "Approximated Social Grade, England and Wales: Census 2021." https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/approximatedsocialgradeenglandandwales/census2021.

OMB. 2003. Circular A-4, Regulatory Analysis https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/

OMB. 2023. "Proposed OMB Circular No. A-4 Modernization-Extension of Public Comment Period." Federal Register vol. 88 No. 109 https://www.federalregister.gov/documents/2023/06/07/2023-12231/proposed-omb-circular-no-a-4-modernization-extension-of-public-comment-period.

Poe, Gregory L., Kelly L. Giraud, and John B. Loomis. 2005. "Computational Methods for Measuring the Difference of Empirical Distributions." *American Journal of Agricultural Economics* 87(2): 353–365.

Povitkina, Marina, Sverker C. Jagers, Simon Matti, and Johan Martinsson. 2021. "Why Are Carbon Taxes Unfair? Disentangling Public Perceptions of Fairness." *Global Environmental Change* 70: 102356. https://doi.org/10.1016/j.gloenvcha.2021.102356.

Rampling, Emily E., Sophus O. S. E. zu Ermgassen, Isobel Hawkins, and Joseph W. Bull. 2023. "Achieving Biodiversity Net Gain by Addressing Governance Gaps Underpinning Ecological Compensation Policies." *Conservation Biology* 9: e14198. https://doi.org/10.1111/cobi.14198.

Rawls, John. 1971. *A Theory of Justice*. Cambridge, MA: Harvard University Press.

Ritz, Robert A., and Robert W. Hahn. 2014. *Optimal Altruism in Public Good Provision*. Economic Studies Working Paper Series. Washington DC: Brookings Institution.

Sircar, Neelanjan, Ty Turley, Peter van der Windt, and Maarten Voors. 2018. "Know your Neighbor: The Impact of Social Context on Fairness Behaviour." *PLoS ONE* 13(4): e0194037. https://doi.org/10.1371/journal.pone.0194037.

Stiglitz, Joseph E., Amartya Sen, and Jean-Paul Fitoussi. 2010. Report by the Commission on the Measurement of Economic Performance and Social Progress. Report.https://www.economie.gouv.fr/files/finances/presse/dossiers_de_presse/090914mesure_perf_eco_progres_social/synthese_ang.pdf.

Train, Kenneth E. 2009. *Discrete Choice Methods with Simulation*. New York: Cambridge University Press.

Vona, Francesco. 2021. *Managing the Distributional Effects of Environmental and Climate Policies: The Narrow Path for a Triple Dividend*. OECD Environment Working Paper No 188. Paris: OECD.

Wilson, Wendy, and Cassie Barton. 2023. "Tackling the Under-Supply of Housing in England." In *Research Briefing, House of Commons Library*. London: House of Commons Library. https://researchbriefings.files.parliament.uk/documents/CBP-7671/CBP-7671.pdf.

zu Ermgassen, Sophus O. S. E., Sally Marsh, Kate Ryland, Edward Church, Richard Marsh, and Joseph W. Bull. 2021. "Exploring the Ecological Outcomes of Mandatory Biodiversity Net Gain Using Evidence from Early-Adopter Jurisdictions in England." *Conservation Letters* 14(6): e12820. https://doi.org/10.1111/conl.12820.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Faccioli, Michela, Diana M. Tingley, Mattia C. Mancini, and Ian J. Bateman. 2024. "Who Should Benefit from Environmental Policies? Social Preferences and Nonmarket Values for the Distribution of Environmental Improvements." *American Journal of Agricultural Economics* 1–27. https://doi.org/10.1111/ajae.12467