Information and Preferences for Post-Fire Restoration Techniques in Protective Forests: A Choice Experiment Approach

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Abstract

As climate change increases wildfire frequency and intensity, post-fire restoration is a critical challenge in protective mountain forests. While ecological literature addresses restoration techniques effectiveness, little is known about public preferences and their responsiveness to information. This study estimates the monetary value attributed to different post-fire management strategies in the Italian Alps, using a repeated choice experiment with 1,210 residents, measuring willingness to pay (WTP) before and after providing science-based information. Results show a preference for visible, active interventions, especially reforestation and salvage logging, driven by symbolic meanings and common-sense notions of recovery. After receiving information, respondents significantly reduced their WTP for intensive practices, and socio-demographic differences narrowed, highlighting the transformative role of targeted information in aligning social preferences with ecologically sound forest management.

1. Introduction

Wildfires can have significant environmental, social and economic impacts. The European Environment Agency (EEA) classifies them as one of the most impactful natural disturbances with long-term effects on ecosystems (EEA, 2020). Indeed, they are a key ecological process, shaping global patterns of biodiversity and vegetation distribution (Pausas and Ribeiro, 2017), yet are often perceived by society as predominantly negative (Doerr and Santín, 2016). Wildfires can be a major source of carbon dioxide emissions and air pollution from particulate matter (PM2.5 and PM10) (Jones et al., 2024), but overall fire effects depend on ecosystem properties, fire characteristics and the socio-ecological system involved, with biodiversity loss and soil degradation more likely where ecosystems lack fire-related adaptations or where fire regimes are altered. Climate change is increasing wildfire frequency and intensity, making many ecosystems more fire-prone due to rising temperatures and climate anomalies (He et al., 2025). Fire regime alterations are particularly pronounced in mountain and alpine regions, where climate change is more intense (Müller M.M. et al., 2020). There, most forests have a direct protective function against natural hazards for nearby assets (Lingua et al., 2020), making it crucial to assess post-disturbance recovery trajectories (Mantero et al., 2023).

Fire risk is further exacerbated by the increasing proximity of human settlements to natural areas (Fox et al., 2018), making the wildland-urban interface issue increasingly relevant (Taccaliti et al., 2023). Burned forests, particularly those including fire-sensitive or fire-independent species (*sensu* Hardesty et al., 2005), can experience degradation that ecologically inappropriate post-fire interventions may worsen.

Restoring degraded ecosystems has become a top global political priority, confirmed by the binding targets of the recently approved Nature Restoration Law (Regulation (EU) 2024/1991), which requires EU Member States to implement restoration measures, including specific measures for forest ecosystems that account for wildfire risk.

Post-fire management can mitigate wildfire impacts and facilitate forest recovery (Singh and Kumar, 2025; Taccaliti et al., 2026), spanning a gradient of increasing human intervention between: passive restoration, removing sources of degradation to allow natural recovery, i.e. recovery based on natural regeneration, and active restoration, involving active human intervention such as reforestation (Holl and Aide, 2011). The most frequent intervention after a large, high-severity wildfire remains salvage logging, the felling and removal of affected trees (Lindenmayer et al., 2008a), often followed by active planting or seeding (Mantero et al., 2024). Although justified on economic and safety grounds, salvage logging remains ecologically controversial, reducing ecological heterogeneity, habitat availability, and natural regeneration (Donato et al., 2006; Leverkus et al., 2018a; Stein et al., 2014). Passive restoration is instead gaining momentum as evidence accumulates worldwide (Di Sacco et al., 2021), yet public opinion often demands prompt removal of dead and burned trees to restore the visual order, a common-sense response that does not necessarily align with ecologically sound recovery.

The scientific debate on these practices is well-developed in ecological disciplines, which have addressed their effectiveness and long-term impacts (see Section A of the Supplementary Material for an overview of the ecological rationale underlying different post-fire restoration techniques), while the economic dimension remains underexplored. Some authors have estimated the costs of restoration techniques (Cyr et al., 2022; Gülci, 2021), while to our knowledge, their economic value, particularly in terms of ecosystem service recovery and public preferences, remains underexplored. Existing literature instead focuses more on the economic benefits of wildfire prevention strategies, such as fuel treatments, and educational programmes (Burton et al., 2024; Diendéré and Kaboré, 2023; Hjerpe et al., 2024; Misal et al., 2023).

This study is conducted within a broader research and policy context promoting sustainable and adaptive forest management to enhance the resilience of protective mountain forests exposed to natural hazards and climate-change-driven disturbances. Public engagement and knowledge exchange are increasingly recognised as essential to post-disturbance management, yet societal preferences often favour rapid, intensive interventions, while ecological assessments increasingly advocate less interventionist approaches based on natural regeneration (Lingua et al., 2020), a divergence that motivates the present analysis and underscores social acceptability as a relevant dimension of sustainability, given that restoration decisions inevitably involve public resources, inhabited landscapes, and societal trade-offs.

Our research aims to identify which post-fire restoration strategies are most preferred by individuals in the Italian Alpine space and how these preferences evolve when individuals receive technical information, helping identify whether, and to what extent, communication can reduce the gap between intuitive expectations and evidence-based forest management practices.

The benefits of post-fire restoration are typical non-market environmental goods. Within random utility theory, individuals' preferences for such goods can be quantified through willingness to pay (WTP), the trade-off between income and changes in the attributes of a good or service (McFadden, 1974).

Our study addresses two research questions:

- RQ1: What monetary benefits does the population perceive from different post-fire restoration techniques in the protective mountain forests of the Italian Alps?
- RQ2: How does additional technical information affect the population's monetary valuation of post-fire management interventions in protection forests?

To assess public preferences, we employed a repeated Choice Experiment (CE), with two information treatments per respondent, allowing us to assess whether, and how technical information influenced individual WTP. Repeated designs are valuable for analysing the role of information in shaping social acceptance of evidence-based management decisions though they can also involve learning and strategic response effects (Scheufele and Bennett, 2012).

2. Survey design and data

2.1. Sampling procedure

The reference population comprised residents of the Italian Alpine regions, as post-fire restoration interventions are financed at the regional level and benefits the wider regional population. A survey agency recruited respondents using strata based on region of residence (Aosta Valley, Piedmont, Liguria, Lombardy, Veneto, Friuli-Venezia Giulia, and Trentino-Alto Adige), age, and gender to reflect the population's demographic composition. The final sample included 1,210 individuals; descriptive statistics are reported in Table 1.

***Table 1**. Descriptive statistics of the variables (1,210 obs).*

Variables	Mean	Std. Deviation
Gender (1=F)	0.503	0.500
Age	49.261	15.071
Age between 18-29 years old (1=yes)	0.169	0.375
Age between 30-44 years old (1=yes)	0.233	0.423
Age between 45-54 years old (1=yes)	0.213	0.410
Age between 55-64 years old (1=yes)	0.210	0.407
Age between 65-75 years old (1=yes)	0.175	0.380
Resident of Piedmont (1=yes)	0.182	0.386
Resident of Aosta Valley (1=yes)	0.006	0.076
Resident of Lombardy (1=yes)	0.440	0.497
Resident of Trentino Alto Adige (1=yes)	0.045	0.208
Resident of Veneto (1=yes)	0.212	0.409
Resident of Friuli-Venezia Giulia (1=yes)	0.050	0.219
Resident of Liguria (1=yes)	0.064	0.244
Resident of North-West (1=yes)	0.692	0.462
Resident of North-East (1=yes)	0.308	0.462
Resident in mountain areas (1=yes)	0.136	0.343
Resident in hill areas (1=yes)	0.211	0.408
Resident in plain areas (1=yes)	0.653	0.476
Education primary school (1=yes)	0.002	0.050
Education middle school (1=yes)	0.250	0.432
Education high school (1=yes)	0.478	0.500
Education bachelor's degree (1=yes)	0.095	0.293
Education master's degree (1=yes)	0.150	0.358
Education postgraduate (1=yes)	0.026	0.158

High-skill job (1 = yes)	0.072	0.258
Middle-skill job (1 = yes)	0.353	0.478
Low-skill job (1 = yes)	0.171	0.377
No job (1=yes)	0.404	0.491
Household size (number)	2.808	2.163
Children under 14 years old (1=yes)	0.260	0.439
Net household income < 1,000 euro/month (1 = yes)	0.061	0.240
Net household income 1,000-2,000 euro/month (1 = yes)	0.269	0.443
Net household income 2,000-3,000 euro/month (1 = yes)	0.272	0.445
Net household income 3,000-4,000 euro/month (1 = yes)	0.155	0.362
Net household income 4,000-6,000 euro/month (1 = yes)	0.079	0.269
Net household income > 6,000 euro/month (1 = yes)	0.020	0.139
Net household income does not answer (1=yes)	0.145	0.353

Source: own elaboration

2.2. Experimental setting and selection of attributes

In a CE, respondents choose among hypothetical scenarios defined by varying attributes (i.e. characteristics of the good or service being evaluated) and select their preferred option in each choice situation. Their choices reveal trade-offs between attributes and allow the estimation of marginal WTP and its uncertainty using the Krinsky and Robb method (Krinsky and Robb, 1986; Mariel et al., 2021).

In our experiment, the attributes correspond to alternative post-disturbance restoration practices adopted within a forest restoration policy. Two main categories of restoration practices along with a complementary post-disturbance technique, were considered for direct protective mountain forests: (1) standing and lying deadwood management, (2) reforestation through active planting, and (3) the installation of artificial grey protection infrastructures (i.e. rockfall nets), usually required when salvage logging is performed in steep slopes above highly vulnerable human assets (Wohlgemuth et al., 2017). Each attribute was specified as categorical levels, whose ecological rationale is detailed in the Supplementary Material (Section A).

An annual regional household tax, expressed as discrete euro amounts, was included to estimate marginal WTP. Table 2 reports the attributes and levels, and Figure 1 shows the pictures and diagrams presented to respondents. For each attribute, the *status quo* corresponds to a non-intervention option, which entails zero cost. Alternatively, dead or damaged trees can be felled and left in place, partially removed (partial salvage logging), or entirely removed (salvage logging). Active reforestation may follow a cluster scheme, where seedlings are transplanted in small groups with irregular spacing, as in Applied Nucleation (e.g. Holl et al., 2024), or a regular scheme with uniform spacing.

***Table 2**. Attributes and levels included in the experimental design.*

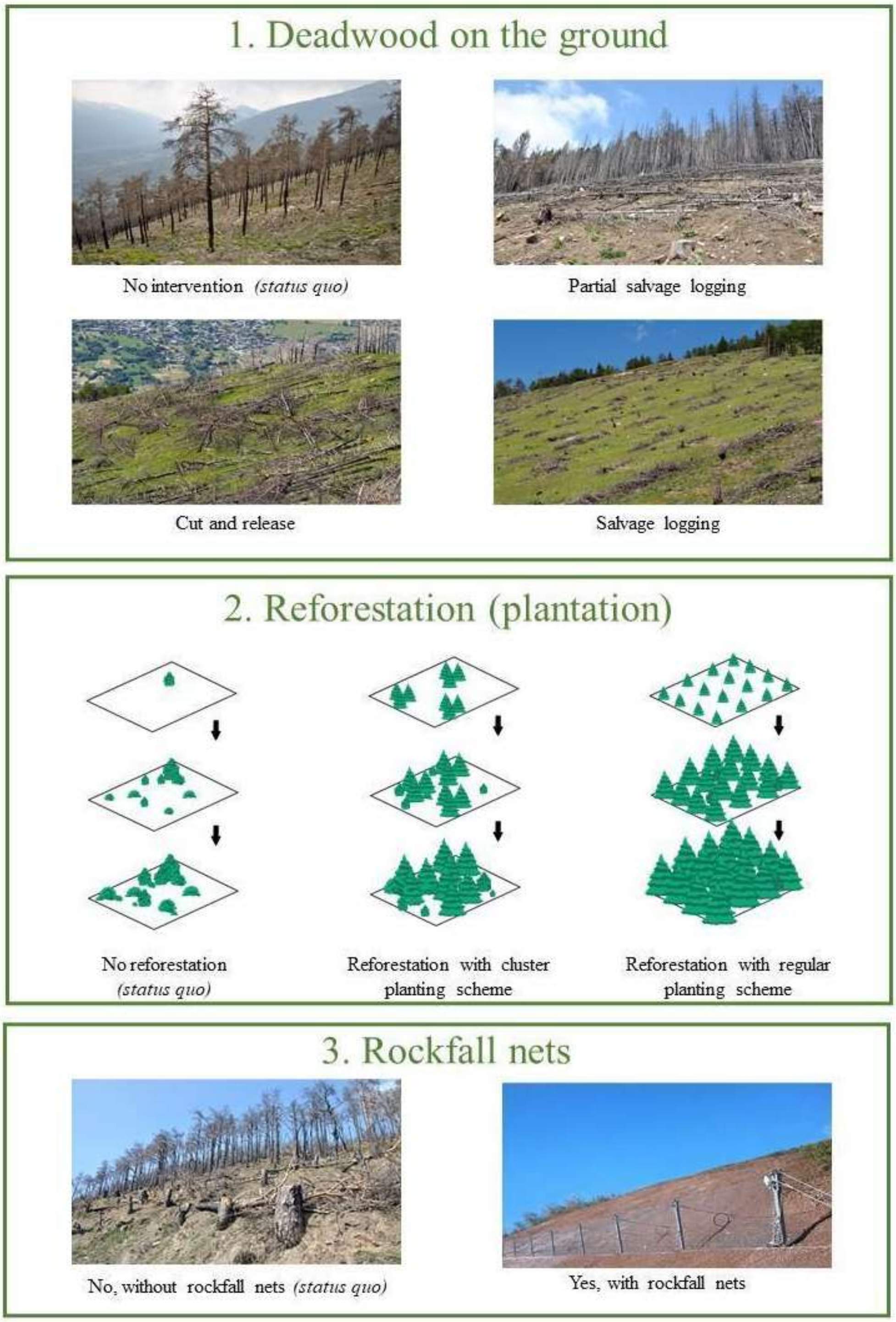
Attributes	**Levels**
Deadwood management	– No intervention: all deadwood, standing and lying on the ground, retained in situ (*status quo*) – Cut and release: felling and leaving all deadwood on the ground – Partial salvage logging: felling and removing part of the deadwood – Salvage logging: felling and removing all deadwood
Reforestation (plantations)	– No reforestation, only natural regeneration (*status quo*) – Reforestation with cluster planting scheme – Reforestation with regular planting scheme
Installation of rockfall nets	– No (*status quo*) – Yes
Cost per household (Annual regional tax in euro)	– 0 (*status quo*) – 10 – 20 – 40 – 80

Source: own elaboration

Finally, when salvage logging is applied, grey infrastructures are necessary to provide protection, no longer offered by the forest, thus rockfall nets have to be installed on salvaged slopes, in substitution of the natural barrier effect provided by deadwood resulting from the disturbance, to guarantee the highest safety level for linear infrastructure and houses. The cost levels (bid vector) were based on European stated-preferences studies valuing payments for forest ecosystem services (Báliková et al., 2021; Czajkowski et al., 2014; Frings et al., 2023; Juutinen et al., 2014; Müller A. et al., 2020).

A subset of attribute-level profiles was selected by using an optimised orthogonal design (Carson and Czajkowski, 2019), obtained by Ngene 1.4, which determined the combinations of levels used to generate the choice scenarios. The final design comprised six choice tasks, divided into eight blocks that were randomly assigned to respondents, limiting the number of scenarios and respondents' cognitive burden (Mariel et al., 2021).

Figure 1. *Attributes and levels included in the CE.*



Source: own elaboration, figure 1.2 is adapted from Corbin and Holl (2012)

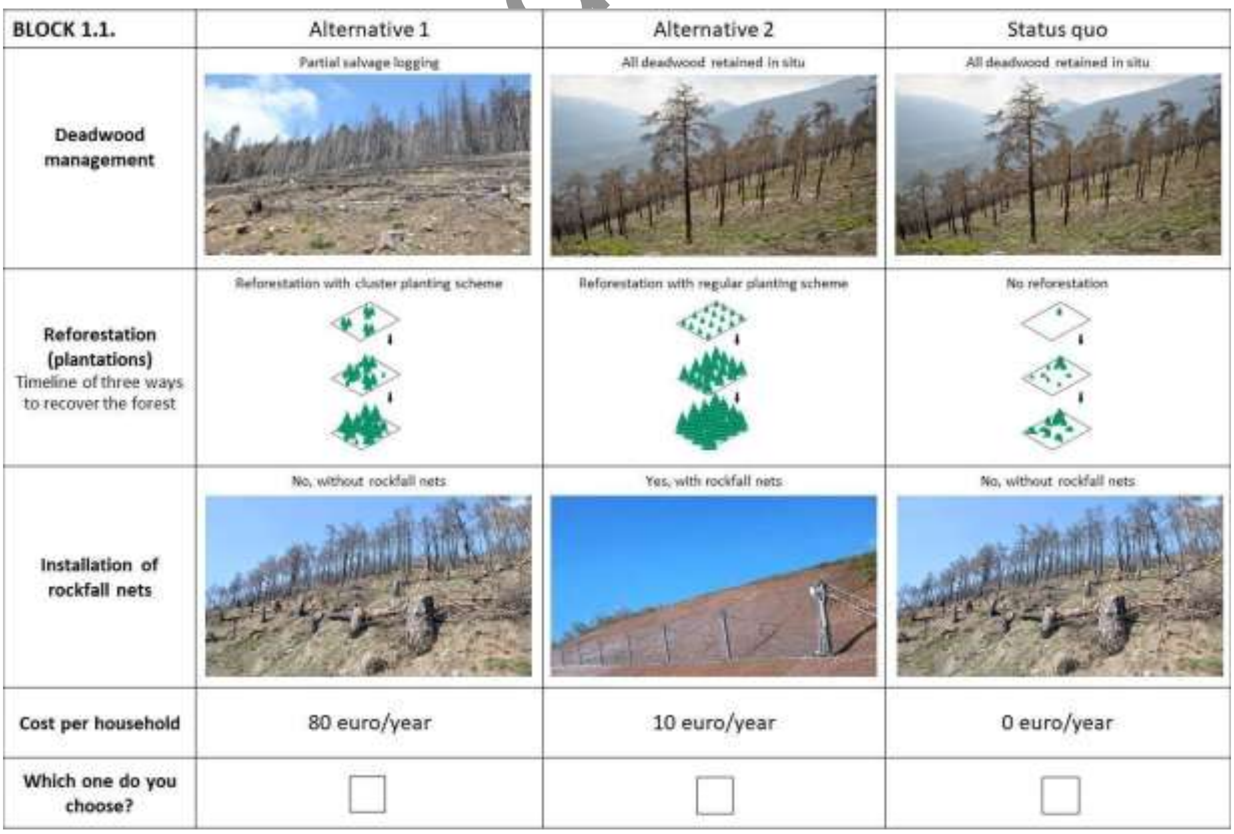
2.3. Questionnaire design and administration

The experiment was implemented as a repeated CE with the same respondents participating in two consecutive rounds. All respondents first completed six choice tasks after receiving only minimal contextual information about the restoration options; after the first round, they were provided with additional science-based information and asked to complete a second round of six choice tasks. To maintain independence between the two choice rounds, respondents were assigned to different experimental blocks across rounds, resulting in different choice tasks.

The questionnaire consisted of three sections. The first section introduced the restoration practices and complementary post-disturbance techniques using photographs and graphical representations. Respondents were informed that implementing these measures would incur costs for regional administrations, to be covered by an annual regional tax per household. Alternatively, the affected areas could be left to recover naturally, with no cost to local residents. Respondents then completed the first round of six choice tasks, choosing in each task between two designed alternatives and a zero-cost, non-intervention *status quo.*

An example of a choice card is presented in Figure 2.

Figure 2*. A choice set example.*



Source: own elaboration

The second section explained that natural regeneration in fire-affected mountain forests can outperform active restoration based on salvage logging and possible reforestation (e.g. Beghin et al., 2010; Marzano et al., 2013). Deadwood creates favourable microsite conditions for seedling and offers protection against rockfall and avalanches by increasing surface roughness (Lingua et al., 2020), while, surviving trees provide seeds and can promote greater species and structural diversity than artificial reforestation (Beghin et al., 2010; Marzano et al., 2013). Standing and lying deadwood can also provide long-term protective functions (up to several decades, e.g. Wohlgemuth et al., 2017), potentially replacing the need for artificial rockfall nets. Participants then completed the second set of choice tasks, allowing us to assess preference changes after the information treatment.

In both rounds, respondents who always selected the zero-cost *status quo* option were presented with follow-up questions to investigate their motivations, to determine whether the non-intervention choice indicated a genuine zero WTP or a protest zero (Meyerhoff and Liebe, 2006). Genuine zeros included indifference to restoration, preference for natural regeneration, doubts about the measures' effectiveness, priority given to wildfire prevention, or willingness to pay only below the proposed amounts.

In contrast, protest responses stem from a rejection of some aspect of the survey itself, often perceived as unfair in terms of content or procedures: in our case, opposition to the introduction of a new tax, belief that existing public funds should finance such interventions, or the idea that resources should be directed towards wildfire prevention rather than post-fire restoration. Since protest responses are not indicative of respondents’ true values, they must be excluded from the analysis to avoid bias in the WTP estimation (Jorgensen et al., 1999).

Respondents’ socio-economic characteristics were collected in the last section of the questionnaire.

Data were collected in January 2025 using the Computer-Assisted Web Interviewing (CAWI) method. A pre-test was administered to 50 individuals to assess the clarity and effectiveness of the questionnaire, followed by the main survey involving 1,210 respondents. All statistical analyses were conducted using the R software environment.

2.4. Econometric strategy

In this study, Discrete Choice Experiment (DCE) responses were analysed with a Mixed Logit (MXL) model in preference space under Random Utility Theory (McFadden, 1974). Unlike the standard Conditional Logit, the MXL relaxes the Independence of Irrelevant Alternatives (IIA) assumption. Following Train and Weeks (2005), utility is separable between the price attribute p and the non-price attributes x - including the Alternative Specific Constant (ASC). In this unlabelled CE, the ASC captures preferences for generic post-fire interventions with respect to the *status quo*. Accordingly, the utility of individual n for alternative j in choice situation t is:

$$U_{njt} = \alpha p_{njt} + \beta_{nj} x_{njt} + \varepsilon_{njt} \quad (1)$$

where ε_{njt} is an independently and identically distributed (i.i.d.) type I extreme value error term, and α the cost coefficient and β_{nj} are individual-specific random parameters.

To account for respondents' individual characteristics, the ASC is interacted with individual-specific variables, the post-treatment indicator, and their interaction, allowing preferences to vary between pre- and post-treatment conditions and across respondent groups. The full derivation of the indirect utility function and the estimation procedure, is provided in the Supplementary Material (Section B). Coefficients are estimated using maximum simulated likelihood (Train, 2009) and marginal WTP for each attribute is given by the ratio of each attribute coefficient to the monetary attribute (Hanemann, 1984).

3. Results

Table 3 reports the Mixed Logit Model (MXL) estimates, while Table 4 reports the empirical WTP after excluding protest responses. These accounted for 2.5% and 4.1% of respondents in the first and second valuation experiment, respectively[1]; the increase in the second round may reflect fatigue or disengagement from repeated choice tasks.

The model includes interaction terms capturing the effect of the information treatment on attribute preferences. To preserve parsimony and avoid implausible parameter distributions, only a subset of attributes was specified as normally distributed random parameters. In fact, preliminary specifications allowing all coefficients to vary randomly resulted in unrealistically large standard deviations. The tax coefficient is assumed to be fixed. Post-treatment coefficients were obtained by summing each baseline coefficient and its interaction with the post-treatment indicator. Significance was assessed with the Poe test, which compares simulated distributions and estimates the probability that the net effect is greater or less than zero (Poe et al.,1997).

In the baseline condition, the positive and highly significant ASC indicates a preference for intervention over the *status quo*. However, the interaction term associated with the information treatment is negative and statistically significant, implying a substantial reduction in the attractiveness of intervention scenarios once information is provided. Using the *status quo* levels as reference categories, most attribute levels in the baseline specification display positive and statistically significant coefficients, suggesting that respondents initially favour active post-fire forest management interventions: both salvage logging options, rockfall nets, and the two reforestation strategies are positively valued. By contrast, the interaction terms associated with the information treatment are negative for several attributes and statistically significant for both salvage logging practices. Combining baseline coefficients with the post-treatment interaction effects, the resulting post-information coefficients for partial salvage logging and salvage logging become negative, indicating that informed respondents clearly prefer avoiding deadwood removal and leaving burned

[1] The models' estimated coefficients for the whole sample and the related WTPs are reported in the supplementary materials (Tables A1, A2 and A3). The results are substantially confirmed, net of, as expected, lower WTPs.

forests to recover naturally.

For the remaining practices, the information substantially reduces coefficient magnitude, rendering them statistically indistinguishable from zero, suggesting that technical information about post-fire ecosystem dynamics, weakens support for active restoration measures relative to passive recovery. Consistent with economic theory, the cost coefficient is negative and highly significant, confirming that higher taxes reduce selection probability. Significant standard deviations estimated for several random parameters indicate substantial preference heterogeneity, supporting mixed logit specification over simpler discrete choice models.

The empirical WTP estimates reported in Table 4 further highlight the magnitude of the information effect. Pre- and post-treatment WTP distributions from the interacted model were treated as non-independent and tested using the Poe approach (Poe et al., 1997).

In the baseline condition, respondents are willing to contribute up to approximately €68 per household per year for regular reforestation, €61 for cluster planting schemes, €26 for rockfall nets, €43 for partial salvage logging and €31 for salvage logging. After the information treatment, however, WTPs decline sharply across all interventions: for deadwood management, WTP becomes negative for both partial salvage logging and salvage logging, indicating a clear preference for maintaining burned wood on site rather than removing it. For the installation of rockfall nets and the two reforestation strategies, WTP values remain positive but fall substantially, approaching zero, suggesting that informed respondents become much less supportive of active interventions than in the baseline condition.

Table 3. *Mixed Logit Model (MXL) estimates.*

Attributes	*Levels*	*Baseline*	*Post-treatment effect*	*Change*
ASC		*2.589*** (0.129)*	*-1.234*** (0.172)*	*1.354*** (0.131)*
Deadwood management	*Cut and release*	*0.003 (0.088)*	*0.041 (0.131)*	*0.045 (0.098)*
	Partial salvage logging	*0.585*** (0.098)*	*-0.957*** (0.148)*	*-0.371*** (0.123)*
	Salvage logging	*0.416*** (0.037)*	*-1.018*** (0.057)*	*-0.601*** (0.043)*
Installation of rockfall nets	*Yes*	*0.359*** (0.035)*	*-0.227 (0.052)*	*0.132*** (0.039)*
Reforestation	*With cluster planting scheme*	*0.835*** (0.104)*	*-0.554 (0.158)*	*0.280** (0.119)*
	With regular planting scheme	*0.927*** (0.105)*	*-0.697 (0.159)*	*0.230* (0.119)*
Tax		*-0.013*** (0.0008)*		
Standard Deviations Random Normal Coefficients				
ASC		*2.594*** (0.068)*		
	Partial salvage logging	*0.669*** (0.260)*		
	Salvage logging	*0.783*** (0.041)*		
Reforestation	*With cluster planting scheme*	*0.316*** (0.078)*		
	With regular planting scheme	*0.595*** (0.051)*		
Log Likelihood		*-11,541*		
N. Observations		*1,170*		

*Standard errors in parenthesis, * p < 0.1; ** p < 0.05; *** p < 0.01*

Table 4. *WTP estimated from the Mixed Logit Model (MXL).*

Attributes	*Levels*	*Baseline*	*Post-treatment*	*Difference*
ASC		*190.06 (169.02;211.61)*	*99.52 (80.52;119.13)*	*-90.54****
Deadwood management	*Cut and release*	*0.26 (-12.52;13.01)*	*3.24 (-11.22; 17.43)*	*2.98*
	Partial salvage logging	*42.93 (28.77;56.85)*	*-27.21 (-45.34; -9.59)*	*-70.15****
	Salvage logging	*30.58 (25.02;36.23)*	*-44.14 (-50.98; -37.62)*	*-74.72****
Installation of rockfall nets	*Yes*	*26.39 (21.35;31.61)*	*9.69 (3.99;15.31)*	*-16.69****
Reforestation	*With cluster planting scheme*	*61.25 (46.13;76.82)*	*20.53 (3.43;37.95)*	*-40.71****
	With regular planting scheme	*68.02 (52.80;83.96)*	*16.84 (-0.45;34.44)*	*-51.17****

*Confidence intervals at 95% in parentheses. The statistical significance of WTP differences between baseline and post-treatment estimates was assessed using the Poe test. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.*

The shift in preferences is further supported by the increase in respondents reporting zero WTP across all choice tasks, explicitly preferring to let forest recover naturally. Their proportion rose from 1.3% before the information treatment to 10.1% afterwards.

Table 5 adds interactions between the ASC and socio-demographic characteristics. Because the ASC is interacted, its main coefficient refers to the reference profile rather than the average respondent. Attribute estimates remain close to those in Table 3: information reverses preferences for partial and full salvage logging and reduces, without eliminating, support for rockfall nets and planting schemes.

The interaction terms further highlight how socio-demographic characteristics shape these shifts in preferences. Gender differences emerge clearly: female respondents show a stronger tendency towards the *status quo* in the baseline model, but this effect weakens after information is provided. Age also plays a role, with older respondents slightly more inclined towards alternative interventions at baseline, while the informational treatment reverses this pattern.

Education and income variables reveal particularly pronounced effects. In the baseline model, higher income groups are associated with a stronger likelihood of choosing policy alternatives over the *status quo*. However, after the information provision, the magnitude of these effects decreases substantially, and in several cases the direction of the interaction changes, suggesting that the informational treatment partly reduces the socio-economic gradient in preferences for post-fire management policies.

Geographical differences appear less pronounced, as the interaction terms for hill and mountain areas are not statistically significant. However, respondents living in the North-East exhibit a slightly stronger baseline preference for policy interventions, which diminishes after the informational treatment. These findings suggest that information does not simply shift average preferences but moderates the influence of socio-demographic characteristics, leading to a more homogeneous pattern of responses across different population groups.

Table 5*. Mixed Logit Model (MXL) estimates with interaction terms.*

Attributes	**Levels**	**Baseline**	***Post-treatment effect***	***Change***
ASC		-1.886^{**} (0.655)	3.010^{***} (0.889)	1.123^{***}
Deadwood management	Cut and release	0.007 (0.088)	0.0300 (0.131)	0.037^{***}
	Partial salvage logging	0.573^{***} (0.099)	-0.953^{***} (0.150)	-0.379^{***}
	Salvage logging	0.420^{***} (0.037)	-1.022^{***}(0.058)	-0.601^{***}
Installation of rockfall nets	Yes	0.360^{***} (0.035)	-0.227^{***}(0.052)	0.133^{***}
Reforestation	With cluster planting scheme	0.834^{***} (0.104)	-0.553^{***}(0.159)	0.280^{**}
	With regular planting scheme	0.932^{***} (0.106)	-0.692^{***}(0.160)	0.239^{*}

Tax	-0.013*** (0.000)		
Interactions of ASC with Socio-demographic Variables			
ASC*Female	-0.519*** (0.110)	0.366*** (0.138)	-0.153*
ASC*Age	0.007* (0.003)	-0.023*** (0.004)	-0.017***
ASC*Hill Areas	0.204 (0.140)	-0.125 (0.175)	0.079
ASC*Mountain Areas	-0.093 (0.155)	-0.075 (0.200)	-0.168
ASC*Middle school	3.840*** (0.587)	-2.589***	1.250**
ASC*High school	3.422*** (0.581)	-2.462***	0.959*
ASC*Bachelor's degree	3.304*** (0.608)	-2.428***	0.875*
ASC*Master's degree	2.691*** (0.590)	-2.364***	0.327
ASC*Postgraduate	2.901*** (0.662)	-1.686*	1.215**
ASC*North-East	0.230* (0.120)	-0.287*	-0.057
ASC*Net household income 1,000-2,000 euro/month (1 = yes)	0.814*** (0.208)	-0.558***	0.256
ASC*Net household income 2,000-3,000 euro/month (1 = yes)	1.222*** (0.216)	-0.614***	0.608***
ASC*Net household income 3,000-4,000 euro/month (1 = yes)	1.365*** (0.238)	-1.257***	0.108
ASC*Net household income 4,000-6,000 euro/month (1 = yes)	1.864*** (0.314)	-2.11***	-0.253*
ASC*Net household income > 6,000 euro/month (1 = yes)	2.640*** (0.477)	-1.586***	1.054***
ASC*Net household income does not answer (1=yes)	0.379* (0.230)	-0.289	0.089
Standard Deviations Random Normal Coefficients			
ASC	2.617*** (0.070)		
Partial salvage logging	0.728*** (0.253)		

	Salvage logging	0.788^{***} (0.042)
Reforestation	With cluster planting scheme	0.428^{***} (0.065)
	With regular planting scheme	0.525^{***} (0.058)
Log Likelihood		11,474
N. Observations		1,169

*Standard errors in parenthesis, * p < 0.1; ** p < 0.05; *** p < 0.01*

Table 6 reports the aggregate WTP for three hypothetical post-disturbance restoration scenarios, derived from the estimated WTP for individual attributes. These scenarios descend from results of past experiments and restoration projects in mountain forests affected by large disturbances (Beghin et al., 2010; Castro et al., 2011; Lingua et al., 2023; Marzano et al., 2013). They are intended to exploit, when possible, natural regeneration and the several beneficial roles of deadwood, or, when deemed as necessary, to apply active restoration practices that could be more effective in promoting forest resilience and biodiversity (e.g. clustered reforestation), while still guaranteeing protection to anthropic assets (e.g. rockfall nets) and partial recovery of the timber economic value (e.g. partial salvage logging). They follow a gradient of increasing anthropic intervention and costs. The first two scenarios involve partial salvage logging and exclude rockfall nets, differing in reforestation: the first assumes no reforestation, thus relies only on natural regeneration, the second includes cluster reforestation. The third scenario entails complete salvage logging, combined with rockfall nets and artificial cluster-planting-scheme reforestation.

***Table 6**. Aggregate WTP for three hypothetical scenarios (€)*

	Hypothetical Scenarios		Baseline	Post-treatment
	Deadwood on the ground	Partial salvage logging		
1	Rockfall nets	No	232.99	72.31
	Reforestation	No		

2	Deadwood on the ground Rockfall nets Reforestation	Partial salvage logging No With cluster planting scheme	294.24	92.85
3	Deadwood on the ground Rockfall nets Reforestation	Salvage logging Yes With cluster planting scheme	308.28	85.61

Source: own elaboration

The results reveal a clear shift in respondents' preferences when scientific information is provided. Without information, all three scenarios yield positive aggregate WTP values, with the third scenario being the most valued (€308.28). However, once respondents receive science-based information, WTP for all scenarios decreases substantially.

4. Discussion

This study addresses the lack of empirical evidence on public preferences for post-fire restoration practices and complementary post-disturbance techniques in protective mountain forests. In the initial information setting, without access to technical knowledge about the ecological implications of the interventions, the analysis reveals a clear preference for active management strategies over natural recovery processes.

Among the interventions, reforestation practices received the highest WTP, suggesting strong societal appeal for visible, symbolic actions like tree planting associated with landscape restoration and environmental stewardship, followed by partial and then complete salvage logging. Without science-based information, respondents appeared unaware that salvage logging is ecologically controversial, despite substantial evidence of its negative consequences on biodiversity, ecosystem recovery and ecosystem services (e.g. Leverkus, 2018b; Leverkus et al., 2021; Thorn et al., 2020; Zema et al., 2025). The installation of rockfall nets, often perceived as safety-enhancing, similarly received positive WTP values.

While direct comparisons with studies using comparable stated preference methods are currently limited, our findings are consistent with qualitative evidence documenting a widespread preference for visible and active post-fire interventions, especially near urban areas (Moreira et al., 2012; Ryan and Hamin, 2008), and echo other stated preference studies reporting higher WTP for protective or preventive measures such as rockfall nets (Burton et al., 2024; Diendéré and Kaboré, 2023). Practices like reforestation and salvage logging match public expectations for rapid recovery, and visual order, even where ecological evidence increasingly supports less intensive approaches in protective mountain forests.

This preference seems driven by symbolic values and collective significance attached to forests, especially after a disturbance (Rival, 1998; Tidball, 2014), rather than ecological effectiveness, underlining the cultural narratives in which visible interventions like planting and cleaning are intuitively associated with order, care for nature, and the healing of community spirit (Ryan and Hamin, 2008).

This divergence underscores the importance of understanding how individuals perceive the utility of restoration options without technical information, setting the stage for examining how preferences shift once scientific knowledge.

Our results are consistent with a marked change in preferences after exposure to ecological information: WTP was significantly lower for almost all active restoration practices, and the sign reversal in WTP for both salvage logging and partial salvage logging, from positive to negative, indicates a shift from initial support to active rejection once respondents learn of their ecological impacts. Information may have contributed to correcting misconceptions about the necessity or effectiveness of measures involving large-scale deadwood removal or artificial structures, thereby realigning preferences with science-based management practices. Similarly, Vanermen et al. (2021) and Jiang et al. (2023) showed that scientific or environmental information in CEs can significantly reshape public preferences toward ecological priorities, reducing purely aesthetic or intuitive judgments. By contrast, Riegel et al. (2023) found no significant effect of information on WTP, suggesting that its impact may depend on how directly it addresses trade-offs or challenges intuitive preferences.

The shift is also evident in aggregate scenarios: although all three remain positively valued after the information treatment, their WTP decreases substantially relative to baseline. This suggests that scientific information is associated with a reduction in the perceived benefits of more intensive management strategies, although respondents continue to value post-fire interventions.

Scenario 3 (complete salvage logging, rockfall nets, and reforestation), initially the most valued, experiences the largest decline in WTP, indicating a reduced preference for highly interventionist approaches in the post-information condition. Scenarios based on partial salvage logging remain positively valued, with slightly higher WTP when reforestation is included, possibly reflecting that the idea of “planting trees” represents a deeply rooted narrative, resonating with the common-sense perceptions of environmentally sensitive individuals (Livingston, 2022). Moderate interventions lose less support, especially when paired with reforestation practices such as applied nucleation or other spatially patterned restoration methods (Holl et al., 2024), considering microenvironmental conditions, natural processes, and species requirements.

Interaction effects with socio-demographic variables provide additional insights into how individual characteristics shape preferences, although main attribute effects remain largely stable across models. Geographical location may influence preferences (Czajkowski et al., 2017): mountain residents express a lower, although not statistically significant, preference for intervention scenarios. This may reflect greater familiarity with post-fire landscapes and forest recovery dynamics, and possibly direct experience and dialogue with forest professionals, academics, and decision-makers in wildfire-prone areas (Shindler and Cramer, 1999).

Education and income also play a role, although their influence changes with information. Initially, higher income and lower education levels are associated with higher WTP. While the income effect is consistent with economic theory, the education effect may reflect the stronger symbolic appeal of visible interventions, such as tree planting or deadwood removal, which may be perceived as signs of care by individuals less exposed to ecological discourse or critical perspectives on intensive management. After the information treatment, these differences tend to diminish: WTP becomes more homogeneous across education groups and the income effect weakens substantially, suggesting information serves as a levelling factor that reduces disparities in preferences and fosters a more uniform understanding of restoration options across socio-economic strata (Czajkowski et al., 2016). The influence of respondents' place of residence highlights an important dimension deserving further investigation. A limitation of this analysis is that it included only residents of the Italian Alpine Space regions, who experience protective forests directly or through proximity-based tourism. Residents of other Italian regions were excluded, although they may also value these interventions as out-of-region tourists or through existence values associated with the protective function of these ecosystems.

5. Conclusions

Our findings reveal a general public inclination towards moderate to intensive post-fire intervention in protective mountain forests, with a marked preference for visible and active measures driven more by symbolic meanings and common-sense perceptions of restoration than by ecological considerations. Scientific information can challenge these assumptions and realign preferences with evidence-based practices. It may foster broader acceptance of passive or minimal-intervention approaches, which better promote resilient, diverse forest ecosystems while ensuring protective functions and minimising economic costs, unless specific priorities apply (e.g. public safety concerns or faster recovery dynamics). Importantly, information not only influences preferences but also reduces socio-demographic heterogeneity, contributing to more informed and equitable public support for forest management.

From a methodological perspective, combining a choice experiment with a MXL model captures heterogeneity in public preferences for post-fire restoration practices. Estimating a single specification with post-treatment effects identifies how preferences differ following information provision, while retaining enough observations for robust estimation. Some limitations remain. The baseline specification treats some attributes as fixed to maintain model parsimony and avoid identification issues. Negative preferences for certain landscape or infrastructure attributes are behaviourally plausible but may also reflect multimodal preference structures not fully captured by a single continuous distribution. Latent Class Models could potentially identify distinct preference segments, but their reliable estimation requires more information per respondent than available in the present design. Future research could explore these specifications to further investigate preference heterogeneity.

The absence of a control group also warrants caution. While the repeated within-subject design controls for a substantial share of unobserved individual heterogeneity, alternative explanations such as learning, fatigue, or repeated-task effects cannot be fully ruled out. Results should therefore be interpreted as consistent with an information effect, while formal causal identification would require a proper experimental setting.

A further limitation concerns potential framing effects: the information treatment was intentionally grounded in scientific evidence on post-fire forest dynamics and highlighted the ecological benefits of natural regeneration and deadwood retention. It therefore cannot be considered fully neutral across management options. While this reflects the study's objective, some observed effects may reflect the framing of ecological trade-offs. However, responses did not uniformly converge towards passive restoration, as preferences for reforestation proved more robust than those for other options. This provides useful insights for communication and public engagement strategies. Future research could compare alternative information treatments to assess how far preference changes are driven by increased knowledge rather than by the way information is presented.

From a public policy perspective, post-fire forest management should integrate structured information provision as a governance component, rather than as a marginal or ex post activity. Transparent, science-based communication can help policy-makers reduce the risk of inefficient or contested interventions and enhance the social acceptability of evidence-based restoration strategies.

Given the relevance of one's living environment in shaping preferences, through familiarity with forested environments and access to technical information, future research should extend the target population to transalpine residents beyond Italy and out-of-region tourists, better capturing the diversity of direct use values attributed to post-disturbance restoration in mountain protective forests. These insights carry implications for both forest management and communication strategies. Post-fire interventions should be designed considering not only ecological evidence and cost efficiency, but also public perceptions, which may vary significantly depending on the information received. Our results highlight the transformative potential of technical information and the crucial role of clear, transparent communication tools in engaging the public, fostering more informed, equitable, and ecologically sound decision-making in forest policy and post-disturbance restoration, particularly when public resources are involved.

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