

Integrating Ecosystem Services Valuation into Territorial Planning: Evidence from Mediterranean Wetlands and Implications for Green Infrastructure

Rafael Vega-Pozuelo ¹, 

1. *Department of Social Sciences, Philosophy, Geography, and Translation and Interpreting, Universidad de Córdoba, Córdoba, ESP*

Abstract

Mediterranean agricultural landscapes are increasingly affected by land-use intensification and environmental degradation, particularly in wetland ecosystems that provide critical regulating and cultural services. Despite advances in ecosystem service (ES) valuation, its integration into territorial planning remains limited. This study aims to assess the economic value of ES associated with wetlands and to examine their integration into territorial planning through green infrastructure (GI) approaches in a Mediterranean agricultural landscape in southern Spain. A mixed-methods approach was employed, combining ES identification based on the Common International Classification of Ecosystem Services framework, economic valuation using the contingent valuation method, and territorial analysis of planning instruments. A structured survey of 385 respondents was administered to estimate willingness to pay (WTP), and a binary logistic regression model was applied to identify the main determinants influencing valuation. Approximately 68% of respondents expressed a WTP for wetland conservation, with a mean WTP of €48.6 per person per year. Regulating and cultural services were identified as the most highly valued. Econometric results indicate that environmental awareness, perceived ecosystem benefits, and income level are statistically significant predictors of WTP. The findings demonstrate that wetlands generate substantial social and economic value that is not adequately reflected in territorial planning. The integration of ES valuation into GI strategies may provide a planning-oriented framework for improving decision-making, enhancing ecological connectivity, and supporting sustainable land-use management.

Categories: Social systems (economies, governments, industry), Sustainable Marketing, Impacts of globalization (trends/changes)

Keywords: ecosystem services, contingent valuation, willingness to pay, wetlands, green infrastructure, territorial planning, mediterranean landscapes, land-use planning

JEL Classifications: R58, O13, Q51, Q57

Introduction

Globally, wetlands have declined substantially over recent decades, with major losses associated with agricultural expansion, urbanization, and hydrological alteration ([Ramsar Convention Secretariat, 2021](#)).

Mediterranean agricultural landscapes are increasingly affected by processes of land-use intensification, urban expansion, and climate change, which are leading to the degradation of ecosystems and the loss of their associated functions. Wetlands, in particular, represent highly vulnerable environments despite their crucial role in biodiversity conservation, hydrological regulation, and climate mitigation ([Millennium Ecosystem Assessment, 2005](#)) ([Mitsch and Gosselink, 2015](#)). The transformation and fragmentation of these systems have reduced their ecological integrity and limited their capacity to provide essential benefits to society.

The concept of ecosystem services (ES) has been widely adopted as a framework to understand and quantify the contributions of ecosystems to human well-being. Since the publication of the Millennium Ecosystem Assessment ([Millennium Ecosystem Assessment, 2005](#)), ES have been categorized into provisioning, regulating, cultural, and

supporting services, highlighting their economic, social, and environmental relevance. Subsequent research has emphasized the importance of integrating ES into policy and decision-making processes, particularly in contexts where land-use conflicts are significant (De Groot et al., 2010), (Costanza et al., 2014), (Johnston et al., 2017), and (Bateman et al., 2011).

Economic valuation has emerged as a key tool for capturing the societal benefits of ES, especially for those not traded in conventional markets. Among the available methods, contingent valuation and willingness-to-pay (WTP) approaches have been extensively used to estimate non-market values associated with environmental goods, including wetlands (Hanemann, 1994), (Daily et al., 2009), (Geneletti, 2015), and (Liquete et al., 2015). These approaches allow for the incorporation of social preferences into economic analysis, providing valuable information for environmental management and conservation strategies.

However, despite the extensive application of economic valuation methods, there remains a persistent gap between the estimation of ES values and their effective integration into territorial planning. Many studies focus on methodological aspects of valuation without addressing how these results can inform spatial planning instruments or land-use policies (De Groot et al., 2010), (Benedict, 2006), and (Haines-Young and Potschin-Young, 2018). This limitation is particularly evident in Mediterranean agricultural landscapes, where multiple and often competing land uses - such as agriculture, urban development, and environmental protection - require integrated and spatially explicit approaches.

In this context, the concept of green infrastructure (GI) has gained increasing relevance as a planning tool aimed at enhancing ecological connectivity, maintaining ecosystem functions, and supporting sustainable territorial development. GI promotes the integration of natural and semi-natural areas into spatial planning frameworks, contributing to biodiversity conservation while generating economic and social benefits (IPBES, 2019), (Díaz et al., 2019), (Haines-Young and Potschin-Young, 2018), and (Maes et al., 2020). In agricultural landscapes, GI can play a key role in preserving multifunctionality, improving resilience, and reinforcing the provision of ES.

This study seeks to contribute to bridging the gap between ES valuation and territorial planning. Specifically, it aims to assess the economic value of ES associated with wetland environments in a Mediterranean agricultural landscape and to analyze how these values can be incorporated into planning strategies through GI approaches. ES have become increasingly important in territorial planning and environmental decision-making processes, particularly within policy frameworks that seek to integrate ecological, social, and economic values into land-use planning and GI strategies (IPBES, 2022) (European Commission, 2021).

Accordingly, this study addresses the following research questions:

RQ1: What economic value do respondents assign to wetland ES in Mediterranean agricultural landscapes?

RQ2: Which socio-economic and perception-related variables explain WTP for wetland conservation?

RQ3: How can ES valuation be operationalized within territorial planning and GI strategies?

Research Method

Study area

The study was conducted in the province of Córdoba (Andalusia, southern Spain), within a Mediterranean agricultural landscape characterized by extensive olive groves, cereal crops, and fragmented wetland ecosystems (Instituto de Estadística y Cartografía de Andalucía, 2024) (Junta de Andalucía, 2023). The study area includes small inland wetlands embedded within an intensively cultivated rural matrix, where agricultural expansion and land-use change have progressively reduced ecological connectivity and increased environmental pressure on wetland ecosystems (Instituto de Estadística y Cartografía de Andalucía, 2024) (Junta de Andalucía, 2023).

The empirical and spatial analysis focused on 15 wetlands in the province of Córdoba (Spain) included in the Inventario de Humedales de Andalucía (IHA; Andalusian Wetland Inventory): San Cristóbal, located in Cabra; La Gamonosa, Consuegra, Butaquillo, La Roa, La Quinta, Cortijo Viejo, and Rincón del Muerto, located in Baena; Jarata, located in

Montilla; Navarredonda, located in Puente Genil; Donadío, located in Santaella; Jarambel, located in Aguilar de la Frontera; and Vadohondo, Curado, and Taraje, located in Lucena.

The region presents a typical Mediterranean climate, characterized by hot, dry summers and irregular precipitation patterns, with marked interannual variability ([Agencia Estatal de Meteorología, 2023](#)). Wetlands in this context perform important regulating functions related to water retention, flood mitigation, biodiversity conservation, and landscape quality.

From a socio-economic perspective, agriculture constitutes the dominant land use and economic activity in the area, particularly olive cultivation ([Instituto de Estadística y Cartografía de Andalucía, 2024](#)). The territorial structure is therefore strongly influenced by the interaction between agricultural productivity and environmental conservation, making the study area particularly suitable for analyzing the integration of ES into territorial planning and GI strategies.

Territorial and environmental information used in the analysis was obtained from regional planning documents, land-use planning instruments, environmental reports, and official cartographic databases produced by the Junta de Andalucía and the Environmental Information Network of Andalusia (REDIAM) ([Junta de Andalucía, 2023](#)).

Figures 2 and 4 provide a broader regional representation intended to situate the selected wetlands within the Andalusian wetland, landscape, and GI context. Their regional extent supports the territorial interpretation of land-use pressures and potential ecological connections, but it does not represent the survey sampling frame. The specific locations of the 15 wetland units included in the study are explicitly identified in Panel B of Figure 2.

Research design and analytical framework

This study adopted a mixed-methods approach combining ES identification, economic valuation, and territorial analysis. The methodological design integrates quantitative and qualitative perspectives to evaluate both the social perception and territorial implications of wetland ES.

The analytical framework consisted of four sequential stages:

1. Identification and classification of ES associated with wetlands using the Common International Classification of Ecosystem Services (CICES) framework ([Haines-Young and Potschin-Young, 2018](#));
2. Economic valuation of ES through the contingent valuation method (CVM) and WTP estimation;
3. Econometric analysis using a binary logistic regression model to identify the main determinants influencing WTP;
4. Territorial interpretation of results in relation to land-use planning and GI strategies.

This integrated approach allows ES valuation to be linked with spatial planning considerations, thereby facilitating the translation of economic evidence into planning-relevant information.

ES were identified and classified according to the CICES, which provides a standardized framework for organizing ecosystem functions and benefits ([Haines-Young and Potschin-Young, 2018](#)).

The analysis focused primarily on regulating services, including water regulation, flood mitigation, and water purification; cultural services, including landscape value, recreation, and local identity; and provisioning services related to indirect agricultural and environmental benefits.

The identification process combined literature review, territorial analysis, and respondent perception obtained through the survey instrument.

Ecosystem service identification and contingent valuation

The economic valuation of wetland ES was conducted using the CVM, a stated-preference approach widely applied in environmental economics to estimate non-market values ([Hanemann, 1994](#)), ([Daily, 2009](#)), and ([Geneletti et al., 2015](#)).

Respondents were presented with a hypothetical conservation scenario involving the implementation of a wetland conservation and ecological restoration program aimed at improving biodiversity conservation, ecological connectivity, water regulation capacity, and landscape quality.

Participants were then asked whether they would be willing to contribute financially to the proposed program and, if so, to indicate the amount they would be WTP annually.

The valuation scenario and questionnaire structure were designed following standard recommendations for stated preference studies (Geneletti et al., 2015). The survey instrument included socio-demographic variables, environmental awareness indicators, perception-based questions regarding ES, and WTP items.

Respondents were informed that the proposed conservation program would be implemented by public environmental authorities and financed through an annual voluntary contribution. The program would support wetland restoration, ecological connectivity measures, biodiversity conservation, water regulation, and improvements in public access. The scenario was presented before the WTP question in order to ensure a realistic and understandable valuation context.

The payment vehicle was defined as an annual voluntary contribution linked to a publicly managed conservation program, rather than as a compulsory tax or fee, in order to make the scenario acceptable and realistic for respondents.

Several procedures were incorporated to reduce potential contingent valuation biases. First, the valuation scenario was described before the WTP question, including the purpose of the conservation program, the implementing public authority, the voluntary annual contribution mechanism, and the expected environmental improvements. Second, the questionnaire was anonymous in order to reduce strategic response behavior. Third, a payment-card format was used instead of an open-ended question to reduce starting-point effects and facilitate more realistic responses. Fourth, a pilot questionnaire was administered to improve clarity and reduce information bias. Finally, zero WTP responses were retained in the unconditional mean, while positive WTP responses were analyzed separately through the conditional mean.

Sampling, survey administration, and measurement

Data were collected through a structured questionnaire administered to adult residents and local stakeholders within the study area and surrounding municipalities.

The target population included individuals with direct or indirect relationships to the territorial and environmental context of the wetlands, including rural residents, land users, agricultural stakeholders, and individuals familiar with the local landscape.

The resident component of the target population comprised adults living in the municipalities of Cabra, Baena, Montilla, Puente Genil, Santaella, Aguilar de la Frontera, and Lucena, which contain the 15 wetlands included in the study. According to the Instituto de Estadística y Cartografía de Andalucía, the combined total resident population of these municipalities was 151,700 inhabitants in 2025. Because the target population also included agricultural stakeholders, land users, and other individuals familiar with the wetland environments, no complete individual-level sampling frame covering all eligible groups was available. Participants were therefore recruited through purposive and convenience sampling. The Cochran calculation was used as a minimum sample-size benchmark and should not be interpreted as evidence of probability-based population representativeness.

The sample size was calculated following standard sampling procedures (Cochran, 1977), assuming a 95% confidence level, a $\pm 5\%$ margin of error, and maximum variability ($p = 0.5$). A total of 542 questionnaires were distributed, of which 385 valid responses were obtained, resulting in a response rate of approximately 71.0%.

The survey was administered between March and June 2025 through a combination of face-to-face and online distribution methods. Participation was voluntary and anonymous. Informed consent was obtained from all participants prior to questionnaire completion, and no personally identifiable information was collected.

The questionnaire was organized into four sections:

1. socio-demographic information;
2. environmental awareness and ES perception;
3. relationship with wetlands and visitation frequency;
4. WTP for wetland conservation.

A pilot version of the questionnaire was initially tested with a small group of respondents to ensure clarity, consistency, and comprehensibility prior to final administration.

Of the 385 valid responses, 223 questionnaires (57.9%) were collected through face-to-face administration and 162 (42.1%) through online distribution. A comparison of the main socio-demographic characteristics indicated no substantial differences between the two survey modes, suggesting that both approaches captured comparable respondent profiles.

For respondents selecting payment intervals, midpoint values were used to estimate annual WTP. The unconditional mean WTP included zero values corresponding to respondents unwilling to contribute financially, whereas the conditional mean WTP was calculated only for respondents reporting a positive WTP.

Participants were recruited using a combination of convenience and purposive sampling techniques. The sample included local residents, agricultural stakeholders, land users, and individuals familiar with the wetland environments under study.

The reliability of the perception-based constructs was evaluated using Cronbach's alpha coefficient. The environmental awareness construct was adapted from previous research on environmental attitudes and stated-preference valuation, while the perceived ecosystem benefits construct was adapted from ES perception and GI studies. Specifically, environmental awareness was operationalized through items related to respondents' awareness of wetland conservation, whereas perceived ecosystem benefits were measured through items referring to biodiversity conservation, water regulation, flood risk reduction, landscape quality, and local identity (Hanemann, 1994), (Daily et al., 2009), (Geneletti, 2015), and (Liquete et al., 2015).

The environmental awareness construct showed acceptable internal consistency (Cronbach's alpha = 0.78), while the perceived ecosystem benefits construct showed good internal consistency (Cronbach's alpha = 0.82).

Construct validity was further assessed through exploratory factor analysis using principal axis factoring and Direct Oblimin rotation. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.79, and Bartlett's test of sphericity was statistically significant, $\chi^2(10) = 612.47$, $p < 0.001$. The analysis supported a two-factor solution explaining 68.4% of the total variance. Primary factor loadings ranged from 0.67 to 0.86, and no substantial cross-loadings above 0.30 were observed. These results provided support for the distinction between environmental awareness and perceived ecosystem benefits used in the study.

Content validity was addressed through alignment with previous literature on ES valuation and through the use of indicators commonly employed in environmental perception and stated-preference studies (Geneletti et al., 2015) (Liquete et al., 2015).

Construct validity was reinforced by ensuring conceptual coherence between questionnaire items and the ES categories defined under the CICES framework.

Territorial and GIS-based analysis

The territorial analysis aimed to assess the extent to which wetlands and their associated ES are incorporated into territorial planning frameworks and GI strategies.

The territorial analysis was based on the systematic review of four planning and environmental instruments: the Andalusian Territorial Planning Plan (POTA), regional environmental planning documents, the Córdoba Municipal Urban Master Plan (PGOU), and REDIAM spatial datasets. Each instrument was assessed according to four operational criteria:

explicit wetland recognition, incorporation of ES, treatment of ecological connectivity, and inclusion of GI objectives.

The analysis was based on the review of land-use planning instruments, regional environmental planning documents, ecological connectivity criteria, and official spatial datasets related to wetlands and land use.

Spatial interpretation was conducted through qualitative territorial analysis supported by cartographic review and landscape interpretation. Particular attention was paid to ecological fragmentation, land-use conflicts, and the integration of wetlands into broader GI networks. The results of this review were then compared with the valuation findings in order to identify whether socially valued ES were reflected in planning priorities, zoning criteria, ecological connectivity measures, or conservation recommendations.

The territorial interpretation was subsequently compared with the results of the economic valuation in order to identify potential mismatches between the recognized social value of wetlands and their effective consideration within planning instruments.

To strengthen the territorial interpretation of the results, a geographic information system (GIS)-based spatial screening was conducted. The analysis used official cartographic sources, including REDIAM datasets, regional land-use information, wetland inventories, and protected-area layers. These spatial sources were used to identify the location of inland wetlands, surrounding agricultural land uses, protected environmental areas, and potential GI connections. The GIS analysis was not designed as a full ES mapping model, but as a spatial support tool to interpret wetland fragmentation, ecological connectivity, and the potential incorporation of wetlands into territorial planning and GI strategies.

The documentary and spatial analysis was operationalized through a two-step procedure. First, the reviewed planning instruments were assessed according to four criteria: explicit wetland recognition, incorporation of ES, treatment of ecological connectivity, and presence of GI objectives. Second, the spatial distribution of wetlands and surrounding land uses was compared with the valuation results in order to identify whether highly valued ES corresponded to areas requiring stronger planning protection, ecological restoration, or connectivity measures.

Planning instrument	Administrative level	Wetland treatment	Ecosystem services integration	Ecological connectivity	Planning implication identified
POTA	Regional	Wetlands recognized as environmental assets	Limited reference to ecosystem functions	Partial consideration of territorial connectivity	Provides a broad territorial framework but lacks operational ES-based criteria for zoning or prioritization
Regional environmental planning documents	Regional	Wetlands explicitly identified and environmentally characterized	Partial consideration of regulating and biodiversity-related services	Connectivity addressed through environmental management criteria	Supports conservation priorities but remains weakly connected to municipal zoning
PGOU Córdoba	Municipal	Wetlands mainly treated as protected or environmentally constrained land	Ecosystem services not explicitly incorporated into zoning criteria	Ecological connectivity weakly developed	Wetlands require stronger integration into land-use zoning, conservation buffers, and municipal GI planning
REDIAM datasets	Regional/cartographic	Wetlands spatially identified and documented	Indirect support through environmental variables	Partial support for connectivity interpretation	Provides spatial evidence for GIS-based screening and planning prioritization

TABLE 1: Evidence of wetland integration in reviewed planning instruments

Source: Author's own elaboration based on regional planning documents, REDIAM datasets, wetland inventories, and municipal land-use planning instruments

Table 1 shows that wetlands are generally recognized as environmentally relevant features, but their ES functions and connectivity roles are rarely translated into operational planning criteria. This gap is particularly evident at the municipal level, where wetlands are mainly treated as protected or constrained land rather than as multifunctional components of GI.

Econometric analysis

To analyze the determinants of WTP, a binary logistic regression model (logit model) was applied, given the dichotomous nature of the dependent variable (WTP: yes/no).

The model estimates the probability that an individual is willing to pay for wetland conservation as a function of socio-economic and perception-related variables.

The explanatory variables included household income, educational level, age, environmental awareness, perceived regulating ecosystem benefits, perceived cultural ecosystem benefits, and frequency of wetland visits.

The selection of explanatory variables was based on previous literature on environmental valuation and ES perception (Haines-Young and Potschin-Young, 2018), (Geneletti, 2015), and (Liquete et al., 2015).

The model was estimated using the variables included in the survey instrument. Variables such as institutional trust, policy awareness, and direct experience with environmental degradation were considered theoretically relevant, but they were not included in the original questionnaire and therefore could not be incorporated retrospectively without compromising methodological consistency.

Before estimating the logistic regression model, multicollinearity among the explanatory variables was assessed using variance inflation factor (VIF) and tolerance statistics. VIF values ranged from 1.18 to 2.07, while tolerance values ranged from 0.48 to 0.85. These results indicated that problematic multicollinearity was not present among the explanatory variables included in the model.

The logistic regression model is presented in Equation 1.

$$P(WTP_i = 1) = 1/[1 + e^{-(\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_n X_{ni})}]$$

Equation 1. Binary logistic regression model.

In Equation 1, $P(WTP_i = 1)$ represents the probability that respondent i is WTP for wetland conservation; β_0 is the intercept; β_n represents the estimated coefficients; and X_{ni} represents the explanatory variables included in the model.

Statistical analyses were performed using IBM SPSS Statistics version 29. Model performance was evaluated using likelihood ratio statistics, pseudo- R^2 , classification accuracy, and the Hosmer-Lemeshow goodness-of-fit test.

Results And Discussion

Descriptive statistics and WTP

A total of 385 valid responses were obtained. Of these, 262 respondents (68.1%) reported a positive WTP for wetland conservation, whereas 123 (31.9%) reported zero WTP. The unconditional mean annual WTP was €48.6 per person, increasing to €71.4 among respondents with positive WTP only. Table 2 presents the descriptive statistics of the study sample.

Variable	Mean / %	SD
Age (years)	47.8	14.2
University education (%)	42.6	–
Monthly household income (€)	2,145	865
Environmental awareness (1–5)	3.74	0.82
Perceived regulating ecosystem benefits (1–5)	4.12	0.71
Perceived cultural ecosystem benefits (1–5)	3.89	0.76
Positive willingness to pay (%)	68.1	–
Mean annual WTP (€)	48.6	37.4

TABLE 2: Descriptive statistics of the study sample (N = 385)

Source: Author's own calculations. WTP = willingness to pay

Respondents showed moderate-to-high levels of environmental awareness (mean = 3.74) and a strong recognition of regulating ES (mean = 4.12). Cultural services were also positively valued (mean = 3.89). The share of respondents with positive WTP reached 68.1%, with an unconditional annual mean WTP of €48.6 per person.

These findings are also consistent with recent evidence showing that public WTP remains a key mechanism for capturing the social value of wetland ES and supporting conservation decision-making (Kong et al., 2025).

Regulating ES were perceived as the most important, particularly water regulation, flood control, and water purification. Biodiversity conservation and landscape value also received high recognition, whereas direct provisioning benefits were comparatively less salient. Figure 7 summarizes the relative importance assigned to each ES category.

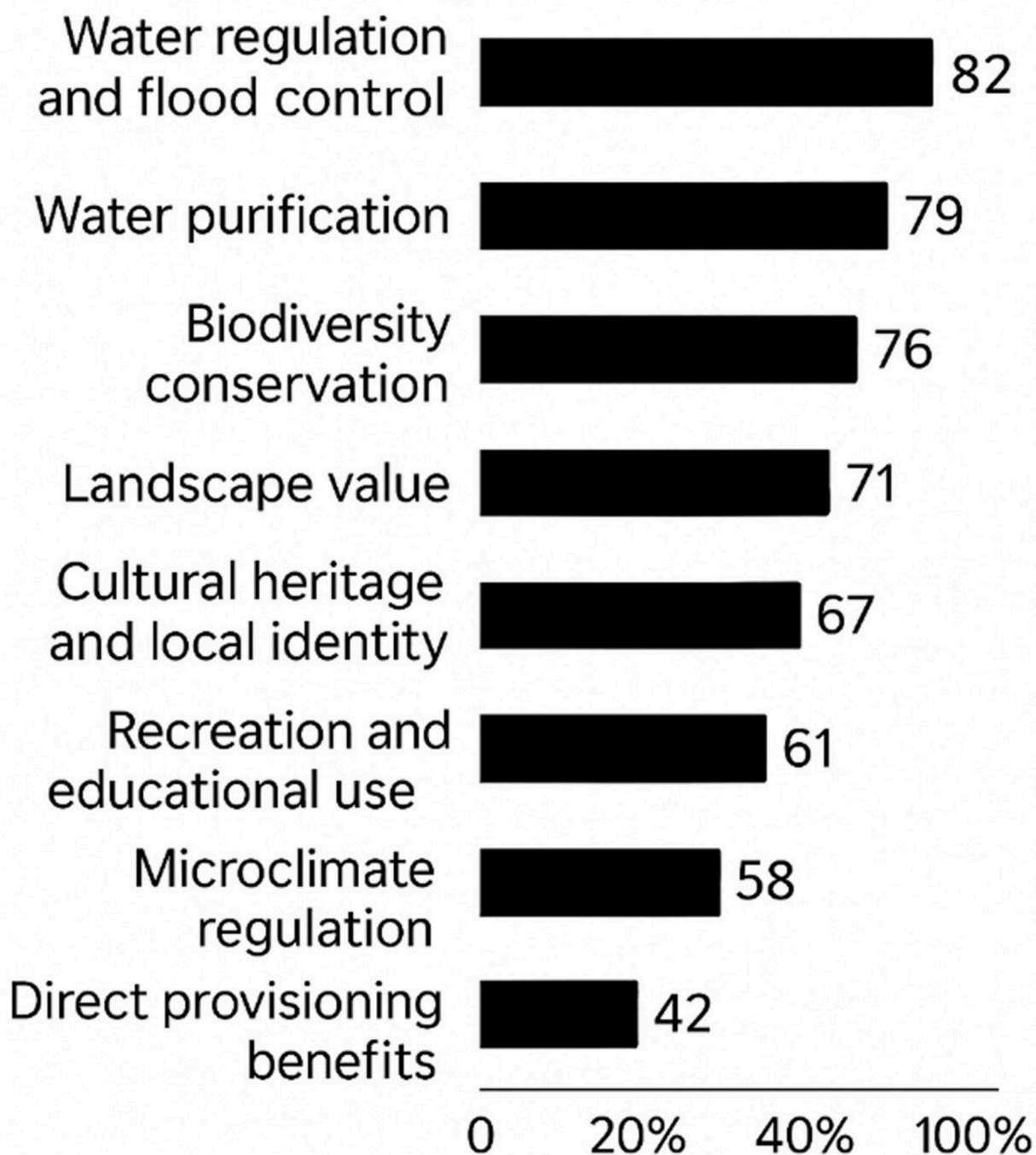


FIGURE 1: Perceived importance of wetland ecosystem services among respondents

Source: Author's own creation

Regulating services received the highest levels of recognition, particularly water regulation, flood control, and water purification. Cultural services such as landscape value and local identity also showed high perceived importance, whereas direct provisioning services were comparatively less valued.

The distribution of positive WTP responses is presented in Table 3. Among respondents with positive WTP, the largest concentration was observed in the €51-75 range, followed by the €31-50 range. Only a small proportion of respondents reported values above €150 per year, suggesting that support for wetland conservation is broadly distributed but concentrated at moderate contribution levels.

Annual contribution (€)	Respondents	Percentage (%)
15–30	42	16.0
31–50	67	25.6
51–75	79	30.2
76–100	41	15.6
101–150	22	8.4
151–180	11	4.2
Total	262	100.0

TABLE 3: Distribution of positive willingness to pay responses (n = 262)

Source: Author's own calculations

These results indicate a moderate but consistent valuation of wetland ES within the study area. The distribution of WTP values shows some variability, with higher contributions associated with respondents who demonstrated greater environmental awareness and stronger perceptions of ecosystem benefits.

Econometric analysis

The binary logistic regression model indicates that household income, environmental awareness, perceived regulating benefits, perceived cultural benefits, and university education significantly increase the probability of WTP for wetland conservation (Table 4). Environmental awareness and perceived regulating benefits were the strongest predictors. By contrast, frequency of wetland visits was not statistically significant, while age showed only a weak negative effect.

Variable	Coefficient (β)	Standard Error	Odds Ratio	p-value
Constant	-2.184	0.631	–	0.001
Household income	0.412	0.119	1.51	0.001
University education	0.538	0.214	1.71	0.012
Age	-0.017	0.009	0.98	0.058
Environmental awareness	0.734	0.168	2.08	<0.001
Perceived regulating benefits	0.821	0.194	2.27	<0.001
Perceived cultural benefits	0.463	0.177	1.59	0.009
Wetland visitation frequency	0.117	0.103	1.12	0.257

Indicator	Value
N	385
Log likelihood	-214.7
LR chi-square (7)	78.4
p-value	<0.001
Pseudo-R ²	0.154
AUC	0.79
Correct classification rate (%)	74.5

TABLE 4: Binary logistic regression model explaining willingness to pay for wetland conservation

Source: Author's own calculations. AUC, Area Under the Curve

The binary logistic model shows that household income, environmental awareness, perceived regulating benefits, perceived cultural benefits, and university education are positively associated with the probability of WTP. Environmental awareness and perceived regulating benefits emerged as the strongest predictors. Age displayed a weak negative effect and was only marginally significant, whereas frequency of wetland visits did not reach conventional significance levels.

Overall, the model identifies several relevant predictors of WTP, although the pseudo- R^2 value suggests that additional unobserved factors may also influence respondents' decisions. These results are consistent with previous studies on wetland valuation, which highlight the significant non-market value attributed to ES by local populations (Haines-Young and Potschin-Young, 2018) (Daily et al., 2009).

The Hosmer-Lemeshow goodness-of-fit statistics are presented in Table 5.

Statistic	Value
Chi-square	6.27
Degrees of freedom	8
p-value	0.41

TABLE 5: Hosmer–Lemeshow goodness-of-fit test

Source: Author’s own calculations

The Hosmer-Lemeshow test indicated adequate model fit ($\chi^2 = 6.27$, $df = 8$, $p = 0.41$), supporting the suitability of the binary logistic regression model.

These results are consistent with previous studies on wetland valuation, which highlight the significant non-market value attributed to ES by local populations (Hanemann, 1994) (Johnston et al., 2017).

Territorial implications

The qualitative territorial component of the mixed-methods design was used to interpret how valuation results relate to planning instruments and GI strategies.

The documentary review showed that wetlands are primarily addressed as protected environmental features rather than as multifunctional territorial assets. The PGOU of Córdoba, for example, recognizes wetlands mainly through environmental protection provisions, while ES provision and ecological connectivity are not explicitly incorporated into zoning or land management criteria. Similarly, regional planning documents acknowledge the environmental importance of wetlands but rarely use ES valuation as a basis for territorial decision-making.

The documentary review revealed substantial differences among planning instruments. While regional environmental documents explicitly recognize wetlands and partially address ecological connectivity, ES are rarely incorporated as planning criteria. At the municipal level, the PGOU mainly treats wetlands as environmentally constrained land, without explicit integration of ES values or GI objectives. These findings support the conclusion that wetlands remain weakly embedded within operational planning frameworks.

From a territorial perspective, the results reveal a mismatch between the recognized social and economic value of wetlands and their limited integration into current planning frameworks, particularly in municipal land-use planning instruments and environmental management policies. Despite the positive WTP and strong social perception of wetland importance, these ecosystems are often spatially fragmented, weakly integrated into ecological networks, and insufficiently protected in land-use planning frameworks.

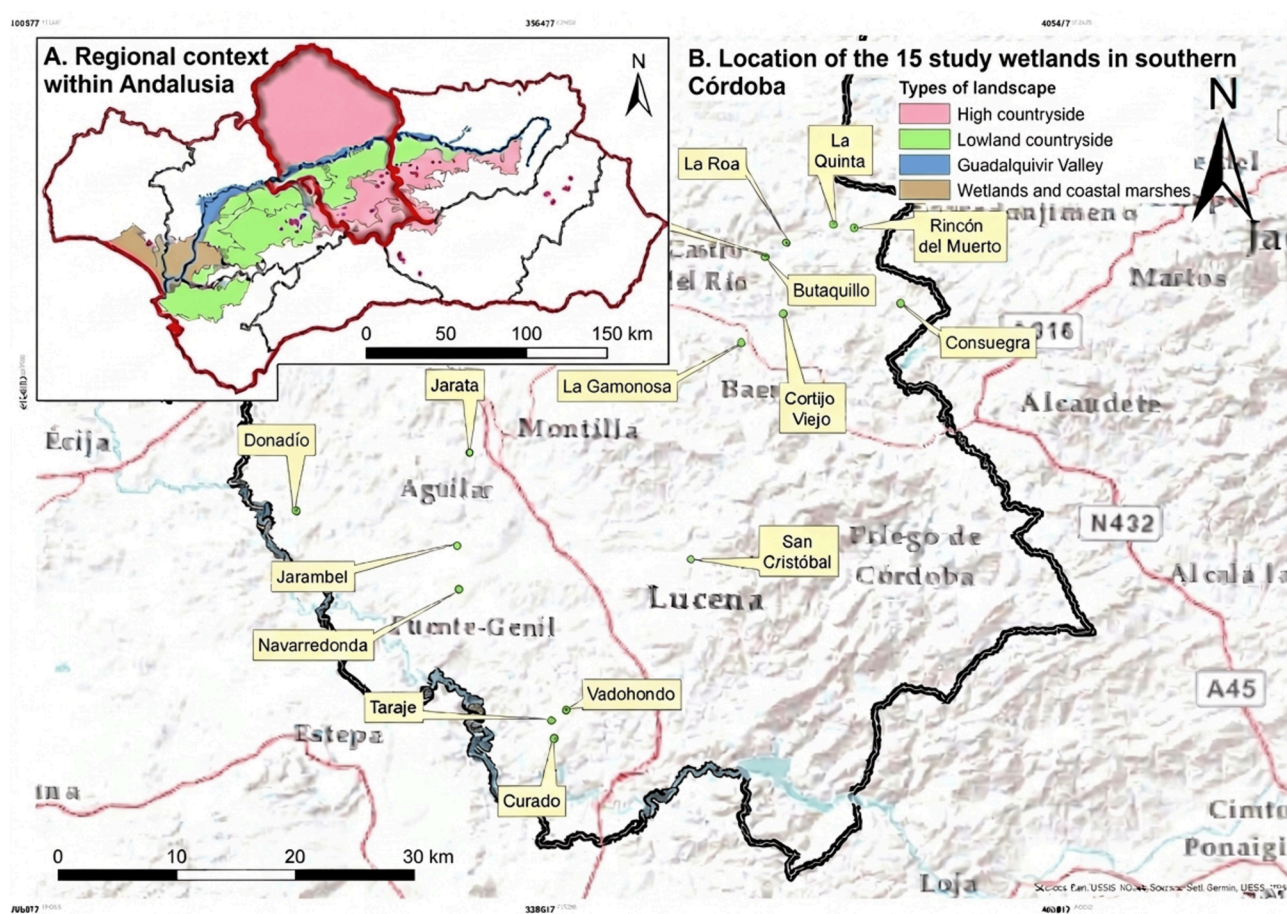


FIGURE 2: Spatial distribution of wetlands, agricultural land uses, and potential green infrastructure connections in the study area. Panel A provides the broader Andalusian wetland and landscape context, with Córdoba province highlighted, while Panel B explicitly identifies the locations of the 15 wetlands included in the study in southern Córdoba

Source: Adapted from Vega-Pozuelo and Garzón-García (Vega-Pozuelo and Garzón-García, 2025)

Figure 2 shows that the wetlands considered in the study are embedded within a predominantly agricultural matrix and remain spatially fragmented. The map also highlights potential GI connections that could support ecological continuity between wetland areas, agricultural landscapes, and protected environmental spaces.

In many cases, wetlands are treated as isolated environmental elements rather than as key components of a broader GI system. The results suggest that incorporating economic valuation into territorial planning could strengthen the justification for conservation measures, support the designation of ecological corridors, and enhance the integration of wetlands into GI strategies.

GIS-based territorial prioritization

The GIS-based screening was used to translate the territorial distribution of wetlands into planning-relevant priority areas. Wetlands located within or near protected environmental areas, surrounded by intensive agricultural land uses, and positioned along potential GI connections were considered high-priority areas for planning intervention. These areas are particularly relevant because they combine ecological vulnerability, connectivity potential, and socially valued ES, especially water regulation, biodiversity conservation, and landscape quality.

Although the prioritization does not constitute a full ES modeling exercise, the classification integrates spatial indicators associated with ES provision, ecological connectivity, protected-area proximity, and agricultural land-use pressures. Therefore, the GIS analysis provides a spatially explicit mechanism for translating valuation results into planning-relevant priorities.

Medium-priority areas correspond to wetlands embedded in agricultural matrices with partial connectivity potential or moderate proximity to protected areas. Low-priority areas correspond to wetlands with lower connectivity potential or weaker strategic relevance within the territorial matrix. This prioritization does not constitute a full ES model, but provides a spatially explicit planning tool to support the interpretation of CVM results and their translation into GI strategies.

Valuation/GIS evidence	Planning problem identified	Operational planning mechanism	Possible instrument	Responsible institution
High WTP for wetland conservation	Social value not reflected in municipal planning	Conservation zoning and stricter protection buffers	PGOU / municipal land-use planning	Municipality
High value assigned to regulating services	Hydrological functions insufficiently incorporated into planning	Buffer zone designation and restoration of wetland margins	Environmental planning instruments	Regional environmental administration
Wetlands located within agricultural matrices and near protected areas	Ecological vulnerability and land-use pressure	Priority conservation areas	PGOU / regional environmental planning	Municipality and regional administration
Fragmented wetland distribution	Weak ecological continuity between wetland areas	Ecological corridor creation and landscape permeability measures	Regional green infrastructure strategy	Regional planning authority
High cultural and landscape value	Landscape identity weakly incorporated into planning	Landscape protection and recreational corridor designation	Landscape planning / local environmental governance	Local and regional authorities
Environmental awareness predicts WTP	Public support not fully mobilized in planning processes	Stakeholder participation and awareness programmes	Local governance instruments	Local government

TABLE 6: Operational translation of valuation and GIS-based results into planning instruments

Source: Author's own elaboration. WTP = willingness to pay

Table 6 provides the operational link between the valuation results, the GIS-based territorial interpretation, and specific planning instruments. The table shows how WTP results and ES perceptions can inform conservation zoning, buffer areas, ecological corridors, restoration priorities, and participatory governance mechanisms.

Operational Planning Applications

The integration of ES valuation into territorial planning requires the translation of economic evidence into operational planning mechanisms. Based on the valuation results and GIS-based prioritization, several planning applications can be identified.

The valuation results can support specific planning interventions. High WTP levels and the strong importance assigned to regulating services justify the designation of conservation buffers around wetlands within municipal land-use plans. Areas identified as strategically relevant for ecological connectivity can be incorporated into GI strategies through ecological corridor designation and restoration programs. Similarly, wetlands associated with high social valuation may be prioritized for environmental investment and conservation funding.

Figure 3 summarizes the analytical pathway through which ES valuation can inform territorial planning and GI strategies.

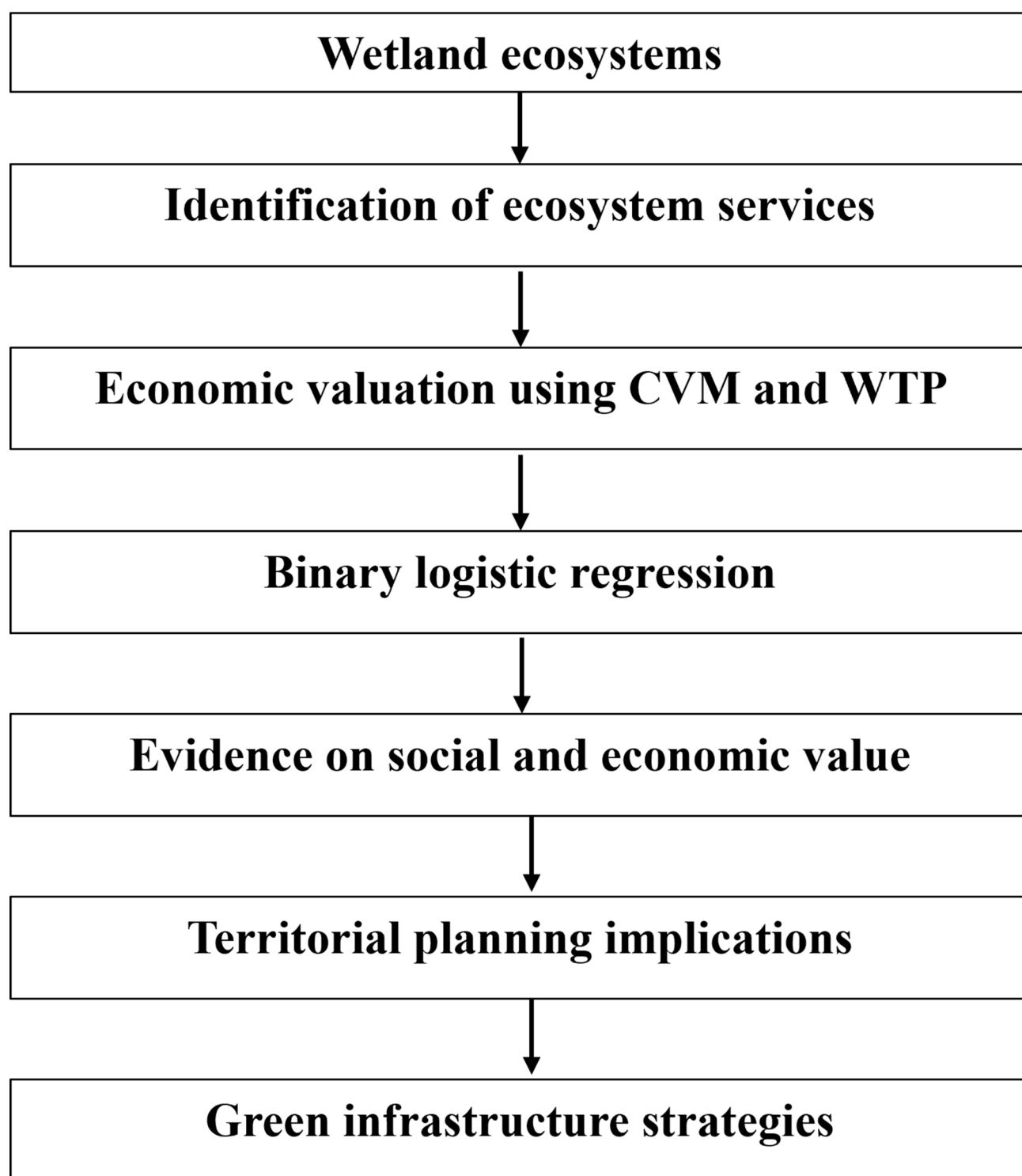


FIGURE 3: Analytical framework linking ecosystem service valuation to territorial planning. CVM = contingent valuation method; WTP = willingness to pay. Source: Author's own creation.

Figure 3 illustrates how wetland ES are identified, valued through contingent valuation, and translated into planning-relevant evidence to support GI strategies. The findings demonstrate that wetlands in Mediterranean agricultural landscapes generate significant social and economic value, particularly through regulating and cultural ES. However, this

value is not fully reflected in current territorial planning practices.

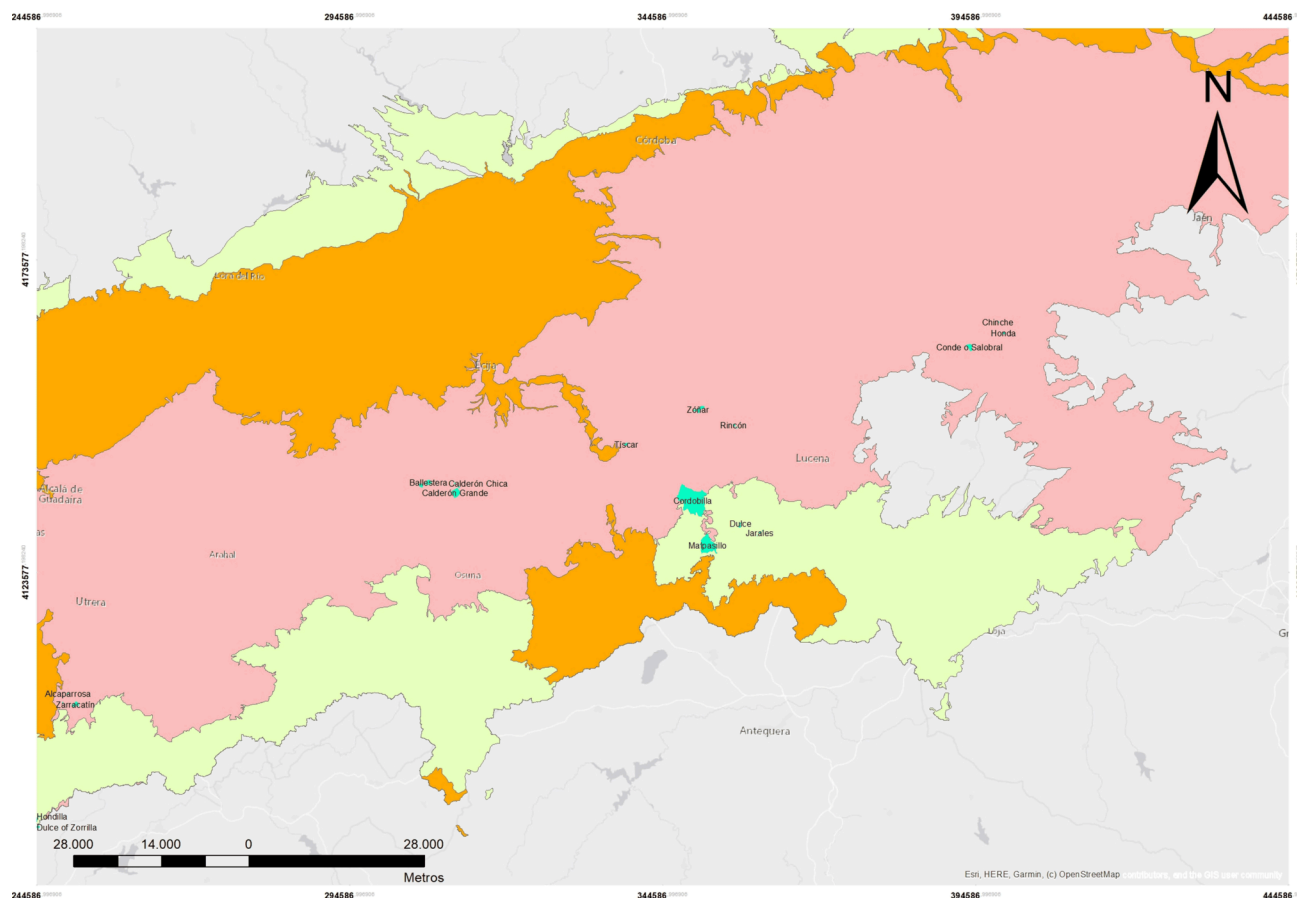


FIGURE 4: Wetland priority areas for green infrastructure planning in the study area. Priority levels were assigned according to ecological relevance, ecosystem service importance, proximity to protected areas, surrounding land-use pressures, and potential ecological connectivity.

High Priority Areas – Wetlands with high ecological relevance, strong ecosystem service value, proximity to protected areas, and significant potential for ecological connectivity.

Medium Priority Areas – Wetlands with moderate ecological relevance and partial connectivity potential requiring targeted conservation and restoration measures.

Low Priority Areas – Wetlands with lower strategic relevance for regional green infrastructure networks and lower connectivity potential.

Source: Author's own elaboration based on REDIAM datasets, wetland inventories, protected-area databases, and GIS-based territorial analysis.

The GIS-based classification of wetland units into high-, medium-, and low-priority areas for green infrastructure planning is presented in Figure 4. The GIS-based prioritization identified seven high-priority wetland units, five medium-priority units, and three low-priority units. High-priority wetlands were concentrated in areas characterized by intensive agricultural land uses, ecological fragmentation, and proximity to protected environmental spaces. These areas represent the most suitable targets for GI interventions, conservation zoning, and ecological corridor development.

Discussion

The results of this study confirm that wetlands embedded within Mediterranean agricultural landscapes generate significant social and economic value, particularly through regulating and cultural ES. The relatively high proportion of respondents willing to pay for their conservation, as well as the estimated mean WTP, reinforces the idea that these ecosystems are perceived as valuable assets despite their limited direct market productivity. These findings are also consistent with recent studies emphasizing the growing role of ecosystem accounting and valuation frameworks in supporting environmental governance and conservation financing (IPBES, 2022) (Angarita et al., 2025).

These findings are consistent with previous research highlighting the importance of non-market ES, especially in relation to wetlands. Economic valuation studies have repeatedly shown that regulating services such as water purification and flood control, as well as cultural services linked to landscape and recreation, are among the most highly valued by local populations (Hanemann, 1994), (Johnston et al., 2017), and (Vallecillo et al., 2019). In this regard, the results align with broader evidence suggesting that society assigns substantial value to ecosystem functions that contribute to environmental stability and quality of life, even when these are not directly monetized (Costanza et al., 2014) (Johnston et al., 2017).

However, beyond confirming existing literature, this study contributes to addressing a critical gap identified in previous research: the limited integration of ES valuation into territorial planning. As noted by De Groot et al. (De Groot et al., 2010) and Daily et al. (Daily et al., 2009), economic valuation often remains disconnected from spatial planning processes, reducing its practical applicability in decision-making contexts. The findings of this research clearly illustrate this disconnect. Despite the demonstrated economic value of wetlands, these ecosystems remain underrepresented in planning instruments and are often treated as residual or isolated elements within the landscape.

The territorial analysis reveals that wetlands are insufficiently incorporated into GI networks, which limits their ecological functionality and reduces their capacity to deliver ES at a landscape scale. This fragmentation is particularly problematic in Mediterranean agricultural systems, where land-use pressures are intense and ecological connectivity is essential for maintaining resilience. In this context, GI emerges as a key framework for bridging the gap between ecological value and planning practice.

This finding is consistent with recent planning research emphasizing the need to integrate ES, GI, and nature-based solutions into spatial planning processes through spatially explicit decision-support frameworks (Lai and Zoppi, 2024).

The integration of economic valuation into GI planning offers several advantages. First, it provides a quantitative basis for prioritizing conservation actions, allowing decision-makers to identify areas where ES generate the greatest social benefits. Second, it strengthens the economic justification for incorporating environmental considerations into land-use planning, particularly in contexts where competing land uses—such as agriculture and urban expansion—create conflicts. Third, it facilitates the communication of environmental values to stakeholders, translating ecological functions into terms that are more readily understood within policy and planning frameworks.

The GIS-based prioritization developed in this study provides a practical mechanism for this integration. By identifying wetlands that simultaneously exhibit ecological relevance, connectivity potential, and strong social support for conservation, valuation results can be directly linked to planning actions such as conservation zoning, ecological corridor designation, restoration priorities, and GI development.

Another relevant contribution of this study lies in the identification of the main determinants of WTP. The strong influence of environmental awareness and perceived ecosystem benefits demonstrates that social perception plays a crucial role in shaping economic valuation. This finding is in line with previous research emphasizing the importance of knowledge and awareness in environmental decision-making processes (Johnston et al., 2017), (Bateman et al., 2011), (Maes et al., 2020), and (Vallecillo et al., 2019). It also highlights the need for complementary strategies—such as environmental education and stakeholder engagement—to support the implementation of planning policies based on ES.

Policy recommendations and practical implications

The findings support several practical recommendations for territorial planning and environmental governance. First, ES valuation should be incorporated into municipal land-use planning in order to strengthen the recognition of wetlands as functional components of the landscape. Second, GI strategies should prioritize ecological connectivity between fragmented wetland ecosystems, particularly in agricultural areas affected by land-use intensification. Third, environmental awareness and stakeholder participation should be reinforced, given the positive association between awareness, perceived ecosystem benefits, and WTP. Finally, territorial planning instruments should include ES indicators to support conservation priorities, ecological corridor designation, and more resilient land management.

Despite these contributions, the study presents several limitations that should be acknowledged. First, although several procedures were adopted to mitigate contingent valuation biases, including a clearly described valuation scenario, anonymous responses, a payment-card format, pilot testing, and the separate treatment of zero and positive WTP responses, the possibility of hypothetical and strategic bias cannot be fully eliminated. The study did not include a follow-up certainty scale or ex-post calibration model, and therefore the WTP estimates should be interpreted as stated preferences rather than observed market behavior ([Hanemann, 1994](#)). Second, the spatial scale of the analysis may limit the generalizability of the results to other contexts with different socio-economic or environmental conditions. Although a GIS-based territorial screening and prioritization exercise was conducted, future research could strengthen the analysis through quantitative ES modeling and spatial simulation techniques capable of estimating service provision across different planning scenarios.

Future research should aim to address these limitations by combining economic valuation with advanced spatial analysis tools and by exploring alternative valuation methods, such as choice experiments or benefit transfer approaches. Additionally, further work is needed to operationalize the integration of ES into specific planning instruments, including land-use plans and environmental regulations, particularly within Mediterranean regions facing increasing environmental pressures.

The explanatory power of the regression model is also limited by the absence of variables related to institutional trust, policy awareness, and direct experience with environmental degradation. These factors may influence WTP and should be incorporated in future survey designs.

Overall, this study illustrates the potential contribution of ES valuation to territorial planning and GI strategies. Rather than demonstrating full institutional integration, the study provides an operational pathway through which valuation results can inform conservation zoning, buffer areas, ecological corridors, restoration priorities, and participatory governance mechanisms.

This finding is also consistent with more recent assessments of ES emphasizing their role in supporting sustainable development and policy integration ([Johnston et al., 2017](#)) ([Bateman et al., 2011](#)). Recent studies have emphasized the growing importance of spatially explicit ES assessments for supporting territorial planning and GI strategies ([Maes et al., 2020](#)) ([Angarita et al., 2025](#)).

Conclusions

This study shows that wetlands embedded within Mediterranean agricultural landscapes generate relevant social and economic value, particularly through regulating and cultural ES. The WTP results indicate that respondents recognize the importance of wetland conservation beyond direct market-based benefits.

The findings also reveal a mismatch between the perceived value of wetlands and their limited integration into territorial planning. This supports the need to incorporate ES valuation into land-use planning and GI strategies, especially in agricultural landscapes affected by fragmentation and competing land uses.

The main contribution of this study lies in the development of a planning-oriented framework that illustrates how ES valuation, GIS-based prioritization, and documentary planning analysis can jointly inform territorial planning and GI strategies. While the direct incorporation of valuation results into formal planning instruments requires further institutional and methodological development, the proposed approach provides a practical basis for improving environmental decision-making in Mediterranean agricultural landscapes.

The GIS-based prioritization exercise further contributes to identifying spatially explicit intervention areas that may support conservation zoning, ecological connectivity measures, and GI development.

Appendices

Appendix A. Survey Questionnaire

The questionnaire used in the survey is reproduced below. All respondents completed the questionnaire anonymously after providing informed consent (Table [7](#)).

Section	Question / Item	Response Format
A. Socio-demographic information	Age	Open response
A. Socio-demographic information	Gender	Male / Female / Other / Prefer not to say
A. Socio-demographic information	Highest educational level	Primary / Secondary / Vocational / University / Postgraduate
A. Socio-demographic information	Monthly household income	Less than €1,000 / €1,000–€1,500 / €1,501–€2,000 / €2,001–€3,000 / More than €3,000 / Prefer not to answer
B1. Environmental awareness	I am aware of the environmental importance of wetlands	Likert scale (1 = strongly disagree; 5 = strongly agree)
B1. Environmental awareness	Wetlands should be better integrated into territorial planning	Likert scale (1–5)
B2. Perceived ecosystem benefits	Wetlands contribute to biodiversity conservation	Likert scale (1–5)
B2. Perceived ecosystem benefits	Wetlands help regulate water flows and reduce flood risk	Likert scale (1–5)
B2. Perceived ecosystem benefits	Wetlands contribute to landscape quality and local identity	Likert scale (1–5)
C. Use and relationship with wetlands	How often do you visit wetland areas?	Never / Once a year / Several times a year / Monthly / Weekly
C. Use and relationship with wetlands	Main reason for visiting wetlands	Recreation / Education / Landscape enjoyment / Professional reasons / I do not visit them
D. Contingent valuation scenario	Suppose that a conservation program were created to improve wetland protection, ecological connectivity, water regulation, and public access. Would you be willing to contribute financially to this program?	Yes / No
D. Contingent valuation scenario	If yes, what annual amount would you be willing to pay?	€15–30 / €31–50 / €51–75 / €76–100 / €101–150 / €151–180

D. Contingent valuation scenario	If no, what is the main reason?	Cannot afford it / Do not trust fund management / Do not consider it necessary / Public administration should pay / Other
----------------------------------	---------------------------------	---

TABLE 7: Survey questionnaire structure and response format

Source: Author’s own elaboration

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Data Availability Statements

The datasets (and/or code) supporting this study are available from the corresponding author upon reasonable request.

Acknowledgements

Ethics Statement Ethics approval was not required because the study was based on an anonymous, non-interventional survey of adult participants and did not collect personally identifiable or sensitive information. All participants provided informed consent prior to participation.

References

1. Agencia Estatal de Meteorología: [Climate Data and Climate Normals for Andalusia](#). 2023,

2. Angarita H, Goldstein J, Mandle L, et al.: [Advancing Ecosystem Accounting for Financing Protected Areas in Colombia: Final Report](#). Callau V, Kimbrell E, Llaguno D, et al. (ed): Colombia; 2025. [10.18235/0013736](#)

3. Bateman IJ, Mace GM, Fezzi C, Atkinson G, Turner K: [Economic analysis for ecosystem service assessments](#). Environmental and Resource Economics. 2011, 48:177-218. [10.1007/s10640-010-9418-x](#)

4. Benedict MA: [Green Infrastructure: Linking Landscapes and Communities](#). Island Press, Washington, DC; 2006.

5. Cochran WG: [Sampling Techniques \(3rd edn\)](#). Wiley, New York; 1977.

6. Costanza R, De Groot R, Sutton P, et al.: [Changes in the global value of ecosystem services](#). Global Environmental Change. 2014, 26:152-158. [10.1016/j.gloenvcha.2014.04.002](#)

7. Daily GC, Polasky S, Goldstein J, et al.: [Ecosystem services in decision making: time to deliver](#). Frontiers in Ecology and the Environment. 2009, 7:21-28. [10.1890/080025](#)

8. De Groot RS, Alkemade R, Braat L, Hein L, Willemsen L: [Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making](#). Ecological Complexity. 2010, 7:260-272. [10.1016/j.ecocom.2009.10.006](#)

9. Díaz S, Settele J, Brondízio ES, et al.: [Pervasive human-driven decline of life on Earth points to the need for transformative change](#). Science. 2019, 366:10.1126/science.aax3100
10. European Commission: [EU Biodiversity Strategy for 2030: Bringing Nature Back into Our Lives](#). European Commission, Brussels; 2021. https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en.
11. Geneletti D: [A conceptual approach to integrate ecosystem services in environmental impact assessment](#). Journal of Environmental Assessment Policy and Management. 2015, 17:1550035. 10.1142/s1464333215500350
12. Haines-Young R, Potschin-Young MB: [Revision of the Common International Classification for Ecosystem Services \(CICES V5.1\): A Policy Brief](#). One Ecosystem. 2018, 3:e27108. 10.3897/oneeco.3.e27108
13. Hanemann WM: [Valuing the environment through contingent valuation](#). Journal of Economic Perspectives. 1994, 8:19-43. 10.1257/jep.8.4.19
14. Instituto de Estadística y Cartografía de Andalucía: [Statistical and Territorial Information of Andalusia](#). 2024,
15. IPBES: [Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services](#). IPBES secretaria, Bonn, Germany; 2019.
16. IPBES: [Methodological assessment regarding the diverse conceptualization of multiple values of nature and its benefits, including biodiversity and ecosystem functions and services](#). Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany; 2022. <https://www.ipbes.net/the-values-assessment>.
17. Johnston RJ, Boyle KJ, Adamowicz WV, et al.: [Contemporary guidance for stated preference studies](#). Journal of the Association of Environmental and Resource Economists. 2017, 4:319-405. 10.1086/691697
18. Junta de Andalucía: [Environmental Information Network of Andalusia \(REDIAM\)](#). Regional Government of Andalusia. 2026,
19. Kong S, Mohamad WNW, Rosland A, Lee Y: [Valuating wetland ecosystem services based on the discrete choice experiments: A systematic review and meta-analysis](#). Environment and Ecology Research. 2025, 13:151-164. 10.13189/eer.2025.130114
20. Lai S, Zoppi C: [Sustainable spatial planning based on ecosystem services, green infrastructure and nature-based solutions](#). Sustainability. 2024, 16:2591. 10.3390/su16062591
21. Liqueste C, Kleeschulte S, Dige G, Maes J, Grizzetti B, Olah B, Zulian G: [Mapping green infrastructure based on ecosystem services and ecological networks: A Pan-European case study](#). Environmental Science & Policy. 2015, 54:268-280. 10.1016/j.envsci.2015.07.009
22. Maes J, Teller A, Erhard M, et al.: [Mapping and Assessment of Ecosystems and their Services: An EU Ecosystem Assessment](#). Publications Office of the European Union, Luxembourg; 2020.
23. Millennium Ecosystem Assessment: [Ecosystems and Human Well-being: Synthesis](#). Island Press, Washington, DC; 2005.
24. Mitsch WJ, Gosselink JG: [Wetlands \(5th edn\)](#). Wiley, Hoboken; 2015.
25. Ramsar Convention Secretariat: [Global Wetland Outlook: Special Edition 2021](#). Ramsar Convention Secretariat, Gland, Switzerland; 2021.
26. Vallecillo S, La Notte A, Zulian G, Ferrini S, Maes J: [Ecosystem services accounts: valuing the actual flow of nature-based recreation from ecosystems to people](#). Ecosystem Services. 2019, 392:196-211.
27. Vega-Pozuelo R, Garzón-García R: [Landscape management and wetland protection in agricultural environments: Insights from the European Landscape Convention in the Baetic countrysides](#). Journal of European Landscapes. 2025, 6:176-200. 10.5117/jel2025.3.009.vega