Assessing the Value of Cultural Landscapes Through the Integration of Biophysical-Economic Valuation, Risk Assessment and Cost-Benefit Analysis

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Abstract. This contribution is a part of an ongoing research work that aims to increase the resilience of cultural landscapes through the development of an integrated method, to safeguard, valorise, and manage cultural landscapes, with benefits on the mobilization of resources, on the participatory process, on the co-design of solutions. The paper aims to explore how ecosystem services and economic valuation can integrate risk assessment of cultural landscape. Two literature reviews are made on the state of the art of Ecosystem Services Approach and Cost-Benefit Analysis to assess the biophysical-economic value of cultural landscapes, mostly in relation with the climate-related hazards and socio-demographic vulnerabilities. The main findings are considered to develop an integrated assessment method, where Ecosystem Services framework will be adapted and integrated within the Risk Assessment, while interacting with the Cost-Benefit Analysis to estimate benefits from measures of conservation and restoration and also costs of adaptation and avoided damage cost. This research work can aid environmental engineers and urban planners to integrate biophysical and economic valuations with landscape conservation and disaster risk reduction. The method can also be addressed to public bodies to better understand the complexity of cultural landscape value and to be informed on potential implications for damages or losses caused by natural hazards.

Keywords: Ecosystem Services Approach · Cost-Benefit Analysis · Risk Assessment · Cultural landscape

1 Introduction

In a context of climate and societal increasing challenges, taking planning decisions is becoming more and more demanding, concurrently with the complexity of decision-making process and the fragility of urban and territorial systems. This is even truer at landscape level, where diverse government levels and planning competencies intersect and overlap, making the decision-making process even more scattered and fragmented.

The European Landscape Convention (ELC 2000) defines the entire landscape as the result of the combination of human and environmental rules. Cultural landscapes (CL),

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which are dealt with this contribution, are famous for representing this union (Pannel 2006), where culture acts as the agent, whereas nature acts as the instrument (Sauer 1925). UNESCO WHC Convention (1992) defined CL, on the one hand, as a site where specific land use techniques contribute to preserve and valorise its biological diversity, and on the other hand, a site as reflection of traditions, beliefs and art of communities connected with nature. CL is labelled as extraordinary when the relationships with the environment and humankind are recognizable and unique (Cassatella and Peano 2010). Its Outstanding Universal Value (OUV) belongs to all communities of the world so that must be preserved for both present and next generations. The non-extraordinary CL have similar characteristics but not enough to be included in humanity's heritage.

Regardless of this classification, all CL express a complex value (i.e. aesthetic, social, cultural, and economic) shaped by local communities for centuries. Compared to the individual cultural good or environmental asset, they encompass the system in which they occur, the relationships with local communities, and the environment. The values they convey continuously evolve over time and mark the intangible sphere of cultural heritage (Wijesuriya et al. 2013). To better explain the complex relations between humans, societal and cultural components with the ecological and environmental dynamics in a CL, we will refer here to the framework of Socio-Ecological Systems (SES) that are defined as complex systems that result from social and ecological forces and factors (Peng et al. 2023).

With rising concerns about climate change impacts, the need for preserving, valorising, and managing CL's value by contrasting natural hazards (e.g. coastal erosion, floods, or fires) and human-induced hazards (e.g. land use change, conflicts, vandalism, tourism pressure, or community abandonment) and by adapting to climate change has become a priority goal (Mitchell et al. 2015).

The concepts of resilience and Ecosystem Services (ES) are relevant pillars to achieve this goal.

Resilience as the capability of a SES to respond, adapt and transform itself across different time and spatial levels (Holling 1996, Gunderson and Holling 2001) has only recently being taken into account for CL's and territorial issues (Brunetta et al. 2019; Assumma et al. 2021; Coscia and Voghera 2023; Aimar 2024). Incorporating resilience "as outcome and as process" (Cutter 2016) within assessment framework can improve the knowledge on resilience in suburban and rural areas, thus increasing the preparedness of Decision Makers (DMs) to damages or losses to the value's components (i.e. cultural, economic, and social).

The Ecosystem Services (ESs) framework and the biophysical-economic valuation are approaches that have triggered relevant results over time in the field of environmental and social sciences for assessing environmental systems. More recently, they have also been employed to support urban and territorial planning issues for example within strategic environmental assessment procedures (Salata et al. 2017; Assumma et al. 2022, Quagliolo et al. 2023).

Integrated assessment frameworks for decision-aiding are needed, on the one hand, to understand and evaluate CL's value, its vulnerabilities, and on the other hand to favour a strengthening of CL's coping capacity through policies and measures. Moreover,

these frameworks must consider more and more the potential effect of instabilities in rescheduling time and financial flows of these interventions.

Public bodies need integrated assessment tools that are intuitive to employ, flexible, and replicable at various phases of the assessment and planning processes, as well as to monitor medium- and long-term impact of measures. Indeed, understanding the potential impacts of climate change over CL and their ES, together with the changing values of those ES in the future, may support the development of preventive actions and the proper definition of Cost-Benefit Analysis (CBA) would allow them to properly plan the actions throughout the time. Private sector is increasingly responsible for integrating environmental and climate change issues together financial affordability into their transformation projects. In fact, the investment on green bonds (e.g. IT BTP Greens, Green Climate Fund, Green transition fund, ESG funds) allow them to raise their capital (UNFCCC 2010; CDP Venture Capital 2022). Since these policies are gradually being defined, European Commission is progressively stimulating both private and public sectors to work together on financing adaptation (EC 2021). These assumptions could also have positive implications in a wider context of CLs enhancement.

In light of this context, it is possible to state that assessment techniques and tools to understand climate hazards and their potential impact over CL and ES naturally evolves to assist DMs and stakeholders according to desiderata and rules (Moroni and Lami 2020; Moroni 2020) and can combine results into interdisciplinary or transdisciplinary outcomes.

In this light, the main aim of this paper to explore the possibility of developing an integrated framework for the assessment of biophysical and economic valuation of cultural landscapes under climate related risk. To do this, this paper develops a literature to design the methodological proposal. On the one hand, the biophysical and cultural assessment of Ecosystem Services and its relations with Risk Assessment models are explored to understand and evaluate their matureness consideration into CL resilience assessment. On the other hand, the CBA integrates both InVEST modelling's and Risk assessment's models by considering costs and environmental and social benefits of a measure (t_1) and the state of the art (t_0), to preserve and increase CL's value and its resilience.

The contribution is subdivided into four sections: Sect. 2 describes the methodology; Sect. 3 presents two literature reviews, the first on Ecosystem Services with Risk Assessment and the second on CBA; Sect. 4 clarifies how the integrated assessment methodology is intended to be developed.

2 Methodology

Two parallel literature reviews are developed to explore what has been done so far for the biophysical and economic assessment of cultural landscapes and in relation to risk assessment, with the purpose of selecting those aspects of the two methodologies that may be particularly effective in responding to a specific assessment problem, namely that of linking biophysical and economic aspects within the assessment of CL's value and its resilience. This will allow us to identify interlinkages for the methodological proposal in the discussion phase.

Both literature analyses were developed by accessing the Scopus database in the reference period 2001–2024 and by considering results mainly in English.

2.1 Literature Review on Ecosystem Services Approach with Risk Assessment

The review started looking for the keywords search in Scopus, departing from 2001, the year when the Millennium Ecosystem Assessment was published, to the beginning of 2024. The initial search included: "Ecosystem Services" AND "Risk Assessment" and Cultural Landscape". This first search reported just 5 results; thus, the search was reformulated using only Ecosystem Services" AND "Risk Assessment".

The literature search gave back 56 results that included scientific papers and one chapter book that was excluded from the first screening process since no abstract nor the full text was available. The remaining 55 papers were screened through the reading of the abstracts. Three of them were excluded because abstracts were not available in English, and relevant papers to be read in full were selected according with the main objectives of this work: papers needed to address the integration of Ecosystem Services into cultural landscape climate-related risk assessment. Most of the papers excluded (N28) were considering the integration of ecosystem services as possible indicators into ecological/chemical risk assessment, while an important number of papers was looking at ES integration into non-climate-related risk assessment (N19). In this case most of the papers looked at past, present and potential future land use change as the main hazard into ES assessment and considered urban areas as their referenced case studies.

The remaining articles (N5) were read in full, and they were analysed looking at the following: climate-related hazard considered (according to the latest IPCC report); location of the case study, if any and methods and tools used for the assessment.

2.2 Economic Evaluation for Resilient Cultural Landscapes

The assessment of CL's economic value considers those techniques belonging to the branch of economic evaluation of public goods. The Total Economic Value (TEV) is a paradigm widely recognised by economist today for estimating the economic value of environmental goods and services such as of cultural heritage and landscape (Pearce and Turner 1991; Adamowicz et al. 1994; Pascual et al. 2010; van der Heide and Heijman 2013; Tagliafierro et al. 2016).

CL are pure public goods that produce externalities, since they can provide multiple benefits to local communities (e.g. psycho-physical well-being, or sense of identity and of belonging, among others) even if this means being exposed to potential damages and land degradation. CL's economic value cannot be dominated by market rules as for private goods. Indeed, the co-presence of non-competitivity and non-excludability from market implies the construction of a hypothetical market in which CL' economic value can be estimated. TEV summarizes the following types of use: (i) Direct use value which is derived from the tangible use of primary resources and/or the services they can produce. This value in turn can be distinguished into primary use (e.g. getting wood from a forest) and secondary use (e.g. using water from a spring near a house property); (ii) Indirect use, which refers to the future and potential use of the good and/or service. This value is further classified into optional use value (e.g. benefits from wildlife and

habitats), bequest value (e.g. local heritage value, or sites in danger), and existence value (e.g. protected areas and animal and plant species).

TEV of cultural landscape can be assessed by employing economic evaluation methods, which can be classified into two groups (Pearce and Turner 1991).

Non-monetary methods employ sets of indicators to calculate cultural heritage and landscape's value at the state of the art or at potential state (t_0 - t_1) by aggregating its multidimensional components (e.g. cultural, economic, or social) and sub-components (e.g. cultural indicators, economic indicators, and so on) into a composite and synthetic index [0, 1]. Composite index valuation can aggregate both qualitative and quantitative data obtained for example from statistical and geo-catalog sources, or surveys (Jesinghaus 2000; van der Heide and Heijman 2013; Tagliafierro et al. 2016). It may be supported for example by Multicriteria Decision Analysis/Making (MCDA/M) to organize the decision problem into simpler elements or to explore interdependencies between the same elements, with the purpose of ranking, sorting, choosing, or describing alternative scenarios. These techniques are retained suitable to integrate dynamic Problem Structuring Methods (PSM) since it can encourage an iterative process between value focused thinking and alternative focused thinking (Corner et al. 2001; Ehrgott et al. 2010). In relation to cultural landscape, this integration could ascertain the relevance of indicators through the involvement of multidisciplinary panels of specialists and with the opportunity to favour the participation of local actors and stakeholders.

Monetary methods can estimate the economic-financial value generated by cultural heritage or landscape, as well as the cost for its preservation, damages, or loss (Price 2013). CL's economic value can be estimated on stated preferences of local communities/tourists through the Willingness to Pay (WTP) to use a CL, or the Willingness to Accept (WTA) a compensation due to CL value's damages/losses. Conjoint Valuation Method (CVM) can estimate WTP using sets of attributes (e.g. olive groves extent, transport accessibility, panoramic view, landscape eyesores, or cost, among others). The revealed preferences can consider the Hedonic Pricing Method (HPM) to explore the effects CL's attributes on the pricing of real estate properties. The Travel Costs Method (TCM) can capture the costs incurred by tourists to use that cultural asset or landscape (La Riccia 2023). However, the application of one of these techniques cannot solely determine the economic-social affordability of a transformation in a cultural landscape. It is necessary to integrate CL's value as WTP/WTA within a Cost-Benefit Analysis (CBA) thus completing the economic evaluation framework.

When the assessment of CL's value is required due to a transformation with DMs' recommendation to adapt to climate-change and specific risks, natural and/or anthropic, or even to a black swan, the integration of biophysical and economic outputs in relation to the function of the risk, becomes of crucial relevance such as for public bodies, in the design and planning of winning measures, or for academics and freelances an opportunity to operationalise interdisciplinary and transdisciplinary approaches to CL's resilience (Fig. 1).

2.2.1 Literature Review on Cost-Benefit Analysis for Cultural Landscapes

To explore the role played by economic valuation in determining CL's value, an investigation on Scopus'database was performed on the most suitable valuation approaches for

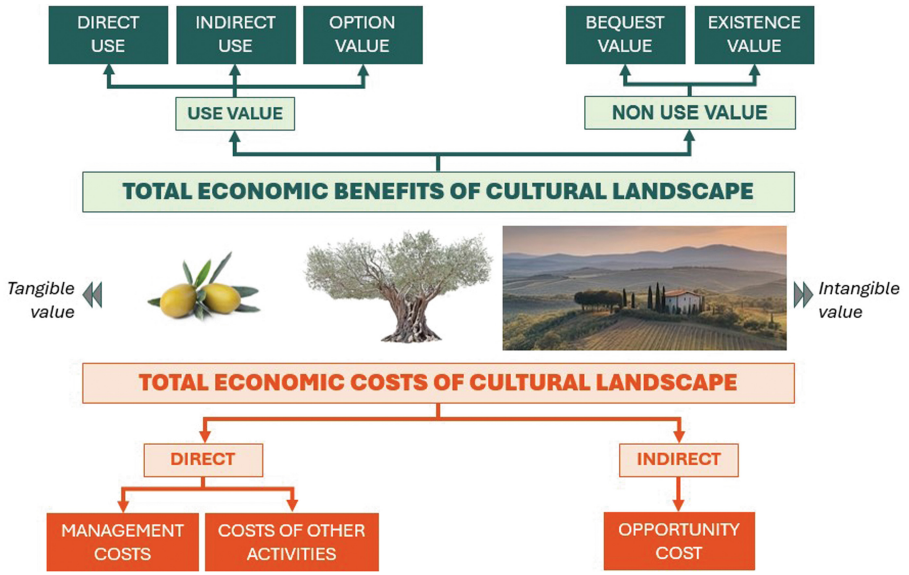


Fig. 1. TEV paradigm between CL's costs and benefits (Adapted from Baig et al. 2007)

decision-aiding and regarding conservation, valorisation, and management procedures in risk and climate change scenarios.

After analysing each query result, the findings were sorted according to consistency classes (i.e. low, medium, and good) following the paper's goal. (i) Low consistency refers to those studies that identify measures without providing the way or the assessment methods that helped the authors to identify them; (ii) Medium consistency refers to reviews or studies that employ assessment methods (not economic); (iii) Good consistency means that reviews or studies consider economic valuation techniques.

The first query considered the keywords "cultural landscape" and "economic value" to investigate the role of economic evaluation with respect to environmental or social assessments, thus giving back 39 results.

Subsequently, the query included the keyword "risk". This returned only three results, only one of which has a medium consistency (Bernués et al. 2014), since it employed a Choice Experiment model (CE) to estimate the WTP to preserve ESs from fire risk in mountain agrosystems, where CL is considered as one of the evaluation model's attributes.

The keyword "risk" was then substituted with "resilience" obtaining 11 results, of which five with a medium consistency. The query's term "economic value" was substituted by "cost-benefit" considering the main goal of employing CBA as part of the methodological proposal. This produced ten results of which three with a medium consistency and four with a good consistency.

A subsequent query considered the integration potential with "cultural landscape" AND "cost-benefit analysis" AND "ecosystem services", thus giving back five results of which two with a good consistency and one mediumly consistent. The searching was concluded with a last query "cultural landscape" AND "cost-benefit analysis" AND

"ecosystem services" AND "risk" which gave back no results. However, no duplicates were found. The results are discussed in detail in Sect. 3.

3 Discussion of the Results

From a research perspective, this analysis assisted the authors in determining the way in which economic valuation, biophysical valuation, and risk assessment can be methodologically and operationally integrated. This will enable the authors to develop an integrated assessment framework that will take into account various types of CLs and be replicated on a European scale. The following subsections discuss the findings of the two literature reviews.

3.1 The Literature Review on Ecosystem Services and Risk Assessment

As detailed in the methodological section, five papers were reviewed having a in depth analysis of the climate related hazard they considered, the method and tools used for the risk assessment analysis and the location of the case studies.

Among the identified relevant articles, four of them considered a multi-hazard evaluation, looking simultaneously at hydrometeorological hazard, temperature and drought and, in some cases, non-climate related hazard as land use change. One paper (Vigna et al. 2024) looked explicitly at the integration of Cultural Ecosystem Services (CES) into wildfire risk assessment.

The case studies covered river deltas (Peng et al. 2023 and 2024) in China, coastal habitats (Barausse et al. 2022) in the North of Italy and in the Atlantic coastal region (Caro et al. 2020), eight small municipalities in the Alpine landscape (Vigna et al. 2024).

Going deeper into the contributions, Peng et al. 2023, performed a systematic literature review of ES integration into risk assessment considering a multi-hazards perspective over coastal deltas as SES. The literature review is comprehensive for coastal deltas assessment, but there are no references to other types of landscape. Nevertheless, this work led (Peng et al. 2024) to propose a systematic and operation integration of ES into risk assessment frameworks for river deltas. Indeed, according to the authors, despite adopting a social-ecological and multi-hazard perspective, previous risk assessments failed to achieve balanced consideration of both social and ecological sub-systems.

The adapted framework proposed and further tested in the case of the Pearl River and Yangtze Delta in China integrates various risk components (Risk = Hazard × Exposure × Vulnerability) from the spatial perspective of the SES and it was applied to four main types of hazard: namely hydrological, meteorological, climatological and mixed (salinity). Peng et al. (2024) used a spatial approach through GIS and a series of indicators that responded to the different risk categories, further weighting them and proposing a composite and risk index. ESs specifically have been integrated within the vulnerability assessment, considering provisioning, cultural, and regulating services as modular independent indicators.

The paper from (Barausse et al. 2022) proposed a novel methodological approach to perform climate risk assessment in Natura 2000 sites integrating the standard of ISO 14090 in combination with the theoretical framework of ecosystem services assessment

and local stakeholder participation. The approach is interesting and mainly looked at the identification of climate-related issues for local protected habitats. Even though the idea of integrating an ISO standard with ES results promising, the implementation of such approach should be tested beyond Natura 2000 sites, further integrating cultural aspects into the evaluation. In this contribution the biophysical evaluation was mainly performed using qualitative impact chain analysis.

Caro et al. (2020) looked at the vulnerability of coastal ecosystems with specific regard to sea level change and organic enrichment of water. To establish a relationship between potential final risk and ecosystem service supply, Caro et al. (2020) proposed to consider ecosystem services' abundance as a resilience descriptor further integrating them into the habitat risk assessment (HRA) model from the InVEST tool. Similarly to Peng et al. (2024), the authors assigning different weights to provisioning, regulation, and cultural services.

Moving deeper into CES, Vigna et al. (2024) argue that conventional assessments of wildfire risks often overlook the potential loss of ecosystem services, particularly cultural ones (CES). This study presents a methodology for integrating CES into wildfire risk assessment, combining expert CES participatory mapping with standard procedures based on fire hazard and vulnerability modelling (Vigna et al. 2024).

As well as in other discussed contributions, the ES information was integrated into the vulnerability assessment contributing to develop five classes of vulnerability (i.e. very low, low, medium, high, and very high vulnerability).

3.2 The Literature Review on Economic Evaluation Methods

The papers were examined in full and from the perspective of consistency with respect to the authors' goal, and this has implied a further reduction of the results. Using the term "cultural landscape" instead of "landscape" in our searching has limited the scope of the literature search. The most common references are to mountainous, agro-forestry, wetland landscapes, agropastoral drylands, peatland and moorland. A considerable number of studies aimed to gather solutions to contrast at specific risks (e.g. wildfire, see Moore 2019) and provided a framework that can be potentially addressed to less developed countries. Most of CLs dealt with these studies is limited to some CL's types, they do not consider a multi-hazard perspective or rather the concurrence of multiple extreme events (i.e. black swan). Moreover, these studies propose the employability of approaches and related solutions to preserve and manage extraordinary landscapes rather than ordinary. Their distribution is unbalanced between the countries of the Great North, represented mainly by USA and UK, and the countries of the Great South that collect the highest number of studies.

The results of the first query showed an asymmetrical distribution ("cultural landscape" AND "economic value"), which attempted to explore the scientific focus on economic value in comparison to the other value's dimensions of cultural landscape (39 results versus 48 and 269 findings, respectively). The number of results can also be attributed to the fact that, with respect to the research on the other two dimensions started in the mid-80s (i.e. environmental and social), CL's economic value only begun to be investigated in the mid-90s.

Mangels et al. (2017) identified relevant effects of land use on species richness and diversity by calculating a Land Use Intensity index (LUI) and using both ANOVA and ANCOVA to explore the relationships between land-use niche and species traits.

Reang et al. (2022) dealt with agrosystems and evaluated biodiversity and aesthetic values of landscapes and the economic value for farmers through indices.

Moore et al. (2019) defined an integrated fire management framework and recognised that damage and loss assessment (e.g. suppression costs and opportunity costs) could have implications for wildland fire prioritization and investment. These results demonstrated this type of approach is still limited and lacks of a comprehensive approach to integrated assessment.

The query that included "cost-benefit" keyword and that produced ten results of which three with a medium consistency and four with a good consistency are discussed below, respectively.

Wersebeckmann et al. (2022) tackled the issue of revegetation of vineyard terrace embankments to reduce erosion risk and satisfy biodiversity conservation demand at the best cost-benefit ratio for winegrowers.

Karanth and Nepal (2012) compared the results on a survey and interviews led in India and in Nepal on the communities' perception of benefits generated by protected areas and on their potential loss.

Wolsko and Marino (2016) discussed that the current uses of CBA and disaster-climate-change studies cannot sufficiently provide sets of solutions without considering the issue of long-term psychological well-being and cultural integrity of communities who survived to "habitual" disasters or be forced to migrate/abandon their places.

Enengel et al. (2011) focused on transactional costs of decision-making and on costs of implementation. They developed an integrated analytical framework to obtain individual efforts (i.e. time and money), benefits, and risks of participants in landscape co-management processes.

Newton et al. (2012) developed a multi-phase approach which consisted of (i) the economic valuation of ESs' for a set of restoration scenarios; (ii) the assessment of costs for restoration of each habitat type (i.e. cost of habitat establishment, annual maintenance costs, marginal cost); estimation of net benefits as Marginal changes in the Value of Benefits (MVB) and Marginal changes in the Value of Costs (MVC) by subtracting the total value of each benefit of each scenario from the total value of each benefit of each restoration scenarios; (iv) CBA to calculate Cost-Benefit Ratio (CBR) for two costs options; (v) assumption of the discount rate; (vi) assessment of biodiversity value; (vii) Multicriteria Spatial Decision Support System (MC-SDSS) to rank the restoration scenarios by considering both market and non-market values.

Rickards and Howden (2012) conceptualised the characteristics of transformational adaptation to climate-change in agriculture sector at the farm and regional scales and focused on five types of costs: (i) transaction costs, (ii) opportunity costs, (iii) cost of relevance to CC adaptation, (iv) cost of incomplete adaptation and (v) cost-efficiency. Mueller et al. (2019) employed Choice Experiment (CE) to assess the value of groundwater recharge for watershed restoration in semi-arid landscapes and then estimated WTP through a Bayesian mixed Logit model. This model allowed to estimate the monetary value of environmental benefits once being imported within CBA.

Nuno and Morales (2020) used a mixed model founded on Linear Mixed Model (LMM) and CBA by taking into account the potential ecosystem service trade-offs resulting from the implementation of agri-environmental measures.

Dorresteijn et al. (2017) recognised the ability of CL to provide cultural ESs to poor local communities by developing a survey on the potential services-disservices on specific ESs. They used a linear model that included location and socio-economic characteristics of local communities, each one associated to one of the following profiles: "high costs/low benefits", "low benefits/low costs", and "high benefits, high costs". That study demonstrated that services and disservices must be disaggregated for a more sustainable management of CL rather than spreading costs and benefits homogeneously to local community.

Davies et al. (2016) investigated the relationships and trade-offs in peatland fire management through the estimation of costs and benefits from the managed fire.

4 Conclusions

The strengths and limits founded in these studies will lead to the design of the integrated assessment framework. As shown in the figure below, this proposal can support both the assessment and planning processes along the ex-ante, in-itinere, and ex-post phases.

A preliminary phase will set the context through the development of sectorial analyses, from the recognition of ecosystem services and disservices to the characterisation of individual risk components, until to the exploration of communities' perception on CL's value and on its potential enhancement or compromission. This phase will be employed in relation to individual hazards and/or to multi-hazards. The choice could influence the complexity of the remaining structure of the integrated assessment framework.

The core phase aims to compare the suitability of sets of alternative options between CL's present conditions (e.g. BAU-Business as Usual scenario) and other potential states. Concerning the integration of ES biophysical values into climate risk assessment of cultural landscape, few publications proposed an operational framework to navigate this complex field. Most of them proposed to integrated ES evaluation into the vulnerability risk components, using, in most of the cases, either qualitative or quantitative weighted systems. GIS, INVEST and similar biophysical and spatial approaches have been used, acknowledging the fact that maps may be considered a powerful instrument to support DMs in this field. Multi-hazards approach is starting to raise, allowing for the evaluation of ES multiple benefits simultaneously. Despite the potential support of ES into climate adaptation and enhanced resilience, the review around this topic still highlights the need for further research.

This is needed to support DMs and planners in better shaping future responses (Vignoli et al. 2021) The ESs outputs will be imported within the risk assessment to act positively on a potential risk reduction. Indeed, the modification of biophysical ecosystem services expressed in monetary units can be better taken into account within risk assessment. Parallelly, CBA will evaluate the socio-economic and environmental affordability of the sets of scenarios by calculating the main economic-financial indices (i.e. NPV, IRR and CBR) and then concluding with a "What-if scenario" analysis on the risk of investment. The CBA outputs will integrate the benefits produced by ESs to refine

eventually the measures considered in the ongoing evaluation and planning phases. Both biophysical and economic-financial outputs will be matched within a matrixial environment to evaluate causes and potential environmental, economic, and social implications. Subsequently, it will be possible to determine the risk acceptability of each transformation scenario. For example, alternative options could refer to transformation scenarios of expansion of given interventions and to their effects on ES and on CL (Caprioli et al. 2021; Assumma et al. 2022; Quagliolo et al. 2022), as well as mitigation actions and/or compensation models for land take reduction (Anelli and Tajani 2022).The scenario retained as the most suitable in biophysical, economic-financial and risk terms can be communicated to actors and stakeholders actively involved into the process and thus moving on risk management and/or overcoming (Torrieri and Rossitti 2020).

A last phase will complete the integrated assessment framework once the measure under evaluation will be implemented effectively. In this sense, a set of Key Performance Indicators (KPI) that derives from the previous analyses and from the relevant literature will monitor the achievement of the objectives, to verify the control of standards and to check the effective implementation of the considered policies. This phase, as it happens in real procedures of strategic environmental impact assessment will be performed periodically and beyond the implementation of the project (Fig. 2).

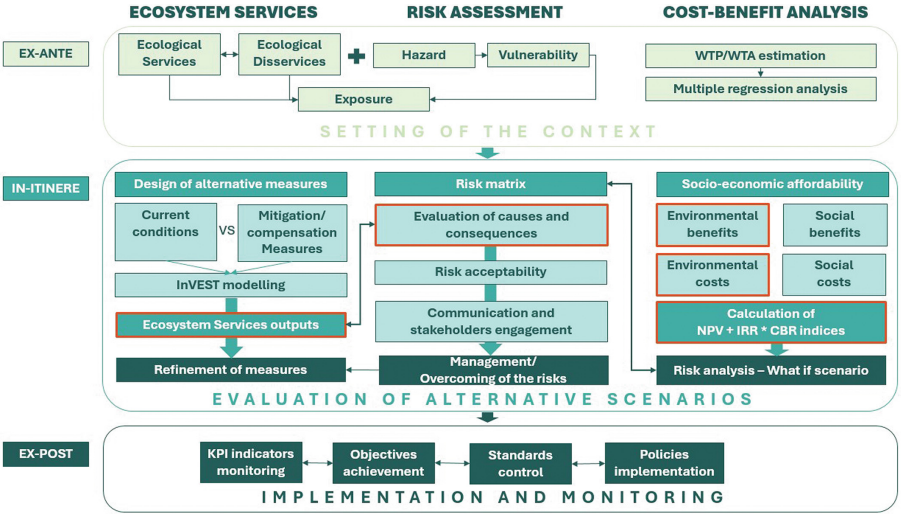


Fig. 2. Design of the preliminary integrated assessment framework

From a research point of view, this analysis supported the authors in determining economic valuation, biophysical valuation, and risk assessment can methodologically and operationally be integrated. This has enabled the authors to define a preliminary integrated framework that can consider the diversity of coastal cultural landscapes and be replicable on a European level.

Both the literature reviews aimed to bridge the current demand of public bodies, urban planners, architects, and engineers' freelancers to employ evaluation techniques and tools capable to provide dynamic results, by considering sets of alternative options, economic feasibility for competitive and buildable projects, while being evaluation techniques accessible to a broad spectrum of users, without renouncing their complexity. These findings will be included in a project's strategy with the purpose of strengthening the interlinkages between the disciplinary areas and thus favouring the preservation, enhancement, and management of the value of cultural landscapes under risk and uncertainty.

Many methodological difficulties are counted today in estimating the costs of adaptation, but the recognition of uncertainty is the most significant requirement to build robust and winning strategies, rather than conceiving it as an excuse for inaction (Watkiss et al. 2010).

A limitation detected at this step may be transformed as an opportunity for the future, that is the need for deepening the knowledge on recent transformation projects, or definite adaptation measures within the project's case studies and gathering data helpful to estimate the Net Present Value (NPV), the Cost-Benefit Ratio (CBR) and the Internal Rate of Return (IRR) through the comparison between the state of the art and sets of alternative transformation scenarios.

A survey will be conducted in a real case study to investigate CL's value perception, by estimating the Willingness to Pay (WTA) for CL enhancement and management and the Willingness to Accept (WTA) for damages caused by natural hazards or human-induced risks on CL. The employment of the Conjoint Valuation Method (CVM), or the Hedonic Price Method (HPM) will be fundamental for the WTP/WTA estimation and their integration within the CBA Analysis.

The next steps of this work are here provided. First, the authors will integrate Ecosystem Service Approach (ESA) with Risk Assessment (RA) and Cost-Benefit Analysis (CBA) by proving its feasibility in a real case study. This objective aims to test the methodologies in different coastal cultural landscapes. The comparison of results will give us the opportunity to consolidate this methodological integration for being replicated for both ordinary and extraordinary cultural landscapes. The methodological framework's usability will be investigated also in relation to the potential interlinkages with other disciplines such as history and conservation of cultural heritage and landscape, hydrogeology, sustainable planning and architecture and building production. The achievement of the mentioned steps will favor the potential consolidation of the integrated assessment framework within a multi-level interoperable platform.

Disclosure of Interests. None.

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