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Conservation of cultural heritage from the perspective of sustainability

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Abstract. In recent decades, in a scenario of instability given by resource constraints, environmental crises and climate change, there has been a paradigm shift requiring new, more sustainable models, also involving the field of cultural heritage conservation. A new approach, based on an overall and more comprehensive view of conservation processes, is required, which calls for a re-evaluation of intervention strategies taking into account the different conservation operations and their implications. To this end, many directions are being taken to apply sustainability principles to the environmental, economic and social aspects of cultural heritage conservation.
However, the absence of a recognised definition of sustainability in restoration interventions and the lack of systemic principles to refer to still leaves many questions open in the field of conservation. Considering the aspect related to restoration products, the absence of parameters often leads to the diffusion and misuse of the term 'sustainable' in an indistinct semantic boundary where terms referring to 'green' and 'sustainable' practices alternate, mainly involving the environmental dimension of sustainability in conservation practices.
Starting from a semantic review of sustainability, the study aims to provide an integrated analysis of possible sustainability parameters to be integrated into assessment tools for restoration interventions, with reference to environmental, economic and social aspects, and in consideration of the compatibility, durability and effectiveness aspects of conservation interventions.

Keywords: Conservation, Sustainability, Cultural Heritage.

1 introduction

The decades following the mid-twentieth century were crucial for the emergence of new issues in the international debate, progressively involving cultural heritage and its protection.

This was the period in which, due to the effects of industrial growth, urban expansion, and the worsening environmental conditions with the consequent alarms generated by pollution and climatic conditions, the debate around development and its limits made it possible for the concept of sustainability to be incorporated into the various environmental, economic and social spheres to assume a decisive position.

It is important to underline that in recent years, the reflections on the need for new paradigms and the commitment to respond to new demands in global terms were already addressed and made known on the occasion of some international meetings such as the *United Nations Conference on the Human Environment* in Stockholm (1972) [1], or even for the drafting of the *World Conservation Strategy* by the International Union for Conservation of Nature (IUCN) in cooperation with the World Wildlife Fund for Nature and the United Nations Environment Programme [2]. This second document is particularly interesting if we consider the attention paid for the first time to the relationship between conservation (of resources) and sustainable development – the latter expression already present in the title of the document – and observe the similarities in the comparison between the definition of "conservation" given in the *World Conservation Strategy* – "Conservation is defined here as the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. Thus, conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration, and enhancement of the natural environment. Living resource conservation is specifically concerned with plants, animals and microorganisms, and with those non-living elements of the environment on which they depend. Living

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resources have two important properties, the combination of which distinguishes them from non-living resources: they are renewable if conserved; and they are destructible if not" [3] – with the better-known concept of sustainable development, provided a few years later by the Brundtland Commission [4].

However, it should be noted that in the 1980 document [5], in order to ensure sustainable development, the pre-eminent attention was paid to ecological and environmental aspects, and only later the vision was extended to the economic and social dimensions [6, 7].

With the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992, the debate on sustainability and development was brought to the forefront of global politics and UNCED's Agenda 21 formalized the principles of sustainable development based on the need to renew resources faster than they are depleted [8], in fact taking up a concept already tackled in German sylviculture centuries earlier [9].

2 The value of sustainability in heritage conservation

In this context, sustainability has also become a fundamental requirement for architecture due to the high environmental impact and exploitation of natural resources attributed to the construction sector. Sustainability in the architectural field has therefore become synonymous with "green architecture" as an approach to architectural design based on the conscious use of resources, the use of non-polluting construction technologies and materials that are not dangerous for human health, on the prediction of the effects induced on the environment by the building throughout its life cycle, also in terms of origin, dismissibility and recycling of the materials used [10].

Only more recently, attention has been turned to cultural heritage, at first limited to improving the energy conditions of historic buildings, highlighting the advantages of preserving the existing heritage not only from the point of view of the intangible values linked to it, but also in environmental and economic terms [11].

Sustainability in the field of conservation has therefore required a new approach to restoration projects, understood as a complex process in which heritage care has been linked to environmental and social protection in the different spatial-temporal developments, underlining the need for a long-term vision [12].

This has led to the need for a re-evaluation of intervention strategies starting from decision-making, conservation management and planning processes up to individual conservation actions.

Only by considering individual conservation interventions can sustainability be pursued in different directions, including the definition of methodological approaches to reduce the risk of incompatibility of materials and treatments [13] and the use of procedures that are respectful of the environment and operators [14], through the selection and choice of materials for restoration [15] that respond to strategies aimed at ensuring adequate durability of conservation solutions and able to take into account a changing scenario such as climate change [16, 17].

3 A semantic revision. From sustainability to "green" language

In this context, the sequence of conservation operations usually carried out for the care of architectural artefacts increases its complexity. In addition to meeting the requirements of compatibility, efficacy and durability, the restoration materials and products used in the traditional sequence of cleaning, consolidation and protection operations [18] must meet new demands.

But, the absence of a recognized definition of sustainability in restoration interventions and the lack of systemic principles to refer to in order for an intervention to be considered sustainable leaves many questions open, starting with semantics. Examining the aspect related to restoration products, the absence of parameters often leads to the diffusion and improper use of the concept both in the scientific and commercial fields, in an indistinct semantic boundary that sees terms such as "bio", "bio-based" [19, 20], "green", "eco-compatible", "eco-friendly" [21, 22] or "sustainable", referring mainly to the environmental dimension of sustainability in conservation practices.

In fact, the value of sustainability in conservation operations is increasingly associated with practices or products linked to the term "green", as demonstrated by the expressions "green conservation", "green product" for the protection of cultural heritage.

But, as Yanarella, Levine and Lancaster [23] point out, the terms “green” and “sustainable”, although they are increasingly used interchangeably, do not have the same meaning and indeed have quite distinct references.

If the adjective “sustainable” is nowadays associated with all three pillars of sustainability, and therefore with the various environmental, economic and social aspects, the terms referring to “green” practices instead only cover the first dimension, which tends towards environmental and health improvement. And it was to this dimension that the expression “green chemistry” was born in the 1980s in response to environmental demonstrations and demands for environmental protection and safer living conditions [24, 25].

Sustainability requires an interaction of the components of the whole system, otherwise, “green” practices represent a single component that does not necessarily refer to a larger system [26].

The strategy involving sustainability therefore concerns a hierarchy of actions capable of maintaining a balance of the entire structure, which is not provided for in green terminology.

However, it should be noted that if the adjective “sustainable” runs the risk of a utopian dimension inherent in its definition and, at the same time, may result in a top-down request, the dissemination of the terms “green” may hide a misleading communication strategy that aims to declare itself committed to the low life-cycle environmental impact products and practices offered [27].

Friedman himself demonstrates in his book *Hot, flat, and crowded* that the use of terms belonging to the sphere of “green” is well accepted and practicable as it suggests quicker and easier to obtain solutions than the consideration of environmental, economic, social and cultural systems together to offer less unsustainable solutions [28].

The difference between the two fields emerges, in addition to a semantic divergence, also in the field of application, as William McDonough and Michael Braungart have demonstrated in *Cradle to Cradle: Remaking the Way We Make Things*. In fact, the concept of sustainability includes sustainable construction and production processes, which may contain green practices but not vice versa. The text shows that only in a broad system of production processes that require transformative approaches, in which not only the limits in terms of recycling are exceeded, but each product component is converted again safely, and without waste for the production of other components or products, sustainability is fully accomplished [29].

4 Tools for assessing the sustainability of restoration products

Behind one of the semantic innovations of universal scope, a series of contradictions emerges both in recent literature and in the operational field, bringing with them ambiguities and possible flexibilities of the term up to the absence of an unequivocal definition of the term “sustainable” in conservative practices.

In order to overcome this gap, the work carried out by international standardization bodies to develop standards is fundamental.

Among them, the European Committee for Standardization (CEN), which works for the standardization of bio-based products, points out, for example, how the prefix "bio" often appears in common language in terms such as "bioproduct", but without reference to clear definitions, some expressions can be misleading. The standard specifically indicates that «the term “biomass-based” or “bio-based” refers to the origin of the raw material. The prefix “bio” can refer to different functionalities (biodegradable, biocompatible, etc.) or processing (biological or biotechnological processes). In order to ensure transparent and non-misleading information [...], the prefix “bio” should be replaced by more accurate and informative equivalents and should refer to a European or international standard» [30].

But in particular, as the standard on sustainability criteria for bio-based products points out, «the bio-based content of a product does not provide information on its environmental impact or sustainability, which can be assessed through LCA and sustainability criteria» [31], the latter including environmental, social and economic aspects.

In Life Cycle Assessment (LCA) analysis [32, 33, 34], which allows to assess the environmental impacts of a product during the entire life cycle, there is certainly a valid approach for the study of all phases in an interdependent way. LCA is a fundamental tool for analysing the environmental impact of architectural artefacts and the materials used, and it is, in fact, the basis of certification schemes and environmental labels such as the Environmental Product Declaration (EPD), even if some limitations in the calculation method still emerge [35].

CEN itself has also established some sustainability parameters for the biological part of products, referable to

1. Environmental criteria (climate and air protection, conservation and protection of water resources, protection of soil quality and productivity, promotion of biodiversity, efficient use of energy and resources, waste management)
2. Social criteria (respect labour rights, land use and land use change, water use rights, promotion of local development)
3. Economic criteria (control of economic and financial aspects, including fraudulent, misleading or dishonest commercial practices) [36].

In this context, other organisations should also be mentioned, such as the European Chemicals Agency (ECHA) and the European Environment Agency (EEA), which are concerned with steering economic decisions towards improving environmental conditions by promoting standards for assessing the impact of chemicals and achieving the objectives of the European Green Deal.

In the European context, the two agencies have developed a specific framework of indicators to monitor the impacts of chemical pollution and steer production towards safe and sustainable chemicals [37].

Taking into consideration the various legislative and scientific references analyzed so far, the evaluation of a "sustainable" restoration product can therefore be said to be currently linked to various indicators relating, on the one hand certainly to safety for humans and the environment, i.e. the absence of toxicity of the products both for operators and for the environment, with a minimum environmental impact, of renewable origin and able to guarantee recyclability.

The assessment should also take into account social and socio-economic impacts, including local development, during the entire life cycle of the products.

It should also take into account production processes that are cost-effective and related to a circular economy, i.e. a regenerative production and consumption system where resources are preserved, and the production of waste is limited through different strategies. By involving the entire life cycle of products, a goal is reflected in the reduction of total materials consumption in order to keep them as far as possible in the cycles of use and to minimize, right from the design stage, the production of waste and pollutants [38].

However, the "sustainability" of a restoration product, in addition to the correspondence of the criteria referring to the production system and the life cycle, must be closely linked to the requirements of conservation, stability over time, compatibility, effectiveness and durability [39, 40].

In the comparative analysis between the restoration products, a quantitative evaluation should therefore be taken into consideration with regard to the time needed to obtain equal effectiveness of the treatment and also with respect to the extension of the surface itself to be treated and the operational choices of the restoration site, with consequent economic consequences [41].

Finally, with reference to the durability of a conservation intervention in the choice of a restoration product, considerations today cannot fail to take into account the data on the observed and expected impacts of climate change on cultural heritage, not only for the mitigation of impacts but also for the assessment of risks due to variations in climatic parameters and air pollution in relation to a specific conservation treatment, which must necessarily be monitored in the medium and long term [42].

5 Conclusions

Today, in order to establish the parameters through which a conservation intervention, and in particular a restoration product, can be said to be sustainable, it is first of all essential to revise the semantics of the terms in use in order to distinguish the different approaches and orientations, such as "green conservation" from "sustainable" practices in the field of conservation of existing heritage. Sustainability in restoration becomes a complex process that brings interdisciplinary and intersectoral assessments into the circuit, as well as spatiotemporal developments related to heritage care. If the evaluation of a product is expressed in the concrete interdependence of the actions of conservation, environmental protection, cost-effectiveness and social protection, the sustainability of a conservation intervention is inevitably linked to the specific and peculiar instances of conservation, and it is, therefore expressed in a solution of coexistence between the needs of today and those of the future, between the use of cultural heritage and its conservation.

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