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Geo-mining landscape, slow mobility and services in spatial regeneration

Abstract. The 'new' tourist demand, motivated also by the restrictions following the spread of the Covid-19 virus in recent years, requires institutions and different local actors to activate development processes by also integrating tourism activities. Slow tourism, properly supported by infrastructures for slow mobility, proves to be interesting territorial development strategies which can provide multiple environmental, social and economic benefits. This contribution takes the Sulcis Iglesiente Guspinese Region (Sardinia, IT), as a case study. In this region, the landscape context is marked by past mining activity and the project of a path of historical, cultural and religious value has proved to be an activator of regenerative processes. As part of this renewed awareness, the Santa Barbara Path (SBP) has been established (2017), as well as the homonymous Foundation - the Santa Barbara Path Foundation (SBPF), which constantly promotes different modality of accessibility (walk, bike, horse), as well as the provision of specific services, integrated to the whole system of facilities and points of interest in the area. The present manuscript proposes a methodological approach to assess the role of physical and digital services for the slow tourism and the local communities.

Keywords: Green Infrastructures, Slow Tourism, Physical and Digital Services.

1 Introduction

In the socio-economic context triggered by the Covid-19 pandemic, tourist destinations around the world have seized the opportunity to rethink their spaces and adapt their local development policies and strategies to the objectives of sustainability, cohesion and inclusion of territories. In this framework, sustainable tourism is the crucial element to create the right synergies for economic growth by combining innovation, connectivity and quality while respecting the carrying capacity of natural and cultural resources.

The World Tourism Organisation (UNWTO) elaborates a definition (1998) and promotes the concept of sustainable tourism as a key priority for the development of the tourism sector globally. The main objective is to maximize the socio-economic benefits of tourism while minimizing negative impacts on the natural environment, cultural heritage and local communities. The indications coming from the international context thus push 'old' and 'new' destinations to activate actions to diversify the tourism offer by promoting the development of 'alternative', innovative and quality tourism products. The UNWTO promotes several forms of sustainable tourism that encourage responsible practices that respect different landscapes. Ecotourism, rural tourism, cultural tourism, eno-gastronomic tourism, but also geotourism - with reference to the geological richness of certain destinations and post-mining landscapes -. are excellent examples of sustainable forms of tourism that can be combined with the slow philosophy of traveling that induces a non-invasive use of the territory. Travelers who engage in 'slow travel' choose specifically created or 'reactivated' routes that represent the authenticity of places. The slow approach thus favours the rediscovery of the identity characteristics of a destination and promotes the development of projects that consider the territory as a common good, fundamental to the well-being and quality of life of both the local population and guests [1,2]. Sustainability, greater cultural awareness and involvement of local communities, and connection with nature all emerge as trends that have contributed to the evolution of the slow philosophy of tourism [3]. The concept of slowness was later applied in other fields: travel and tourism, urban planning, fashion, culture, etc. Slow travel is characterized by the conscious enjoyment of landscapes, respect for the environment and the use of sustainable means of transport that allow for experiential holidays [4-6]. It also represents the frame to increase the system of physical and digital services, shared between tourists and the local communities. The slow crossing of places must also be planned through the creation of a green infrastructural offer, which acts as a connecting element between natural, semi-natural, agricultural and urban areas.

In the context of slow tourism, Green Infrastructures (GIs) assume a key role as networks of trails and paths, in urban, peri-urban and rural settings, that simultaneously conserve and provide ecosystem services to affected communities including biodiversity and wildlife, mitigation of air quality, recreation, environmental beauty and protection of disasters [7,8]. The Green Economy Strategy, put in place since 2013, sees Member States committed to developing the terrestrial, marine and coastal network of GIs through the planning and management of natural, semi-natural and other environmental features to provide ecosystem services [9-11]. The most recent interest and actions are also guided by the 'Biodiversity strategy for 2030' [12] which, in addition to protecting and preserving, aims in accordance with a more holistic, multifunctional and connected vision, to create, improve and restore ecological networks by actively involving all local actors (public and private operators, resident communities, universities and research centers) [13].

The GIs, whose backbone is formed by the sites of the 'Natura 2000 Network' and other Protected Areas (PAs), therefore have an ecological, economic, cultural and social regenerative function that is realized through Ecosystem Services (ES) that have fed the scientific and other debate since the late 1990s [14].

The concept of ES, within 'The Millennium Ecosystem Assessment' has been defined as benefits that humans obtain from ecosystem functions [15] or as reported by Boyd and Banzhaf (2007) [16] are the ecological factors consumed by humans in producing new well-being. The valorization of ES represents an opportunity for local communities to create spaces of 'community conviviality' to be experienced, also in terms of tourism [17].

Within this framework, the projects of paths and cycle paths, which constitute the network to favor slow mobility, contribute to the realization of GIs, recognized as drivers of spatial regeneration. This is what is emerging in the Sulcis-Iglesiente region, located in the south-western part of the Autonomous Region of Sardinia (Sardinia Region) in Italy, an area went through a phase of economic conversion based on sustainable slow tourism development as a result of abandoned mines.

The Santa Barbara Path (SBP) represents one of the most interesting results. In addition to pedestrian and bicycle mobility, the project for a horse-trail is underway. In this sense, the present manuscript focuses on the SBP as a relevant case study to develop a methodological approach to assess, from the design phase, positive and negative externalities that the implementation of a network of physical and digital services may generate both for tourists and local communities.

The manuscript is organized as follows: Section 2 - Case study, provides a description of the Sardinia Mining Landscape (Section 2.1) and presents the Santa Barbara Path (SBP) project (Section 2.2); Section 3 - Methodological framework; Section 4 - Discussion and conclusions.

2 Case study

2.1 Sardinia Mining Landscape

Sardinia is similar to a little continent because of its distinct environmental features. Along with biological rarities, woodland, marshes, natural landscapes, subterranean caverns, and ancient riches, it has a variety of geological, paleontological, and mineralogical features. The Island is well-known around the world in the mining industry for its extensive geological history and mines [18]. Sardinia's 24,000 square kilometer mining tradition, which stretches back over 8,000 years, is represented in a wide variety of mines of various importance and worth [19].

The "metal ring of the Iglesias," where ancient lead, silver, and zinc mineralizations may be found in carbonatic geological layers that date back more than 500 million years and constitute Italy's oldest known rocks, is home to the majority of the country's mines. Sardinian have had a significant impact on the local populations that use the island's subsurface resources. In the area, which has seen enormous changes, the remnants of this industry, influenced by historical events, remain visible. The impacts of material culture, social structures, and towns that have grown up around mining operations may be seen in the natural environment.

These related constructions have produced distinctive ecosystems, both social and cultural, that are both representative of the larger Mediterranean area and have global importance. The Historical Environmental Geo-Mining Park of Sardinia (Geo-Mining

Park) was established in 1997 as a result of the Sardinia Region's efforts, in partnership with the Sardinian Mining Authority and other institutions [20].

The most important mining districts in the Sulcis-Iglesiente-Guspinese region as well as famous mining buildings from neighboring islands are all included in this park. The Santa Barbara Path (SBP) was built in the Sulcis-Iglesiente region in 2017 as a part of this program (Figure 1) [21]. Additionally, to encourage beneficial territorial growth and change, the Santa Barbara Path Foundation (SBPF) was established as a challenge by neighborhood communities and authorities [22].

2.2 The Santa Barbara Path

The Santa Barbara Path (SBP) is an itinerary drawn in the Sulcis-Iglesiente area, in south-western Sardinia, an historical region that was the most important district for national and international mining until the 1990s, when the crisis hit the sector, causing the mines' dismantling [23]. As a consequence, the mining landscape is marked by large open-air and underground works, mine adits, tunnels, and numerous mine wastes.

The principal result of this extensive mining activity is the economic depression that required the rethinking of a new development, also through forms of sustainable tourism capable of enhancing the great heritage of industrial archeology [24] in a particularly beautiful mining and coastal landscape [25].

The SBP, which extends along a 500 km ring, organized into 30 tracks, follows the traces drawn by mining activities in the past decades in a unique landscape in transition—or landscape in progress—understood as the outcome of different stages of human–nature interaction.

In this sense, the SBP represents a response to the demand for a particular type of rural and slow tourism associated with the use of GIs, which, in the Sulcis-Iglesiente region (mining bioregion), arises as a driving force for economic development.

Over the last few years, the SBP has been included in the regional register of historical-religious walks of Sardinia and in the Atlas walk of Italy of the Ministry of Cultural Heritage and Activities.

In line with the objectives of the Geo-Mining Park, the SBPF constantly promotes different types of accessibility as a primary condition for a new development phase based on the concept of rural and slow tourism [26], according to principles that guide the political strategies of the regional level. As a matter of fact, the construction of a horse trail, connected to the SBP and to the cycle path (a thematic route connected to the great cycling network of Sardinia), represents one of the most important projects carried out by the SBPF (Figure 1).

The horse trail consists of a ring route of over 500 km, divided into 18 tracks and 19 Stop Points (SPs), which crosses 24 municipalities. In this sense, the SBPF intends to enhance the SBP and the relative SPs as a GI for rural and slow tourism for several integrated aspects: the recovery of the old mining tracks; provision of a different travel way (walk, bike, and by horse); and the offer of a widespread and low-cost hospitality system, which integrates the existing one.

As argued in previous research [27,28], the project may represent a real opportunity to integrate the system of physical and digital services to support tourists and the local communities themselves.

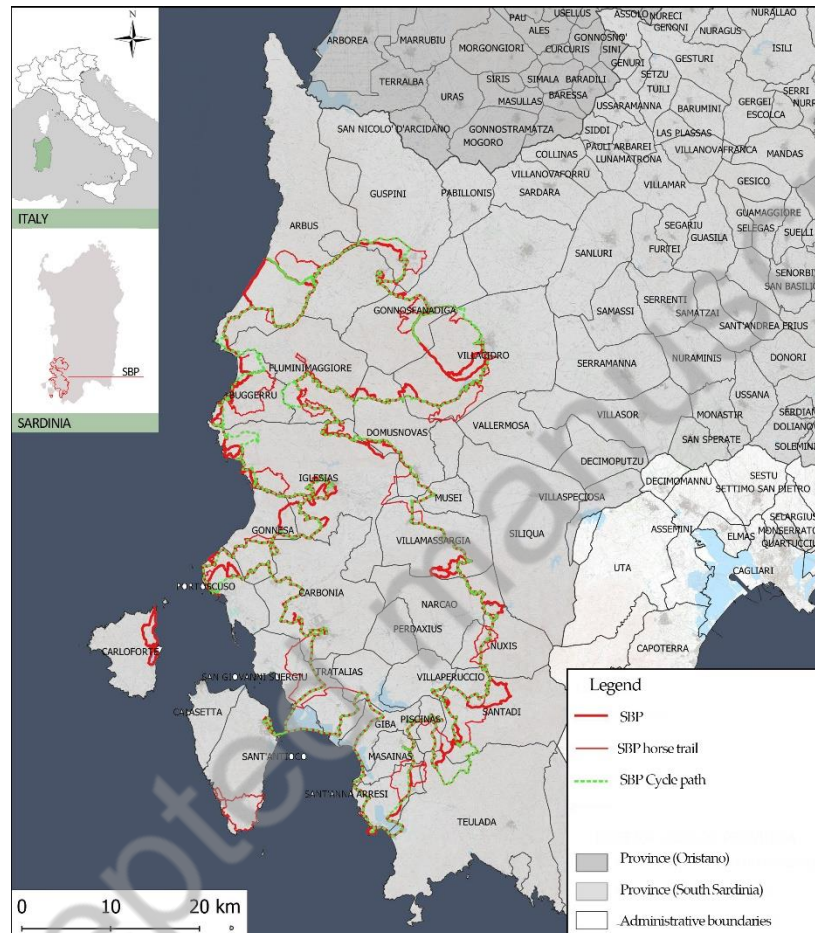


Fig. 1. The SBP, in the Sulcis-Iglesiente region, in relation with the SBP cycle path and the new SBP horse trail (M. Ladu, 2023).

3 Methodological framework

The GIs project for slow tourism, in particular that of paths (walk, bike, horse) [29], requires the provision of a series of services and facilities to promote accessibility [30-32] and to increase attractiveness, always of the under-tourism type [33]. According to the recent evolution of services, also accelerated by the pandemic, it is possible to classify services according to the following categories: physical, digital and hybrid,

provided by public or private entities. Below is a brief and concise list of the two macro categories of services, physical and digital, divided into active services (urban and environmental) and services in progress (in GIs and slow tourism).

Active Physical Services:

- Urban facilities: urban services (health services, cultural services like libraries and museums, post offices and other offices and basic necessary services, etc.); commercial activities (pharmacies, banks, markets, etc.); urban amenities (public spaces like squares, parks, gardens, etc.).
- Points of interest: Cultural Heritage (areas and nodes): mining villages, industrial and/or mining heritage, archaeological villages, churches, museums, and historic buildings. Sites of naturalistic interest (areas and nodes) like natural parks, waterfalls and springs, caves, lakes, beaches, natural monuments. Historical urban centers.

Physical Services in progress:

- Infrastructures for slow tourism (paths, cycle paths, bridleways), i.e., long networks to be understood as GIs, essential for safeguarding and restoring ecosystem services.
- Stop points: pilgrim accommodation, horse-shelter, and paddocks (in the case of bridleways), rest areas and modal interchange.

These categories fall within the broader dimension of Ecosystem Services (ESs), including biodiversity and wildlife, mitigation of air quality, recreation, environmental beauty, and protection of disasters, fall into the category of physical services, although in some respects are intangible. More precisely, ESs are divided into four main categories: 1. Support services (habitat for species, maintenance of genetic diversity); 2. Regulatory services (climate regulation, carbon sequestration, prevention of erosion and maintenance of soil fertility, pollination, biological control, etc.); 3. Supply services (food, raw materials, fresh water, medicinal resources); 4. Cultural services (recreation and physical and mental health, tourism, aesthetic appreciation and inspiration for culture, art and design, spiritual experience and sense of place) [15].

Active Digital Services:

- Municipal and National Digital Service.
- Other digital services of public interest (Leisure, Museums, monuments, etc.).

Digital Services in progress:

- Information on the GI for slow tourism (official website, applications of the GI, etc.).
- Booking accommodation (official website and applications of the GI; other websites and applications - Booking, Airbnb, etc.).
- Registration of pilgrims (official website and applications of the GI, etc.).
- Ticket purchase to visit points of interest (official website and applications of the GI; other specific websites and applications of the points of interest).
- Offer and management of mobility in line with the concept of Mobility as a Service (MaaS) [34, 35], which allows to better integrate the different transportation services

(public transport, sharing mobility, ride hailing) and give tourists and local communities the opportunity to easily plan, book and pay for multiple types of mobility services (MaaS platforms and applications; other websites and applications).

Within this framework, the present study proposes a methodological approach to assess positive and negative externalities that the implementation and the integration of a network of physical and digital services may generate both for tourists and local communities (Figure 2).

PHYSICAL SERVICE IN PROGRESS		DIGITAL SERVICE IN PROGRESS	
EXTERNALITY		EXTERNALITY	
POSITIVE	NEGATIVE	POSITIVE	NEGATIVE
Conservation and enhancement of cultural heritage and landscape; preservation and restoration of ecosystem services	Commodification of cultural heritage and landscape	Institutional and government dashboardS to know, plan and manage the territory in a digital environment	Technocratic government; investment cost for the conversion of the services (economic inequality)
Sustainable development models (slow tourism) and healthy lifestyles	Anthropic action in the natural environment; over tourism	Digital ecosystems: integration of urban facilities, point of interests, tourist facilities, mobility (MaaS) - efficient and sustainable travel organization -, etc.	Commodification of cultural heritage and landscape; over tourism; traffic volume
New forms of mobility and new intermodal hubs	Urbanization process; over tourism	Complementary services (Booking accommodation; Registration of pilgrims; Ticket purchase) - optimization, reconciling of the time, tourism expectation	Online shopping fraud; over tourism; digital divide; social exclusion; technology dependency; technological failure
Functional mixite in the urban and rural environment (community and tourists' landmarks; new spaces for social relations and inclusion)	Urbanization process; fragmentation and dispersion; over tourism	Increase in the offer of the Active Digital Services (digital services of public interest) and job opportunities	Digital divide; social exclusion
Increase in the offer of the Active Physical Services (Urban facilities; Points of interest) and job opportunities	Urbanization process; over tourism	Local control and security; monitoring	Technology dependency; technological failure
Local control and security	Anthropic action in the natural environment		

Fig. 2. Methodological framework of physical and digital services in progress (G. Balletto and M. Ladu, 2023).

4 First results and future development

The methodological framework highlights the main positive and negative externalities of physical and digital services in progress. The positive externalities of physical services can be summarized as follows: conservation and enhancement of cultural heritage and landscape, of tangible and intangible values; preservation and restoration of ecosystem services; sustainable development models (slow tourism) and healthy lifestyles; functional mixite in the urban and rural environment (community and tourists' landmarks; new spaces for social relations and inclusion); new forms of mobility and new intermodal hubs. As for digital services, other positive externalities

concern the possible increase in the supply of active services and job opportunities, as well as the local control and security, albeit in different ways.

On the other hand, negative externalities include, above all, the possible increase in the urbanization process and anthropic action in the natural environment, the fragmentation and dispersion of services, as well as the risk of commodification of cultural heritage and landscape and over tourism, which is also common to digital services.

With reference to the latter, the development of institutional and government dashboard to know, plan and manage the territory in a digital environment, the integration of different physical services, the implementation of online services and the consequent complementarity of services represent the main positive externalities.

The negative externalities concern not only the possible commodification of cultural heritage and landscape and over tourism, but also the risk of technocratic government and economic inequality - due to the investment cost for the conversion of the services -, digital divide and social exclusion, technology dependency and technological failure, online shopping fraud, as well as the possible traffic growth generated by the implementation of MaaS applications.

However, with reference to the SBP case study, it can be estimated that the negative externalities have a lower weight by virtue of the modest number of presences recorded in recent years and, above all, in the autumn and spring months, less affected by tourist flows in the Sardinia region.

In this sense, the integration physical and digital services, tangible and intangible, active and in progress, represents a real opportunity to generate material and immaterial effects on the intercepted urban centres and their local communities.

The new services in progress within the GIs for slow tourism may increase the system of services provided to local communities, in quantitative (number) and qualitative (variety) terms, defining a new organizational and functional arrangement, on an urban and territorial scale, which necessarily has spatial implications in terms of infrastructures for a multimodal and sustainable mobility.

At the same time, the active physical services located near the GIs in progress, especially those related to commerce, health services, cultural services, public spaces etc., together with digital and hybrid ones, may guarantee a wider offer also to tourists and non-residents, increasing the accessibility and attractiveness of places.

Within this framework, the proposed methodology represents a strategic tool to assess possible externalities related to the implementation of territorial regeneration schemes not only in the design phase but also in the ex-post development scenario, thus supporting the monitoring activity.

The methodological approach is exportable to other sites with similar characteristics to the case study. However, the future development of the methodological framework will address several aspects, including the implementation of the two macro categories of services here proposed, as well as the application to the SBP, where the provision of a different travel way (walk, bike, and by horse) and the offer of a widespread and low-cost hospitality system it's still in progress.

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Author Contributions

M.L., G.B., S.B., A.A.G. collaboratively designed this study. Individual contributions are as follows: S.B. and G.B. Section 1; A.A.G. Section 2.1; G.B. Section 2.2; M.L. and G.B. Section 3 and Section 4.

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