TERRITORY OF RESEARCH ON SETTLEMENTS AND ENVIRONMENT
INTERNATIONAL JOURNAL OF URBAN PLANNING
20

Inclusive coastal landscapes

green and blue infrastructure for the urban-land interface 2

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II
CENTRO INTERDIPARTIMENTALE L.U.P.T.

Federico II University Press
fedOA Press

Vol.11 n.1 (JUNE 2018)
e-ISSN 2281-4574

sommario

Inclusive coastal landscapes: green and blue infrastructure design for the urban-land interface 2

Table of contents/*Sommario*

TRIA TERRITORIO DELLA RICERCA SU INSEDIAMENTI E AMBIENTE
INTERNATIONAL JOURNAL OF URBAN PLANNING

Federico II University Press
fedOA Press

TRIA 20 (1/2018) 21-38/ e-ISSN 2281-4574
DOI 10.6092/2281-4574/5816

Licensed under the Creative Commons Attribution Non Commercial License 3.0 - www.tria.unina.it

abstract

Reshaping the sea-land interface through sustainable mobility: a project for a greenway in western Sicily

Ignazio Vinci, Fabio Cutaia

Abstract

This work illustrates the planning experience, still underway, carried out by five municipalities of western Sicily (Italy) in the preparation of a sustainable urban development strategy in the framework of the EU's urban agenda 2014-2020. The strategy, whose general objectives are strengthening territorial cohesion and increasing accessibility to local resources, focuses on sustainable mobility corridors in coastal areas as the instruments through which such objectives can be better achieved and reciprocally integrated.

Aerial view of the coast of western Sicily from the Stagnone lagoon towards the Trapani urban area

After an exploration of the literature, the article provides an analysis of the potential demand for sustainable mobility in the given urban system, an explanation of the criteria considered for the design of the slow mobility infrastructure, as well as of the overall benefits the intervention can provide in terms of local development. Particularly, we intend to demonstrate that a revised green way concept, being able to increase accessibility to a broad range of resources and functions (natural sites, landscapes, cultural heritage, urban functions), can play a multidimensional role in increasing connectivity between sea and land, urban and rural areas.

Key Words
Greenway, Waterfront, Sustainable mobility, EU's Urban Agenda

Rimodellare l'interfaccia terra-mare attraverso la mobilità sostenibile: un progetto per una greenway nella Sicilia occidentale

Il paper restituisce l'esperienza di pianificazione, tuttora in corso, che vede impegnati cinque dei comuni della Sicilia occidentale nella stesura di una strategia di sviluppo urbano sostenibile all'interno della cornice della programmazione comunitaria 2014-2020. La Strategia, i cui obiettivi generali riguardano il rafforzamento della coesione territoriale e l'incremento dell'accessibilità alle risorse locali, si focalizza sui corridoi di mobilità sostenibile nelle aree costiere, intesi quali strumenti attraverso cui detti obiettivi possano essere meglio raggiunti e integrarsi reciprocamente.

Dopo un'indagine sulla letteratura scientifico-disciplinare, l'articolo offre una analisi della domanda potenziale di mobilità sostenibile nei sistemi urbani in oggetto, segue una disamina dei criteri considerati per la progettazione di un'infrastruttura per la mobilità dolce e, infine, una rassegna dei benefici che l'intervento può apportare in termini di sviluppo locale. In particolare, si intende dimostrare che una revisione del concetto di greenway, potendo aumentare l'accessibilità ad un'ampia gamma di risorse e funzioni (aree naturali, paesaggi, patrimonio culturale, servizi urbani), può giocare un ruolo multidimensionale per il miglioramento delle connessioni tra il mare e la terra, tra le aree urbane e quelle rurali.

Parole Chiave
Greenway, Waterfront, Mobilità sostenibile, Agenda Urbana dell'UE

Reshaping the sea-land interface through sustainable mobility: a project for a greenway in western Sicily

Ignazio Vinci, Fabio Cutaia

1. Introduction

In many European countries, including Italy, medium-sized cities represent a phenomenon characterizing regional development both from a spatial and an economic perspective (Cremaschi, 2005; Servillo *et al.*, 2017). The reasons for such an urban organisation has its roots in the remote past of each country, but also in the capacity of small and medium-sized cities to offer a range of accessible services, environmental qualities and other amenities that often make these contexts more attractive to citizens respect to the largest urban agglomerations (ESPON, 2014; Hristova *et al.*, 2015).

Although being characterised by large rural and low-density areas, Sicily is one of the Italian regions with a more structured urban network, including three metropolitan agglomerations – Palermo, Catania, Messina, with a population of around one million each – and 31 towns with a population between 30,000 and 100,000. In some areas of the region, economic specialisation and spatial proximity are at the base of functional synergies between medium-sized cities, so that they can be described as examples of polycentric development in the way it has been conceptualised by the European Union (ESPON, 2005). This is the case of the western side of the region, where five main urban areas (Trapani, Erice, Marsala, Mazara del Vallo, Castelvetrano), home of around 250,000 inhabitants, are encompassed within a range of 90 kilometres of coastline along which relevant resources for local development are located: infrastructures, such as an international airport and ports and marinas of regional level; natural

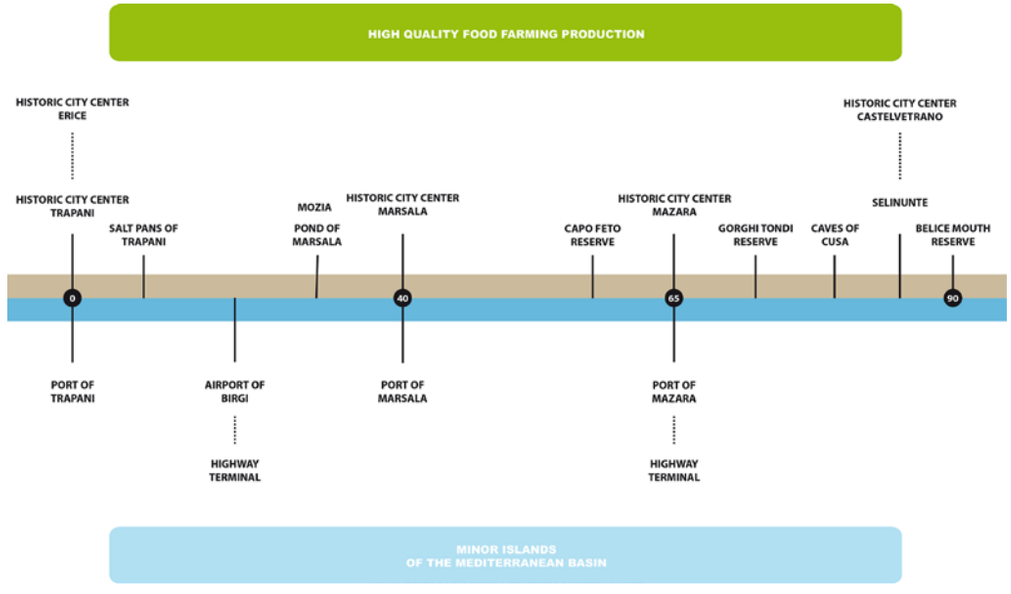

Fig. 1 – The system of knots-attractors along the costal arch of western Sicily (Source: present authors)

sites of community importance and distinctive landscapes; some cultural amenities of international relevance, including the historic centre of Erice and the Selinunte archaeological site (figg. 1 and 2). Alongside these assets for territorial development, the area is also characterised by a remarkable tradition in quality food and wine production, increasingly recognised by cultural tourism and, in some cases, organised in thematic itineraries.

Fig. 2 – Collage of representative areas. From left to right and from top to bottom: Saline di Marsala; view of the historical centre of Trapani; the Castel of Venere in Erice, the archaeological park of Selinunte; view of the historical centre of Castelvetrano; the nature reserve of Capo Feto; the nature reserve of Stagnone; the Caves of Cusa; the historical centre of Mazara del Vallo (Source: present authors)

In 2016, in the framework of the 2014-2020 EU's programming cycle, the five mentioned municipalities decided to start the implementation of a common strategy for sustainable urban development based on the following main objectives:

(1) promoting territorial cohesion and increasing synergies between the cities;

(2) increasing accessibility to the urban and environmental resources;

(3) an improvement of local services, particularly in the fields of sustainable mobility, energy and social inclusion.

The strategy, being funded with around 70 million euro from the European Regional Development Fund, will be implemented through an action plan with a specific focus on

the urban waterfronts, places still characterised by unsolved environmental problems, but also in which the three above mentioned objectives can be achieved with a larger impact in terms of sustainability, urban regeneration and local development.

In the part of the action plan dedicated to sustainable mobility, the main project consists of a cycling corridor that, following a greenway approach, aims to create different patterns of mobility and accessibility within the territorial system. As a result, the project implementation is conceived in two different temporal steps:

- the urban sections (around 26 kilometers), with the aims of improving the quality of the waterfronts and increasing the share of citizens to use sustainable modes of transport;
- the suburban section (around 70 kilometers), with the aims of increasing connectivity among the urban areas and to facilitate sustainable access to the environmental resources spread over the coastal areas.

This paper illustrates the analyses and the preparatory work supporting the greenway as an instrument to provide mobility solutions for different types of users and territorial scales. After this introduction, the second section explores the literature to set the role of green infrastructures in providing environmental, economic and social benefits in a spatial dimension. In the third section we analyse the mobility behaviours in the five cities in order to understand the amount of flows and potential beneficiaries of the future green infrastructures. In the fourth section we describe the principles and criteria adopted in the planning process, with a set of design concepts to ensure the green infrastructure feasibility. The conclusion discusses the results of the planning scenario according to the local development potentials given by the local context.

2. Reconceptualizing the green infrastructures: how to integrate places and sustainable mobility

In contemporary societies, we are witnessing deep changes in the way people travel and move around. This process, as many have argued (Banister, 2008; Grieco & Urry, 2012), depends on diverse cultural and technological factors, including the emergence of new lifestyles, a more sustainable approach to the use of urban space, and an increased interest regarding the environment. Such changes in social behaviour, among other things, implicates that some old conceptual barriers – for instance, between urban and rural space – are reconsidered, with the consequence of creating a demand for new types of infrastructures and new challenges to planning (Bertolini, 2017).

These different demands can be addressed in an holistic way by reconceptualizing the idea of "green infrastructures", a concept that has ancient roots and analogies with the pioneering concepts of "parkway" and "green belt" (Fabos, 1995) and now it can be interpreted as a set of interconnected natural spaces that while preserving the values and functions of a natural ecosystem, provides also wider benefits to human populations (Benedict & McMahon, 2006). Therefore, the new planning scenario requires a

completely different approach to green infrastructures design, based on multifunctional criterion (Lovell & Taylor, 2013) and able to cross not only different sectors, but also administrative borders (ESPON, 2013). For this reason, green infrastructures can easily accommodate slow-mobility infrastructures within existing natural networks, increasing accessibility to the area while proposing itself as an instrument of ecological and environmental regeneration (Steiner, 2010). In the context of this paper, the metaphorical use of the term infrastructure is particularly relevant, because the creation of new services and facilities for the community is combined with the protection of un-built spaces at the margins of grey-infrastructures such as a rail line.

In a contemporary perspective, a green infrastructure can be defined as a tool to provide environmental, economic and social benefits through natural solutions and help people to reduce the dependence on the "grey infrastructures" (roads, railways) that are often more expensive to build and maintain (Marques-da-Cruz & Costa Pinto, 2015). They can be described as a strategically planned network of natural and semi-natural areas designed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation[1]. Therefore, for green infrastructure we mean an equipped network that fulfils the dual function of ecological networks: a system connecting areas rich in biodiversity and able to provide accessibility to public space (Peraboni, 2010; Steiner, 2010; Uzzel *et al.,* 2000).

Starting from these considerations, we can distinguish at least three perspectives from which to evaluate the positive effects of green infrastructures on territorial organisation: (a) for their role in protecting ecological values, (b) in terms of promoting new forms of transport and mobility and (c) as a driver for sustainable tourism.

As regards ecological values, green infrastructures may act in a positive way if resulting from the combination of two categories of actions: on the one hand, because they are oriented to maintain the existing environmental units that constitute the natural capital able to produce ecosystem services; on the other, for their role in the implementation of new natural ecosystem units, with characteristics and performances similar to those existing in nature (Costanza *et. al.*, 1997; Malcevschi & Bisogni, 2016). On this point, the "European Biodiversity Strategy" (COM, 2011) can be mentioned, as it aims to preserve and enhance ecosystems, and all related services, through green infrastructures and the restoration of at least 15% of degraded ecosystems.

Another important element of green infrastructures is their potential contribution to climate regulation, resulting for instance from actions to reduce the amount of impermeable soils in the semi-natural areas; or, as an alternative to the traditional means of transport, in terms of reducing congestion and pollution in the urban areas (Gill *et al.*, 2007). This last benefit, particularly, can be pursued by reshaping the mobility networks through an extensive adoption of cycle paths (that are part of the green infrastructure concept), given their compatibility with the environment and the response they can give to the growing demand for safe and sustainable mobility in contemporary cities. Among other things, it is demonstrated (Forman *et al.*, 2003) that growth development in bike/pedestrian movements can also generates an increase in the use of public transport, if

such networks are effectively interconnected with the green infrastructures.

The third aspect that should be highlighted is the role of green infrastructures in support of sustainable tourism. This can be ensured if the greenways are conceived to guarantee easy and safe accessibility (on foot or by bicycle) to a variety of recreational activities in places with a high environmental and landscape quality (Aa. Vv., 2008; Mastronardi and Giannelli, 2014; Torricelli, 2016). When such territories are characterized by natural/ cultural sites of significant attractiveness (see fig.1 as regards the case study), green infrastructures can offer alternative ways to enjoy such resources, with the consequence of stimulating the emergence of new brands in tourism and the request for customized services, the provision of which may have an impact on local development.

Ensuring integration between such different benefits, however, must not be taken for granted but rather the result of the of a long term development strategy and an integrated action plan able to affect, in a cross-cutting way, different domains and policy-sectors. There are recent cases in Europe where the different benefits of the green infrastructures are being considered within an overall planning strategies carried out by municipalities (Socco et al., 2007). Some examples in this direction are presented below.

In Rotterdam the Climate Change Adaptation Strategy focuses on three key aspects: (a) maintaining and strengthening existing infrastructures, (b) adapting the entire urban environment using nature-based approaches and (c) working together with other city projects to link adaptation measures and spatial development (Munoth & Thakur, 2017). Szeged city officials consider the city as a complex system where an alteration could induce other changes in the urban fabric. Factors such as EU funding, laws and regulations support the integration of urban green space in development planning, requesting compensation measures when grey infrastructure projects impact urban green space (Száraz & Gerőházi, 2015). The Bristol Local Plan and the Parks and

Case cities	Rotterdam - Netherlands	Szeged - Hungary	Bristol - UK	Halle - Germany	Almada - Portugal
Geography and population	Located in the south of Holland, it has about 639,600 inhabitants	Located near the southern border of Hungary, it has 161,900 inhabitants	Situated within the West of England sub-region, it has around 432,400 inhabitants	Located about 150 km southwest of Berlin, it has about 237,000 inhabitants	Located 3 km south of Lisbon, its population is around 173,600 inhabitants
Aim	Defending from heat waves and flooding	Increasing green areas both for recreational purposes and wildlife habitats	Providing different types of accessible green space to all local people	Maintaining and improving urban green space and promoting recreational and touristic activities	Preserving natural, rural and urban environments, and connections between them.
Strategy	Implementation of green adaptation measures	Adaptation to climate change and promotion of biodiversity and social cohesion	Establishment of new connections for wildlife and people	Multifunctionality of urban green space	Connectivity and multifunctionality of green spaces
Principle benefits	• Climate regulation and biodiversity increasing; • Leisure and sport equipment; • Reduction of traffic noise; • Air purification	• Reconstruction and creation of new green areas with multiple functions; • Reducing car use • Maintenance of cultural and recreational values	• Improvement of the green network; • Green economy development; • New slow mobility paths • Access to "biocultural" places	• Recognition of the central role of the river; • Linkage of the city to its river; • Provision of access facilities to user groups	• Conservation of soil and agricultural systems • Accommodation of sustainable mobility networks • Opportunities for leisure and the enjoyment of nature

Tab. 1 – Relevant experiences of green infrastructures in European cities with a population size similar to that of the area presented in this paper (Source: own construction based on Munoth & Thakur, 2017 and Davies et al., 2015)

Green Space Strategy drive decision-making around the local green infrastructure development. These highlight the need to: (a) address health inequalities through providing accessible, varied green spaces and (b) improving the green network, and adaptation to climate change through tree planting and flood prevention measures (van der Jagt *et al.*, 2015). In the urban redevelopment strategy of Halle, the green infrastructure is considered an important element for creating a positive image of the city. Special attention is given to the river Saale, fostering the connection between the city and the river and promoting recreational and touristic activities (Hansen & Santos, 2015). The new Almada's Master Development Plan comprise the Municipal Ecological Structure as a key instrument for city planning, aiming at a better coordination between green planning and traditional, engineering focused infrastructure planning, enhancing ecological features and improving connectivity in natural, rural and urban environments (Santos *et al.*, 2015).

Beyond the differences, we can notice that all these strategies consider green infrastructures not simply as a technical solution to deal with environmental problems in urban areas but, rather, a new way of looking at the structure of the built environment and a perspective through which to reconsider the citizens' quality of life.

3. Analysis of mobility trends in the western Sicily urban system

In a polycentric urban system, the analysis of mobility flows at an inter-municipal scale may provide important evidences in support of a sustainable development strategy. Such analysis, particularly, can be helpful for the identification of planning targets whether it is able to describe: (a) the amount of movement between each urban area, and (b) for which purposes these movements are generated and (c) its modal split.

Firstly, in order to estimate the composition of systematic mobility in the territory, we analysed the Origin-Destination Matrix (OD) of daily 'home to work' trips and 'home to study' trips, based on the data of the last available population census (ISTAT, 2011). As it is well known in the literature (Cascetta, 1984; Cascetta *et al.*, 1993; Lo *et al.*, 1996; Bierlaire, 2002; Wong *et al.*, 2010), this approach uses procedures for processing categorical data, generating a basic tool for quick reading: the mobility tables. These are matrices that contain the source classes in the rows and the arrival classes in the columns. The individual amount of these matrices show the frequency with which the subjects of a given class of origin are present in a given class of destination.

In the given case, the cross-section is constituted by 94,975 individuals, about 14% of the district's population, of which 41,908 move for study reasons and 53,066 for work reasons. Regarding the inter-municipality study trips (Tab. 2), the main flows are registered from Erice to Trapani and vice versa, two municipalities that are strictly interconnected in functional terms. By observing the other OD pairs, Trapani seems to be the largest pole of attraction from the other municipalities (it is the province's capital), while Marsala clearly ranks as the first urban area in term of internal movements

(+16,8% over the second ranked).

Tab. 2 – Origin-destination matrix of systematic movements in the territory of the Urban Agenda (Source: present authors based on ISTAT – 2011)

Origin \ Destination	Erice	Trapani	Marsala	Mazara del Vallo	Castelvetrano	Total
Erice	5,633	5,162	123	12	14	10,946
Trapani	2,935	22,876	339	55	27	26,234
Marsala	99	1,067	26,503	484	107	28,263
Mazara del Vallo	5	310	413	16,524	660	17,914
Castelvetrano	5	237	83	237	11,053	11,616
Total	8,679	29,654	27,462	17,315	11,863	94,975

The dynamic of the flows as regards home-work movements between the cities are quite similar (Tab. 3). In fact, globally, most of them are recorded from Erice to Trapani and vice versa, but the direction of flows presents clear differences due to the amount of higher urban functions hosted within the Trapani urban area.

Alongside the movements for work and study reasons, a strategy for sustainable mobility can be obviously affected by the extent of movements generated by tourism. According to data released by the Regional Tourism Observatory[2] (2016), from 2005 to 2015 the five cities under consideration are characterized by a considerable increase of tourist flows: + 5% in terms of arrivals and +9,4% in terms of attendance, with an average permanence far above the regional level. In the last ten years, furthermore, the province of Trapani has recorded a global increase of tourists of around 660,000 units (+67,1%). As a result, the area must be considered one of the most dynamic tourist destinations of the region, with a touristic index (10,4) second only to the area of Messina (16,8) – the unique area which records values close to the national average (tab. 3).

Tab. 3 – Incoming flows for movement reasons (Source: present authors based on ISTAT – 2011)

	Incoming for Study (2011)	Incoming for Work (2011)	Incoming for Tourism (2015)
Erice	461,074	742,388	84,526
Trapani	996,811	2.295,652	208,294
Marsala	186,541	515,174	170,301
Mazara del Vallo	80,654	351,634	65,077
Castelvetrano	245,182	295,085	353,662
Total	1,970,262	4,199,933	881,860

Being the strategy described in this work aimed at changing – through green infrastructure interventions – in a more sustainable way the citizens mobility behaviours, it seems essential also to know the current transport modal split. As clearly shown in table 4, like in other southern Italian regions, the most common mode of movement in the area is ensured by private cars, 58.9% of which as a driver. In fact, the preference given to the car by users represents more than 72% of the most diffused modes of movement in the territory. As a result, the use of public transport seems to be marginal, far below the national and even the regional share, whether we consider the use of buses or the rail network.

Given the distance of the current situation from a virtuous model of mobility (Bhat, 1995), and the emphasis given to sustainability mobility in the urban agenda under implementation, specific attention has been paid to the cycling network. While to date

	School and company's bus	Urban and extra-urban bus	Train	Bicycle	On foot
Erice	0.9	2.1	0.8	0.4	5.6
Trapani	1.3	2.3	0.0	0.8	6.3
Marsala	1.5	2.1	0.4	0.4	4.6
Mazara del Vallo	0.5	0.9	0.1	0.9	6.8
Castelvetrano	0.3	0.9	0,0	0.2	5.9
Average	1.1	1.8	0,4	0.6	5.8
Sicily	2.6	7.2	1	0.5	19.1
Italy	2.9	8.7	4.7	3.3	15.8

Tab. 4 – Percentage of trips depending on travel modalities (Source: present authors based on ISTAT – 2011)

the realization of cycle paths in the municipalities of the area is almost irrelevant (Tab. 5), after a survey carried out within one of the five cities (Mazara del Vallo) it is argued that the spread of the bicycle as a means of movement for citizens is prevented by the possibility of having an equipped infrastructure that satisfies the minimum standards of safety and comfort when moving, This fact makes clear that the potential amount of users can be considerably affected by the extent and quality of the cycling infrastructures.

	Existing cycle lines (km)	Cycle lines in the Urban Agenda (Km)	Current trips (%)	Potential trips (%)
Erice	1	–	0.4	1.5
Trapani	2.4	7	0.8	1.5
Marsala	0.60	7	0.4	1.5
Mazara del Vallo	–	6	0.9	1.5
Castelvetrano	–	4	0.2	1.5

Tab. 5 – Extension of cycle lines and trips, current and potential data (Source: present authors based on ISTAT – 2011)

The strategy for sustainable urban development (SSUD) quantifies the extension of new urban cycle pathways in 26 kilometres. If supported by other interventions, such as the creation of modal interchange nodes, it is expected that it may lead to an increase of users from a current 0.5% on average up to 1.5%. At the same time, interventions for cycle paths will also contribute to the redevelopment of coastal areas along urban waterfronts. Globally, it is expected that the implementation of the SSUD will lead to a reduction of around 7% of users of private vehicles for systematic trips. The expected investment for the cycle routes implementation in the urban areas is 5.8 million euro, around 8% of the total budget.

4. Criteria and solutions for the greenway design

The promotion of projects and innovative policies to enhance sustainable modes of transport is capturing increasing attention among European cities (La Rocca, 2008). Paraphrasing the "Brundtland Report", sustainable transport is defined by Black (1996, p.151) as «satisfying current transport and mobility needs without compromising the ability of future generations to meet their needs». Such effort requires an urban transformation towards a supportive city structure that provides accessible, attractive and safe pedestrian and bicycle facilities. The way urban form and streets are designed, in fact, can play a significant role in affecting citizens' behaviour and in shaping

Fig. 3 – The urban system of western Sicily and, in yellow colour, the greenway planned (Source: present authors)

pedestrian and bicycle traffic. In this regard, it has been demonstrated (Hankey *et al.*, 2012) that bicycle traffic can increase considerably in the presence of well designed bicycle facilities (+37%) and even more in the presence of off-street bicycle facilities (+332%). Consequently, a growing number of scholars emphasise the need to provide the territory of a larger network of walking and cycling paths (Rybarczyk & Wu, 2010; Hankey *et al.,* 2012; Buehler & Pucher, 2012).

Within the strategy for sustainable urban development of western Sicily, the identification of the greenway route and its design solutions were based on three main criterion presented in the literature: to connect in a unique system the area's functional and environmental resources, especially those less easy to reach (Valentini, 2005); to offer a "sustainable" alternative for the systematic movements (Bergamaschini, 2014) and to promote the bicycle-train intermodality (Maternini & Pezzagno, 1999), since the greenway frequently is joined to the railway line and intercepts stations. The route is divided into a main axis and a secondary one, further distinguishable in urban (26 km) and extra-urban (70 km) arterial roads (fig. 3).

The two arteries are complementary and conceived of as two steps of a unique development scenario. In fact, it is necessary to aim at its complete implementation in order to ensure both the systematic home/school and home/work movements and increase accessibility to the widespread environmental resources. In the urban areas, particularly, the greenway implementation is oriented (a) to facilitate accessibility to the higher urban services, (b) to re-establishing human-resources relationships and (c) the redevelopment of degraded areas. In this way, the planned routes provide exclusive lanes to non-motorized vehicles and the use of ad hoc materials for its realization. In the case of extra-urban roads, where exclusive lanes are not always allowed, the greenway aims to ensure connections between the urban centres and between the tourist facilities and the cultural/natural sites spread over the territory. In such cases, according to Ahern (1995), we have to consider the occasional incompatibility of greenway goals which has to be solved with specific design options and trade-offs between functions. For instance, the segments of the itinerary where the cycle pathways have been placed side by side to the railway line.

After defining the whole greenway itinerary, we have identified a set of "typical

sections" of the cycle path by taking into account the following criteria:

- general context – urban, peripheral and rural;
- width of the road section;
- functional characteristics;
- average travel speed time;
- vehicles admitted on the carriageway;
- geometric characteristics and technical parameters;
- frequency of intersections;
- regulation of the pit stop;
- regulation of the pedestrian flow.

Operating the road characterization, we verified the possibility of using different types of road layouts, in order to guarantee the continuity of the route and to assign exclusively dedicated itineraries to pedestrians and bicycle users. The guiding principles that inspired these choices can be summarized as follows:

- to prefer sections with null or paltry slopes;
- to guarantee security conditions for users;
- to contain limited construction and maintenance costs;
- to connect territorial resources.

Considering that intersections with ordinary roads represent the most dangerous points for the greenway users, we underline the necessity of their careful planning and designing. In the urban areas, the arrangement of the route or – where necessary – its new implementation, are the very first interventions to do in order to make every greenway easily accessible for users. This kind of intervention allows the redevelopment of the crossed environments and, therefore, it amounts to an opportunity for improving the quality of life (Toccolini *et al.,* 2004). Due to the security of the path, vegetation and other natural features, and in many cases the separation of cycle lanes from existing motorised roads, greenways are likely to attract people to walk and cycle more frequently (Hickman *et al.* 2013; Rittel *et al.* 2014; Wang *et al.* 2016). In this sense, the guiding criteria we followed for the path design have been the following:

- to create platforms with a minimum width of 2.5 m, up to 5 m where permitted;
- to provide the necessary urban furnishing to the paths;
- to adopt similar pavements to those already used for the paths realized, in order to allow better integration with the surrounding environment;
- to use eco-friendly materials that require low levels of maintenance and are durable over time.

Based on these criteria, we have identified some "standardized solutions" of intervention. One typology is called "urban road with wide carriageway": we refer to urban roads, in which pedestrians and any type of vehicle are allowed because of the very low speed limits. The section is very wide and, although it is on average constant, varies in width between 17 m and 15.5 m. The project proposes the realization of a cycle path and a pedestrian platform in its own places, on different levels and generally protected from motorized traffic by natural elements (fig. 4).

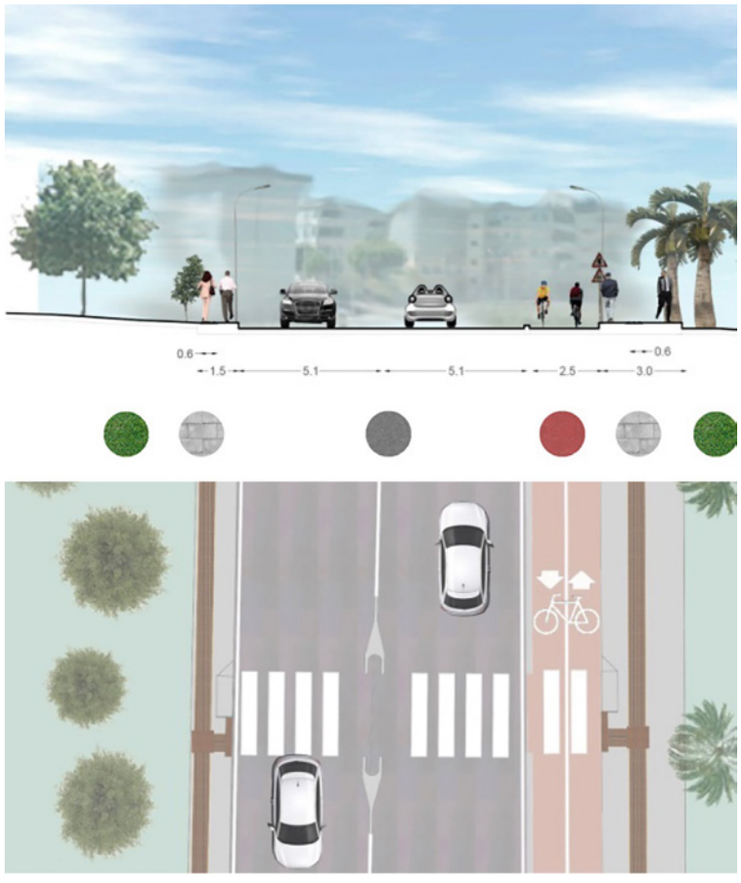

Fig. 4 – Urban road with wide carriageway (Source: present authors)

In the green infrastructures planning, a solution recently followed in many countries consists in taking advantage of already existing linear structures (Angrilli, 1999) such as bus corridors or rail networks. In fact, combining the movement by bicycle with that by bus or train, makes possible to set up multimodal connections able to cover long range movements, even at an inter-municipal scale (AA. VV., 1997; Cantarella, 1997). In this sense, intermodality between bicycle and public transport can have a multiplicative effect because of the greater demand that it is able to satisfy (Pileri, 2014). In many European countries, by now, transporting bicycles on suitable rail coaches is possible on most trains. Benefits are communal for both kind of transport systems:

- the creation of an ideal interchange for daily displacement – we refer to the opportunity of alternating tracks to do by cycling and by placing a bike on a train);
- the increasing of cycle-tourism for long, medium and short distances – we think that the intermodality of train-bicycle is indispensable in order to easily reach the heritage spread throughout the countryside and to satisfy the important demand today known as “cycle tourism” and “sustainable tourism” (Amoroso & Migliore, 2002).

While several contemporary greenways projects are planned on the routes of abandoned railways (Oppido, 2014), in this case the railway is still in use and, in spite of its inefficiency, represents for the local community an important alternative to the private means of mobility. As a consequence, in order to preserve and increase the usage of the existing railway, we adopted two different solutions to juxtapose the greenway layout to the railway line.

The first typology is called “free areas adjacent to railways” and describes a road section in which the global largeness varies from 10 and 20 meters (fig. 5). This is the case of secondary non-urban roads, flanked by the train tracks, that go through areas with different levels of urbanization. Moreover, the presence of the railway, reducing the frequency of grade-level crossing, facilitates the installation of platforms for non-motorized mobility between the pavement and the railway. The second typology differs from the first because its platform for non-motorized mobility is situated on rural roads, next to the railway, hence it can be defined as “rural road alongside the railways” (fig. 6). For its implementation, in some cases it is necessary to acquire a tight strip of land beside the road. The new platform will be located 3 meters from the railway tracks, ensuring security for users and contact with the environment, but also more direct connection with the rail station if necessary.

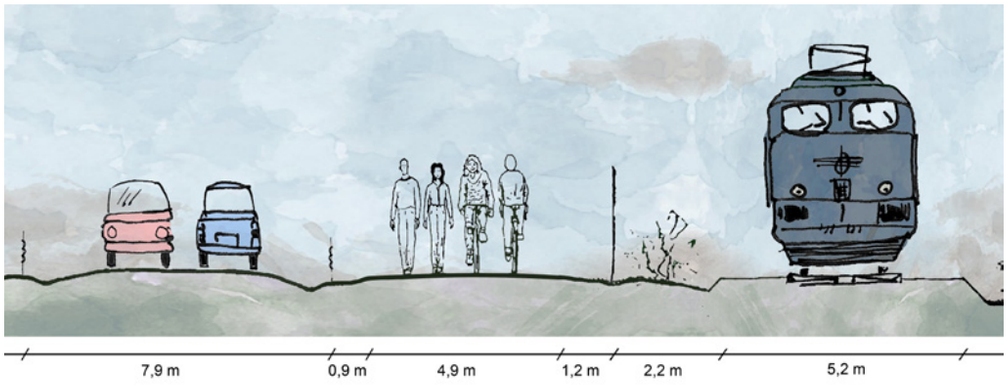

Fig. 5 – Free areas adjacent to railways (Source: present authors)

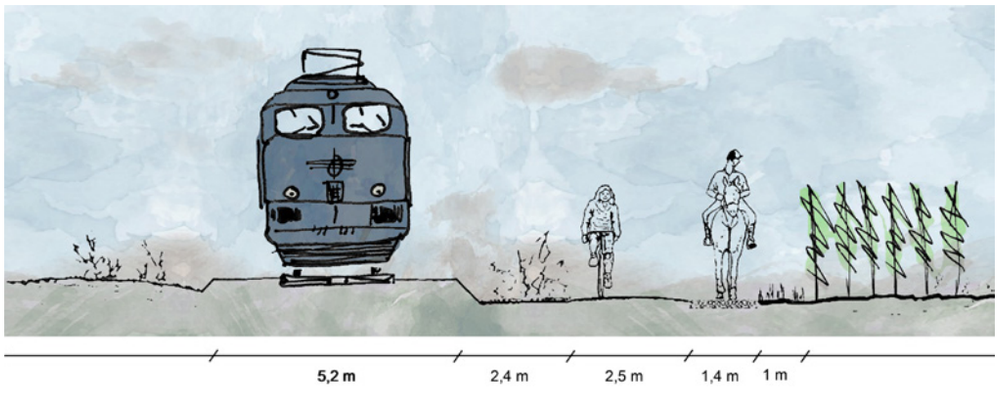

Fig. 6 – Rural road alongside the railways (Source: present authors)

5. Conclusions

In this paper we want to demonstrate that green infrastructures can meet sustainable development in a more effective way where they are able to pursue different objectives:

- working at different territorial scales, urban and suburban, in order to connect different kinds of functions and territorial resources;
- meet demands from a broader range of potential users, such as people using bike for home-work moving, or others for leisure or tourism activities.

The analysis about people movements in the urban system showed that bicycle use is very low, despite the fact that the amount of trips for home-work and home-study reasons are considerable. Beside that, the increasing flows deriving from tourists and leisure activities legitimize a significant improvement of the infrastructural supply in the area. The planning solutions adopted is explicitly addressed to integrate a greenway approach with the promotion of intermodality, a factor that could facilitate greenway usage by several types of user. This is especially true in the case of the Marsala-Trapani itinerary, both for the advantageous morphologic profile, and for the presence of a railway which already includes eight stations and twelve daily trips in both directions. In this respect, we assume that the urban waterfront and more generally the areas close to the coastline are places where this approach to greenway planning can be more easily implemented, due to the density of environmental resources and mobility corridors such as the rail line.

- As part of a wider sustainable development strategy, as in the cases of the

European cities reported in section 2, the greenway being implemented in western Sicily aims also to meet a set of crosscutting priorites for cities' policy, that are:

- adaptation to climate change;
- promotion of sustainable mobility;
- fruition of cultural and recreational resources;
- establishment of new wildlife connections and promotion of biodiversity;
- designing of multifunctional urban green spaces to foster social cohesion.

Furthermore, our planning experiment tries to demonstrate that the involvement of low-used traditional infrastructures such as a rail way line in a greenway strategy can increase the amount of train users, with benefits both on accessibility to urban functions and for the environment. In fact, in this case we suggested the use of the railway corridor for a double objective: on the one hand, in order to take advantage of the existing space beside the railway line; on the other, to increase the combined usage of bicycle and train for different travel reasons.

Endnotes

1 http://ec.europa.eu/environment/nature/ecosystems/benefits/index_en.htm
2 https://osservatorioturistico.regione.sicilia.it/public/default

References

- Aa. Vv. (2008), *L'infrastruttura verde del parco del Po torinese*, Alinea Editore, Firenze.
- Aa.Vv. (1997), *Rail with trails. Sharing corridors for transportation and recreation. Rail to Trails Conservancy*, National Park Service, Washington, D.C.
- Ahern J. (1995), "Greenways as a Planning Strategy", *Landscape and urban Planning*, 33, pp. 131-155.
- Amoroso S., Migliore M. (2002), "Bike & railway: an integrated approach for an urban sustainable mobility", in *Proc. IX International Conference Living and Walking in Cities*, Brescia e Piacenza, 13 – 14 giugno 2002.
- Angrilli M. (1999), "Greenways" in *Urbanistica*, n. 113, INU, Roma, pp. 92-97.
- Banister D (2008), "The sustainable mobility paradigm", *Transport Policy*, 15 (2), 73-80.
- Benedict M.A., McMahon E.T. (2006), *Green Infrastructures. Linking Landscapes and Communities*, Island Press, Washington.
- Bergamaschini I. (2014), "Grandi ciclovie tra turismo e mobilità sostenibile", *Ecoscienza*, 3, ARPAE Emilia Romagna.
- Bertolini L. (2017), *Planning the mobile metropolis. Transport for people, places and planet*, Palgrave, London.
- Bhat C.R. (1995), "A heteroschedastic extreme value model of intercity travel mode choice", *Transportation Research, part B: Methodological*, vol. 29, n. 6, pp. 471-483.
- Bierlaire M. (2002), "The total demand scale: a new measure of quality for static and dynamic origin-destination trip tables", *Transportation Research, part B: Methodological*, vol. 36, pp. 837-850.
- Black W.R. (1996), "Sustainable transportation: A US perspective", *Journal of Transport Geography*, 4 (3), pp.151-159.
- Buehler R., Pucher J. (2012), "Cycling to work in 90 large American cities: New evidence on the role of bike paths and lanes", *Transportation*, 39, pp. 409-432.
- Cantarella G.E. (1997), "A general fixed-point approach to multimodal multi-user equilibrium assignment with elastic demand", *Transportation Science*, 31, pp. 107-128.
- Cascetta E. (1984), "Estimation of trip matrices from traffic counts and survey data: a generalized least squares estimator", *Transportation Research, part B: Methodological*, vol. 18, pp. 289-299.
- Cascetta E., Inaudi D., Marquis G. (1993), "Dynamic estimators of origin-destination matrices using traffic data", *Transportation Science*, vol. 27, pp. 363-373.
- COM (2011), *Our life insurance, our natural capital: an EU biodiversity strategy to 2020*, Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions, Luxembourg.
- Costanza R., Darge R., Degroot R. *et. al.* (1997), "The value of the world's ecosystem services and natural capital", *Nature*, vol. 387, pp. 253-260.
- Cremaschi M. (2005), *L'Europa delle città. Accessibilità, partnership, policentrismo nelle politiche comunitarie per il territorio*, Alinea Editrice, Firenze.
- Davies C., Hansen R., Rall E., Pauleit S., Lafortezza R., De Bellis Y., Santos A., Tosics I. (2015), *Green infrastructure planning and implementation. The status of European green space planning and implementation based on an analysis of selected European city-regions*, University of Copenhagen, Copenhagen.
- ESPON (2005), *Potentials for polycentric development in Europe*, Project 1.1.1, Final Report, Luxembourg.
- ESPON (2013), *EU-LUPA. European Land Use Pattern*, Applied Research 2013/1/8, Draft Report June/2012, Luxembourg.
- ESPON (2014), *TOWN. Small and medium sized towns in their functional territorial context*, Applied Research 2013/1/23, Final Report, Luxembourg.
- Fabos J. (1995), "Introduction and overview: the greenway movement, uses and potentials of greenways", *Landscape and urban planning*, 33, pp. 1-13.
- Forman R.T.T., Sperling D., Bissonette J.A., Clevenger A.P., Cutshall C.D., Dale V.H., Fahrig L., France R.L., Goldman C.R., Heanue K., Jones J., Swanson F., Turrentine T., Winter T.C. (2003), *Road ecology. Science and Solutions*, Island Press, Washington D.C.
- Gill S., Handley J., Ennos R., Pauleit S. (2007), "Adapting Cities for Climate Change: the Role of the Green Infrastructure", *Built Environment*, 33, pp. 115-133.

- Grieco M., Urry J. (2012), *Mobilities: new perspectives on transport and society*, Ashgate, Farnham.
- Hankey S. *et al.* (2012), "Estimating use of non-motorized infrastructure: Models of bicycle and pedestrian traffic in Minneapolis", *Landscape and Urban Planning*, 107 (3), pp. 307-316.
- Hansen R., Santos A. (2015), "Halle, Germany", in *Case Study City Portrait: part of a Green SURGE study on urban green infrastructure planning and governance in 20 European cities*, Trans-national research project funded through the European Union's 7th Framework Programme.
- Hickman R., Hall P., Banister D. (2013), "Planning more for sustainable mobility", *Journal of Transport Geography*, 33, pp. 210-219.
- Hristova S., Dragićević Šešić M., Duxbury N. (ed by.) (2015), *Culture and Sustainability in European Cities: Imagining Europolis*, Routledge, London-New York.
- La Rocca R.A. (2008), "Mobilità dolce e trasformazioni del territorio: esempi europei", *TeMA*, 3, pp. 57-64.
- Lo H.P., Zhang N., Lam W.H.K. (1996), "Estimation of an origin-destination matrix with random link choice proportions: a statistical approach", *Transportation Research, part B: Methodological*, vol. 30, pp. 309-324.
- Lovell S.T., Taylor J.R. (2013), "Supplying urban ecosystem services through multifunctional green infrastructure in the United States", *Landscape Ecology*, 28, pp.1447-1463.
- Malcevschi S., Bisogni G.L. (2016), "Infrastrutture verdi e ricostruzione ecologica in ambito urbano e periurbano", *Techne*, n.11, Firenze University Press, pp. 33-39.
- Marques-da-Cruz J., Costa Pinto E. (2015), "Landscape, beyond green and grey infrastructure", in Sinnet D., Smith N., Burgess S. (ed. by), *Green Infrastructure. Planning, Design and Implementation,* Edward Elgar, Cheltenham, pp. 317-335.
- Mastronardi L., Giannelli A. (2014), "I 'rami verdi' d'Italia: proposte per l'implementazione di sistemi integrati a basso impatto per la fruizione turistica del territorio: il caso della tratta ferroviaria Carpinone-Sulmona", in *Atti della XXXV Conferenza Scientifica Annuale dell'Associazione Italiana di Scienze Regionali*, Padova, pp. 1-23.
- Maternini G., Pezzagno M. (1999), "Le caratteristiche funzionali delle greenways – Un primo approccio metodologico", in *Atti del 2° Convegno Europeo sulle Greenways*, Milano, 22 ottobre 1999.
- Munoth N., Thakur S. (2017), "An approach to make the Indian cities sustainable through the concept of Blue - Green Infrastructure", in Moccia F.D., Sepe M. (ed. by), *Crisis and rebirth of Cities – 10° INU Study Day, Urbanistica Informazioni*, n. 272, INU, Roma, pp. 659-664.
- Oppido S. (2014), *La valorizzazione diffusa: il riuso del patrimonio ferroviario dismesso*, BDC, Università degli studi di Napoli Federico II, vol.14, pp. 221-236.
- Peraboni C. (2010), *Reti ecologiche e infrastrutture verdi*, Maggioli, Santarcangelo di Romagna.
- Pileri P. (2013), "Una strada leggera come Vento", *Tekneco*, 18, pp. 64-79.
- Rittel K. *et al.* (2014), *Grün, natürlich, gesund: Die Potenziale multifunktionaler städtischer Räume*, Bundesamt für Natuschutz (BfN), pp. 1-61.
- Rybarczyk G., Wu C. (2010), "Bicycle facility planning using GIS and multi-criteria decision analysis", *Applied Geography*, 30 (2), pp. 282-293.
- Santos A., Santos Reis M., Branquinho C. (2015), "Almada, Portugal", in *Case Study City Portrait: part of a Green SURGE study on urban green infrastructure planning and governance in 20 European cities*, Trans-national research project funded through the European Union's 7th Framework Programme.
- Servillo L., Atkinson R., Hamdouch A. (2017), "Small and medium-sized towns In Europe: conceptual, methodological and policy issues", *Tijdschrift voor Economische en Sociale Geografie*, 108 (4), pp. 365–379.
- Socco C., Cavaliere A., Guarini S. (2007), *L'infrastruttura verde urbana*, Osservatorio Città Sostenibili, Dipartimento Interateneo Territorio - Politecnico e Università di Torino.
- Steiner F.R. (2010), *The Living Landscape: an Ecological Approach to Landscape Planning*, Island Press, Washington.
- Száraz L., Gerőházi E. (2015), "Szeged, Hungary", in *Case Study City Portrait: part of a*

Green SURGE study on urban green infrastructure planning and governance in 20 European cities, Trans-national research project funded through the European Union's 7th Framework Programme.
- Toccolini A., Fumagalli N., Senes G. (2004), *Progettare i percorsi verdi. Manuale per la realizzazione di green way*, Maggioli Editore, Rimini.
- Torricelli M.C. (2016), *ES-LCA e patrimonio naturale: Life Cycle Analisi ambientale e sociale di un'area protetta*, Firenze University Press, Firenze.
- Uzzel D., Groger J., Leach R., Wright A., Ravenscroft N., Parker G. (2000), *User Interaction on non-motorized shared use routes. Final Report to the Contryside Agency*, University of Surrey.
- Valentini A. (2005), "Mettere in rete le risorse: le greenway quali strumenti per il progetto del paesaggio periurbano", in *Quaderni della Ri-Vista Ricerche per la progettazione del paesaggio*, Firenze University Press, pp. 15-26.
- Van der Jagt A. Ambrose-Oji B., Davies C. (2015), "Bristol, United Kingdom", in *Case Study City Portrait: part of a Green SURGE study on urban green infrastructure planning and governance in 20 European cities*, Trans-national research project funded through the European Union's 7th Framework Programme.
- Wang Y. *et al.* (2016), "A review on the effects of physical built environment attributes on enhancing walking and cycling activity levels within residential neighborhoods", *Cities*, 50, pp. 1-15.
- Wong K.I., Wong S.C., Tong C.o., Lam W.H.K., Lo H.K., Lo H.P., Yang H. (2010), "Estimation of Origin-Destination Matrices for a Multimodal Public Transit Network", *Journal of Advanced Transportation*, vol. 39, n. 2, pp. 139-168.

Ignazio Vinci
Department of Architecture, University of Palermo
ignazio.vinci@unipa.it

Ignazio Vinci is Associate Professor of Urban planning at the University of Palermo. As researcher and consultant he has worked extensively on urban policy in Europe and Italy, urban regeneration and local development, strategic planning, innovation in spatial planning and territorial governance. On these topics he has published around 120 works, including his latest book *The spatial strategies of Italian regions* (2014). Between 2014 and 2015 he was guest lecturer at the University College of Dublin (UCD), while since 2015 is member of the Governing Board of the European Urban Research Association (EURA).

Fabio Cutaia
Department of Architecture, University of Palermo
fabio.cutaia@unipa.it

Fabio Cutaia is PhD in Urban and Regional Planning at the University of Palermo with a thesis on the evaluation of landscape resources in the spatial planning processes. His interests include the analysis of landscape transformations, the urban development dynamics and the innovation of spatial planning instruments. Author of several publications in scientific journals, conference proceedings, books and chapters, at this moment he is working in the field of ecosystem services, green infrastructures and sustainable.