ARCHITECTURE HERITAGE and DESIGN

Carmine Gambardella

XVI INTERNATIONAL FORUM

Le Vie dei Mercanti

WORLD HERITAGE and KNOWLEDGE

Representation | Restoration | Redesign | Resilience

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Collana fondata e diretta da Carmine Gambardella

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WORLD HERITAGE and KNOWLEDGE
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Le Vie dei Mercanti
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WORLD HERITAGE and KNOWLEDGE
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Le Vie dei Mercanti _ XVI International Forum

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Le Vie dei Mercanti
XVI International Forum

Napoli | Capri
14 - 15 - 16 June 2018

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Scholars has been invited to submit researches on theoretical and methodological aspects related to Smart Design, Planning and Technologies, and show realapplications and experiences carried out on this themes.Based on blind peer review, abstracts has been accepted,conditionally accepted, or rejected.Authors of accepted and conditionally accepted papershas been invited to submit full papers. These has beenagain peer-reviewed and selected for the oral session and publication, or only for the publication in the conference proceedings.

Conference report

300 abstracts and 650 authors from 36 countries:

Albania, Australia, Benin, Belgium, Bosnia and Herzegovina, Brasil, Bulgaria, California, Chile, China, Cipro, Cuba, Egypt, France, Germany, Italy, Japan, Jordan, Kosovo, Malta, Massachusetts, Michigan, Montserrat, New Jersey, New York, New Zealand, Poland, Portugal, Russia, Slovakia, Spain, Switzerland, Texas, Tunisia, Turkey, United Kingdom.

160 papers published after double blind review by the International Scientific Committee

Preface

In the present era, technologies are becoming increasingly important in helping and supporting man in research, knowledge and production activities, almost as if they were smart prostheses. With the theme of the XVI Forum "World Heritage and Knowledge", I propose to the International Scientific Community to debate and establish a comparison of knowledge carriers to communicate methodologies of good practices adopted and experiences in the use in the protection, conservation and safeguarding of cultural heritage and landscape as well as in the design of the "new, "that, adopting in the building processes and building construction Innovative Building Modelling, can realise a non-contemporaneity of what has the same date (Giulio Carlo Argan) respectful of the values of the pre-existing, legitimate because it participated ex ante and monitored becoming all its ethical, aesthetic and performance connotations.

With the Internet of things, for example, sensors that are used to produce data autonomously that widen the processes of knowledge on all levels, from the territory with its infrastructures, to the environment, to the artefacts entering into the body itself of their physicality, or, in the case of the new, building the project as a prediction throughout physical consistency.

Nevertheless, the use of new technologies allows for economies of scale, both temporal and economical, not only for the surveying and representation of the built and the territory in the analysis phase but above all for the management of the resulting data that makes the design activity of the restoration of the historical heritage and landscape or of the newly constructed in a single process no longer divided into steps but also unitary in concrete constructions and the realisation of the works, in the intermediate checks, in the testing, in the monitoring and in the programmed maintenance.

In conclusion, it is indispensable for the scientific community to highlight how technologies, without a responsible attitude that commit man's choices and knowledge in dealing with and planning appropriate responses to the issues and needs of the collective, can create a deception that unfortunately materialises with the subtle persuasion of uncontrolled astonishment that overwhelms the imagination.

Carmine Gambardella

President and Founder of the Forum

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Green infrastructures and Eco-Planning: the Aversa conurbation

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Abstract
Contemporary cities and territories are undergoing structural transformation both morphologically as well as in terms of social, political, economic and symbolic relationships; such new urban conditions have also led to loss of identity. The planning discipline takes two opposing positions on this topic: one vacillates on accepting these models as contemporary urban landscapes with indifference toward problems like sprawl and land consumption, while the other adopts a critical viewpoint and seeks tools and spaces to redefine the contemporary city if not as a fait accompli, at least as a structured fact. The second viewpoint often coincides with peri-urban and regional landscape planning and design. It is not only the solid that produces the form of void space, but it is the void that penetrates the solid, redefining and requalifying it, giving form to the urban settlement. Green infrastructure plays an important role in this context. This paper begins with an overview of the green economy to then examine some definitions of green infrastructure. It proceeds to analyze the functions and performances of ecosystems for humans provided by green infrastructure and presents a design proposal for green infrastructure in the Aversa Conurbation in the wake of the Regi Felix project by Andreas Kipar for the environmental regeneration of Regi Lagni area. The paper concludes with some general remarks unrelated to the specific territorial context.

Keywords: Environmental Territorial Planning, Eco-Planning, Urban Ecosystem, Green Infrastructures.

1. Green economy and ecosystem services
The economic crisis of the last decade that has impacted countries with liberalized economies tied to the financial markets requires structural reforms and a radical change of perspective to take into account factors barely considered previously, such as improving ecosystem services [1] by developing strategies and suitable technical/legal frameworks. A green “new deal” for Italy based on the green economy [2] can help overcome this economic and environmental crisis by transitioning to more equitable and sustainable development. However, profound reconsideration of the role of natural capital [3] is necessary for achieving this goal. The renewal of the traditional economy will have to be based on high ecological quality, on landscape-environmental regeneration and on the enhancement of natural capital as preconditions for avoiding growth without development. The green economy pursues wellbeing and equity, significantly reducing the risks deriving from environmental decay and scarcity of resources. It has been defined in terms of two interdependent measures: sustainable development and the eradication of poverty. To pursue the first, focus must move to the recovery/requalification of natural capital and the enhancement of ecosystem services; the second goal must seek employment growth and the revival of the economy, severely compromised by unruly and hyper-consumerist development models aimed only at GDP [4] growth. In the long run, healthy and resilient natural ecosystems are necessary for society and for the economy and are crucial for the quality of life. The concept of ecosystem service lies at the heart of the process of enhancing natural capital and is an important reason for preserving nature and biodiversity [5].
Biodiversity is the main component creating in the richness and functionality of ecosystems. Depletion of biodiversity causes serious decay of ecosystem quality and the reduction of its functionality and service capacity. Ecosystem services can materialize through the flows provided by stocks of natural

capital, most of which are essential for the life of people and nature itself. Ecosystem services are made up of flows of matter, energy and information coming from the stocks of natural capital; these are combined with the services of anthropogenic artefacts to generate wellbeing and quality of life [1]. Nature is the foundation of life on our planet. Its complexity and extraordinary capacity for transformation and adaptation allow it to sustain a large number of interdependent forms of life and to ensure the resilience of ecosystems [6] and the services provided to humanity. Indeed, nature provides essential services of support, regulation, supply and culture. It therefore produces, consumes and provides employment according to its own logic, which people cannot replace except to a very limited extent. It is therefore a substantial part of every economy; any change to its fundamental performance translates into reducing possibilities for generating value. Global-scale analyses show a dangerous decline in the productivity of ecosystems in terms of services rendered. To halt this phenomenon, it is first necessary to undertake rigorous study in order to identify possible measures to implement in each region, clarifying the extent of the problem for decision-makers and citizens. This analysis, with a view to integrating data into new environmental accounting systems [7] (overcoming GDP econometrics) is particularly urgent in Italy where natural capital stocks are richer.

2. To define a green infrastructure

There is no unambiguous and shared definition of green infrastructure, but there are documents and proposals that can help outline a first profile. The broader definitions include both green spaces and their interconnections. The more restrictive definitions refer to connections between green spaces and to the concept of interconnectivity by more closely referencing the concept of ecological network [8].
Sites, hubs and links are the basic components of green infrastructure that encompasses a large variety of natural ecosystems and characteristic landscapes. Hubs are large portions of a territory that serve to anchor a network; they are made up of natural reserves, national parks, forests, farms, regional and local parks whose natural characteristics and ecological processes are protected or recovered. Links are the connections that hold the system together and allow the green infrastructure network to function. They are differentiated in terms of their size, function and characteristics and include: large protected areas that connect existing parks, rivers and other watercourses. Sites are similar to hubs but are much smaller and more localized; they include local parks and arboretums.
The Green Infrastructure Planning Guide [9], published in 2007 with the contribution of many UK institutions, defines green infrastructure as the physical environment within and between our cities. It is a network of multifunctional open spaces that includes parks, gardens, wetlands, green corridors, watercourses, rows of trees lining roads and the general countryside all of which contribute to the sustainable management of environmental resources. The meaning of the term is wide-ranging and covers a broad spectrum of typologies that includes natural reserves, urban green spaces, and even gray spaces that help improve the functionality of the green network.
In 2009, the American EPA (Environmental Protection Agency) described green infrastructure as a vast array of products, technologies and practices that use natural systems or engineered systems that imitate natural processes to improve overall quality and provide useful services. In general, green infrastructure uses the ground and vegetation for infiltration, evapotranspiration and/or recycling and runoff of rainwater. It is a multifunctional network of green spaces - newly constructed and existing, rural and urban - that encourages and supports natural and ecological processes. It is a basic component for the health, welfare and quality of life of the human community.
The European Commission (KH-32-10-314-ITC) states that green infrastructure, beyond SCI [10] and SPA [11] includes: healthy ecosystems and highly valued natural areas outside protected zones; natural and artificial landscape elements; multifunctional zones; areas for implementing measures to improve the overall ecological quality and permeability of the landscape; urban elements that host biodiversity and allow ecosystems to function and provide their services.
An effective green infrastructure is a network of corridors and spaces assembled from man-made, natural and mixed ecosystem components. Such components can be organized to mutually reinforce one another for efficient land use. Ideally the components are organized into networks of spaces and corridors [12] (Fig. 1). The Sustainable Cities Observatory at the Politecnico and the University of Turin defines green infrastructure as a well-appointed network that plays a dual role: as an ecological network, a system of natural landscapes that improve the natural patrimony and environmental quality of the networks of the city; and as a publicly utilized accessibility network meant as a system of green paths and routes that allow safe pedestrian or bicycle access to multiple recreational and work activities passing through places of high environmental and landscape quality. These two networks are integrated with two others: the cultural heritage network meant as the system of material memory incorporated into the territory as the basis for the built historic, agricultural and natural landscape; and the agricultural network made up of a system of farms intended as topologically organized productive units based on a network of roads and irrigation canals. Green infrastructure is made up of the integration of these four networks, which must find cohesive and cooperative coexistence within an overall infrastructure. The four networks serve different functions that might even be conflicting. They

can, however, find dynamic equilibria characterized by synergetic relationships and environmental compatibility.
Green infrastructure is simultaneously an ecological, historical/cultural and social/economic network whose presence is indispensable for ensuring that the urban network is endowed with environmental quality. A city devoid of good green infrastructure is a poor-quality city that is less livable and competitive. In the sustainable city scenario, green infrastructure should be considered of strategic importance for development just like transportation or energy infrastructure (gray infrastructure [13]). A multifunctional green infrastructure network must also be environmentally compatible with the hard infrastructure networks and urban settlements, intended as a system of buildings and facilities connected by linear infrastructure of different kinds.

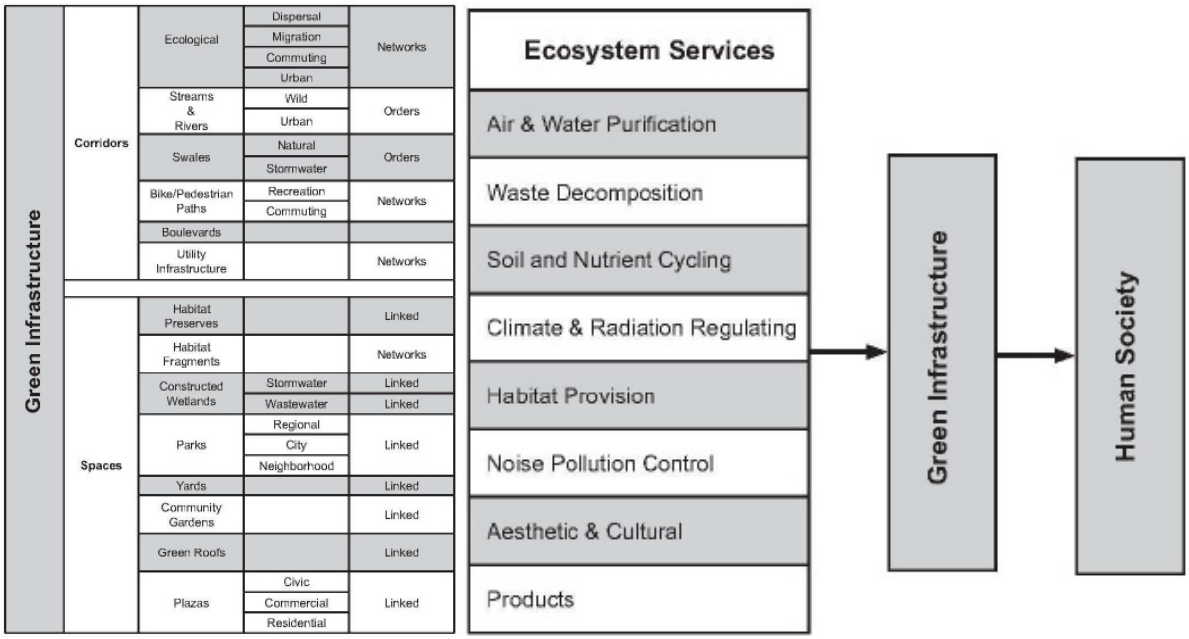

Fig. 1: On the left: A Green Infrastructure is a network of corridors and spaces. The components can be organized to reinforce each other and lead to land use efficiencies.
Fig. 2: On the right: Ecosystem Services and products are provided to people through green infrastructure. Services can be furnished only when the state of the ecosystem is maintained. The components indicated here are not independent; they are incorporated into and interact within an ecosystem.

The concept of green infrastructure recalls certain aspects of the ecological network. While an ecological network is monofunctional and refers more to ecosystem characteristics, green infrastructure is multifunctional, associating ecosystem factors with those tied to agriculture and forestry, recreational activities, mobility and more strictly landscape-related aspects.
The Italian Ministry of the Environment [14] defines green infrastructure as networks of natural and seminatural areas strategically planned with other environmental elements designed and managed to provide a wide array of ecosystem services. The green infrastructure network penetrates the landscape uninterruptedly to increase continuity of natural and seminatural areas, improve functionality and reduce barriers and waste. Nature is no longer reduced to an object of consumption and aesthetic enjoyment but recovers and puts at the center its role as provider of vital resources, rebalancing those imbalances caused by human activities.

3. Ecosystem functions and performance provided by green infrastructure

When human beings utilize the environment and its related products either directly or indirectly, they receive ecosystem services. This chapter will summarize potential ecosystem services and their benefits for people. In green infrastructure, there is a close connection between the health of the ecosystem and its ability to provide environmental services. It can be evaluated by six indicators: air quality, water quality, soil structure, energy cycle and materials, habitat and biodiversity, ecosystem resilience.
Products like wood, food and medicines are the most evident benefits/advantages provided by the ecosystem however many other important services include air and water purification, decomposition of waste, soil and nutrient cycling, climate and heat regulation, habitat preservation, management of noise pollution and aesthetic and cultural benefits. They can be classified into eight types (Fig. 2),

Ecosystem services that benefit people can, in turn, be broken down into four classes for the purpose of their evaluation: support, regulation, supply, and cultural services. Supporting the performance of ecosystems brings indirect benefits to people, while in the other three categories, the benefits are direct. The eight services and products interact among themselves and are organized according to the four assessment categories.
The benefits deriving from the support of ecosystem functions are products ranging from seafood to wood to fodder and other natural products that are commonly commercialised; they are ecosystem services provided on a vaster scale than generally associated with green infrastructure. Nonetheless, the network of paths, spaces and habitats within the city impact these products that come from distant places. Agriculture, forestry, and residential and public landscapes depend upon the maintenance of ecosystem support services such as: soil preparation and the nutrient cycle, habitat preservation, the water cycle, and primary production constitute support ecosystem services.
The benefits deriving from the regulation of ecosystem services like climate and radiation, temperature, wind, humidity, regulation of disease and parasites, water regulation and purification, storm protection, pollination, water treatment, and waste decomposition are all compensation services due to their ability to clean the air and dissipate pollution. Most trace gases emitted into the atmosphere are removed through oxidation in a process that normally preserves the composition of the atmosphere and climatic properties.
The benefits deriving from the provision of ecosystem services such as food, energy, fiber, biochemistry, and air purification are preconditions for human life and activities.
The benefits deriving from cultural ecosystem services (culture/aesthetics, health and leisure, tourism) are the premises upon which people can experience the beauty of the landscape, admire its patterns, colors, variety, and harmony, indeed the images of the landscape itself are a sensitive part of the territory and involve all senses.

4. A green infrastructure for the Aversa conurbation

The level territory of the Clanio river basin was known to the Romans who identified the agricultural potential of the area; in fact, they named it Campania felix. The river flowed in the most depressed furrow of the plain and flooded with every important rainfall, flowing into the coastal bog formed by it because waters blocked by the coastal dunes could no longer empty into to the sea. The descent of Hannibal and the subsequent betrayal of ancient Capua triggered the revenge of Rome that eliminated all State functions from the Etruscan city. The surrounding area, declared public agricultural land, was assigned to 20,000 former Roman legionnaires, veterans from prior wars. The area between the Clanio and the Volturno rivers was subdivided, leading to multiple reclamation works of the marshy lands with increased agricultural production. The classic gridded landscape, which survives today with the regular geometry of the Roman *limitatio*, is still recognizable in the latticework of country roads, irrigation canals, river banks or simply rows of trees. During Spanish domination, the need to provide food for the populous city of Naples led to rational reclamation work. In fact, this work provided for the creation of a large canal system (Regi Lagni) to collect the waters and correct the course of the Clanio (Fig. 3). This system required continuous maintenance, which was not always carried out by successive governments. The first public reclamation works were begun in 1539 by the Spanish viceroy, Don Pedro of Toledo, and completed in 1610 by the Viceroy Count of Lemos under the direction of Giulio Cesare Fontana, the son of Domenico Fontana. The length of the main Regi Lagni canal is about 55 km; its catchment area covers rural and urban areas. Their extension accounts for 17% and 83% of the total respectively.

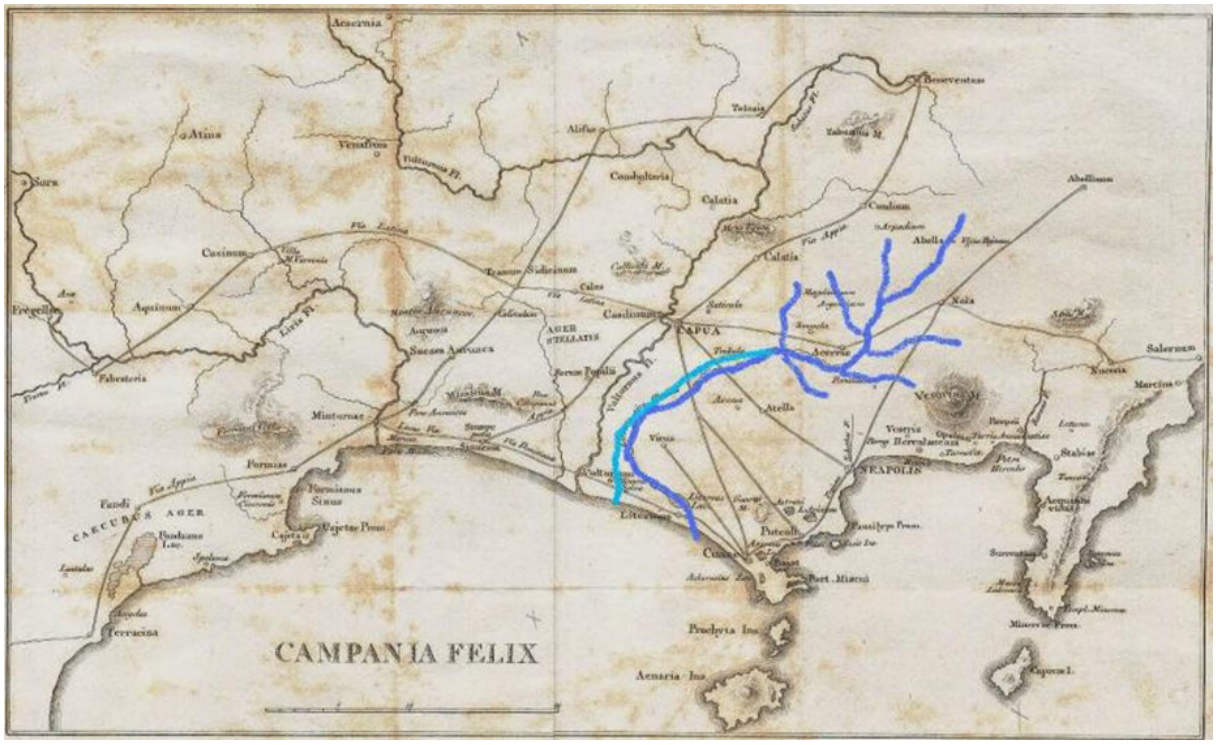

Fig.3: The course of the Clanio river in dark blue; the main Regi Lagni canal in light blue, on the right the Neapolitan gulf.

From 1915 on, at the same time as the transferral of jurisdiction over the reclamation work from the State to the owners' consortium, an electromechanical drainage system was adopted, today performed by eight powerful pumping stations. The Reclamation Consortium of the Lower Volturno Basin subsequently established a collective irrigation system, still under completion, leading to significant growth in agriculture in such sectors as beet farming, horticulture, specialized fruits, cultivation of products from industry and intensive cattle breeding. In the 20th century, with sudden acceleration after WWII lasting until today, human settlement near the Regi Lagni became a spontaneous, disorderly and haphazard process. Urban growth gave rise to the Aversana conurbation to the south with 19 municipalities and the Caserta area to the north with 20 municipalities; this growth had repercussions on the local administrations, which have proven to be incapable of finding solutions to supra-muncipal territorial problems. The municipalities in the Regi Lagni basin are influenced by this urban structure; they are endowed with different and often outdated urban planning instruments that are unable to understand present problems or provide answers to the real needs of the territory and its development thus causing widespread environmental, territorial and urban decay. The causes of environmental decay are many: surface water pollution, groundwater contamination, urban disorder and widespread illegal construction in urban centers and their outskirts. The causes of pollution are equally various: inadequate wastewater collection, networks unconnected to treatment plants, plant malfunctioning, presence of numerous illegal wastewater dumping sites (including abundant industrial sewage), deposits of contaminated sandy materials, and the presence of illegal and toxic landfills. The process of hydraulic reclamation that characterized the region in past centuries has now become a process of environmental rehabilitation and reclamation along with legal compliance. The aforementioned actions should be considered priorities and prerequisites for any form of development. Once the structural (material) and non-structural (intangible) measures have been implemented, a third phase of the reclamation/redevelopment program can be carried out. This calls for regional planning with important environmental content aimed reinforcing and incrementing the historic, cultural, environmental, landscape-related and recreational value of the entire area. Eco-Planning and green infrastructure are essential for pursuing these goals in order to overcome the concepts of ecological network and monofunctional, integrating the accessibility and public use network with the network of the agricultural fabric to compose a single system (Fig. 4).

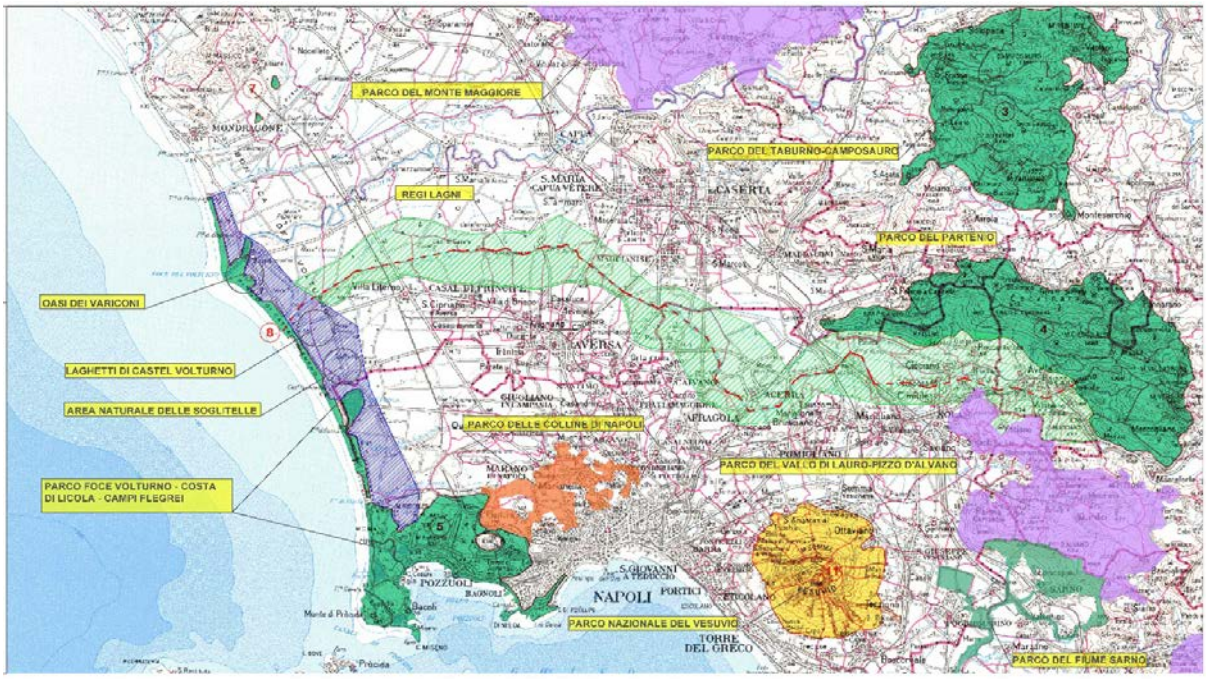

Fig. 4: Green infrastructure (shown in light green diagonal hatch) along the course of the Regi Lagni, also an ecological corridor between the protected coastal areas and the Apennine areas. The area could be established as an urban park pursuant to the Campania Regional Law n. 17/2003.

The integration of numerous networks seeks to protect and enhance regional specificities and associate naturalistic and landscape elements with mobility, productivity and recreational activities. For the identification of the correct plan form and the definition of its proper limits, territorial analyses of the natural/environmental subsystem characterized by green areas, the hydrographic network and the urban subsystem (including the urbanized fabric and the main existing functions, the relational subsystem, defined by the dense road network, by the more modest railway network and by a scarce, if not non-existent, cycle/pedestrian network) were drawn up. These analyses helped define a structural plan having variable limits based on different goals and management criteria as the proper plan form. The Environmental Restructuring Plan pinpoints an organic system of general and specific measures aimed at enhancing the region and its products while restoring, insofar as possible, environmental and landscape harmony in coordination with the Regi Felix proposal (creation of the large ecological corridor project for the Regi Lagni) (Fig. 5) structured by the following elements:

Fig. 5: *Regi Felix* project, Environmental/landscape masterplan Studio LAND, Arch. A. Kipar, Milano.

Multipurpose agricultural park. The aim is to create a park that defines the limits to urban centers and areas for future urbanization in order to establish a green belt characterized by recreational and service areas and exclusively agricultural and similar activities, like botanical gardens, nurseries, cultural and scientific research centers for the experimentation of agricultural techniques and the selection of botanical species.
Revegetation with medium-tall specimens. The edges of the railway infrastructure and B-type roads will be characterized by tall tree specimens with the exclusive use of indigenous species. This measure is aimed at mitigating the environmental impact of the infrastructure, reducing noise pollution, and enhancing traditional local products.
Renewable energy park. This is intended both as a center for applied research on renewable energies with particular focus on photovoltaics, and as a network of various energy production facilities.
Quality agriculture and production chain. Local crops will be planted in large areas with an integral organic system that can guarantee profitable and high quality products. Measures will be introduced to promote direct sales by producers and their access to the fruit and vegetable markets. At the same time, measures will be taken to implement and develop all necessary activities for the transformation and conservation of products.
Agricultural area to support breeding. Environmental improvement of vast areas for cultivating herbaceous species, which can partially fulfill the region's widespread zootechnical requirements, especially concerning buffalo breeding. To limit the impact of the biological pollutants caused by these activities, measures will be taken to develop and install electricity and heat production systems based on cogeneration processes. The construction of sludge farms in order to generate biogas to be used as a source of renewable energy will be encouraged.
Re-naturalization of the Regi Lagni. Corresponding to green areas identified for leisure and sports, the renaturalization of small sections of the Regi Lagni can regenerate conditions that are useful both for the realization of an ecosystem that respects biodiversity and the biological cycle as well as the restoration of natural characteristics to guarantee full usability of the area. The naturalistic and hydraulic engineering measures, together with landscape measure should interest the entire course of the river.
Equestrian - Pedestrian - Cycling Trails. A system of low-speed, unpaved road structures will connect different areas and allow their use.
Recreational areas. These are areas and amenities including a visitors' center with facilities for promotional activities and assistance for guided tours, a multi-purpose space with classrooms, and a nature trail with informational signage and observation points.
Improvement of the Caserta - Grazzanise airport. After analyzing the infrastructure system, it became clear that, through the realization of 2.5 Km of the railway network, it might be possible to connect the Caserta-Grazzanise airport to the Rome-Naples express line, thus providing users with a service that can reach Naples in 30 minutes and Rome in 60. Currently the airport is a military infrastructure (Fig. 6).

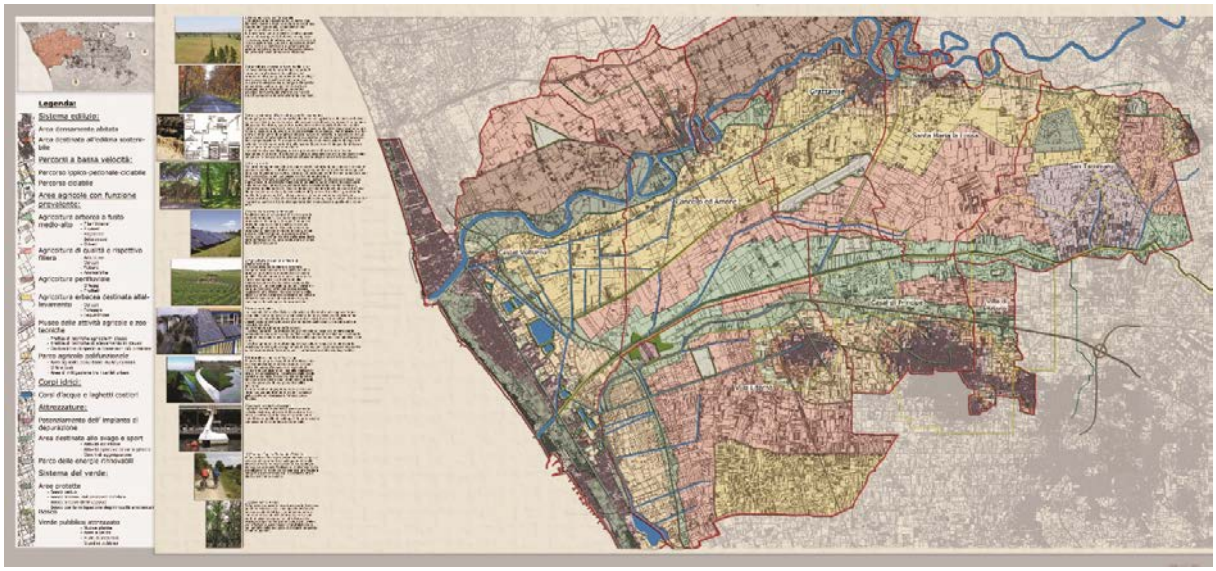

Fig. 6: Map from the Structural Plan for the Environmental Restructuring of the last section of the Regi Lagni towards the Tyrrhenian Sea.

From a legislative point of view, the Regional Regi Lagni Park can be established according to Regional Law n. 17/2003; this would allow the creation of an ecosystem network that begins at the sea (Foce Volturno-Costa di Licola Nature Reserve) and reaches the Apennines, specifically the Regional Parks of Partenio and Vallo di Lauro - Pizzo d'Alvano, part of the *Apennine Park of Europe - APE* [15] program, thus greatly increasing biodiversity. From a management point of view, this kind of park allow the collaboration of all the municipalities falling within its jurisdiction as well as the autonomous management of their individual portions of the park.

5. Some conclusive remarks

The implementation of green infrastructure promotes an integrated approach to land management and can bring about positive effects from a socio-economic point of view. Let us just think of the containment of the damage resulting from hydrogeological instability, the battle against climate change and the reestablishment of the quality of the air, water, and soil. The concept of green infrastructure recalls practices of re-naturalization, construction with nature and biomimicry [16], while infrastructure encompasses human intervention and the functional and potentially massive use of measures to mitigate the serious ecological crises underway today.

Innovative green infrastructure plans and measures are being implemented mainly in the United States and the United Kingdom, where there is a firm belief that green infrastructure should be considered equally important as gray infrastructure. Indeed, if the latter constitutes the built capital of our cities and is necessary for the economic development of a region, green infrastructure represents the natural capital necessary for guaranteeing ecological sustainability, offering a wide range of social, economic and environmental benefits. Ensuring that both types of infrastructure function properly is the key to sustainability, insofar as both play equally vital roles in maintaining the quality of life of our cities (National Land Consumption Observatory, 2009). Investments in green infrastructure are generally characterized by a high return over time, providing new job opportunities and are often a beneficial and complementary alternative to gray infrastructure and intensive land use. Green infrastructure serves the interests of people and nature.

From this perspective, traditional planning should move towards eco-planning [17] to reconcile the enhancement of the territory and landscape with new, more sustainable models based on the improvement of natural capital through the redevelopment of brownfield sites, rehabilitation, regeneration, re-naturalization, recovery and re-use of already urbanized areas, limiting or completely eliminating land consumption especially in terms of soil-sealing [18]. Non-urbanized land, including rural areas, is a set of ecosystems of strategic interest insofar as they furnish essential environmental services in terms of biodiversity and landscape quality, such as carbon sinks [19], hydrogeological structure, precipitation absorption, water runoff, slope stability, as well as agri-food production. It is therefore necessary to limit and/or eliminate land consumption [20] in its various forms - especially agricultural land – in order to protect the environment and the ecosystem and as a fundamental strategy for the structure of the national territory. This should be implemented by integrating two approaches: one concerning ecosystems with green infrastructure measures for strengthening their natural resilience, and the other through regulatory measures with integrated codes for the protection and development of the territory as a resource. With these ends in mind, it is also necessary to create regional planning tools that incorporate green infrastructure and re-naturalization, especially in the built context. Today, green infrastructure is probably the most promising tool for developing necessary biodiversity strategies and for adapting to and mitigating climate change.

Attributions

Within the present paper, personal contributions can be identified as specified as follows: *Green economy and ecosystem services* by Luigi Macchia, *Abstract, To define a green infrastructure, Ecosystem functions and performance provided by green infrastructure, A green infrastructure for the Aversa conurbation* and *Some conclusive remarks* by Salvatore Losco.

Bibliographical References

[1] The guiding definition of this precious concept was provided by COSTANZA Robert in: *The value of the world's ecosystem services and natural capital,* Nature, vol. 387, 1997, p. 253-260. It was later adopted as a paradigm and definitively consecrated in the scientific and political literature, see: Millennium Ecosystem Assessment, of the United Nations (MEA, 2001).

[2] Green economy is understood as an instrument for sustainable development based on the improvement of economic capital (investments and revenues), natural capital (primary resources and environmental impacts) and social capital (employment and well-being), just as sustainable

development is based on three dimensions: economy, society and the environment. If in its early stages, the definition of green economy tended to be identified as a small part of the economy referred to the so-called environmental industry and, in particular, to the renewable energy sector. Today it is recognized as a tool that can be applied in all sectors of production of goods and services, as well as the conservation and sustainable use of natural resources.

[3] From a historical point of view, the term “natural capital”, introduced in 1973 by E. Schumacher in his bestseller *Small is Beautiful: A study of economics as if people mattered,* is connected to narratives regarding artificial worlds like *Biosphere 1 and 2* and to economic models like *Natural Capitalism* by Hawken and Lovins (1999). Scientifically consolidated in the works of Robert Costanza, the term definitively entered the language of development policy with the World Bank’s publication, *The Wealth of Nations* (2006).

[4] In macroeconomy, the Gross Domestic Product - GDP - measures the aggregate market value of all finished goods and services produced within the borders of a nation in a given period of time. The notion of product therefore refers to the goods and services that are valued within an exchange process.

[5] The concept of biodiversity is complex. Biodiversity is defined on genetic, specific and systemic levels. Not only are quantitative aspects taken into account, but so are those that concern spatial distribution and interactions. Loss is expressed in the number of (known) species that disappear each year due to anthropogenic causes. Since 1992, protection has been entrusted to the United Nations Framework Convention, the UNCBD, which defines it as: the variability of any origin of living organisms, including, among others, the terrestrial, marine and other aquatic ecosystems ecological complexes of which they are part; this includes diversity within species, between species and between ecosystems.

[6] An ecosystem is a dynamic complex of plants, animals, microorganism communities, and non-living components that interact as functional units, of which man is an integral part, see ASH, Neville BLANCO Hernán, GARCIA Keisha, TOMICH Thomas, VIRA Bhaskar, ZUREK Monika, and BROWN Claire. *Ecosystems and Human Well-being. A manual for assessment practitioners,* Island press, Washington DC, 2010.

[7] Environmental problems and costs are not reflected in public accounts, which are still formulated according to purely administrative criteria. To move towards sustainability, new tools must identify, account for, manage and communicate environmental costs and benefits. Environmental accounting is one such tool; it can be defined as a system that allows the detection, organization, management, and communication of environmental information and data, the latter expressed mostly in both physical and monetary units. It refers to social budgeting and, therefore, to the growing need for both public and private organizations to develop reporting systems that are not only economic and financial, but also social and environmental, that can quantify the overall impact of their activities on civil society and on the environment/territory.

[8] One of the most widespread definitions considers the ecological network as an interconnected habitat system that safeguards biodiversity, and thus focused on potentially threatened animal and plant species. Working on the ecological network means creating and/or strengthening a system of connections and interchanges between areas and isolated natural elements, counteracting fragmentation and its negative effects on biodiversity, see http://www.isprambiente.gov.it/it/progetti/biodiversita-1/reti-ecologiche-e-pianificazione-territoriale/reti-ecologiche-a-scala-locale-apat-2003/cose-una-rete-ecologica.

[9] DAVIES Clive, MACFARLANE Rob, MCGLOIN Chris., ROE Maggie. *Green infrastructure. Planning Guide,* English nature, Forestry commission, Ground work, Landscape access recreation, North east community forests, Northumbria University, University of Newcastle, 2007, p. 2-43.

[10] Sites of Community Importance (SCI) define areas that contribute significantly to maintaining and restoring habitat types and/or maintaining the species defined in Annexes 1 and 2 of the Habitats Directive in a satisfactory state of conservation in order to contribute significantly to maintaining the biodiversity of its regional context.

[11] Special Protection Areas (SPAs) are located along avifauna migration routes. The regulations seek to maintain and define suitable habitats for the conservation and management of wild migratory bird populations. These areas are identified by European Union member states and, alongside the Special Areas of Conservation (SAC), constitute the Nature 2000 Network.

[12] TZOULAS Konstantinos, KORPELA Kalevi, VENN Stephen., YLI-PELKONEN Vesa, KAŹMIERCZAK Aleksandra, NIEMELA Jari, JAMES Philip*. Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review,* Landscape and Urban Planning, vol. 81, issue 3, 2007, p. 167-178.

[13] YEANG Ken. *EcoMaster-planning*, John Wiley & Sons, London, 2009, describes an innovative approach to master-planning based on the ecological concept of physical planning intended as the bio-integration between the built context and natural systems. Over 20 masterplans created by the author all over the world are examined; in these, the primary goal was to remedy current environmental imbalances in order to reduce the impact of built systems on the environment. The author structures the natural and the man-made environment within a single system made up of 4 infrastructures (green, blue, gray and red). With respect to conventional master-planning which, in many cases, irreversibly modifies ecosystems, ecomasterplanning tries to preserve the integrity, connectivity and operativity of a given site. Eco-planning, in fact, aims to create, through design, a single dynamic living system containing the man-made environment and the natural one that is both interactive and functional and requires the bio-integration of the four infrastructures. Green infrastructure is nature eco-infrastructure. Blue infrastructure is water eco-infrastructure (ie natural drainage, water conservation systems and hydrological management in general). Gray infrastructure is the engineering infrastructure, (ie roads, sewers, drain pipes, etc. as support systems sustainable for urban development). Red infrastructure is the human infrastructure meaning the built context, including human activities and the economic, legislative and social systems. Their integration provides the basis for eco-planning and eco-city design.

[14] National Conference, *La Natura dell'Italia: Biodiversità ed Aree protette: La Green Economy per il rilancio del Paese*, December 11-12, 2013, Rome.

[15] The Apennine Park of Europe - APE program is the brainchild of Legambiente and the Abruzzo Region. The Apennine parks constitute a network that has at its center a vast and almost entirely protected territory. By virtue of their intrinsic dynamics that leads them to "infect" surrounding areas, they constitute a system that is closely linked not only to the rest of the mountain areas, but also to the small cities with which it is possible to undertake original economic relations and test a model that can combine environmental protection with economic development.

[16] See: http://biomimicry.net/about/biomimicry38/institute/

[17] LOSCO Salvatore, MACCHIA Luigi. *Urban planning and environmental sustainability toward innovation*. In TADEAU António, URAL Derin, URAL Oktay, ABRANTES Vitor (edited by) *40th IAHS World Congress on Sustainable Housing Construction.* Coimbra, ITeCons - Instituto de Investigação e Desenvolvimento Tecnológico em Ciências da Construção, 2014, p. 1-12.

[18] Soil Sealing: change in the nature of the soil in such a way that it becomes an impermeable medium due both to certain agricultural processes (compaction) and the use of impermeable materials to cover it. The importance of impermeabilization of the ground, resulting from urbanization and the creation of transport infrastructure, is recognized by the EU as one of the main threats to European soils. Soil Sealing is one of the eight main threats indicated in the Soil Thematic Strategy together with: erosion, reduction of organic matter, local and widespread contamination, compaction, decrease in biodiversity, salinization, flooding and landslides. European Commission. *Sealing Guidelines*, Bruxelles, 2012.

[19] The UNFCCC (United Nation Framework Convention on Climate Change) defines carbon sink as *any process, activity or mechanism to remove greenhouse gases, aerosols or precursor of greenhouse gases from the atmosphere. Carbon sinks are therefore activities, processes, or mechanisms of removal (and sequestration) of carbon dioxide (CO_2) from the atmosphere*.

[20] LOSCO Salvatore, MACCHIA Luigi. *Problemi di metodo nella quantificazione del consumo di suolo: La Conurbazione Aversana*. In AA.VV. Atti SIU XVIII Conferenza Nazionale. Roma-Milano, Planum Publisher, 2014, vol. 29, p. 1032-1043.

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