Working with urban and territorial resilience in multi-risk environments. The case of Bagnoli, in the western area of Naples, Italy.

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Introduction

Climate change and rapid urbanization processes are urging contemporary cities to face unprecedented sustainability and resilience challenges (IPCC 2019).

In addressing the complex and interconnected challenges of multi-risk urban contexts, it is becoming clear that an approach to spatial research and policy needs to be increasingly integrated, multidisciplinary and multiscale. In this context, achieving resilience in critical urban contexts becomes an important challenge, as it involves the ability of cities and communities to cope with, adapt to, and recover from a wide range of hazards, including environmental, natural, and man-made hazards. Urban research and policies should integrate the concept of multi-hazard resilience, considering the interconnections between different factors and adopting a holistic approach that takes into account the multiple dimensions of vulnerability and adaptive capacity of urban communities.

This contribution aims to deepen the definition of urban resilience widely shared by the scientific community, and to focus on how it declines in critical and multi-risk contexts. The slow remediation process in the area of Bagnoli, in Naples (Italy), is described as a study case.

Research background and questions

According to the UN (UN-Habitat, 2022) Program on Human Settlements, resilience refers to the ability of an urban system to maintain its structure in response to various environmental shocks and stresses, adapting and regenerating, while promoting positive and sustainable change (Glossary Climate ADAPT). A resilient city is one that assesses, plans and acts to prepare to respond to all hazards, both sudden and slow-onset, anticipated or unforeseen, that may threaten the stability of the environmental, social and economic system.

In today's urban policies and studies, resilience must be at the heart of the cities of the future. Working on resilience is a process aligned with 17 Sustainable Development Goals of the Agenda 2030. Making cities and human settlements inclusive, safe, resilient and sustainable is a top priority for SDG 11, also the Paris Agreement prioritizes resilience and adaptation to multi-hazard (UNDRR/ISC) to reinforce the international response to climate change. The United Nations launched the Cities and Climate Change Initiative (CCCI) in 2023, headed by UN-Habitat, to face resilience and climate change adaptation in a coherent and interconnected vision.

Under the National Recovery and Resilience Plan, in line with Missions 2 and 5, funds have been allocated for resilience, land development and energy efficiency in municipalities along with urban regeneration investments aimed at reducing marginalization and social degradation.

Initiatives to improve urban resilience include the Sendai Framework for Disaster Risk Reduction (2015–2030) by the United Nations Organization (UNDRR, 2015), the Rockefeller Foundation's "100 Resilient Cities'' programme and related indices (Rockefeller Foundation, 2015) and the MCR 2030 programme curated by the United Nations Office for Disaster Risk Reduction (UNDRR). The idea of resilience has come to light in the current discussion on disaster risk reduction and management as a crucial framework for understanding and dealing with the complexity of multi-hazard contexts. In a multi-hazard environment, resilience is achieved through the combination of tactics and approaches that improve ecosystems' and communities' ability to withstand and recover from a variety of concurrent or sequential disasters. In this context, the concept of urban resilience highlights the need for reliable urban transformation projects to improve land safety and the habitability of cities (Russo 2020).

RETURN: Focusing on urban resilience

The Extended Partnership PE 3 *RETURN* (*Multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate*) is funded by the European Union Next-GenerationEU, within the National Recovery and Resilience Plan. RETURN aims to reinforce national research chains on environmental, natural and anthropic risks by understanding their interrelations with climate change in order to enhance methodologies for prevention, adaptation and mitigation and to develop shared knowledge for effectively managing disaster risk. Thanks to the involvement of diverse research institutions, public administrations, stakeholders and private companies, RETURN studies risks as complex multidimensional phenomena through a multidisciplinary perspective, and focusing on different aspects, from the most traditional field of Disaster Risk Management studies (UNISDR, 2016) such as water, ground instabilities, earthquakes and volcanoes, environmental degradation, to new and complementary fields such as circular metabolism in urban and metropolitan settlements, multi-risk resilience of critical infrastructures. The research addresses the resilience of communities through the social, economic, legal and cultural dimensions of risk and with the tools of scientific science underlying climate services for risk mitigation and adaptation, also through bio-based solutions. The approach will be tested in the Urban Living Labs (Chronéer et al., 2019). Being RETURN an ongoing research, this contribution reports the first outcomes from Spoke 5 - TS1 “Urban and metropolitan settlements'', Task 4.4 entitled “Towards a circular metabolism for urban and metropolitan settlement” which discusses the contribution of urban planning disciplines and techniques to risk management of multi-risk areas from a metabolic perspective. Within the frame of TS1 Work Package 4 (WP4) “Mitigation and adaptation for more resilient and livable cities”, the Task 4.4 introduces the circular metabolism approach strategically applied to critical urban contexts. By exploring the possibility to generate new relations between cities and their resources, or to regenerate their existing relationship, implementing the assumption “*from cradle to cradle”* (Braungart, McDonough, 2002) in urban settlements, the research focuses on life-cycles of settlements and infrastructures, to be co-designed and tested in the context of living labs implementing the transition to a new

ecological balance that must be regarded as a fundamental reference in planning (Russo, 2018).
In order to ensure a sustainable transition for critical multi-risk contexts, RETURN identifies test-areas to develop a circular metabolic strategy as a risk-resilient tool able to rebuild the site-specific ecological component that could be lost during the cities' life cycle. Thus, contaminated post-industrial landscapes provide a complex environmental scenario in which auto-regenerative principles can be investigated in risk-exposed areas with a particular focus on anthropic risks, also implementing adaptive nature-based solutions and temporary actions.

Urban planning that takes these models into account the length of urban and natural processes is necessary to guarantee the rehabilitation of these neglected and frequently abandoned post-industrial zones and to generate new life cycles within the city's metabolism. The revitalization of brownfields is thus becoming increasingly urgent because they pose a danger to public health and safety and actually hinder urban transformations. Among the hazards to which urban areas are subjected, pollution and soil contamination are directly linked to urbanization, land use and the cities' life cycles. Process industry, transport, urban sprawl, agriculture, illegal dumping or landfill without adequate resource recovery are indeed currently reported among the main sources of pollutants (Zhang, Wang, 2020) causing the direct release or indirect deposition of organic and inorganic pollutants (including heavy metals, mineral oils, and polycyclic aromatic hydrocarbons) into the soil, with hazardous effects on the environment and human health (UNDRR, 2020) (Grifoni et al., 2022). In Europe it's estimated that 60-70% of soils are estimated to be degraded due to human use practices: for example, 21% of soils have limits for cadmium above the danger threshold for humans and 83% of soils have at least one pesticide residue (European Commission, 2020).

Contaminated sites refer to areas where, as a result of past or ongoing human activities, it has been determined that any pollutant has periodically altered natural soil properties up to existing standards (ISPRA, 2023a). Potentially contaminated sites can often be found in these post-industrial areas due to the production models and processes that have taken place there. From this perspective, contaminated and exposed sites should be considered as ecosystem environments that are not fully resilient, because they often lack the capacity to provide biodiversity, have mineralized soils with high levels of pollution and elements from anthropogenic contamination that have deprived them of their capacity to provide ecosystem services (Johnson, Lewis 2007). The IPCC defines land degradation as "a negative trend in land conditions caused by direct or indirect human processes - including anthropogenic climate change- expressed as a long term reduction and loss of at least one of the following: biological productivity, ecological integrity or human value. Working to clean up these polluted soils is therefore a priority; in fact, the European Green Deal calls on EU member states to create a toxic-free environment that requires urgent remediation and clean-up initiatives.

According to Ispra (2023), the total number of proceedings remediation processes in Italy are 34,478 of which 16,264 are still ongoing. The areas under remediation represent 0.22 percent (666 square km) of Italy's land area.
In Italy, environmental remediation is beset by a number of challenges, these include the high cost of materials and operating techniques, the lengthy permission and implementation process for interventions and, in certain situations, the difficult interactions with regulatory authorities. The challenges that emerge as part of the urban regeneration process of these areas are frequently related to their inherent characteristic: these are polluted soils. In this context marked by risks, uncertainties, long and complex technical interventions, opening these sites to compatible and temporary uses for communities represents an interesting field of work within the RETURN research.

Bagnoli as test-case to develop a circular metabolism for resilient processes

The former *Ilva* industrial area located in the district of Bagnoli, in the western part of Naples, has been recognized as a Site of National Interest (SIN) in 2014 (D.M. 08/08/2014) for environmental contamination. It covers an area of approximately 249 hectares on land and 1.453 hectares at sea.
Moreover, Bagnoli is embedded in a complex volcanic system named Campi Flegrei whose bradyseismic activity is in constant evolution. The coexistence of environmental, anthropic and natural risks makes this area an ideal laboratory for assessing the feasibility of new risk mitigation guidelines combined with circularity principles. Its complexity, beyond its degraded and abandoned condition, is given by the overlapping of different risks that makes it a field of experimentation to elaborate and test guidelines for the development of a Proof of Concept (PoC) useful as a tool in decision processes.
In Italy, the reference legislation for soil remediation is Title V "Remediation of Contaminated Sites" of the Legislative Decree 152/06. According to the law's safety objectives, prior and complete environmental remediation is required for carrying out any type of intervention or activity in a SIN area. The environmental remediation of the former Ilva industrial area is, however, a long and complex process and was one of the first tasks undertaken after the dismissing of the production activities in 1993. In 1994 CIPE has raised funds for remediation work with the approving of the *Environmental Recovery Plan. Project of technical operations for the reclamation of disused industrial sites in the high environmental risk area of the Bagnoli production and employment crisis zone* drawn up by Ilva in Liquidazione S.p.a. In 1996, the company Bagnoli s.p.a. was founded with the aim of carrying out the remediation, but the works were limited to the demolition and dismantling of the industrial plants (Coppola, 2020). In 2002, new funds were used to establish the company for urban redevelopment named "Bagnoli Futura s.p.a." with the same aim of initiating soil remediation activities. In 2013, however, due to heavy debts and the seizure of the areas for environmental fraud, Bagnoli Futura declared bankruptcy (Piscopo, 2022). *"Bagnoli renaturalised and touristic remains a drawing and, even before that, the reclamation that was, in some ways, a pre-condition of it, remains at the stake"* (Lepore, 2017).

The Ministry of the Environment and Protection of Land and Sea (MATTM) decree of 8 August 2014 officially delimited the Bagnoli Coroglio SIN site. Subsequently, art. 33 of Law Decree n. 133 of 12 September 2014 (*Sblocca Italia* decree), converted into Law n. 164 of 11 November 2014, was approved enacting provisions on the environmental reclamation and urban regeneration of the areas of the Bagnoli-Coroglio SIN. Law n. 164 contains both the provision of a new implementing institution named Invitalia s.p.a. (the National Agency for Attracting Investment and Enterprise Development) and the introduction of the figure of the Government Extraordinary Commissioner for Environmental Remediation and Urban Regeneration. The Commissioner and the Invitalia s.p.a. have formalized their commitment to carry out the 'programme of environmental rehabilitation and urban regeneration of the area of significant national interest Bagnoli-Coroglio' within the 'Extraordinary Commissioner - Invitalia Convention'. Newly conducted investigations on the types of contaminants in terrestrial and marine areas detected zinc and tin lead for the surface soil, and mercury, copper and arsenic, on both land and sea areas. High above-normal traces of polycyclic aromatic hydrocarbons (PAH), heavy hydrocarbons and traces of polychlorinated biphenyls (PCB) are also present throughout the site. In the deep soil, the potential contamination trend substantially follows the surface soil. In groundwater, contamination by organic compounds and metals such as iron, manganese and, in rare cases, nickel was detected (https://bonifichesiticontaminati.mite.gov.it/sin-17/).

The entire SIN area has been divided into sub-lots with respect to the pollutants present, and reclamation action has been assigned a period in which it must be completed. First soil characterization investigations have been completed. The remediation technologies identified, supported by demonstration tests, are divided into off-site technologies such as soil washing and thermal desorber and in-situ remediation technologies such as chemical oxidation and bio-phytodepuration (Invitalia, 2021).

While the regeneration project of brownfield sites has inevitably to face the legacy of contamination and pollutants left behind by industrial production to ensure safety for future users of the area, it is also necessary to consider the remediation project as part of the design process and not as an activity that postpones the use of land. Through temporary uses, new scenarios can be implemented making these areas accessible, while the reclamation process is being completed. New scenarios to be built with communities thought a co-design approach, involving stakeholders and institutions within urban living labs.

Land remediation is not just a technical requirement or an obstacle to transformations but becomes an opportunity to test of new practices to build conditions of environmental justice and resilience of territories.

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