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Entry

Bagnoli Urban Regeneration through Phytoremediation

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Definition: The Bagnolidistrict in Naples has needed urban redevelopmentfor many years. The area is not only affected by pollution caused by many industries but also by environmental pollutants, according togeognostic surveys that have found numerous contaminantsin the subsoil and water.Currently, the combination of an urban rehabilitation processwith the phytodepuration technique may represent a successful idea for obtaining bothurban regenerationand environmental remediation. Phytoremediation, a biologically based technology, has attracted the attention of both thepublic and scientists as a low-cost alternative for soil requalification. The use of plants as well as the microorganisms present in their root systems plays an important role in the ecological engineering field in controlling and reducing pollutants present in theair, water and soil.The result is efficient, sustainable and cost-effective environmental recovery compared to conventional chemical–physical techniques. In this way, not only the environmental recovery of SIN Bagnoli-Corogliocan be obtained, but also the regeneration of its landscape.

Keywords: urban regeneration; phytoremediation; Bagnoli former area

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1. Introduction

The alteration of the natural balance of thecoastal landscape of theBagnoli urban district in Naples, caused by urbanization but even more so by industrialization processes (Ilva, Eternit, Cementir and Federconsorzi), will be mitigated by an urban regeneration plan. The Bagnoli district, located along the highly urbanized coast of the Gulf of Pozzuoli, is included in the volcanic system of CampiFlegrei. In 1905,the construction of the Ilva plant (flat rolled and similar industrial products) marked the conversion of Bagnoli-Coroglio from a residential to an industrial center, which lasted until the end of 1990 when the first phase of closure of the industry occurred. In 2018, the Environmental and Urban Regeneration Plan was developed [1], which recognizes Bagnoli/Coroglio as aNational Interest Site (SIN) and was a variant of the urban planning instruments already in force. In order to plan the environmental rehabilitation and urban regeneration of the site, an international competition of ideas was organized by INVITALIA (National Agency for Inward Investment and Economic Development), the implementing body of the program, which is owned by the Italian Ministry of Economy. The projectproposes the realization of integrative environmental characterization, the restoration of bathing facilities, waterfront requalification and reconnection with the city. The decommissioning and reclamation of the steel plants began in 1994, following the decision of the Interministerial Committee for Economic Planning and Sustainable Development.The Italian Governmentfunded the remediation plans viaspecific laws (N. 582—18 November 1996 and N.388—23 December 2000). The project proposed the utilization of theIlvaand Eternit sites for nonindustrialactivities. At theFederconsorzi site, the "Cityof Science" was built, an institute for the dissemination and enhancement of scientific culture(IDIS foundation). INVITALIAhas announced the completion of the asbestos remediation at the former Eternit site. The plan provided forthe carrying out of the environmental recovery of disused industrial sites by dismantling them and creating a park characterized by botanical species suitable for aiding the reduction in environmental pollution [1]. Afforestation will form part of theenvironmental mitigation and phytoremediation measures intended to respond to the need to reduce the pollution caused by anthropogenic pressures [2]. In this regard, it is crucial to design green areasfor the Bagnoli districtwith theintroductionof botanical species selected especiallyforsoil depollution. In fact, in the sector in front of the industrial plant, which is now decommissioned, high concentrations of polycyclic aromatic hydrocarbons (PAHs), heavy metals, such as arsenic and beryllium, and trace elements, such as lead, zinc, cadmium, copper and mercury, have been found, even at deep levels [3].

2. The Bagnoli Plain in Historical Cartography:between Reality and Utopia

The evolution of the coastal landscape in the western area of Naples can be analyzed using historical cartography to understand howanthropization has modified the coast over two centuries. The historical cartography of thePhlegraean area is scarce. To obtain cartographic information, we must refer to the most complete maps of the city of Naples, whose landscape outlines [4] continue towardsCampiFlegrei and its most famous areas, such as Nisida, Agnano and Astroni. These representations show an uninhabited and marshy agricultural area, with few architectural additions. The circular tower of Nisida, represented in the cartographies of the 17th century, stands out in the well-known representation of De Fer, “Les Merveilles de Pozzuoli”, from 1701 [5]. In the map of Giovanni Carafa Duke of Noja (Figure 1) [6], Bagnoli is characterized by its seashore and by thecultivated areas of Coroglio. The road system that would influence the evolution of the 19th century road network is also clearly discernible, based on two lines that connect Pozzuoli with Naples:“the road that leads to the city of Pozzuoli to the marina” and “the road from Pozzuoli to the mountain”.

Figure 1. Topographical map of the city of Naples and its outlines (Giovanni Carafa Duke of Noja, Naples, 1775) [6].

To observe the evolution during the 19th century, an important instrument is offered by the Kingdom of Naples cartography (from 1817 to 1823), where the topography of the plain shows a green countryside separated from the sea by a coastline characterized by hydrothermal springs. In the pre-unification map, a long straight line represents a road thatbegan the incorporation of the Phlegraean coast into thecity area, extending the line of urban development towards the west.

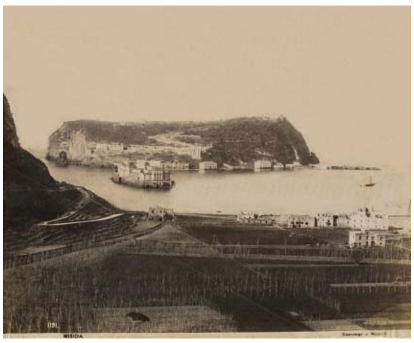
The Bagnoli area assumed the role of an entry point to the CampiFlegrei [7]. In the 19th century, the cartography showed a shooting range and a sandy coast.In this period, factories for chemical products and the well-known Lefevre glassworks were built, whose buildings now house the “City of Science” scientific center [8]. InTopographical Engineerscartography, there is no trace ofa residential settlement whose construction [9] began at the end of 1800 at the hands of the Marquis Candido Giusso, making Bagnoli a residential area suitable for vacation. Between 1883 and 1888, a valid urban planning idea for the Bagnoli area was proposed by Lamont Young [10], which exhibited the drawings of his futuristic project

(Figure 2). The utopia of the Anglo-Neapolitan architect will be overturned by a reality that has decreed the environmental destruction of one of the most evocative places in Naples.

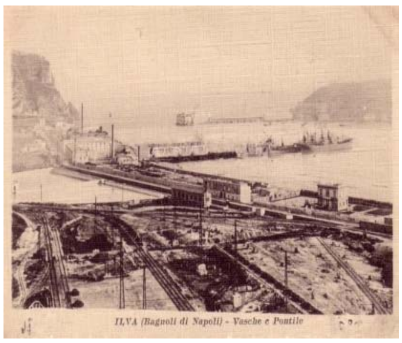
Figure 2. Lamont Young Project (1883–1888). GIS cartography realized by at the Laboratory on the Landscape of the CNR/ IRET implementing orto-imagine 2007 of the Province of Naples, Extract n° 8 of the Cartography of 1817–1823. Graphical elaboration by Marina Russo.

3. Brief History of Bagnoli, a District with Great Disregarded Potential

When in 1853 the Bournique and Damiani glassworks and the sulfuric acid, alum and iron sulphate factory of Lefevre were established near the beach of Coroglio, at the foot of the Posillipo hill, the whole area still preserved its fascinatingpotential. Today what remains of the coast tells a reality very far from one of peace and healthiness. The Italsider plant in Bagnoli represents the emblem of one of the largest urban voids in Europe, a symbol of environmental degradation caused by development policies implemented without taking into account the environmental and landscape impacts. The 19th century photographs by Alinari and Sommers [11] (Figure 3a) portrayed an agricultural territory that reached almost to the coastline. The rediscovery of the first thermal spring in 1827 (TermeMasullo) led to the progressive rebirth of the thermal culture, promoting the recovery of several spas with tourist vocations. Manganella (1831), Cotroneo (1831), Rocco (1850) and Tricarico (1882) beaches, born as an extension of the thermal bath, played a significant role in the development of the local economy. As documented by the postcards of the time, since the 1920s, Bagnoli has been a holiday destination full of tourist facilities, hotels and restaurants. Subsequently, the urbanization growth and the opening of new industrial sites sanctioned the definitive closure of the thermal complexes. The first significant urbanization in Bagnoli occurred at the end of 19th century (1880–1885) with the Marquis Giusso's plan, which foreshadowed the design of an area characterized by cottages and spas [12,13].



(**a**)



(**b**)

Figure 3. (**a**) Nisida and lazzaretto—Bagnoli (G. Sommers) "Isle of Nisida"(Catalogue #: 1191) [11]; (**b**) Ilva 1905: Tanks and pier [14].

The Marquis made a first parceling, inspired by coeval European experiments of settlements with tourist and residential purposes. In 1914, Giusso organized a town planestablishingthe building parameters, and the plan maintained its effectiveness until the last post-war reconstruction.The city plan allowed the construction of the municipal roads and decreed compliance with the legislation to preserve “a dignified appearance” for the Bagnoli district [13].

Launched under Saredo inquiry (1902), Francesco Saverio Nittiapplied the first special law (1904) for the industrialization of Naples, glimpsing the potential ofthe steel industry for the development of the local economy. The Ilva company [15], established in Genoa in 1905, had acquired the area behind the beach of Coroglio at a low cost, building in 1906 the first Italian continuous cycle plant [14] (Figure 3b), directed by a German technician teams led by the engineer FrizLührmann [16].

After the Second World War, Ilva began to expand the facilities, advancingalong the coastline. The landscape and environmental damage was being inexorably consumed [13]. In 1961, the industry, with state participation, assumed the name of Italsider, implementing the production of steel that contributed to the Italian “economic miracle” [17].

However, from the early 1970s onwards, the economic situation rapidly worsened.The economic crisis was caused by problems with the supply of the raw materials and by the increase in energy costs.After numerous restructuring hypotheses, in the second half of the 1970s, a world steel crisis led toa progressive closure of the steel mills. Theplants’ closures met with opposition from the workers, who began a long period of clashes and demands against the management [13].

On 20 October 1990, with the last casting, the hot area ofthe Bagnoli steel center was finally switched off [18]. The dismantling of the Italsider plant was placed at the center ofcultural and political debate surrounding the problems related to the recovery of abandoned areas, seeking to find abalance between conservation and demolition. In 1993, the symbol of the waterfront rebirth of Coroglio was the “City of Science”. The transformation andredevelopment of the Naples industrial areas constituted the guidelines of the extensive process of revision of the General Town Plan, begun by the urban manager De Lucia with the administration of Mayor Bassolino. Naples disused industrial areas were subject to the guidelines ofthe Territorial Pact of CampiFlegrei. The variant for the western area of Naples, which includes Bagnoli, covers a large area of about 1300 hectares [19].

Within this complex territorial system, the decommissionedareas represent about 330 hectares, in a position of great value for the surrounding landscape: Coroglio overlooking the Gulf of Pozzuoli between the hilly edge of Posillipo and the Bagnoli urban fabric of the 20th century. The strategic plan provided for the creation of a “green city”, replacing chimneys, rolling mills and sheds, with a large city park stretching out to the sea, where the construction ofa beach reopened to tourismwas planned. The strong signal that the Municipality of Naples intended to send to its citizens was to restore the Bagnoli area to its condition prior to indiscriminate industrialization, breaking any kind of compromise with the past [1].

With the approval of the variants, this purpose was gradually blunted and the will to preserve a part of the numerous industrial buildings, as evidence of industrial archeology, prevailed (Figure 4). The most significant projects are aimed at enhancing the industrial components in order to preserve their identity, and at the creation of a technology park with services for leisure, sporting and cultural activities [1]. In recent years, the theme of the reconversion and redevelopment of abandoned industrial areas has played an important role inprocesses of transformation and urban regeneration that stimulates a new season of reflection.

Figure 4. View of the urban void left by the decommissioning of steel plants.

4. The Environmental Recovery of Bagnoli and Its Coast Regeneration

In the Bagnoli area, there has been an overlap of pollution of chemical elements (e.g., arsenic) transported by hydrothermal fluids characteristic of the Gulf of Pozzuoli, linked to industrial activities that have released metals and fossil fuels into the environment.

The volcanic activity is still present today, as evidenced behind the former Cementir plant, by the thermal water that flows from the ground.

As previously highlighted, the Bagnoliurban district is located close to the active volcanic caldera of the Campi Flegrei. Despite its tourist vocation, during the twentieth century numerous and different industrial complexes were established in the area, such as the well-known Italsider steel mill, cement factories (Cementir) and companies producing fertilizers (Federconsorzi) and asbestos (Eternit).

In this context, about 40% of the samples, taken from surface areas of Bagnoli up to about 20 years after the dismantling of the industrial plants, showed a moderate to high degree of contamination. The sediments recently deposited are still influenced by contributions of contaminants released by the Italsider plant [3].

Several studies on the pollution factors affecting the Bagnoli area have been carried out over the years [20–24]. In particular, the source of heavy metal pollution in seawater and soil of the brownfield [25] site derivedfrom hydrothermal fluids related to the volcanic activity (natural source) and from the use of fossil fuels and industrial emissions for the steel production (anthropogenic source). De Vivo and Lima [3] have shown that the hydrothermal fluids that rise in the underground waters inthe Bagnoli-Coroglio area are the main cause of heavy metal pollution. The groundwatercontent analysis highlighted the presence of metals such as As, Cd, Cu, Hg and Pb normally represented in areas of high volcanic activity.In addition, the sea sediment samples collectedalong the Bagnoli coastline, near the former discharges of the Ilva plant, contained metals (Cd, Cu, Hg, Pb, Zn and Fe) and PAHs of high molecular weight at concentrations well above the tolerable levels for health safety [26]. The studies carried on sediment cores have traced the presence of metals such as As, Cr, Ni and V to a mainly natural contribution, being associated with the presence ofclay [27].

However, what is evident from the analysis of metals is the overlapping of elements of natural and industrial pollution. Emblematic is the arsenic case, which some studies attribute to a prevalentgeogenic nature [26]. Arsenic pollution has also been related to brownfield sites (steelworks and glass factories used arsenic in their production cycle), as high concentrations of the metal have been found in thesewage drains along the coast [28]. This evidence showsthe difficulty of attributing the origin of pollution to a single phenomenon.

In contrast, PAHs and PCBs (polychlorinated biphenyls) percolating through soils and landfills, are certainly ascribable to industrial activities [22].

The prevention of contaminant migration becomes crucial and requires the recovery of the brownfield sites. Conventional technologies for reclamation and redevelopment of polluted areas are consideredto be underperforming. Today, it is necessary to define strategies based on urban ecology capable of preserving the urban system over time without producing degradation but triggering regenerative processes. The use of suitable technologies, materials and systems can become the tool to transform dismissed areas, preserving the urban and natural heritage with a conscious management of the resources.

The current demand is to achieveeconomic, nondestructive and eco-friendly redevelopments [7]. In this context, phytoremediation, a well-known plant-based technique, is considered very promising and widely used. The main utility lies in the removal of pollutants from contaminated water and soils by restoring part of the self-purifying capacity typical of the ecosystems themselves. Numerous advantages are derived from the use of this biotechnology [29–31]. The costs of realization and management are certainly reduced. The landscape insertion of species, especially the native ones, could be optimal and applicablefor vast polluted areas. Furthermore, the aspect strictly linked to an economic circularity must be considered.The waste biomass can be exploited as a renewable energy supply or, when adequately treated, as a source of phytoproducts. Considering the use of the phytoremediation, the evaluation of sustainability takes on fundamental importance, as it is the tool that enhances the phyto approach. In this regard, compared to other technological approaches, phytoremediation already has an inherent idea of sustainability at an environmental, economic and social level.

Plants' behavior in contaminated soils depends on several factors. The plant species have different abilities to tolerate pollutants, and therefore depend on their resistance and the possibility of absorbing and moving them. The feasibility can be established even before the success of the phytoremediation intervention. An environmental analysis of the site examining the characteristics of the soil, pH, texture, organic matter and nutrients, hydrology and climatic conditions to identify the most suitable plant species for this purposeis crucial. The information about the real mobility and bioavailability of contaminants is fundamental in the phytoremediation technique, which uses living organisms and can act on the concentration of bioavailable contaminants.

There are numerous reports [30–32] that highlight the ability of selected plants to sequester contaminants present in amended soils.Interestingly, some plants capable of growing naturally in contaminated areas will be selected for their characteristics as possible candidates for phytostabilization, phytoremediation and revegetation processes. The physical and chemical properties of the soil are decisive in influencing the distribution of contaminants in the different chemical forms in which they are present.

The plants play a fundamental role in the environmental decontamination of sites heavily polluted by organic substances or heavy metals, through their absorption, degradation and stabilization. In areas contaminated by heavy metals, shrubs and herbs, such as *Armeria marittima* and *Minuatariavernato* (detects Cu), *Alyssum bertoloniia* (Ni accumulator) and *Viola calaminare* (accumulates high levels of minerals in the leaves) [31], can act as indicators of pollution.In Mediterranean areas, *Arundodonax*, a perennial cane, showed strong tolerance to heavy metals [33]. The presence of high concentrations of cadmium and nickel, indeed, has not had depressive effects on the photosynthetic rate and growth of the cane. In addition, *A. donax* does not enter the food chain, thus reducing the spread of substances harmful to health [34].

The reclamation of the Bagnoli soil is made problematic because of its fragility, instability and the contaminated seabed. Despite the pollution, insmall artificial lakes used to collect the wastewater of steel processing, several botanical species have been observed [35], such as *Phragmites australis* and perennial and rhizomatous marsh plant, together with *Typha latifolia* and *Arundo donax*, characterized by phyto vegetating action [36] (Table 1).

Table 1. Plants useful for the remediation of polluted sites (Adapted from [36]).

Filtration	Rhizofiltration	Phytostabilization	Phytodegradation	Phytovolatilization
Cupressus sempervirens	*Panicum virgatum*	*Picea abies*	*Sorghas trumnutans*	*Brassica oleracea*
Platanus spp.	*Festuca arundinacea*	*Agrostis capillaris*	*Panicum virgatum*	*Beta vulgaris*
Taxus baccata	*Carexelata*		*Agropyron desertorum*	*Oryza sativa*
Thuya occidentalis	*Phragmites australis*		*Medicago sativa*	*Brassica juncea*
Acer campestre	*Typha latifolia*		*Bromus inermis*	
Chamae cyperispisifera	*Salix* spp.		*Festucaarundinacea*	
Quercus robur	*Populus* spp.		*Morus* spp.	
Sambucus racemosa	*Eichhornia crassipes*		*Malus* spp.	
Sorbus aucuparia	*Hydrocotyle umbellata*		*Kochia scoparia*	
Acer campestre	*Lemna minor*		*Nepeta cataria*	
Populus deltoidestrichocarpa	*Azolla pinnata*		*Carduus nutans*	
Pinusnigra				
Cupresso cyparisleylandii				

An ongoing in situ bioremediation aims to cleanup the soils in the contaminated zone of Bagnoli. In the brownfield site area, the presence of metals in the roots and tissues of *Bituminaria bituminosa* and *Daucus carota* plants, which growth spontaneously, was tested [37]. Theconcentration ofmetalsin the root was higher than in leaves and shoots, indicating the immobilization ofmetals in the roots of plants.

Guarino et al. [38] identified plant families more represented in the polluted area of Bagnoli. Poaceae, Fabaceae, Asteraceae and Apiaceae areadapted to grow and survive also under contaminated soil condition. The analysis of the composition of pollutantsin the site's soil showed that the mainsources of PAHs derived from the combustion of oil and coal. Several native plants present in the studied site accumulated PAHs in the roots, limiting theirtranslocationinto the soil [38].

The field test on Bagnoli soil was carried out in two different places: (i) inside the SIN; and (ii) in a cold greenhouse with polyethylene cover [39]. The species used, reported in Table 2,were selected considering the positive results obtained in situ.

Table 2. Plants used in mesocosms experiment (Adapted from [39]).

Family	Species
Fabaceae	*Lotus corniculatus*
	Bituminaria bituminosa
	Medicago sativa
Poaceae	*Festuca arundinacea*
	Dactylis glomerata
	Piptatherum miliaceum
	Arundo donax.
Scrophulariaceae	*Verbascum sinantum*
Asteraceae	*Ditrichia viscosa*
	Helianthus annuus
Salicaceae	*Salix purpurea*
	Populus alba

Interestingly, the phytoremediation processes take place mostly in the rhizosphere, where the soil microenvironments are among the most dynamic and biologically diverse on the earth, due to the presence of numerous nematodes, bacteria, protozoa, algae, actinomycetes and mushrooms [40]. The multi-contaminated soil, containing As, Pb, Zn and Cd, revealed an enrichment of bacteria tolerant to these metals, which include *Paenibaciluus* spp., *Mycobacterium* spp., *Pseudomonas aeruginosa*, *Pseudomonas fluoresens* and *Rhodococcus* spp., which are also involved in the degradation and adsorption of polycyclic aromatic hydrocarbons [41]. In addition to bacteria, in the rhizosphere a particular type of fungi is represented, mycorrhiza, living in symbiosis with plant roots and producing hyphae that branch and penetrate the roots, reaching a length of between 5 km and 20 km. In the presence of heavy metals, mycorrhiza maintain high availability of essential nutrients for the plant, and at the same time dilute heavy metals, reducing their toxic effects.

The result ofthe SIN Bagnoli analysis highlighted that the remediation process also involved rhizosphere microbes [38]. *P. aeruginosa*, *P. fluoresens*, *Mycobacterium* spp., *Rhodococcus* spp. and *Paenibaciluus* spp. are involved in PAHs' degradation. 85% of the microorganisms detected belong to the phylum of Proteobacteria. At lower levels, Alphaproteobacteria and Gammaproteobacteria were also represented [38].

A method to increasethe degradation capacity andtolerance to the contamination stress was the integration of a beneficial consortium of microorganisms and bacteria of the rhizosphere. In this perspective, in addition to ligninolytic fungi, mycorrhizal fungi and rhizosphere bacteria that promote plant growth have also been inoculated into the soil [38].The widespread contamination by persistent organic pollutants in the SIN Bagnoli soils makes remediation particularly complicated. The degradation of these xenobiotics occurs by enzymes mainly produced by ligninolytic fungi able to degrade lignin. The microorganism–plant associations improve the transformation and degradation of pollutingcompounds, ultimately resulting in their removal and therebyin lower levels of abiotic stress for plants. It can be concluded that hydrocarbons' degradationin SIN Bagnoli may be based on an integrated rhizodegradation. In fact, microbiotaenzymes and those produced by the roots contribute to PHAs' degradation [39].

Interestingly, the benthic foraminifera sea population was also characterized by microorganisms resistant topollution [42]. Some species, such as *Miliolinellasubrotunda* and *Elphidium advena*, among the 113 recognized atBagnoli, showed percentages of abnormal specimens correlated with pollutants such as Mn, Pb, ZnandPAHs. Hence, in SIN Bagnoli, the environmental stress on foraminiferalcommunities may actually be attributable to the pollution of brownfield sites.

Therefore, the use of phytotechnologyinvolves allbiological, chemical and physical processes that allow the absorption, the seizure, the biodegradation and the metabolization of contaminants, both byplants and bymicroorganisms of the rhizosphere [43].

In the Bagnoli case, the soils polluted by nonbiodegradable heavy metals, not metabolized by plants by direct absorption, can be decontaminated by phytoextraction with removal of pollutants, followed by phytostabilization to reduce their mobility.The reported species can be used to allow an effective and durable removal of pollutants, producing biomass useful for bioenergy production [44]. The biomass used to extract pollutants takes on an important economic value when used to produce energy, for combustion or through gasification followed by cogeneration. The ash produced, rich in metals, can be applied in extractive processes to recover the metals themselves. In addition, some plants, which do not move metals to the reproductive organs, will be used in nonfood productions (such as glues, plastics, biodiesel or industrial oils).In conclusion, phytoremediation, as well as being a technique capable of regenerating polluted areas, is ableto provide the spaces reserved for ecosystem services in a newly conceived city, promoting the redevelopment of the concept of green in an urban context.

5. Conclusions

The SIN Bagnoli-Coroglio reclamation plan has a long and troubled history, which still has yet to be fullyimplemented. After the industrial activities'closure, over the years, the requirements for the environmental recovery of the site have been monitored and evaluated. The plan for recovery must consider thatthe pollution originated from industrial activities over a century ago. The major contaminants are represented by heavy metals and PHAs derived from fossil fuels' combustion, industrial waste, dumps, slag and scum. However, Bagnoli is affected by the geothermal activity of the CampiFlegrei, in whose caldera is located. Therefore, the brownfield site represents an overlap between anthropogenic and natural contaminationcomponents.

Among the different typologiesof applicable remediationtreatments, phytoremediation is a sustainable option. Phytotechnology involves agricultural practices and integrated biological systems, allowing the reduction in pollutant concentrations and restoring the functions of the soil over time. In the SIN Bagnoli-Coroglio, numerous analysis and studies conducted over the years have verified the feasibility of using phytoremediation for the reclamation of polluted soils and the creation ofa green space in anurban parkcontext. For thisreason, the utilization of native plants in conjunction with microbe-assisted phytoremediation was found to be an advantageousapproach, obtaining high rates of degradation also suitable for the environmentalecological balance. The plant species selected were characterized by high tolerance to specific contaminants, extensive root systems and the presence of a rich rhizosphere. In particular, Fabacee and Poaceae have a fibrous rootsystem that improvesthe contact between contaminants and degrading microbes.

The phytoremediation-integrated systems used forcontaminants' reduction in soils are an interesting form of green technology with great potential. At the same time, the improvement of environmentalquality, the restoration of soil functions and the protection of human health can be achieved. Crucial to obtaining positive results through bioremediation is the right combination of different biological elements and a well-designed agronomic practice.

While we wait for the completion of the urban redevelopment of the western suburbs of Naples, the reclamation of the decommissioned industrial area of Bagnoli would represent a dynamic reality of landscape reconversion, restoring historical identity to the territory of the Campi Flegrei.

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