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ORCID:
PDP: 0000-0002-5612-995X

The stigma effect in the Land of Fires: the impact of negative environmental externalities on residential property values

Pierfrancesco De Paola[1,*], Orazio Campo[2], Valeria Scarica[1], Maria Laudando[1], Valentina Liguoro[1], Mario Ferraro[1]

[1] *Department of Industrial Engineering, University of Naples Federico II, Naples, Italy*
[2] *Department of Architecture and Design, Sapienza University of Rome, Rome, Italy*
*Corresponding author
E-mail: pierfrancesco.depaola@unina.it; orazio.campo@uniroma1.it; valeriascarica1994@gmail.com; marialaudando@gmail.com; liguorovalentina9@gmail.com; mario.ferraro@mail.com

Abstract. The “Land of Fires” is an area extending between the provinces of Naples and Caserta (Italy). This vast region is notoriously affected by the burial and illegal disposal of toxic and special waste in abandoned quarries or unauthorized landfills, with waste often being burned, triggering numerous toxic fires. These phenomena create a “stigma effect” on the livability of the area under examination, with the local population suffering the most significant consequences. Residents are forced to live in a territory where mortality and cancer incidence rates are significantly higher than the national average. The primary objective of this study is to assess how environmental and social quality in the “Land of Fires” influence prices in the local real estate market. The first part of the study delves into the issues of urban quality in this context and its impact on residential property prices. The second part focuses on a specific portion of the “Land of Fires”, known as the “Triangle of Death” which includes the municipalities of Acerra, Marigliano, and Nola, with the aim of evaluating the geospatial variability of real estate values.

Keywords: Land of Fires, stigma effect, environmental externalities, property values.
JEL codes: Q24, Q51, R23, R32.

1. INTRODUCTION

“Contaminate” is a term etymologically derived from the Latin “taminare”, which has the precise meaning of “leaving a tactile imprint”. In its absolute sense, the term does not inherently carry either a positive or negative connotation. When applied to the history of a country, contamination can be seen as a place’s ability to welcome new peoples, thereby expanding its cultural heritage, history, and connection with the world. Through this process, it inherits new customs, traditions, and practices that endure over time, perfectly embodying the concept of “leaving a tactile imprint” inherent in the word’s etymology.

The region of Campania (Italy) has long been a land of multiple contaminations in this sense. Greeks, Romans, Spaniards, and Arabs have all been both guests and admirers of the Campanian lands, long regarded as symbols of beauty, wonder, and prosperity. The Romans even bestowed upon it the name *Campania Felix*, highlighting the fertility of its soil. However, today, the territorial area between the metropolitan city of Naples and the southwestern part of Caserta presents a very different image, far from an idyllic, thriving landscape.

Currently, the concept of contamination in this area carries an entirely negative meaning in the collective imagination. Human activity has left a tangible imprint, not through creation, but through the destruction of wealth and beauty. This contamination is defined by the presence of toxic substances throughout the territory, giving rise to the term "Land of Fires" ("Terra dei Fuochi" in Italian).

The expression "Land of Fires" first appeared in 2003 in the *Ecomafia Report* by Legambiente (2003). It was used to describe a vast geographical area encompassing 90 municipalities (56 in the province of Naples and 34 in the province of Caserta), regularly plagued by the illegal disposal and burning of toxic waste, an area covering approximately 1,076 square kilometers and home to around 2.5 million people (see Figure 1).

However, the term "Land of Fires" is often misused, as it originally referred specifically to the phenomenon of toxic fires and not to the burial of waste. Despite this distinction, both issues are frequently conflated under a single label.

The term "Land of Fires" has even been recognized as a neologism in the Treccani Dictionary, which defines it as: *"A vast area, originally rural but now heavily urbanized, located between Naples and Caserta, characterized by frequent fires set by Camorra clans to illegally dumped toxic waste, leading to the release of highly harmful and polluting substances into the air. The situation in the northern area of Naples, which Roberto Saviano has dubbed the 'Land of Fires' due to the recurring waste fires that illuminate a landscape devastated by neglect, is even more dramatic. (Antonio Castaldo, Corriere della Sera, July 25, 2009, p. 11). For years, along with others, I have been recounting the disasters of the Land of Fires, which over time has swallowed up entire municipalities, constantly expanding its boundaries. Ever since Peppe Ruggiero of Legambiente coined this evocative phrase – so far removed from the Land of Fire described by Magellan – it has evoked the same image: just as the Portuguese explorer saw fires along the coast from the sea, those traveling along the Strada Statale 7 bis Terra di Lavoro (Nola-Villa Literno) or the Asse Mediano, if they take their eyes off the road, will see smoke rising from the ground, and if they lower their car windows, they will inhale a pungent, throat-burning odor with an acidic aftertaste. (Roberto Saviano,* Repubblica.it*, November 25, 2013, Cronaca)*" (Vocabolario Treccani, 2013).

Waste management has long been at the center of political, social, economic, and health debates across the Campania region, largely due to a lack of transparency and difficulties in effectively tracing the recycling process, particularly for industrial waste. However, the "Land of Fires" is not just a snapshot of waste mismanagement specific to Campania; it can be considered a broader Italian phenomenon. Across abandoned quarries, illegal landfills, and roadside waste dumps, the same system of circumventing regulations plays out, amounting to a true ecological catastrophe.

This issue has existed for decades. According to Legambiente, between 1991 and 2013, approximately 10 million tons of various types of waste were illegally dumped in Campania (Legambiente, 2013). This included:

- slag from aluminium thermal metallurgy;
- dust from smoke purification systems;
- industrial wastewater sludge;
- liquid effluents contaminated with heavy metals;
- asbestos-containing waste;
- paint residues;
- contaminated soil from remediation activities.

The fires, on the other hand, predominantly involve urban waste, plastics, leather scraps, and textile remnants, producing devastating consequences. These include not only soil and groundwater contamination through leachate but also the release of dioxins into the air and soil. Recent regulations have been introduced to facilitate land mapping in order to assess the presence of contaminants and micro-pollutants such as polycyclic aromatic hydrocarbons (PAHs), pesticides, and heavy metals.

A 2019 study (*Veritas*), conducted by the Sbarro Institute for Cancer Research and Molecular Medicine at Temple University of Philadelphia, along with the National Cancer Institute – Fondazione Giovanni Pascale (Chamber of Deputies of the Italian Republic, 2022), found abnormally high levels of heavy metals in cancer patients from several municipalities in the Naples metropolitan area (Giugliano in Campania, Qualiano, Castel Volturno, and the Pianura district of Naples). Given these alarming conditions, the "medical record" of the land, water, and air in this area paints a bleak picture, where any hope for a greener, healthier future seems to decay alongside the very "monnezza" (a Neapolitan dialect term for "waste") that represents gold for organized crime but a death sentence for the local population.

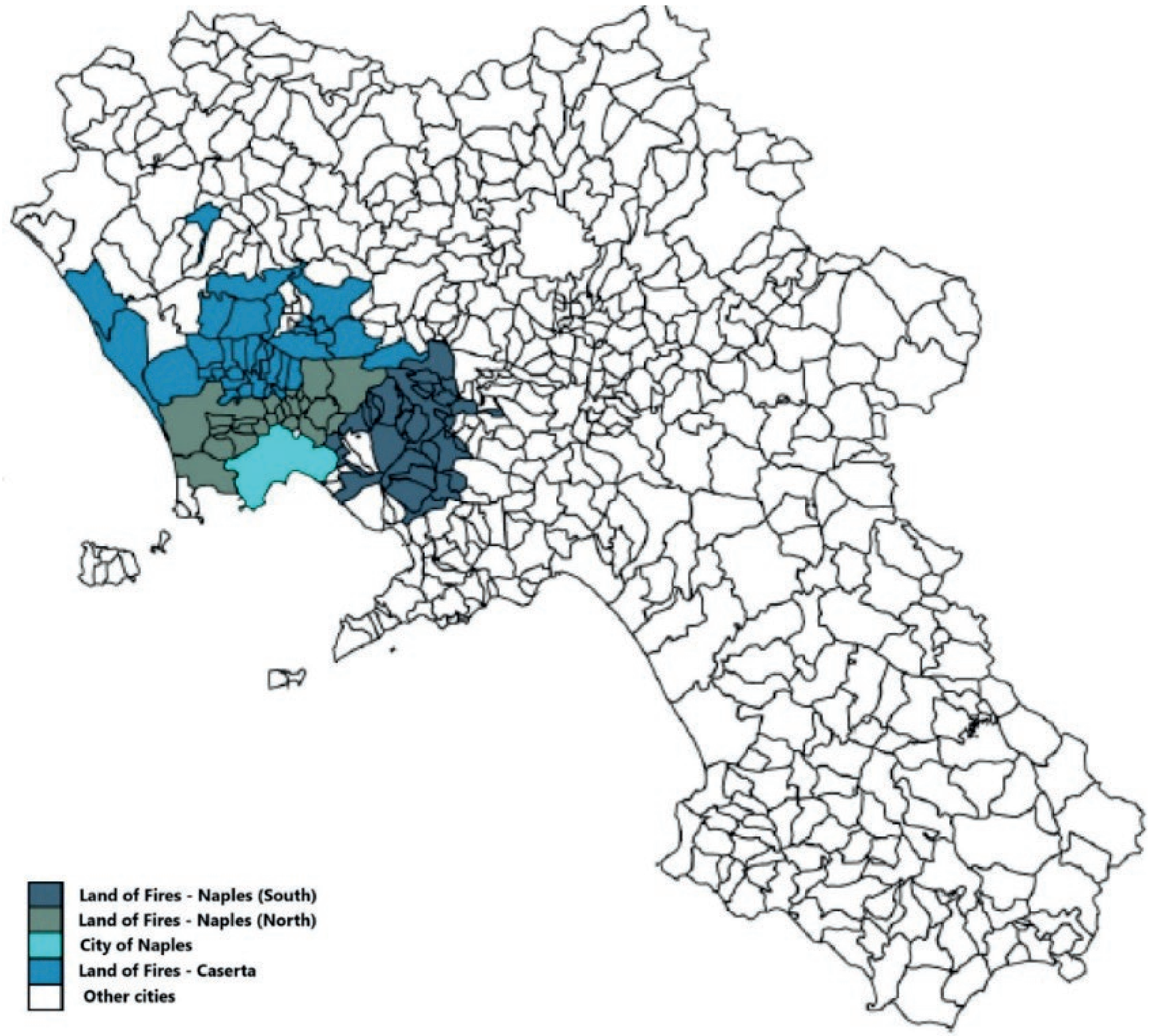

Figure 1. Land of Fires: territorial overview.

In 2025 the European Court of Human Rights has issued a final ruling condemning Italy for failing to adequately protect the inhabitants of the Land of Fires. According to the Court, the health of the population has been put at risk due to the failure to adopt effective measures to counter the phenomenon. Italy is therefore required to introduce, without delay, general measures to adequately address the pollution in the area. This is a historic ruling that acknowledges the serious institutional responsibilities in managing the environmental crisis in the Land of Fires (Corriere della Sera, 2025).

Following an analysis of the relevant literature on the "stigma effect" in the real estate market, this study first provides a territorial overview of the "Land of Fires", highlighting its characteristics and critical issues. It then addresses the challenge of selecting appropriate indicators to measure the phenomenon and evaluate the urban quality of the region in quantitative terms. The first part of the study presents data analysis and a discussion of the results. The second part focuses on a specific area within the "Land of Fires", known as the "Triangle of Death", comprising the municipalities of Acerra, Marigliano, and Nola. The goal is to assess the geospatial variability of real estate values using innovative models such as Evolutionary Polynomial Regression and Geo-Additive Models.

2. LITERATURE REVIEW

Addressing the issue of the impacts of environmental stigma on real estate properties might initially seem to revolve around a single question: What is its economic impact on housing prices? Table 1 provides a general summary of the main references related to this issue. However, reducing the study to the resolution of a single question could lead to the misconception that the only relevant factor is the price of homes affected by contamination, disregarding other related aspects and issues.

The issues addressed by the scientific community are numerous, highlighting how the approach to the problem is not uniform, as it is highly dependent on the context. Soil pollution is one of the key factors contributing to the stigma effect associated with a territory, and its impact on the real estate market is particularly evident. The mere presence of contaminated land increases the perception of risk among residents and potential buyers.

The literature on this topic is extensive; however, it can generally be divided into two main areas:
– soil pollution caused by waste disposal;
– soil pollution caused by water contamination.

When thinking about soil pollution, it is most often associated with the presence of hazardous toxic waste which, through natural degradation or improper disposal processes, leads to the contamination of the surrounding land. This environmental and economic issue has been analyzed by considering the studies summarized in Table 2.

The analysis clearly highlights how the real estate market reflects the distrust people have in living in polluted areas, regardless of the type of contamination affecting habitat quality.

However, an environment with pollution levels exceeding the standard, once remediated and restored to acceptable ecological conditions, tends to shift perceptions regarding its suitability as a residential area, leading to a more or less significant increase in property prices.

3. DESCRIPTIVE VARIABLES OF THE ENVIRONMENTAL, SOCIAL AND URBAN CONTEXT OF THE LAND OF FIRES

3.1 Urban quality: a multidimensional character of a territory

Urban quality depends on numerous factors and is primarily linked to how users perceive the territory in which they live, based on the presence or absence of any

Table 1. Summary of the main references related to the stigma effect on real estate properties.

Year	Author(s)	Site	Issue
1995	Kiel K. A.	Hazardous waste sites	Impact of hazardous waste discovery, effects of disclosure of discovery announcement, influence on property values of future contaminated site cleanup
1999	Dale L., Murdoch J. C., Thayer M. A., Waddell P. A.	Lead smelter	Impacts on property values before, during and after site remediation
2003	McCluskey J. J., Rausser G. C.	Unspecified	Analysis of the short-term and long-term impact of the stigma effect
2005	Decker C. S., Nielsen D. A., Sindt R. P.	Unspecified	Impact of polluting emissions and toxic substances
2006	Simons R. A., Saginor J. D.	Unspecified	Meta-analysis of the effect of environmental contamination
2007	Kiel K. A., Williams M.	Superfund	Impact of superfund sites on local property values
2008	Neupane A., Gustavson K.	Contaminated sites	Impacts of contaminated sites
2016	Phanaeuf D. J., Liu X.	Unspecified	Stigma measurement post site cleanup
2017	Sullivan K. A.	Urban brownfield sites	Effects of remediation on property values and tax revenues
2018	Silaeva P., Akhmedinova K., Redina M., Khaustov A.	Urban areas	Evaluating the correlation between real estate prices and pollution conditions
2019	Noh Y.	Abandoned railways	Real estate market analysis before and after abandoned railways are converted into greenways
2020	Del Giudice V., De Paola P., Bevilacqua P., Pino A., Del Giudice F. P.	Abandoned industrial areas	Impacts of contaminated sites on real estate value
2021	Otsuka N., Abè H., Isehara Y., Miyagawa T.	Contaminated sites	Role of green infrastructure in brownfield regeneration
2022	Tureckovà K., Martinat S., Nevima J., Varadzin F.	Contaminated sites	Impact of distance between properties and contaminated sites
2022	Drenning P., Chowdhury S., Volchko Y., Rosén L., Andersson-Sköld Y., Norrman J.	Urban brownfield sites	Improving ecosystem services in urban brownfield sites

Table 2. Summary of the main references related to the impacts of soil pollution on real estate values.

Year	Author(s)	Causes of contamination	Objective of the study
1992	Ketkar K.	Hazardous waste	Impact on property values due to the presence of a hazardous landfill
2004	Ready R., Abdalla C.	Dump	Effects on property values with respect to the Euclidean distance from the site at risk
2004	Ihlanfeldt K. R., Taylor L. O.	Hazardous waste site	Effects of non-severely polluting hazardous waste sites
2004	Deaton B. J., Hoehn J.J .	Unspecified	Effects on property values with respect to the Euclidean distance from the site at risk
2007	Van Herwijnen R., Laverye T., Poole J., Hodson M. E., Hutchings T. R.	Lead	Remediation using organic materials
2008	Greenstone M., Gallagher J.	Unspecified	Comparison of landfill sites
2010	Affuso E., De Parisot C. V., Ho C. S., Hite D.	Lead	Investigation into the effect of lead pollution
2011	Braden J. B., Feng X., Won D.	Unspecified	Effects of waste polluted sites
2013	Gamper Rabindran S., Timmins C.	Hazardous waste	Localization of the benefits arising from the remediation of contaminated sites
2019	Mei Y., Gao L., Zhang P.	Dump	Relationship between landfills and residential construction prices
2019	Zwickle A. et. al.	Dioxins	Investigation into the effect of dioxin pollution
2020	Baragano D. R., Gallego J. L., Forjan R.	Heavy metals	Use of phytoremediation plants as possible toxicological indicators
2023	Shen X., Ge M., Handel S. N., Jin Z., Kirkwood N. G.	Chemical pollutants	Using spontaneous invasive plants to implement soil phytoremediation

source of pollution, the development of social networks, the natural and cultural habitat, and the potential for economic growth. Considering this general perspective, we can understand that urban quality can be defined as the ability of the urban environment's configuration to meet, both quantitatively and qualitatively, the overall material and immaterial needs of its users by providing the required services.

From this, it follows that urban quality has a multidimensional character: it is not only related to urban development but also to environmental enhancement, health protection, and the ability to satisfy social needs. In this sense, the relationship between a city's urban quality and the needs of its users can be seen as an interaction between the demand for livability, safety, and efficiency – emanating from the local community – and the city's ability to meet these demands. In summary, we can define urban quality based on its components (Saaty and De Paola, 2017; Del Giudice et Al., 2014):

- Environmental Quality: Dependent on the presence of specific environmental resources (climate, landscape, physical-structural characteristics of both settled and natural environments), related to both anthropic and natural systems.
- Social Quality: Dependent on socio-economic and cultural factors, often referred to as "quality of life," including the social and cultural system, identities, and housing characteristics.
- Quality of Life: Linked to individuals' living conditions, as reflected in the health status of the communities themselves.

Based on a meta-analysis of the literature (Sica et Al., 2025), a series of indicators have been defined for the study of urban quality (Table 3). Among these, the indicators selected for the territorial context of interest take into account that data on crime phenomena are not available at the municipal level. Moreover, the data obtained to describe land use characteristics are not correlated with temporal factors, while variables related to land consumption show limited flexibility.

About the social environment, it is important not only to consider the presence of recorded crimes but also to take into account the coexistence of multi-ethnic communities within a given urban context. The Land of Fires, even from this perspective, presents a dramatic reality. On one hand, the high presence of immigrants might suggest a phenomenon of great inclusion and tolerance; on the other hand, it is closely linked to severe instances of labor exploitation and beyond.

In light of this consideration, it was deemed important to study the presence of foreign nationals in the Land of Fires area. For the assessment of environmental quality, however, it was considered useful to analyze the presence of landfills, as they represent a distinctive feature of this region, which suffers from ongoing illegal waste trafficking and disposal. This latter phenomenon

Table 3. Summary of the main indicators to study urban quality.

Environmental Quality	Social Quality	Quality of Life
Presence of dioxin	Presence of multi-ethnic groups	Cancer incidence rate
Presence of heavy metals and/or toxic substances	Crime rate	Respiratory disease rate
Presence of nearby landfills	Population density	Mortality rate
Recycling rate	Residential turnover rate	
Presence of polluted watercourses	Vacancy rate of housing units	
Air quality	Accessibility to essential public services	
Drinking water quality	Obsolescence of housing units	
Remediation rate (completed or planned)		
Environmental certifications		
Presence of abandoned industrial areas		
Presence of contaminated sites		
Presence of contaminated sites		
Amount of waste produced		
Surface area of land suitable for agricultural activities		
Risk of environmental or natural disasters		

gives rise to another critical issue: that of toxic fires. The presence of these fires turns the environment into a true incubator of pollution, affecting both air and soil with dramatic consequences for human health and the surrounding ecosystem.

It is therefore logical to assume that excluding this variable as a descriptive indicator of the reality in Land of Fires would lead to an incomplete analysis of the urban quality of the territory. Consequently, aware that the indicator accounting for the presence of toxic fires is entirely innovative compared to the long list of traditional indicators developed thus far, it was decided to include it in the analysis as it is absolutely necessary for a comprehensive and truthful description of the urban context.

Therefore, the indicators actually employed, expressed in terms of percentage variation – alongside changes in real estate prices – are as follows:

- Mortality rate;
- Presence of multi-ethnic groups;
- Rate of land reclamation;
- Presence of landfills;
- Number of toxic fires;
- Land consumption;

The indicators selected to describe the urban quality of the area under study take into account the following situations:

- available data on crime presence is not recorded at the municipal level in any public archive but only at the provincial level;
- available data related to land use does not account for temporal changes;
- land consumption represents an indicator with limited flexibility.

3.2 Mortality rate

With reference to this indicator, data relating to the mortality rate of 61 municipalities of the Land of Fires were collected, for a time range that starts from 2009 and arrives at 2021 (see Appendix 1). Figure 2 summarizes the mortality quotient of the territory under investigation, obtained through an average operation of the quotients collected for each municipality and repeating the procedure for the period 2009-2021: it is possible to note a significant increase in the mortality rate over time, in reference to the entire area, taking into account the marginal contribution of all the municipalities. The mortality quotients concerning Italy and Campania and those concerning Campania and the two provinces of

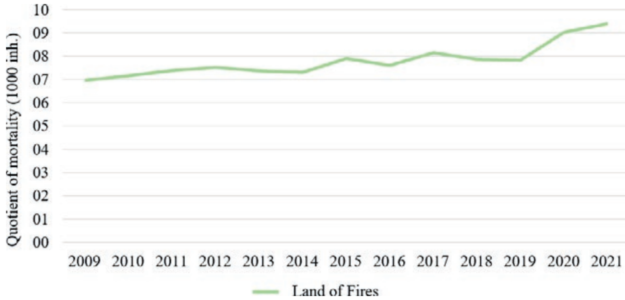

Figure 2. Quotient of mortality in the period 2009-2021.

Naples and Caserta were also compared, where in both cases the trend is substantially similar. In the period considered, it is noted that the mortality rate in Campania is higher than the national average, while the mortality rate in Campania is lower than that of the two provinces investigated (ISTAT, 2024).

3.3 Presence of multi-ethnic groups

A key component to consider in the investigation of a crime-ridden area, useful for assessing the perception of the safety of the place, would be the crime rate, understood as the number of crimes reported in the municipalities of interest. On the one hand, the data available on crime rates are limited only to provincial levels, on the other hand, in the considered area the variable closest to the crime rate is that relating to the presence of multi-ethnic groups in the area, as a symbol not only of inclusion and acceptance but also of significant exploitation, of all kinds.

Settlement development is the driving force behind the settlement of foreign residents in the most disadvantaged places, whose attractiveness derives both from economic reasons and from poor control of the territory; in general, it is precisely the complexity in finding work in disadvantaged areas that facilitates, in addition to social marginalization, also recruitment into criminal organizations, making the perception of the place, by the community, equal to a spoiled, unsafe and unlivable environment. This condition is strongly linked to the crime rate and the number of crimes reported to the judicial authorities.

The intense phenomenon of immigration is such that it has repercussions on economic, social, demographic and cultural aspects of society; it is weighted by evaluating the presence of foreign citizens as a variable of the social and economic intertwining of the territorial context considered, taking into account the possible weight, like the environmental condition, on the investigation conducted (Forte et al., 2018).

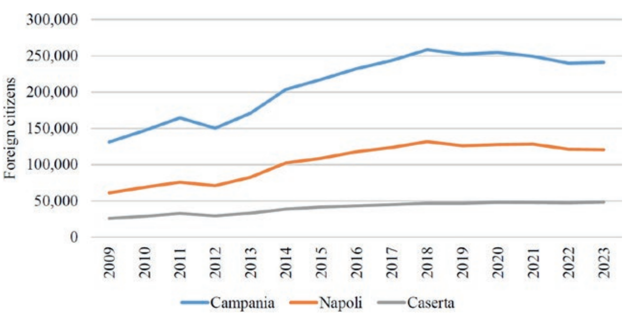

Figure 3. Foreign population in the period 2009-2023.

In the period 2009-2023, the data relating to the foreign population resident in the provinces of Naples and Caserta, show a growing trend, with some municipalities showing increases of over 80-90% in the last decade analyzed (Giugliano in Campania, Castel Volturno, Mondragone), (ISTAT, 2024; Statistiche demografiche e sociali, 2024; see Appendix 2).

3.4 Rate of land reclamation

In order to protect areas subject to pollution, soil remediation works are considered of fundamental importance, implemented with the aim of recovering and restoring a deeply degraded environment; to do this, once the contamination of the site has been established, it is essential to implement interventions aimed at reducing or removing the sources of contamination or, in any case, aimed at decreasing the concentrations of harmful substances to a degree that is equal to or lower than those specified by the legislation, depending on the intended use of the land.

The most widespread contaminants in the territory considered are Hydrocarbons, Heavy Metals and Solvents depending on the areas and types of industrial production (ARPAC, 2024).

In the analysis conducted, a time frame was taken as a reference that starts from 2017 and arrives at 2022, where the data relating to the years 2020 and 2021 are missing. The data are represented in terms of surface area expressed in square meters (see Appendix 3).

3.5 Presence of landfills

Since we are investigating an environmental fabric characterized by strong territorial pollution, it is of fundamental importance to evaluate the presence of negative factors that constitute the pillars of the place, as they designate its peculiar characteristics; among these, the presence of landfills stands out, of a generally abusive nature in the territorial context of interest and at the basis of the contamination of the soil (by percolation into the aquifer), of the air (emissions of vapors and greenhouse gases) and of the general health of the inhabitants. Through the Regional Reclamation Plan of Campania, including a specific census of landfills – including municipal and consortium ones, both public and private – "Vast Areas" have been identified, with the aim of monitoring those surfaces within which the investigations conducted have brought to light a situation that is generally damaged and prejudiced (Regione Campania, 2024).

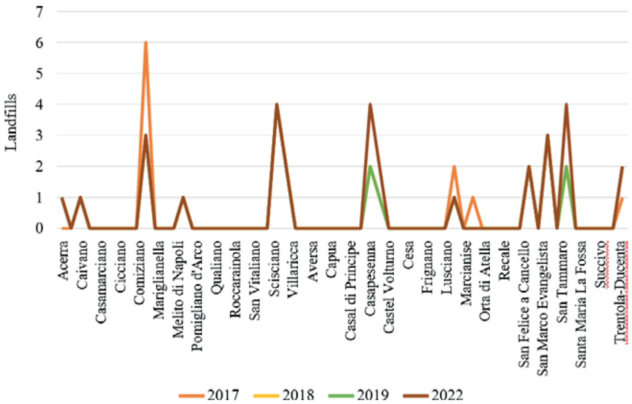

Figure 4. Number of landfills in the period 2009-2023.

Briefly summarizing, using a line graph, the distribution of landfills in the territory enclosed in the Land of Fires, the following municipalities stand out from the others (see Figure 4):

– 2017: Giugliano in Campania, Marcianise, Orta di Atella and Villa Literno;
– 2019: Caserta and Santa Maria La Fossa;
– 2022: Giugliano in Campania, Tufino, Caserta, San Tammaro, Santa Maria La Fossa and Villa Literno.

3.6 Number of toxic fires

The phenomenon of toxic fires derives from illegal activities of systematic burning of waste present in illegal landfills in order to reduce the occupied volume to a minimum (see Appendix 4).

Most of the fires are fueled by piles of special waste (i.e. deriving from industrial activities, demolition and construction activities, commercial activities, machinery, vehicles, etc.) whose management does not follow the treatment methods prescribed by environmental regulations, but the positions taken by a deep-rooted criminal system that disregards costs and controls. These events of significant problem have led to a considerable accumulation of environmental pollutants, contained in the columns of toxic fumes released, including dioxins – highly toxic and carcinogenic substances – which initially settle on grass, soil and water, and which then end up fixing themselves in the adipose tissue of animals that have ingested contaminated food and cause significant damage, not only to the ecosystem, but also to the human health of residents.

The main sources of soil pollution in Campania are gathered in the Caserta hinterland and in the territorial area located north of the province of Naples; among the contaminants, the following are mostly found: textile waste, lead and metals, acids, plastic materials, construction waste, tires and radioactive waste.

As an example, Figure 5 shows the distribution of toxic fires in the provinces of Naples (Fig. 5a) and Caserta (Fig. 5b) for year 2021 (ARPAC, 2024).

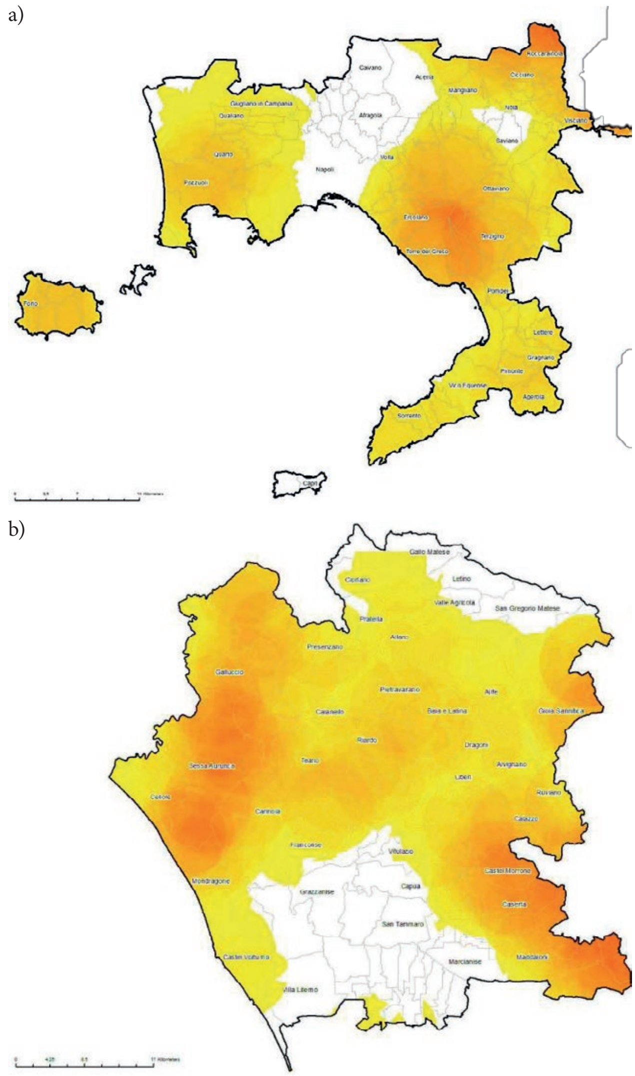

Figure 5. Number of toxic fires in 2021 for the provinces of Napoli (a) and Caserta (b).

3.7 Land consumption

The available data consist of the surface area of consumed land (expressed in hectares), the density of land consumption in relation to the total area of each municipality (expressed in square metres/hectare), and the percentage of consumed land (see Appendices 5 and 6).

Figure 6, derived from the values in Appendix 5, show the trend of land consumption for the entire dis-

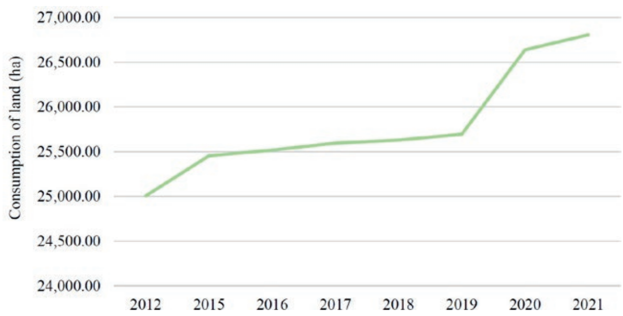

Figure 6. Consumption of land for the Land of Fires.

trict of the Land of Fires (Sistema Nazionale per la Protezione dell'Ambiente, 2024).

3.8 Real estate market in the Land of Fires

In temporal analogy with the other indicators, the average values of the residential real estate market (€/sqm) of the municipalities constituting the Land of Fires (Immobiliare.it, 2024) were detected, in the period from 2012 to 2021 (see Appendix 7).

Through the Pareto diagram, it is quicker to identify the municipalities that present the highest trends in average annual property prices, in the time range considered. Figure 7 traces the distribution of the data collected in decreasing order and presents a cumulative line on a secondary axis as a percentage of the total.

It is the municipality of Pozzuoli – followed by Quarto, Pomigliano d'Arco and Caserta – that presents the most significant values in the entire territory of the

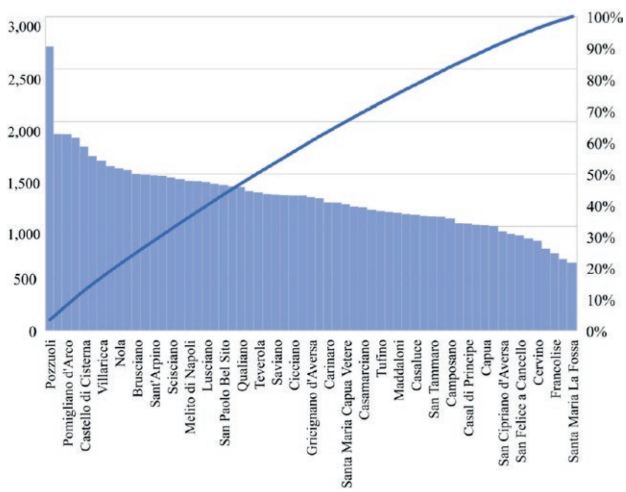

Figure 7. Pareto diagram: the trend of average annual prices of residential properties in the territory of the Land of Fires.

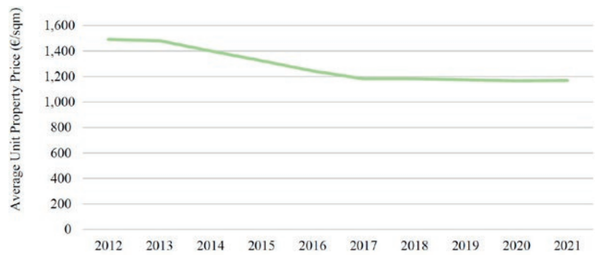

Figure 8. Trend of the average annual prices of residential properties in the territory of the Land of Fires.

Land of Fires. Santa Maria La Fossa, Castel Volturno and Francolise are, instead, the municipalities that present the lowest trend.

Instead, by using an average operation of the values relating to all 61 municipalities taken into consideration, the average price is obtained, discriminated for each of the years considered, of residential properties located in the Land of Fires (see Figure 8): the trend appears, in general, decreasing, with a dizzying drop after 2013 and which found substantial completion in 2017 (the year in which the recorded value was the lowest).

4. METHODS

4.1 Multiple regression models

Multiple regression models are statistical tools used to analyze the relationship between a dependent variable (or response) and two or more independent variables (or predictors). This methodology is particularly useful for studying complex phenomena where multiple factors influence an observed outcome.

The goal is to estimate the regression coefficients that indicate the contribution of each predictor to explaining the dependent variable, while controlling for the effects of the other predictors.

The general form of the multiple linear regression model is (Simonotti, 1997):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p + \varepsilon \quad (1)$$

where:

- Y: dependent variable;
- $X_1, X_2, \ldots, X_p$: independent variables (predictors);
- β_0: model intercept (expected value of Y when all X values are 0);
- $\beta_1, \beta_2, \ldots, \beta_p$: regression coefficients (expected change in Y for a one-unit change in X_i, holding other variables constant);

– ε: residual error (the difference between the observed and predicted values).

The coefficients β_i are estimated by minimizing the sum of squared residuals (SSR), which is the difference between the observed (Y_i) and predicted values.

In matrix notation, the model can be expressed as:

$$Y = X\beta + \varepsilon \tag{2}$$

where:
- Y is the vector of observed values;
- X is the matrix of predictors;
- B is the vector of coefficients;
- ε is the vector of errors.

The coefficients are estimated as:

$$\widehat{\beta} = (X^T X)^{-1} X^T Y \tag{3}$$

Main advantages of using a multiple regression model are: allows simultaneous consideration of multiple predictors, identifies relationships between variables, and provides an interpretable model. On the other hand, the main limitations are constituted by multicollinearity (when predictors are highly correlated, the estimated coefficients can become unstable), strong assumptions (requires linearity, homoscedasticity, and normality of residuals), overfitting (adding too many predictors can make the model overly complex and less generalizable).

4.2 Geoadditive models

Geoadditive models are composed by a semi-parametric additive component to express the relationship between model's non-linear response and explanatory variables, and a component with linear mixed effects to expresses the spatial correlation of observed values (De Paola et Al., 2019 and 2021; Del Giudice et Al., 2015 and 2021).

In the case of two additive components, if (s_i, t_i, y_i), $1 \leq i \leq n$, represent the measurements on two predictors s and t for the response variable y, the additive model is:

$$y_i = \beta_0 + f(s_i) + g(t_i) + \varepsilon_i \tag{4}$$

where f and g are unspecified smooth functions of s and t respectively. Therefore, if we define u_+ to equal u for $u > 0$ and 0 otherwise, a penalized spline version of the model (4) involves the following functional form (Del Giudice & De Paola, 2014a and 2014b):

$$y_i = \beta_0 + \beta_s \cdot s_i + \sum_{k=1}^{Ks} u_k{}^s (s_i - \kappa_k{}^s)_+ + \beta_t \cdot t_i + \sum_{k=1}^{Kt} u_k{}^t (t_i - \kappa_k{}^t)_+ + \varepsilon_i \tag{5}$$

In equation (5) there is the penalization of the knot coefficients $u_k{}^s$ and $u_k{}^t$, where $\kappa_1{}^s, \ldots, \kappa_{ks}{}^s$ and $\kappa_1{}^t, \ldots, \kappa_{kt}{}^t$ are knots in the s and t directions respectively. The penalization of the $u_k{}^s$ and $u_k{}^t$ is equivalent to treating them as random effects in a mixed model.

Setting $\beta = (\beta_0, \beta_s, \beta_t)^T$, $u = (u_1{}^s, \ldots, u_{ks}{}^s, u_1{}^t, \ldots, u_{kt}{}^t)^T$, $X = (1\ s_i\ t_i)$ with $1 \leq i \leq n$, $Z = (Z_s|Z_t)$, with:

$$Z_s = [(s_i - \kappa_k{}^s)_+]_{1 \leq i \leq n,\, 1 \leq k \leq Ks},\ Z_t = [(t_i - \kappa_k{}^t)_+]_{1 \leq i \leq n,\, 1 \leq k \leq Kt} \tag{6}$$

penalized least squares is equivalent to best linear unbiased prediction in the mixed model:

$$y = X\beta + Zu + \varepsilon\ ;\ E\begin{pmatrix} u \\ \varepsilon \end{pmatrix} = 0\ ;\quad cov\begin{pmatrix} u \\ \varepsilon \end{pmatrix} = \begin{bmatrix} \sigma^2{}_s \cdot I & 0 & 0 \\ 0 & \sigma^2{}_x \cdot I & 0 \\ 0 & 0 & \sigma^2{}_\varepsilon \cdot I \end{bmatrix} \tag{7}$$

Model (7) is a variance components model since the covariance matrix of $(u^T \varepsilon^T)^T$ is diagonal. The variance ratio $\sigma_\varepsilon{}^2/\sigma_s{}^2$ acts as a smoothing parameter in s direction. Penalized spline additive models are based on low rank smoothers, considering that linear terms are easily incorporated into the model through the $X\beta$ component.

At this point we can incorporate a geographical component by expressing kriging as a linear mixed model and merging it with an additive model such as model (7) to obtain a single mixed model (defined as geoadditive model).

Universal kriging model for (x_i, y_i), $1 \leq i \leq n$ (y_i are scalar and x_i represent geographical location included in R^2 domain) is:

$$y_i = \beta_0 + \beta_1{}^T x_i + S(x_i) + \varepsilon_i \tag{8}$$

where $S(x)$ is a stationary zero-mean stochastic process and ε_i are assumed to be independent zero-mean random variables with common variance $\sigma_\varepsilon{}^2$ and distributed independently of S. Prediction at an arbitrary location x_0 is done through the following expression:

$$y(x_0) = \beta_0 + \beta_1{}^T x_0 + S(x_0) \tag{9}$$

Then for a known covariance structure of S the resulting equation is:

$$y(x_0) = \beta_0 + \beta_1{}^T x_0 + c_0{}^T (C + \sigma_\varepsilon{}^2 I)^{-1} (y - \beta_0 - \beta_1{}^T x) \tag{10}$$

where:

$$C = (cov\{S(x_i), S(x_j)\})_{1 \le i,j \le n} \tag{11}$$

$$c_0{}^T = (cov\{S(x_0), S(x_i)\})_{1 \le i \le n} \tag{12}$$

For all aspects and matters above reported, a geoadditive model can be described, substantially, as a single linear mixed model as follow:

$$y_i = \beta_0 + f(s_i) + g(t_i) + \beta^T{}_1 \cdot x_i + S(x_i) + \varepsilon_i \tag{13}$$

Or in this further representation:

$$y = X\beta + Zu + \varepsilon \tag{14}$$

where:

$$E\begin{pmatrix} u^s \\ u^t \\ \widetilde{u} \end{pmatrix} = 0 \ ; \ cov\begin{pmatrix} u \\ \varepsilon \end{pmatrix} = \begin{bmatrix} \sigma_s^2 I & 0 & 0 & 0 \\ 0 & \sigma_t^2 I & 0 & 0 \\ 0 & 0 & \sigma_x^2 I & 0 \\ 0 & 0 & 0 & \sigma_\varepsilon^2 I \end{bmatrix} \tag{15}$$

5. CASE STUDY

Once the useful data relating to the variables considered were collected, to provide a synthetic description of the phenomenon for each municipality, an average operation was chosen to take into account what happens in different years. A comparison was carried out between two types of averages by calculating the standard deviation: simple arithmetic mean (AM) and moving arithmetic mean (MAM). The best average was found to be the AM as it generates a lower standard deviation than the MAM. If the individual municipalities are compared based on the standard deviation, the MA is always better than the MS as the relative normal distribution is much more regular than the one considered as the MAM.

For each indicator, and in correspondence with each municipality, the average annual increase for the period 2012-2021 was developed (see Appendix 8).

In the case of interest, we referred to a regression model without an intercept, in order to ignore other possible variables on the average percentage variation of the price.

Any outliers were eliminated from the sample, namely: some small municipalities adjacent to large municipalities, as they may be affected by the influence of the phenomena of the adjacent municipality in addition to those of their own; some municipalities in the coastal area characterized by a strong phenomenon of irregular migration, such that the variable relating to the presence of foreigners would have had a preponderant aspect compared to the other independent variables.

Starting from the exploratory analysis of the regression model, the determination coefficient R^2 is equal to 0.85, denoting an acceptable value in order to hypothesize a good adaptation of the regression plan to the observed points. The value of the corrected R^2 is equal to 0.80, while the multiple R is equal to 0.92, returning an acceptable degree of relationship between observed and predicted values, and the relationship between the set of independent variables defined and the dependent variable is sufficiently adequate. The standard error, on the other hand, corresponds to 0.014: being close to zero, it guarantees that the regression model is accurate.

The confirmatory analysis of the model is the process of testing against a null hypothesis. In regression analysis, the null hypothesis consists in the absence of a linear relationship between the dependent variable and the explanatory variables. Since in our case p-value is associated with the F statistic < 0.05 we can affirm that there is an effective linear relationship between the independent variables and the dependent variable and that the model is not a mere theoretical construction: the relationships in the model actually exist and are not random, therefore there is evidence that at least one variable X_i significantly influences the price variable Y.

The equation of the regression model is the following:

$$\Delta_{price} = -\ 0{,}392 \cdot \Delta_{mortality} - 0{,}217 \cdot \Delta_{multi\text{-}ethnic\ groups} - 0{,}090 \cdot \Delta_{land\ reclamation} + 0{,}062 \cdot \Delta_{landfills} + 0{,}00008 \cdot \Delta_{toxic\ fires} - 0{,}791 \cdot \Delta_{land\ consumption} \tag{16}$$

Using the regression coefficients and the mean value of the individual independent variables, it is possible to determine the influence of the individual "weighted" variable for the dependent variable; the information obtained from the Weighted Average Coefficient (WAC) is, in fact, more complete as an information set. To define the WAC, both the sign of the mean value inherent to the individual variable and the sign inherent to the "weight" deriving from the results of the regression model must be considered. A summary is provided in Table 4 where the impact of the single variable following a unitary change in price. However, if we consider the average of the price changes in the municipalities of the selected sample, we can see how much the single variable impacts the real average change ($\bar{\Delta}_{price} = -0.031$).

We can define the RWAC (Relative Weighted Average Coefficient):

$$CMPR_i = \frac{CMP_i}{\bar{\Delta}_{valore}} = \frac{CP_i * \bar{\Delta}_i}{\bar{\Delta}_{valore}} \tag{17}$$

Through the RWAC it is found that an average

Table 4. Influence of the individual "weighted" variable with respect to the dependent variable.

Variable	Regression coefficients	$\bar{\Delta}$	WAC	WAC %	RWAC	RWAC%
$\Delta_{mortality}$	-0.392	0.037	-0.0145	-1.450%	0.4677	46.77%
$\Delta_{multi\text{-}ethnic\ groups}$	-0.217	0.042	-0.0091	-0.911%	0.2935	29.35%
$\Delta_{land\ reclamation}$	-0.009	-0.002	0.00018	0.018%	-0.0058	-0.581%
$\Delta_{landfills}$	+0.062	-0.0125	-0.00078	-0.078%	0.0252	2.516%
$\Delta_{toxic\ fires}$	+0.00008	2.519	0.00020	0.020%	-0.0065	-0.645%
$\Delta_{land\ consumption}$	-0.791	0.006	-0.00474	-0.475%	0.1529	15.29%

change in real estate prices of -3.1% is correlated with a change of:

- +46,77% in mortality rate;
- +29.35% in the multi-ethnic groups;
- -0.581% in the unreclaimed land;
- +2.516% in the presence of landfills;
- -0.645% in toxic fires;
- +15.29% in land consumption.

It follows that: the mortality rate is the factor that most influences the collapse of real estate prices, followed by the rate of multi-ethnic groups and land consumption. The same qualitative information is obtained from the WAC: observing the absolute value, the ranking of the variables that affect the cost is the same.

Considering the average variation of a phenomenon has allowed us to examine phenomena of temporal evolution in a stationary manner: the results we obtained must therefore always be read in terms of variation in a "horizontal" manner.

There is an inverse relationship between the mortality rate and the variation in prices, the same one present with the rate of multi-ethnic groups, unreclaimed land and land consumption; this implies that as one of the above-mentioned rates increases, there is a decrease in the increase, over time, of real estate prices. The distrust resulting from the poor liveability of a generally unhealthy urban context, such as that of the Land of Fires, is tangible from the high values of all four of the above-mentioned variables; life in a territory that presents: a higher mortality rate than the national average (the causes of which are strongly linked to the low urban quality of the place), a high rate of multi-ethnic groups, tending to increase, generally overshadowed by the possibility of an "easy life" offered by organized crime (just think of the migrant settlements – located in unauthorized or abusive areas – that turn into a real business for eco-mafias), high levels of unreclaimed land and particularly the land consumed by artificial casings, cannot but translate into a disadvantage, which also affects property prices, in which the distrust deriving from the dangerousness of the place is poured, without remedy, onto the real estate market discouraging the value of the assets pertaining to it. However, in the analysis conducted, there are two rates that, by increasing, generate positive variations in prices, they are the presence of landfills and that of toxic fires.

Concerning the first factor, the data show that, from 2017 to 2021, there was a reduction in the quantity of active landfills in the territory, consequently generating an increase in decommissioned plants (a landfill that does not comply with European directives is a danger during the work phase as well as during closure, since the resulting leachate penetrates the subsoil causing irreparable and profound pollution); this increase, while on the one hand it may seem like a potentially positive effect and generate an increase in changes in real estate prices, in reality it hides serious negative implications. The last rate discussed is that relating to fires; the harmful fires for which we have information are those collected by official monitoring that uses actual video surveillance booths. It is a variable with a very low weight – in the order of 10^{-5} – whose positive influence on price changes deserves careful attention; the positive variation in the number of fires recorded is seen to correspond to a positive variation in prices, the impact of which is very small, being a phenomenon characterized by a negative prerogative and extremely monitored and opposed. Despite the actions implemented regarding monitoring, knowledge and prevention, it remains a disadvantageous factor in terms of the liveability of the place.

Synthesizing, in short, what has been exposed, it is clearly noted that the majority of environmental and social phenomena, considered in the analysis, lead to a negative variation in property prices; this is indicative of a real estate market that receives an increasingly smaller number of consents and that appears vigorously stigmatized by the indelible mark that pollution has placed on the territory (the stigma effect, in fact, is not only linked to the dangerousness of the phenomenon but also, and above all, to the perception that one has of it). The situation worsens if we consider that phenomena such as the setting of fires, dumping activities, and the presence of illegal landfills dedicated to the disposal of illicit waste, appear to be out of control, taking on a greater gravity in the eyes of those who perceive it.

Of the 61 municipalities that are part of the Land of Fires, the municipalities of Acerra, Nola and Marigliano, due to their geographical positioning and the high mortality linked to the onset of tumors, have been defined as "the triangle of death".

The high mortality rate in these municipalities appears to be mainly linked to pollution caused by the illegal dumping of toxic substances in the environment managed by the Camorra, which operates an illegal waste traffic throughout the country, transporting industrial waste produced by industries in northern Italy to the Campania region. The illegal dumping of waste occurs in illegal landfills but often also in legal landfills, all accompanied by the phenomenon of fires that already devastate the entire area of the Land of Fires.

To describe the real estate market of this territory in spatial terms, n. 384 residential properties, chosen in such a way as to homogeneously cover the territory of the 3 municipalities, were detected during the year 2021 (Immobiliare.it, 2024). The real estate market remained stationary until 2024. To take into account the different locations, the data were "homogenized" through specific market ratios drawn up based on data from the Real Estate Market Observatory of the Italian Revenue Agency (Osservatorio del Mercato Immobiliare, Agenzia delle Entrate, 2024).

For each property the real estate market price and the amounts of some real estate characteristics are known, as shown in Tables 5 and 6.

Based on real estate data, the following geoadditive model has been implemented:

$$UPRICE = FLOOR + MAIN + CAR + f(XCOORD, YCOORD) \quad (18)$$

Table 6. Statistical description of the variables used in the geoadditive model.

	UPRICE	FLOOR	MAIN	CAR
Mean	1285.08	1.50	1.31	1.125
Standard Error	26.26	0.087	0.047	0.050
Median	1237.24	1.00	1.00	1.00
Standard Deviation	514.65	1.71	0.91	0.98
Sample variance	264869.60	2.92	0.83	0.96
Interval	2983.33	10.00	3.00	7.00

Table 7. Determination index relating to the subsamples relating to the three distinct municipal territories (Nola, Acerra and Marigliano).

	Acerra (116 properties)	Marigliano (133 properties)	Nola (135 properties)
Multiple R^2	0.944	0.961	0.950
R^2	0.891	0.924	0.903
Adjusted R^2	0.879	0.915	0.894

Results and main indices of model verification are presented in tables and graphics that follow. The determination of knots for the spatial component and its geographical coordinates are identified by the space filling algorithm, implemented in default.knots.2D function library of R Software Wand et Al., 2005). The geoadditive model was therefore estimated by the Re.M.L. method using the spm library of R software.

A preliminary multiple regression analysis conducted on the data relating to the individual municipalities, to verify the reliability of the data used in the geoadditive model, is provided in Table 7.

The estimates of effects in the non-linear model have been significant by values of freedom degrees (df) and smoothing parameters (spar). The values of obtained predictions are consistent with observed data,

Table 5. Description of the variables for the geoadditive model.

Variable	Description
Real estate price (PRICE)	expressed in Euro
Commercial surface (SUR)	expressed in sqm
Real estate unitary price (UPRICE)	expressed in Euro/sqm
Commercial surface (SUR)	expressed in sqm
Level of floor (FLOOR)	cardinal scale
Maintenance status (MAIN)	expressed via a score scale varying from 0 to 3, starting from buildings to be renovated up to new ones;
Number of parking spaces (CAR)	cardinal scale
Geographic coordinates (XCOORD, YCOORD)	expressed with longitude and latitude

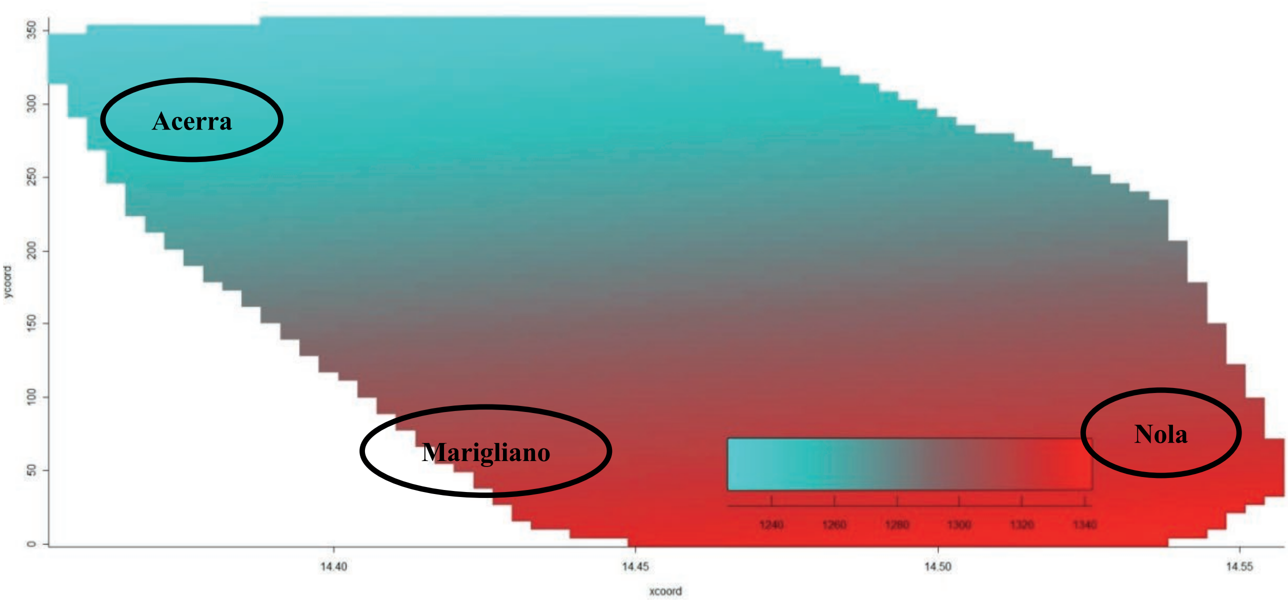

Figure 9. Spatial distribution of real estate unitary prices in the Triangle of Death.

also analysis of residuals has not shown any abnormality in its structure. In examined area, the spatial distribution of real estate unitary prices clearly shows how the geographical component affects the prices of sampled properties.

The main result of the interpolation is a thematic map depicting the real estate unitary values in the urban context considered, in which blue and red colors represent unitary values, respectively, lowest and highest values (see Figure 9).

From Figure 9 it can be observed that unit prices increase from the municipality of Acerra (high vertex of the triangle, with lower prices) to that of Nola (low vertex of the triangle, with higher prices).

Unit sales prices cover a range from € 1220/sqm to € 1340/sqm and fall within the range of values provided by the Real Estate Market Observatory of the Italian Revenue Agency for the areas analysed.

The analysis of the geo-additive model appears to be in line with a series of phenomena related to the urban quality of the municipal contexts considered. To explain the phenomenon of the variability of unit prices between these three municipalities, in the municipality of Acerra there are 137 industries, in that of Marigliano 322 and in that of Nola 484: the number of industries increases from municipality to municipality and with it, the perception of the potential for growth and economic development increases and in accordance with this it is easy to think that a greater prospect of a better environment from a socio-economic point of view is linked to a greater real estate value. If we take into account the fact that in Nola there is the Campania interport, which is an international logistics platform connected to the main world hubs, we realize that the higher sale price, demonstrated by the geo-additive model, of the properties in this area is largely justified. If we consider the percentage of consumed land as an indicator of urbanization (how much artificial has been built on the territory), we see that, for increasing values of the percentage of consumed land, the municipal ranking we obtain is: Acerra, Marigliano, Nola. Therefore, Acerra appears to be the least urbanized municipality while Marigliano is the medium urbanized one while Nola is the most urbanized one. For this reason, it can be assumed that, since the price of a property is directly linked to the urban context and the services that a certain place offers, it increases with the increase in the degree of urbanization since the increase in the latter also increases the services that the city can offer to its residents. The fact that the lowest selling prices refer to the municipality of Acerra, the highest ones to the municipality of Nola and the intermediate ones to the municipality of Marigliano, can also be linked to other factors that are also linked to the perception of healthiness of the area. If we consider that moving from the municipality of Acerra to that of Nola there is a reduction in polluted surfaces of 10%, we can understand how an urban context of better environmental quality is certainly associated with a higher price of properties since environmental quality is an asset that impacts the quality of life of residents who are therefore willing to pay more to live in an urban context that is considered better as it is home to a lower polluting impact.

When talking about remediation and soil pollution, it is good to remember that the chemical, physical and biological alteration of the soil is linked to anthropic phenomena and human activities that can compromise it, even irreversibly. In this regard, it can be considered that among the most disastrous causes is the incorrect disposal of waste, which often occurs without regulations and in a completely abusive manner. The municipalities considered are part, as we know, of the broader context of the Land of Fires characterized by the presence of abusive fires that are triggered to burn waste that is sometimes even toxic and dangerous. Following this, we realize that going to live in a context where there is a greater ignition of toxic fires is certainly less inviting than going to live in places where phenomena of this type do not occur. If we move from the municipality of Nola to that of Acerra, the data on the ignition of fires (obviously we are talking about those registered but the real number is much higher as the phenomenon appears to be uncontrolled), an increase in fires, on average per year, of 60% is recorded, therefore it is easy to understand that prices in correspondence with this notable increase undergo a notable decrease as the perception, and the actual, dangerousness of the phenomenon discourages buyers from living in these areas.

6. CONCLUSIONS

This work was aimed at verifying how environmental and social externalities influence the market prices of residential buildings in the Land of Fires.

The results obtained make it clear that the problems strongly related to environmental pollution strongly influence the real estate market, even if their consequences appear, only theoretically, less worthy of consideration than those generated by the elements concerning the mortality risk and those relating to social risks, specific to the territory taken into consideration.

The clear sign of a real estate market that admits a number of consents that is gradually declining is visible in the reduction of property values in the selected municipalities, guilty of being located on a land affected by an indelible stigma, related not only to environmental pollution – due to the scattered and massive toxic fires and harmful elements discernible from abandoned industrial and waste disposal sites – but also to an ever-increasing trend in mortality (which sees the development of tumor diseases as the main cause) and multi-ethnic groups subjugated by the presence of criminal organizations, capable of actively establishing themselves in social reasoning.

Through data processing tools, it has been concluded that positional characteristics have effects on the formation of market prices, but how can this information be put to good use? Rather than implementing future estimates regarding the trend of costs, it would be of fundamental and primary importance to make changes to the sick matrix of the "Land of Fires", not only from the point of view of environmental remediation which, only marginally, is already underway – through innovative soil phytoremediation technologies, which allow the restoration of the original conditions, replacing those physical-chemical steps that return totally infertile soils – but also by determining more precise comparison frameworks, in particular for the municipalities not included in the final analysis and through continuous monitoring of those factors that generate the greatest critical issues, drawing inspiration from the operations already implemented regarding the "fire issue". The crisis of the Land of Fires serves as a harsh reminder of the complex interaction between industrialization, lax regulation and environmental degradation and highlights the need for proactive measures to prevent similar crises from emerging elsewhere. It is clear that by learning from the mistakes made on this soil, governments, industries and civil societies can work together to create a more sustainable future, characterised by responsible waste management, strong regulatory frameworks and a commitment to preserving the health of the planet and its inhabitants.

REFERENCES

Affuso, E., de Parisot, C. V., Ho, C.S., & Hite, D. (2010). The impact of hazardous waste on property values: the effect of lead pollution. *Urbani Izziv*, 21(2), 117–126.

ARPAC – Agenzia Regionale per la Protezione Ambientale della Campania (2024). Available at: https://www.arpacampania.it (accessed 30 October 2024)

Baragaño, D., Forján, R., Welte, L., & Gallego, J. L. R. (2020). Nanoremediation of As and metals polluted soils by means of graphene oxide nanoparticles. *Scientific Reports*, 10(1), 1896.

Braden, J. B., Feng, X., & Won, D. (2011). Waste sites and property values: a meta-analysis. *Environmental and Resource Economics*, 50, 175–201.

Chamber of Deputies of the Italian Republic (2022). Meeting report of the 18.1.2022. Available at: https://www.camera.it (accessed 20 January 2025)

Corriere della Sera (2025). Terra dei Fuochi, la Cedu condanna l'Italia: mette a rischio la vita degli abitanti. Don

Patriciello: "Quante calunnie subite". Available at: https://napoli.corriere.it/notizie/cronaca/25_gennaio_30/terra-dei-fuochi-la-cedu-l-italia-mette-a-rischio-la-vita-degli-abitanti-e531ff37-353e-40bc-8287-80280f6ecxlk.shtml?refresh_ce (accessed 30 January 2025)

Dale, L., Murdoch, J. C., Thayer, M. A., & Waddell, P. A. (1999). Do property values rebound from environmental stigmas? Evidence from Dallas. *Land Economics*, 311–326.

Deaton J., & Hoehn J. J. (2004). Hedonic analysis of hazardous waste sites in the presence of other urban disamenities. *Environmental Science & Policy*, 7(6), 499–508.

Decker, C. S., Nielsen, D. A., & Sindt, R. P. (2005). Residential property values and community right-to-know laws: Has the toxics release inventory had an impact?. *Growth and Change*, 36(1), 113–133.

De Paola, P., Del Giudice, V., Massimo, D. E., Forte, F., Musolino, M., & Malerba, A (2019). Isovalore maps for the spatial analysis of real estate market: a case study for a central urban area of Reggio Calabria, Italy. In Calabrò, F., Della Spina, L., & Bevilacqua, C. (Eds.). *New Metropolitan Perspectives. Smart Innovation, Systems and Technologies*, Vol. 100, pp. 402-410. Cham (Switzerland), Springer. https://doi.org/10.1007/978-3-319-92099-3_46

De Paola, P., Del Giudice, V., Massimo, D. E., Del Giudice, F. P., Musolino, M., & Malerba, A (2021). Green building market premium: detection through spatial analysis of real estate values. A case study. In Bevilacqua, C., Calabrò, F., & Della Spina, L. (Eds.). *New Metropolitan Perspectives. Smart Innovation, Systems and Technologies*, vol 178, pp.1413- 1422. Cham (Switzerland), Springer. https://doi.org/10.1007/978-3-030-48279-4_132

Del Giudice, V., & De Paola, P. (2014a). Geoadditive models for property market. *Applied Mechanics and Materials*, 584, 2505–2509. https://doi.org/10.4028/www.scientific.net/AMM.584-586.2505

Del Giudice, V., & De Paola, P. (2014b). The effects of noise pollution produced by road traffic of Naples Beltway on residential real estate values. *Applied Mechanics and Materials*, 587, 2176–2182. https://doi.org/10.4028/www.scientific.net/amm.587-589.2176.

Del Giudice, V., De Paola, P., & Torrieri, F. (2014). An integrated choice model for the evaluation of urban sustainable renewal scenarios. *Advanced Materials Research*, 1030, 2399–2406. https://doi.org/10.4028/www.scientific.net/amr.1030-1032.2399

Del Giudice, V., Manganelli, B., De Paola, P. (2015). Spline Smoothing for Estimating Hedonic Housing Price Models. In Gervasi, O., Murgante, B., Misra, S., Gavrilova, M. L., Coutinho Rocha, A. M. A., Torre, C., Taniar, D., Apduhan, B. O. (Eds.). Computational Science and Its Applications -- ICCSA 2015. ICCSA 2015. Lecture Notes in Computer Science, vol 9157. Cham, Springer. https://doi.org/10.1007/978-3-319-21470-2_15

Del Giudice, V., De Paola, P., Bevilacqua, P., Pino, A., & Del Giudice, F. P. (2020). Abandoned industrial areas with critical environmental pollution: evaluation model and stigma effect. *Sustainability*, 12(13), 5267.

Del Giudice, V., Massimo, D. E., De Paola, P., Del Giudice, F. P., & Musolino, M. (2021). Green Buildings for post carbon city: determining market premium using spline smoothing semiparametric method. In Bevilacqua, C., Calabrò, F., & Della Spina, L. (Eds.). *New Metropolitan Perspectives. Smart Innovation, Systems and Technologies*, vol 178. Cham (Switzerland), Springer. https://doi.org/10.1007/978-3-030-48279-4_114

Drenning, P., Chowdhury, S., Volchko, Y., Rosén, L., Andersson-Sköld, Y., & Norrman, J. (2022). A risk management framework for Gentle Remediation Options (GRO). *Science of the Total Environment*, 802, 149880.

Forte, F., Antoniucci, V., & De Paola, P. (2018). Immigration and the housing market: the case of Castel Volturno, in Campania region, Italy. *Sustainability*, 10(2), 343. https://doi.org/10.3390/su10020343

Gamper-Rabindran, S., & Timmins, C. (2013). Does cleanup of hazardous waste sites raise housing values? Evidence of spatially localized benefits. *Journal of Environmental Economics and Management*, 65(3), 345–360.

Greenstone, M., & Gallagher, J. (2008). Does hazardous waste matter? Evidence from the housing market and the superfund program. *The Quarterly Journal of Economics*, 123(3), 951–1003.

Ihlanfeldt, K. R., & Taylor, L. O. (2004). Externality effects of small-scale hazardous waste sites: evidence from urban commercial property markets. *Journal of Environmental Economics and Management*, 47(1), 117–139

Immobiliare.it (2024). Available at: https://www.immobiliare.it (accessed 30 October 2024).

ISTAT (2024). Available at: https://www.istat.it (accessed 30 October 2024)

Ketkar, K. (1992) Hazardous waste sites and property values in the State of New Jersey. *Applied Economics*, 24(6), 647–659.

Kiel, K. A. (1995). Measuring the impact of the discovery and cleaning of identified hazardous waste sites on house values. *Land Economics*, 428–435.

Kiel, K. A., & Williams, M. (2007). The impact of Superfund sites on local property values: are all sites the same?. *Journal of Urban Economics*, 61(1), 170–192.

Legambiente (2003). Rapporto Ecomafia. Available at: www.legambiente.it (accessed 30 September 2024).

Legambiente (2013). Le rotte della Terra dei Fuochi. Available at: https://legambiente.campania.it/wp-content/uploads/2014/04/1115rotte_terradeiFuochi.pdf (accessed 30 September 2024).

McCluskey, J. J., & Rausser, G. C. (2003). Stigmatized asset value: is it temporary or long-term?. *Review of Economics and Statistics*, 85(2), 276–285.

Mei, Y., Gao, L., & Zhang, P. (2019). Residential property price differentials of waste plants: evidence from Beijing, China. *Applied Economics*, 51(55), 5952–5960.

Neupane, A., & Gustavson, K. (2008). Urban property values and contaminated sites: A hedonic analysis of Sydney, Nova Scotia. *Journal of Environmental Management*, 88(4), 1212–1220.

Noh, Y. (2019). Does converting abandoned railways to greenways impact neighboring housing prices? *Landscape and urban planning*, 183, 157–166.

Osservatorio del Mercato Immobiliare, Agenzia delle Entrate (2024). Available at: https://www.agenziaentrate.gov.it (accessed 30 October 2024).

Otsuka, N., Abe, H., Isehara, Y., & Miyagawa, T. (2021). The potential use of green infrastructure in the regeneration of brownfield sites: three case studies from Japan's Osaka Bay Area. *Local Environment*, 26(11), 1346–1363.

Phaneuf, D. J., & Liu, X. (2016). Disentangling property value impacts of environmental contamination from locally undesirable land uses: implications for measuring post-cleanup stigma. *Journal of Urban Economics*, 93, 85–98.

Ready, R. C., & Abdalla, C. W. (2004). The impacts of land use on nearby property values: estimates from a hedonic house price model. In Bergstrom, J. C., Goetz, S. J., & Shortle, J. S. (Eds.). *Land use problems and conflicts: causes, consequences and solutions*. pp. 202-218. London, Routledge Taylor & Francis Group.

Regione Campania (2024). Available at: https://www.regione.campania.it (accessed 30 October 2024)

Saaty, T. L., & De Paola, P. (2017). Rethinking design and urban planning for the cities of the future. *Buildings*, 7(3), 76. https://doi.org/10.3390/buildings7030076

Shen, X., Ge, M., Handel, S. N., Wang, W., Jin, Z., & Kirkwood, N. G. (2023). Advancing environmental design with phytoremediation of brownfield soils using spontaneous invasive plants. *Science of The Total Environment*, 883, 163635.

Sica, F., De Paola, P., Tajani, F., & Doko, E. (2025). Spatial–Temporal Ontology of Indicators for Urban Landscapes. *Land*, 14(1), 72.

Silaeva, P., Akhmedinova, K., Redina, M., & Khaustov, A. (2018). Identification of environmental characteristics of urban areas as a factor in the formation of property prices. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM. International Multidisciplinary Scientific Geoconference. 2018. pp. 727-732.

Simonotti, M. (1997). *La stima immobiliare*. Torino, UTET Editore.

Simons, R., & Saginor, J. (2006). A meta-analysis of the effect of environmental contamination and positive amenities on residential real estate values. *Journal of Real Estate Research*, 28(1), 71–104.

Sistema Nazionale per la Protezione dell'Ambiente (2024). Available at: https://www.snpambiente.it (accessed 30 October 2024).

Statistiche demografiche e sociali (2024). Available at: https://www.tuttitalia.it (accessed 30 October 2024).

Sullivan, K. A. (2017). Brownfields remediation: Impact on local residential property tax revenue. *Journal of Environmental Assessment Policy and Management*, 19(03), 1750013.

Turečková, K., Martinát, S., Nevima, J., & Varadzin, F. (2022). The Impact of Brownfields on Residential Property Values in Post-Industrial Communities: A Study from the Eastern Part of the Czech Republic. *Land*, 11(6), 804.

van Herwijnen, R., Laverye, T., Poole, J., Hodson, M. E., & Hutchings, T. R. (2007). The effect of organic materials on the mobility and toxicity of metals in contaminated soils. *Applied Geochemistry*, 22(11), 2422–2434.

Vocabolario Treccani (2013). Neologismi 2013. Available at: https://www.treccani.it (accessed 20 January 2025).

Wand, M. P., French, J. L., Ganguli, B., Kammann, E. E., Stuadenmayer, J., & Zanobetti, A. (2005). SemiPar 1.0 R package. Available at: https://cran.r-project.org.

Zwickle, A., Cox, J. G., Zhuang, J., Hamm, J. A., Upham, B. L., Chung, M., ... & Dearing, J. W. (2019). The effect of dioxin contamination and remediation on property values. *International Journal of Environmental Research and Public Health*, 16(20), 3900.

Appendix 1. The mortality rate for the municipalities of the Land of Fires (blue: municipalities of Napoli's province; light blue: municipalities of Caserta's province).

Municipalities	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Acerra	6.5	6.1	6.1	6.5	6.7	6.3	7.1	7	6.7	6.7	7.1	7.9	8.5
Brusciano	6.5	7.1	7.2	6.2	7	6.6	7.5	5.9	7.4	7.5	6.2	8.5	9.2
Caivano	6.5	8.1	7.3	7.1	6.6	7	7.7	7.1	7.6	6.7	7.9	9.8	10.3
Camposano	8.1	7.9	9.2	9.4	9	8.1	10.5	10.3	10.7	9.6	9.9	11.2	10.6
Casamarciano	8.3	7.7	12.1	8.6	9.2	10.9	9.7	11	9.8	11.1	10.2	11.6	15.4
Castello di Cisterna	5.9	5.6	7.1	6.9	6.8	6.8	7	6	6.7	5.4	6.3	6.8	7.8
Cicciano	9.3	7.3	7.5	9.6	7.2	9	8.9	9.1	9	9.7	10.4	8.9	10.6
Cimitile	8.4	9.5	11.4	8.3	7.5	7	9.9	9.8	8.1	11.5	10.4	11.9	9.4
Comiziano	11.6	8.8	8.2	9.3	10.9	10.4	12.1	8.3	13.8	9.6	8	14.2	14.1
Giugliano in Campania	5.3	5.5	5.5	6.5	6	5.6	6.4	5.6	6.3	5.9	5.6	7.2	6.9
Mariglianella	7.2	7.2	6.8	6.3	6.2	5.8	6.7	7.3	6.7	6.2	7.3	8.1	10.28
Marigliano	8.4	8.5	7.8	9	8.6	8.8	9.2	8.7	9.6	9.1	9	10.1	10.2
Melito di Napoli	5.2	5.1	4.9	5.5	4.4	5.8	6.2	6	5.6	5.8	5.8	6.7	7.6
Nola	8.8	9.4	8.7	9.4	8.5	8.5	8.7	9.9	9.2	8.5	8.4	9	10.1
Pomigliano d'Arco	7.8	7.7	9.2	7.7	8.2	8.4	8.6	8.9	9.2	7.9	8.5	9.9	10.1
Pozzuoli	6.7	6.5	6.8	8.1	7.9	7.8	8.1	7.8	8.5	7.9	7.8	9.5	9.9
Qualiano	6.1	5.8	7	6	6.2	7	7.5	7.3	8	7.6	7.2	9.2	9.4
Quarto	6	5	5.3	5.7	5.3	5.4	7	6.2	6.2	5.7	6.5	6.4	6.9
Roccarainola	9.5	9.9	9.6	7	9.8	7.9	6.6	8.5	11.9	10.7	11.5	10.1	12.1
San Paolo Bel Sito	7.4	6.5	5.4	9.2	8.5	8.5	9.4	9.1	11.8	9.3	9.1	7.7	8.9
San Vitaliano	5.7	7.6	7.7	7.3	8.1	7	9.6	7.8	9.9	10.2	7.7	9.9	9.2
Saviano	7.9	7.9	9.6	8.6	9.1	7.9	9.2	7.9	9.8	7.9	9.6	11.2	11
Scisciano	5.6	8.1	7.1	8.6	8.5	8	8.2	8	7.1	6.9	6.5	8.7	8.5
Tufino	8.8	6.4	4.8	9.8	9.6	5.1	8.2	6.7	8.7	8.5	6.9	12.3	13.7
Villaricca	5.3	5.4	6	5.5	6.6	5.7	6.8	6.9	7.1	7	7.5	8.6	8.7
Visciano	9.8	10.7	10.1	9.7	10.9	10.7	11.2	8.3	13.3	11.2	10.8	13.3	10.7
Aversa	7.7	7.3	7.9	8.6	7.6	8.7	8.9	7.9	9	8.6	8.5	10.3	9.4
Capodrise	5.6	6.7	6	6.6	6.2	4.4	5.8	5.9	6.8	6.8	5.7	8.7	7.7
Capua	10.2	9.1	9.8	12.1	8.8	9.7	10.6	10.8	10.9	9.4	10.8	11.4	11.3
Carinaro	5.8	9	5.6	6.9	9.6	6.5	7.5	6.7	7.7	7.6	7.3	5.8	8.8
Casal di Principe	4.2	5.5	5.9	5.8	6.1	6.8	6.6	7	7.4	6.4	7	7.9	9.4
Casaluce	6.2	6.3	8	5.7	5.9	5.6	7.1	6.3	8.5	7.3	7.4	7.7	9.4
Casapesenna	3.6	6.2	6.7	6.3	6.8	7.7	7	5.7	7.9	8.9	7.3	11	11.5
Caserta	8.1	8.5	8.6	9.1	9.3	8.7	10.3	9.3	9.7	9.7	9.5	11.4	10.1
Castel Volturno	10	8.7	7.6	9	7.6	7.6	8.4	7.9	7.8	8	6.9	8.5	8.6
Cervino	8.8	9.7	7.9	11	7.3	8.1	8.3	8.6	5.6	7.8	9.2	9.8	8.3
Cesa	5	6.2	5.8	5	5	6.1	6.1	5.5	5.7	5.8	5.9	7.2	7.4
Francolise	7.2	9.4	9.5	10.2	12.4	11.8	7.7	11	9.2	8.9	9.9	9.1	10.4
Frignano	8.1	7.8	7.9	7.9	7.6	7.5	8.6	8.2	8.5	9.5	7.6	7.7	9.5
Gricignano di Aversa	4.9	4.1	4.4	4.8	4	4.5	6.1	4.2	5.6	5.9	5.7	7.2	5.1
Lusciano	5	6	6.5	7.3	6.3	6.4	7.6	6.7	5.9	6.6	5.7	7.4	6.8
Maddaloni	7.6	8	7.2	8	8.4	7.2	8	7.1	8.5	8.3	8	8.9	9.3
Marcianise	6.4	6.6	6.4	7.4	6.9	7.3	8	7.1	7.6	7.9	6.9	7.6	9.3
Mondragone	7.8	9.6	8.5	8.6	9	7.6	8.9	8.8	9.1	9	8.8	10.1	10.7
Orta di Atella	3.9	3.8	3.9	3.4	4	4.5	4.7	4.6	4.7	4.6	4.5	5.2	5.3
Parete	6.2	7.4	7	5.7	6.7	6.3	6	6.6	7.1	6.7	6.2	7.8	7.5
Recale	6.6	6.8	6.2	6.4	6.1	8.8	7	8.4	8.5	6	7.7	8.4	8.9
San Cipriano d'Aversa	4.8	6.1	8.2	7.3	7.3	7.1	9	9.4	9	7.5	8.4	10.6	11.7
San Felice a Cancello	8.2	7.3	8.8	7.2	6.4	8.1	9	8.8	9.5	9.9	8.8	11.2	10.7
San Marcellino	5.2	7.5	6.3	7.5	5.7	6.7	6.6	6.3	6.7	7.4	7.3	7.6	7

Municipalities	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
San Marco Evangelista	5.7	6.2	5.6	7.8	6.4	6.8	6.5	6.6	7	5.8	8.3	8.7	9.3
San Nicola la Strada	7.5	7.7	7.8	6	7.3	7.4	7.4	6.9	7.7	8.1	7.9	8.9	8.6
San Tammaro	4.6	6.9	7.8	7.2	6.7	6.3	4.9	8.3	9.3	6.7	8.7	8.2	9.6
Santa Maria Capua Vetere	9	10	11.3	10.2	11.1	10.4	11	10.1	9.7	10.7	9.8	10.9	10.7
Santa Maria la Fossa	9.6	7.7	9.2	10.1	8.5	9.5	15.7	9.6	7.1	10.5	9.1	9	12.5
Sant'Arpino	6.8	5.3	6.5	6.4	6.2	5.9	6.8	6.5	7.4	5.8	7.2	8.1	9.3
Succivo	7.5	5.3	6.9	6.1	6.1	7.3	6.2	6.6	7.1	7.7	6.9	8.3	6.9
Teverola	4.6	4.9	5.9	4.9	5.9	4.7	6.2	5.6	5.8	5.8	7	7.4	5.9
Trentola Ducenta	6.4	5.1	5.5	5.4	6.7	5.3	6.4	5	6.3	6	6.8	6.6	7.5
Villa di Briano	6.5	5.3	5.2	6.7	4.8	6.5	2.8	8.1	8.1	7.1	5.6	8.3	9.7
Villa Literno	6.3	7.4	7.6	8.3	5.6	5.9	6.2	6.5	5.9	6.7	7.3	9.1	9.9

Appendix 2. Foreign population in the Land of Fires (blue: municipalities of Napoli's province; light blue: municipalities of Caserta's province).

Municipalities	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Acerra	1,231	1,378	1,133	1,240	1,756	1,797	1,830	1,952	2,092	2,008	2,192	2,187	2,128	2,208	2,294
Brusciano	199	227	215	221	270	290	324	310	296	287	279	275	257	237	208
Caivano	552	637	605	663	692	667	708	756	800	864	850	858	813	818	780
Camposano	95	122	107	122	138	141	141	142	143	142	130	126	104	86	78
Casamarciano	53	52	56	62	66	62	60	51	55	51	43	43	40	40	46
Castello di Cisterna	122	150	127	131	152	154	152	161	163	170	178	173	178	163	144
Cicciano	228	282	243	242	315	322	341	341	357	374	355	340	245	243	245
Cimitile	120	142	134	187	198	210	232	242	247	262	275	246	254	232	208
Comiziano	46	56	37	35	47	48	49	54	54	54	52	50	46	49	53
Giugliano in Campania	3,470	3,974	2,702	3,393	4,555	5,229	6,098	6,512	6,980	6,908	6,914	6,087	6,569	6,184	5,844
Mariglianella	152	174	190	218	243	232	213	225	242	239	237	236	232	245	231
Marigliano	677	772	778	827	939	1,032	1,111	1,112	1,112	1,144	1,124	1,097	1,022	990	1,021
Melito di Napoli	348	401	296	393	446	596	585	678	750	815	771	722	739	714	632
Nola	907	979	887	931	1,046	1,138	1,201	1,248	1,357	1,440	1,497	1,524	1,425	1,283	1,290
Pomigliano d'Arco	575	648	646	714	840	870	911	943	960	960	1,042	1,016	935	919	954
Pozzuoli	1,638	1,768	1,254	2,071	1,899	2,045	2,056	2,151	2,176	2,220	2,273	2,263	2,199	1,931	1,889
Qualiano	519	607	497	575	685	867	1,038	1,055	1,108	1,130	1,195	1,128	1,075	1,023	1,025
Quarto	351	425	406	483	525	593	653	719	734	754	793	760	898	814	766
Roccarainola	137	148	139	176	184	184	193	194	202	176	213	205	143	143	150
San Paolo Bel Sito	76	96	73	79	87	92	85	80	81	74	75	74	74	70	79
San Vitaliano	88	109	108	117	117	109	99	95	106	128	145	144	132	126	128
Saviano	383	437	453	469	529	586	618	724	770	849	849	815	733	686	689
Scisciano	91	98	97	115	127	139	153	169	179	181	167	164	163	156	154
Tufino	53	48	48	51	48	54	64	64	50	54	49	49	33	37	31
Villaricca	454	504	503	544	639	685	703	690	799	792	704	721	699	703	683
Visciano	129	111	111	111	113	103	101	98	77	76	89	88	84	83	81
Aversa	1,939	2,100	2,248	2,530	2,747	2,914	2,963	3,037	3,099	3,203	3,103	3,019	3,030	2,876	2,951
Capodrise	241	278	213	190	240	247	252	267	290	287	327	313	289	293	295
Capua	749	874	747	813	927	972	1,067	1,069	1,117	1,159	1,266	1,178	1,236	1,337	1,518
Carinaro	266	270	230	255	311	320	315	312	309	312	306	299	354	333	344
Casal di Principe	617	718	660	815	913	988	1,052	1,171	1,164	1,164	1,317	1,234	1,327	1,409	1,482
Casaluce	345	401	421	494	522	553	503	486	439	473	370	350	370	418	445
Casapesenna	220	249	191	220	313	379	437	473	539	540	449	438	496	514	550
Caserta	2,997	3,345	2,568	2,735	3,402	3,575	3,605	3,632	3,793	4,007	4,048	3,955	3,825	3,775	3,916

Municipalities	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Castel Volturno	2,512	2,933	3,071	3,415	3,568	3,854	3,880	3,954	4,114	4,012	4,352	4,081	4,691	4,933	4,824
Cervino	111	135	77	88	141	155	143	151	168	184	183	174	158	167	182
Cesa	209	246	225	231	270	283	296	302	305	337	350	342	336	313	311
Francolise	182	224	201	216	243	266	280	300	305	289	296	282	292	288	348
Frignano	272	266	172	182	283	296	288	290	320	328	337	334	366	345	347
Gricignano di Aversa	403	461	384	431	513	388	484	522	544	599	870	853	881	806	807
Lusciano	362	431	457	578	577	655	656	705	730	772	793	779	719	734	764
Maddaloni	598	731	778	803	835	900	950	950	1,027	1,080	838	820	881	889	944
Marcianise	751	834	861	873	882	922	981	1,025	1,122	1,224	1,268	1,204	1,203	1,145	1,152
Mondragone	1,286	1,598	1,741	2,110	2,578	2,857	3,079	3,231	3,521	3,909	4,581	4,279	4,111	3,689	3,717
Orta di Atella	369	449	411	482	578	666	739	747	752	760	800	813	754	674	673
Parete	528	607	565	586	769	853	876	873	888	917	997	987	1,015	1,037	1,083
Recale	233	249	301	304	321	337	356	251	232	240	242	231	241	247	248
San Cipriano d'Aversa	529	627	453	520	615	721	736	796	917	972	1,034	1,009	869	845	826
San Felice a Cancello	424	483	315	338	418	438	438	469	502	485	498	474	515	543	563
San Marcellino	608	699	500	602	841	940	1,026	1,030	1,036	1,060	1,062	1,075	49	990	971
San Marco Evangelista	171	185	202	238	268	299	334	366	369	372	334	320	302	293	290
San Nicola la Strada	798	920	816	853	1,097	1,246	1,365	1,599	1,701	1,632	1,505	1,393	1,380	1,356	1,304
San Tammaro	99	107	56	76	100	88	94	104	99	93	162	154	161	176	194
Santa Maria Capua Vetere	1,198	1,349	1,068	1,107	1,403	1,453	1,478	1,560	1,739	1,819	1,729	1,695	1,729	1,629	1,692
Santa Maria la Fossa	74	111	89	108	120	168	191	173	167	163	127	135	136	143	162
Sant'Arpino	268	299	214	256	304	328	324	403	461	487	500	483	537	495	513
Succivo	179	226	200	242	278	300	336	341	322	365	369	371	407	371	338
Teverola	364	411	370	390	498	505	521	505	508	517	444	438	447	424	410
Trentola Ducenta	623	679	443	517	704	758	785	799	804	834	953	943	848	829	873
Villa di Briano	249	331	184	286	343	384	607	539	597	640	643	580	628	601	591
Villa Literno	743	588	349	430	752	900	919	960	1,085	1,274	1,336	1,275	1,214	1,428	1,572

Appendix 3. Potentially contaminated/unremediated sites in the Land of Fires (blue: municipalities of Napoli's province; light blue: municipalities of Caserta's province).

Potentially contaminated/ unremediated sites	2017	2018	2019	2022
Acerra	1,623,710	1,642,711	1,502,449	1,419,196
Brusciano	60,634	60,641	60,641	58,251
Caivano	1,956,060	1,809,272	1,825,433	1,555,704
Camposano	2,967	2,968	2,968	2,968
Casamarciano	254,613	254,624	254,624	254,624
Castello di Cisterna	161,353	161,361	161,361	161,361
Cicciano	47,805	47,806	47,806	47,806
Cimitile	15,506	15,511	15,511	15,511
Comiziano	204,927	204,930	204,930	204,930
Giugliano in Campania	6,745,723	6,227,107	6,227,107	6,026,963
Mariglianella	62,874	62,878	64,418	62,418
Marigliano	339,325	339,337	334,521	302,341
Melito di Napoli	109,784	109,791	109,791	109,791
Nola	1,516,436	1,517,647	1,510,233	1,423,718
Pomigliano d'Arco	2,969,546	2,764,587	2,753,607	2,779,028
Pozzuoli	1,136,506	1,755,157	1,647,277	1,646,228
Qualiano	126,601	126,604	126,604	126,604

Potentially contaminated/ unremediated sites	2017	2018	2019	2022
Quarto	247,859	247,864	231,268	247,864
Roccarainola	194,532	194,535	194,535	194,535
San Paolo Belsito	838	839	839	839
San Vitaliano	202,069	202,074	183,030	182,439
Saviano	133,842	133,846	133,846	133,846
Scisciano	37,860	37,863	37,863	37,863
Tufino	534,917	534,925	534,925	534,925
Villaricca	284,988	285,251	285,251	285,251
Visciano	0	0	0	0
Aversa	96,603	99,238	84,238	83,548
Capodrise	68,047	68,050	42,838	40,976
Capua	2,463,009	2,468,933	2,460,209	2,308,087
Carinaro	174,472	182,170	182,170	182,170
Casal di Principe	36,988	41,091	37,991	36,700
Casaluce	22,593	22,594	22,594	20,660
Casapesenna	2,523	2,523	2,523	2,523
Caserta	1,246,361	1,239,682	1,627,890	1,535,614
Castel Volturno	3,973,000	3,982,183	3,982,183	3,972,524
Cervino	27,112	27,115	27,115	27,115
Cesa	8,805	9,266	9,266	6,807
Francolise	172,385	172,393	172,393	172,393
Frignano	58,542	58,545	58,545	58,545
Gricignano d'Aversa	179,818	179,820	179,820	179,820
Lusciano	3,907	3,907	3,907	3,907
Maddaloni	1,463,828	1,400,585	1,357,122	1,360,644
Marcianise	853,513	850,915	783,752	806,145
Mondragone	1,121,746	1,120,669	1,118,795	1,115,339
Orta di Atella	296,016	281,053	281,053	281,053
Parete	16,617	16,617	16,617	16,617
Recale	21,901	21,902	21,902	21,902
San Cipriano d'Aversa	1,187	1,187	1,187	1,187
San Felice a Cancello	237,554	237,565	237,565	237,565
San Marcellino	2,193	2,194	2,194	2,194
San Marco Evangelista	410,870	410,891	410,891	410,891
San Nicola La Strada	160,081	160,085	160,085	160,085
San Tammaro	703,837	703,849	703,849	703,849
Santa Maria Capua Vetere	400,209	396,163	381,641	381,641
Santa Maria La Fossa	417,560	405,642	405,642	405,643
Sant'Arpino	234	234	234	234
Succivo	48,360	48,361	48,361	48,361
Teverola	491,270	493,267	492,115	485,715
Trentola-Ducenta	57,710	57,712	57,712	57,712
Villa di Briano	119,787	119,790	119,790	119,790
Villa Literno	1,514,918	1,514,921	1,514,921	1,514,920

Appendix 4. Number of toxic fires in the Land of Fires (blue: municipalities of Napoli's province; light blue: municipalities of Caserta's province).

Municipalities	2014	2015	2016	2017	2018	2019	2020	2021
Acerra	5	8	5	3	47.26	81.79	73.28	53.29
Caivano	4	19	4	11	85.72	148.02	132.61	94.43
Castello di Cisterna	0	2	0	0	4.5	7.79	6.98	5.08
Giugliano in Campania	2	96	65	27	472.61	740.09	663.05	482.14
Marigliano	0	1	0	0	2.25	3.89	3.49	2.54
Melito di Napoli	0	0	0	1	2.25	3.89	3.49	2.54
Pozzuoli	0	10	1	2	29.26	50.64	45.37	32.99
San Vitaliano	0	0	0	0	0	0	0	0
Qualiano	0	12	9	6	60.76	105.17	94.22	68.51
Aversa	0	0	2	1	3.11	3.49	3.48	1.99
Capua	0	1	0	1	2.07	2.32	2.32	1.33
Carinaro	0	0	1	1	2.07	2.32	2.32	1.33
Casal di Principe	4	6	1	1	12.44	13.94	13.91	7.98
Casaluce	0	1	0	1	2.07	2.32	2.32	1.33
Castel Volturno	0	4	23	3	31.09	34.85	34.78	19.95
Frignano	0	2	2	2	6.22	6.97	6.96	3.99
Gricignano d'Aversa	0	3	2	3	8.29	9.29	9.27	5.32
Lusciano	0	1	0	0	1.04	1.16	1.16	0.66
Maddaloni	0	0	1	1	2.07	2.32	2.32	1.33
Marcianise	0	0	0	0	0	0	0	0
Mondragone	0	0	17	1	18.66	20.91	20.87	11.97
Orta di Atella	0	2	0	0	2.07	2.32	2.32	1.33
Parete	0	1	0	0	1.04	1.16	1.16	0.66
San Cipriano d'Aversa	0	1	0	1	2.07	2.32	2.32	1.33
San Felice a Cancello	0	0	0	0	0	0	0	0
San Marco Evangelista	0	0	0	0	0	0	0	0
San Tammaro	0	10	1	0	11.4	12.78	12.75	7.32
Santa Maria Capua Vetere	0	6	0	0	6.22	6.97	6.96	3.99
Succivo	0	2	0	1	3.11	3.49	3.48	1.99
Teverola	0	3	2	2	7.26	8.13	8.12	4.66
Trentola Ducenta	0	1	2	0	3.11	3.49	3.48	1.99
Villa Literno	0	5	11	6	22.8	25.56	25.51	14.63
Villa di Briano	0	0	2	1	3.11	3.48	3.48	1.99

Appendix 5. Consumption of land in hectares (blue: municipalities of Napoli's province; light blue: municipalities of Caserta's province).

Municipalities	2012	2015	2016	2017	2018	2019	2020	2021
Acerra	1.040.27	1.049.54	1.050.65	1.053.00	1.053.67	1.058.77	1.158.86	1.179.91
Brusciano	202.33	202.55	202.69	202.74	202.87	202.87	211.56	216.94
Caivano	720.49	726.78	729.12	733.42	734.93	738.67	770.41	778.21
Camposano	104.15	105.73	105.73	105.73	105.90	105.90	108.80	109.19
Casamarciano	123.77	125.33	125.72	128.13	128.18	129.39	131.52	132.78
Castello di Cisterna	159.71	160.21	160.46	161.35	161.35	162.62	166.47	167.26
Cicciano	196.33	196.73	196.73	196.79	197.20	197.25	200.77	201.56
Cimitile	117.93	118.03	118.03	118.03	118.03	118.03	119.25	119.28
Comiziano	63.45	63.45	63.45	63.46	63.46	63.46	64.97	65.11
Giugliano in Campania	2.300.91	2.377.16	2.381.28	2.384.48	2.384.69	2.386.57	2.457.11	2.470.51
Mariglianella	127.69	128.03	128.03	128.04	128.44	129.12	133.68	135.75

Municipalities	2012	2015	2016	2017	2018	2019	2020	2021
Marigliano	566.02	568.38	570.06	570.96	571.35	571.91	602.02	608.51
Melito di Napoli	305.66	306.82	306.95	307.07	307.07	307.07	307.39	307.39
Nola	1.258.67	1.268.14	1.269.83	1.276.66	1.276.66	1.279.64	1.311.59	1.325.91
Pomigliano d'Arco	662.32	663.23	664.03	664.43	666.21	670.08	677.68	680.48
Pozzuoli	1.428.32	1.430.25	1.434.52	1.435.80	1.435.80	1.435.80	1.456.98	1.459.44
Qualiano	283.83	284.32	284.32	285.96	285.96	285.96	291.87	292.61
Quarto	570.49	573.69	576.46	578.59	578.59	578.59	596.54	607.04
Roccarainola	245.77	251.10	259.47	260.46	260.46	260.76	268.03	269.36
San Paolo Bel Sito	68.26	68.26	68.38	68.63	68.72	68.72	68.95	68.95
San Vitaliano	154.13	154.98	155.24	157.00	157.00	157.00	164.32	165.57
Saviano	412.51	414.59	415.62	416.38	416.38	417.67	424.26	429.29
Scisciano	160.11	160.31	161.34	162.06	162.42	162.48	167.75	172.69
Tufino	96.51	96.51	96.66	96.66	96.80	96.97	100.17	101.45
Villaricca	351.24	352.30	353.75	354.64	355.79	355.79	361.24	361.69
Visciano	86.32	86.48	86.55	86.62	86.80	86.80	87.81	87.81
Aversa	568.79	571.11	571.17	571.87	571.87	571.87	577.99	578.33
Capodrise	166.74	167.37	167.63	167.78	167.81	167.81	170.77	170.77
Capua	473.84	608.02	609.10	614.12	614.41	614.47	623.60	624.00
Carinaro	267.02	274.26	276.51	278.69	278.69	280.39	290.94	295.93
Casal di Principe	467.75	472.93	473.84	475.24	475.24	475.24	477.64	481.76
Casaluce	161.45	163.39	163.99	165.39	165.72	165.73	169.68	173.48
Casapesenna	152.21	152.91	153.56	153.56	153.56	153.56	155.13	155.26
Caserta	1.297.35	1.307.35	1.310.31	1.313.96	1.317.59	1.324.41	1.338.98	1.342.56
Castel Volturno	1.299.58	1.302.79	1.305.02	1.305.54	1.306.05	1.306.08	1.507.18	1.507.78
Cervino	107.29	108.07	108.33	108.33	108.41	108.41	110.89	110.89
Cesa	108.98	109.70	109.79	110.05	110.05	110.32	110.88	110.88
Francolise	239.08	242.68	244.51	245.71	246.16	246.16	252.12	255.22
Frignano	170.34	171.78	172.86	173.50	173.50	173.85	176.43	178.48
Gricignano d'Aversa	380.91	389.14	390.46	392.15	392.70	394.77	433.89	442.47
Lusciano	209.47	211.85	212.65	214.05	214.10	214.10	215.75	216.76
Maddaloni	917.81	928.39	930.61	930.82	932.81	952.91	998.29	1.005.89
Marcianise	1.117.58	1.127.17	1.129.59	1.143.71	1.158.98	1.160.59	1.175.43	1.170.60
Mondragone	663.56	669.44	670.03	670.28	670.42	670.42	713.55	713.55
Orta di Atella	286.12	286.57	287.12	287.26	287.26	287.74	298.46	299.73
Parete	158.80	160.09	160.58	161.97	162.29	164.00	171.61	175.25
Recale	110.58	112.91	113.11	113.14	113.17	113.17	114.00	114.84
San Cipriano d'Aversa	257.19	258.87	259.16	260.34	260.34	260.34	263.69	263.69
San Felice a Cancello	427.30	429.60	430.62	431.80	432.31	432.94	449.30	450.59
San Marcellino	207.17	209.03	210.33	210.86	210.86	210.86	215.71	219.04
San Marco Evangelista	209.15	211.15	211.23	212.08	212.85	217.38	221.44	223.16
San Nicola la Strada	268.95	269.83	270.60	270.72	270.92	271.74	274.89	273.65
San Tammaro	244.86	249.80	249.95	250.84	250.84	250.84	254.45	255.26
Santa Maria Capua Vetere	559.02	563.91	564.08	564.37	564.37	564.37	569.80	571.82
Santa Maria La Fossa	179.80	186.90	187.06	187.06	187.06	187.06	190.94	192.63
Sant'Arpino	180.90	183.77	184.69	186.20	186.20	186.20	189.12	189.12
Succivo	139.38	140.13	140.21	140.30	140.34	140.74	147.73	147.73
Teverola	291.40	301.10	301.78	303.40	303.40	304.87	315.40	316.70
Trentola Ducenta	277.48	279.80	280.17	281.06	281.06	281.06	283.87	285.51
Villa di Briano	159.05	160.64	160.73	160.82	160.82	160.82	162.31	163.13
Villa Literno	471.73	538.55	540.34	540.97	541.58	541.58	605.30	614.87

Appendix 6. Density of consumed land in relation to the total area (sqm/ha) (blue: municipalities of Napoli's province; light blue: municipalities of Caserta's province).

Municipalities	Density of consumed land
Acerra	28.01
Brusciano	47.92
Caivano	33.41
Camposano	31.40
Casamarciano	39.55
Castello di Cisterna	50.20
Cicciano	7.99
Cimitile	3.91
Comiziano	2.32
Giugliano in Campania	38.27
Mariglianella	38.58
Marigliano	23.48
Melito di Napoli	12.51
Nola	32.00
Pomigliano d'Arco	42.88
Pozzuoli	10.15
Qualiano	13.50
Quarto	52.66
Roccarainola	19.75
San Paolo Bel Sito	5.22
San Vitaliano	36.27
Saviano	30.33
Scisciano	53.88
Tufino	12.42
Villaricca	26.10
Visciano	2.00
Aversa	14.25
Capodrise	12.37
Capua	9.08
Carinaro	103.15
Casal di Principe	17.29

Municipalities	Density of consumed land
Casaluce	35.86
Casapesenna	17.78
Caserta	19.84
Castel Volturno	4.09
Cervino	5.67
Cesa	16.38
Francolise	9.69
Frignano	18.88
Gricignano d'Aversa	78.05
Lusciano	41.98
Maddaloni	57.74
Marcianise	48.46
Mondragone	4.78
Orta di Atella	14.36
Parete	65.01
Recale	38.39
San Cipriano d'Aversa	19.03
San Felice a Cancello	8.48
San Marcellino	53.93
San Marco Evangelista	72.03
San Nicola la Strada	13.28
San Tammaro	6.44
Santa Maria Capua Vetere	15.54
Santa Maria La Fossa	10.46
Sant'Arpino	57.74
Succivo	10.49
Teverola	80.73
Trentola Ducenta	30.42
Villa di Briano	15.50
Villa Literno	45.08

Appendix 7. Unitary real estate market values for the municipalities of the Land of Fires (blue: municipalities of Napoli's province; light blue: municipalities of Caserta's province).

Municipalities	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Acerra	1618	1560	1475	1455	1400	1338	1273	1227	1218	1241
Brusciano	1625	1591	1444	1412	1464	1459	1455	1451	1615	1489
Caivano	1111	1321	1220	1168	1108	1100	1146	1052	1096	1061
Camposano	1409	1374	1161	1058	787	812	1077	1053	1034	1012
Casamarciano	1286	1296	1317	1154	1132	1112	1190	1156	990	1183
Castello di Cisterna	2144	1956	1884	1836	1795	1778	1573	1568	1564	1530
Cicciano	1648	1454	1341	1302	1209	1229	1206	1169	1197	1170
Cimitile	1532	1586	1478	1233	1268	1243	1320	1268	1184	1269
Comiziano	1218	1432	1418	1012	990	1010	1052	963	992	928
Giugliano in Campania	1864	1775	1670	1573	1497	1454	1413	1397	1395	1371
Mariglianella	1753	1632	1593	1468	1407	1491	1433	1355	1287	1416
Marigliano	1627	1523	1493	1484	1491	1441	1365	1337	1297	1262

Municipalities	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Melito di Napoli	1854	1725	1537	1403	1354	1334	1280	1298	1304	1265
Nola	1876	1741	1654	1529	1523	1492	1481	1440	1426	1377
Pomigliano d'Arco	2065	1984	1883	1810	1784	1770	1884	1853	1865	1913
Pozzuoli	3232	3050	2862	2870	2757	2578	2530	2454	2433	2392
Qualiano	1648	1518	1464	1359	1343	1360	1320	1301	1242	1213
Quarto	2227	2156	2061	1914	1821	1760	1732	1690	1666	1800
Roccarainola	1303	1138	1204	1221	1080	1024	1085	989	981	1142
San Paolo Bel Sito	1689	1528	1519	1526	1423	1381	1356	1218	1213	1095
San Vitaliano	2085	1914	1766	1718	1590	1581	1569	1499	1501	1517
Saviano	1356	1298	1332	1281	1236	1266	1236	1333	1386	1330
Scisciano	1660	1505	1479	1532	1500	1330	1396	1464	1432	1367
Tufino	1322	1309	1272	1202	1118	1052	1061	1061	1026	1036
Villaricca	1977	1869	1738	1587	1535	1572	1551	1499	1506	1456
Visciano	1274	1240	1203	1196	1123	1008	969	987	948	948
Aversa	1695	1729	1718	1669	1642	1579	1456	1429	1429	1411
Capodrise	1612	1450	1403	1308	1151	1249	1172	1173	1190	1203
Capua	1223	1162	1127	1048	1017	913	914	916	866	920
Carinaro	1280	1464	1361	1327	1198	940	1172	1170	1207	1169
Casal di Principe	1282	1293	1163	1102	954	764	851	934	972	951
Casaluce	1222	1345	1362	1265	1132	1030	1015	942	903	905
Casapesenna	1499	1486	1300	971	824	735	638	582	560	701
Caserta	2164	2239	2047	2189	1862	1752	1615	1549	1522	1513
Castel Volturno	663	910	901	762	662	608	623	599	572	556
Cervino	1251	1271	1036	561	748	794	743	750	687	757
Cesa	1264	1331	1254	1279	1421	1245	1201	1273	1212	1197
Francolise	713	763	715	812	812	818	698	699	708	682
Frignano	406	886	1067	1035	936	884	1072	874	741	937
Gricignano d'Aversa	1519	1345	1247	1309	1246	1244	1132	1234	1311	1217
Lusciano	1392	1498	1609	1523	1290	1309	1324	1363	1379	1552
Maddaloni	1383	1414	1261	1223	1113	1083	985	969	965	935
Marcianise	1285	1327	1072	958	952	983	920	928	902	981
Mondragone	848	764	771	790	824	821	782	745	749	771
Orta di Atella	1601	1577	1489	1430	1289	1192	1149	1146	1138	1081
Parete	1422	1492	1383	1423	1230	1135	1138	1193	1239	1323
Recale	1284	1381	1264	1304	1261	952	1005	1101	1017	1019
San Cipriano d'Aversa	1226	1306	1121	1026	871	701	761	811	840	839
San Felice a Cancello	1218	1274	1154	917	744	646	724	846	858	754
San Marcellino	1454	1458	1274	1272	1119	963	1048	1095	1090	1117
San Marco Evangelista	1208	1503	1646	1520	1235	1043	1035	1008	992	1084
San Nicola la Strada	1786	1768	1656	1545	1527	1395	1300	1222	1169	1150
San Tammaro	1330	1240	1234	1141	1075	944	938	977	1069	989
Santa Maria Capua Vetere	1550	1506	1407	1281	1184	1068	1104	1057	999	969
Santa Maria La Fossa	668	735	770	688	655	646	613	587	573	588
Sant'Arpino	1674	1639	1508	1446	1337	1328	1452	1453	1502	1525
Succivo	1472	1478	1470	1428	1336	1332	1380	1407	1373	1391
Teverola	1506	1443	1347	1296	1284	1263	1199	1293	1297	1293
Trentola Ducenta	1820	1679	1544	1503	1424	1361	1342	1424	1447	1367
Villa di Briano	1226	1305	1131	1102	999	775	796	896	910	903
Villa Literno	1392	1447	1188	1009	790	592	860	958	1045	870

Appendix 8. Dataset (blue: municipalities of Napoli's province; light blue: municipalities of Caserta's province).

Municipalities	Δ mortality	Δ foreign population	Δ unreclaimed land	Δ landfills	Δ toxic fires	Δ land consumed	Δ real estate prices
Acerra	0.032	0.069	-0.018	0.250	6.899	0.014	-0.029
Camposano	0.020	-0.014	0.000	0.000	0.000	0.004	-0.025
Castello di Cisterna	0.021	0.037	0.000	0.000	0.726	0.005	-0.036
Cicciano	0.022	0.012	0.000	0.000	0.000	0.003	-0.036
Cimitile	0.036	0.035	0.000	0.000	0.000	0.001	-0.018
Giugliano in Campania	0.014	0.083	-0.019	-0.125	68.591	0.011	-0.033
Mariglianella	0.063	0.011	0.006	0.000	0.000	0.007	-0.022
Marigliano	0.016	0.026	-0.004	0.000	0.363	0.008	-0.028
Melito di Napoli	0.046	0.079	0.000	0.000	0.363	0.000	-0.041
Nola	0.011	0.050	-0.001	0.000	0.000	0.006	-0.033
Pomigliano d'Arco	0.033	0.033	-0.018	0.000	0.000	0.003	-0.008
Pozzuoli	0.026	0.008	0.121	0.000	4.713	0.002	-0.033
Qualiano	0.056	0.077	0.000	0.000	9.787	0.003	-0.033
Quarto	0.028	0.073	-0.017	0.000	0.000	0.007	-0.023
San Vitaliano	0.047	0.018	-0.024	0.000	0.000	0.008	-0.034
Scisciano	0.005	0.041	0.000	0.000	0.000	0.008	-0.020
Tufino	0.102	-0.034	0.000	0.000	0.000	0.006	-0.026
Villaricca	0.057	0.032	0.000	0.000	0.000	0.003	-0.033
Visciano	0.038	-0.026	0.000	0.000	0.000	0.002	-0.032
Aversa	0.016	0.021	-0.031	0.000	0.284	0.002	-0.020
Capodrise	0.043	0.052	-0.093	0.000	0.000	0.002	-0.030
Capua	0.001	0.049	0.000	0.000	0.190	0.023	-0.030
Casal di Principe	0.059	0.058	0.009	0.000	0.569	0.003	-0.027
Casaluce	0.069	-0.027	0.000	0.000	0.190	0.007	-0.031
Casapesenna	0.091	0.106	0.000	0.000	0.000	0.002	-0.072
Caserta	0.017	0.041	0.077	0.000	0.000	0.004	-0.037
Castel Volturno	0.001	0.038	0.001	0.000	2.850	0.018	-0.010
Cervino	-0.003	0.082	0.000	0.000	0.000	0.003	-0.030
Maddaloni	0.022	0.015	-0.019	0.000	0.190	0.010	-0.042
Marcianise	0.031	0.037	-0.020	-0.125	0.000	0.005	-0.026
Orta di Atella	0.053	0.054	-0.013	-0.250	0.190	0.005	-0.042
Recale	0.060	-0.019	0.000	0.000	0.000	0.003	-0.020
San Cipriano d'Aversa	0.062	0.063	0.000	0.000	0.190	0.002	-0.036
San Felice a Cancello	0.054	0.051	0.000	0.000	0.000	0.006	-0.044
San Nicola la Strada	0.044	0.061	0.000	0.000	0.000	0.002	-0.047
San Tammaro	0.066	0.111	0.000	0.000	1.046	0.004	-0.030
Santa Maria Capua Vetere	0.008	0.054	-0.012	0.000	0.570	0.002	-0.050
Teverola	0.036	0.020	0.000	0.000	0.666	0.008	-0.016
Trentola Ducenta	0.053	0.063	0.000	0.000	0.284	0.003	-0.030
Villa Literno	0.033	0.141	0.000	0.250	2.090	0.025	-0.030