



*Research article*

## **A preliminary analysis of the relationship between special economic zones (SEZs) and land usage. Highlight accessibility between logistical nodes and transportation systems**

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**Abstract:** Special economic zones (SEZs) are significant in South Italy and the Campania Region as a result of their capacity to promote industrialization, draw in foreign investment and accelerate economic globalization. To assess the effectiveness of land use in Campania's SEZs, this study examined the connections between land use, the transportation network and accessibility. SEZs require a lot of spaces, and land use in SEZs in Campania is always expanding. The accessibility indicator, which is associated with the adaptability of investments, activities and linkages, can be helpful to assess land use and potentiality. This study suggests examining the components of SEZ areas (residential, commercial and industrial) as well as an accessibility-based land use analysis between poles and nodes to provide a clustering between areas potential and where SEZs can improve.

**Keywords:** SEZ; Campania; accessibility; transport; land use

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### **1. Introduction**

In many developing nations, special economic zones—which can take on many different types, such as industrial parks or integrated logistics areas—have emerged as a crucial tool for fostering economic growth [1]. Currently, industrial parks and special economic zones (SEZs) are becoming more and more common in Southeast Asian nations, in Africa and in Europe in Italy.

Special economic zones are established by policymakers to promote economic and territorial development, port improvements, attract foreign direct investment and maybe create jobs. One

example of indirect economic benefits is modernizing local industry to serve as hubs for the diffusion of knowledge, invention and technology. More nations are creating new special economic zone regimes or responding to the increase in interest in zone-based development plans throughout the world by modernizing outdated ones. Countries like Japan, China and Singapore have strongly established SEZs and industrial parks in several Southeast Asian countries [2,3]. SEZs are a widely discussed topic in the current literature under the guise of investment and economic growth, even though they are a component of urban planning and human activities [4–8].

In 2018, Italy created SEZs [9] in its southern regions that offer benefits for the environment, social welfare and economic growth, comparable to many other foreign experiences, including those in Poland, China and the most recent in Africa [10]. The SEZs are in different geographical settings, and those, located in Southern Italy known as “Mezzogiorno” have different territorial components drawn from the areas to which they belong (population, economic power, import/export index). Land use, the transportation system, and the economic system all have a role in the formation of Mezzogiorno cities, and each of these factors may be enhanced and fostered by SEZs. It is widely acknowledged that land use integrated transportation solutions are essential for promoting urban sustainability. This study will examine how land use, including various forms of land use, and transportation variables connect to SEZs in Campania because there is currently a shortage of empirical research on SEZs [11,12].

Additionally, it has an impact on commerce, employment, foreign talent acquisition, tax incentives, and real estate. SEZs aim to considerably support the creation of numerous employment necessary to meet the operational demands of both national and international development, both directly and indirectly. At the regional level, the effects aim to improve employment in the logistics industry and add jobs to support the expansion of the region’s population brought on by these facilities. From a real estate perspective, buildings and other local assets, especially residential and tourism infrastructures, have been revalued. In the SEZs, or more generally in the territory that offers them, a variety of roles including production, consumption, and distribution, are inherent in many economic, social and cultural activities. While having comparable location criteria but a varied spatial response, SEZs around the world have a very wide range of land uses and this diversity is influenced to some extent by transport infrastructure. The transport systems that are part of the SEZs network in Campania are the TEN-T network. Despite the transport connection, many places experience geographical alienation, whereby access to transport systems and nodes relates to economic and productive activities.

Because of the complex, dynamic relationship between land use and transportation, according to [13] there is a broad spectrum of literature on the subject. The land use transport interaction (LUTI) model has advanced significantly during the integration of land use and transport modeling research [14]. The distribution of urban activity follows a hierarchy, with core locations arising for institutional (universities), political (government offices), institutional (management and retail), or cultural (religious institutions) reasons. The core regions have high rates of spatial accumulation and matching land uses, such as retail. In contrast, distant residential and warehousing zones build up less frequently.

Geographically, some more dynamic, and fragmented regions are encountered by the SEZs chosen for the case study that is being studied in Campania and the South. Industrial areas are also situated inland, distant from port cities but still essential to Campania’s exports and economy. The economic impact of SEZs and the relationship between investments and economic growth have been evaluated in several publications [15,16], but little has been written about the examination of SEZs in relation to land use. The SEZs were developed specifically near internal areas with a logistical role

and port districts. The SEZ metropolitan regions are distinguished by a web of social, cultural, and economic activity occurring in several locations. People and object movement are frequently an issue in these tasks. Areas in the interior have a particularly robust economic and industrial history. The varied transportation demands caused by urban activities taking place in diverse urban environments are all attempted to be met by urban transportation. Patterns and processes in the transport-land use system must be examined, as the same processes may have different effects on results, to better understand SEZs accessibility, benefits, and externalities on urban entities. The transportation of products is typically a part of these acts. This division requires transport integration since several operations occur at many locations. As a result of this, the SEZs still need a solid economic transportation infrastructure even if they excel in innovation. Urban transportation tries to satisfy the numerous transportation demands created by urban activities in various urban environments. Due to the possibility that the same activities may have different impacts on accessibility, benefits and externalities on urban entities, analysis of patterns and processes in the transport-land use system is important. The extremely complicated SEZs system has several relationships with the land use, geographical interconnections and transit system. The “transport processes” or modes of transportation and physical facilities enable the movement of people and products in SEZ areas. They are essential for the growth of the economy, the creation of manufactured products and for enabling value addition in regions that are already populous but undeveloped. Consequently, one of the connections between land use, SEZs and the transport system repeats the fundamental degree of accessibility. In urban areas, spatial interactions play a role in the movement of people and products. SEZs are an extremely complicated system with many connections to the transportation system, spatial dynamics and land use, and the modes and structures that enable the movement of people and products are referred to as transportation mechanisms. These transport systems are crucial for increasing economic and manufacturing productivity, as well as for enabling the development of value in business.

The relationship between the SEZs’ accessibility and the transportation network has an impact on the economics, business expansion, and overall prosperity of the region. Foreign funding for SEZ research has been very strong, particularly in Poland’s eastern and central areas, where SEZs have been in operation for some time. Considering the SEZs’ recent entry into the Italian market, the current research does not provide ex-post and ex-ante study on the SEZs in Campania.

### *1.1. The role of the SEZs in the Mediterranean area*

When discussing the Mezzogiorno’s economic revival, the Mediterranean and the Mezzogiorno are frequently mentioned together. The SEZs are a part of a larger strategy for the Mediterranean region’s economic growth. FZ and SEZ have supported economies of scale and increased trade volumes. To encourage the growth of Southern Italy, through the development and expansion of already operating businesses and the establishment of new businesses, the Special Economic Zones (SEZs) were established with the “Mezzogiorno Decree” (article 4 of the law decree No. 91/2017 converted into Law 123/2017)<sup>1,2</sup> [17] which strengthened the bonus established by the 2016 Stability Law (Law No. 208/2015). Italy took a determined effort to meet European standards in 2016 when it overhauled its port infrastructure, earning the moniker “South Pier” of Europe. This classification

<sup>1</sup> <https://www.gazzettaufficiale.it/eli/id/2017/06/20/17G00110/sg>

<sup>2</sup> <https://www.agenziacoesione.gov.it/zes-zone-economiche-speciali/>

grants preferential admittance to those who may profit from the region's geographic advantages over larger ports. The goal is more crucial than ever, particularly considering the Suez Canal's closure in 2015. The government is attempting to reclaim the economic advantage that Italian ports hold over those of other European nations by lowering the number of administrative authorities and redesignating them as system authorities administrative [12,18–21].

Southern Italy has the potential to function as a strategic European hub in the Mediterranean by utilizing the SEZs and positioning itself as a gateway to the African continent and the Orient as well as a route for travelers traveling between these regions and the Atlantic as it traverses Europe. The SEZs have demonstrated their efficacy as a tool for accomplishing development objectives on a national and international level. The southern regions are emblematic of Italian economic development. Unlike the northern regions of Italy, which are at a more advanced level of development, the southern regions of Italy are impacted by the effects of national and international socioeconomic conditions.

Southern ports such as those of Naples, Salerno, Gioia Tauro and Bari are known as “Quadrilatero” since their geographical position influences both the distribution of the goods handled and the creation of a tactical territorial position. Ports provide evidence of economic benefits and growth. A significant portion of the southern mainland, which is home to more than 12 million people, might be developed through the linking of the four port system within SEZs [22]. To achieve this objective of Mediterranean, interregional, and internal connection to the Campania region between the various SEZ areas and of consolidating the medium-long term possibilities, the infrastructural upgrading lines necessary to successfully convey the propulsive impacts on the territory must be defined. The growth of the “perimeter” of the Quadrilateral allows for multiple relationships to be activated within the vast area of the continental South and, with skillful intertwining, to enhance it and, by connecting it, to enhance it; thus, the growing marginal fragility of extensive territories will remain so until when it does not see the system as an organic container which, starting from its metropolitan areas, equips itself with productive and infrastructural capacities and resources. The Ministry of Transport is currently examining a detailed proposal on the matter including (a) equipping dry ports with the necessary repairs so that they can function as production hubs of SEZs according to the principles of the distripark for the growth of value logistics; (b) open the Closed Customs Zone by providing the necessary infrastructure to meet the closure criteria. Compliance with these conditions necessitates cutting short the National Train Company “RFI” too-optimistic 2026 timeline for the construction of the Naples-Bari High Speed-High Capacity “TAV-TAC”<sup>3</sup> train corridor. To give the Quadrilateral the competitive edge of a previously unheard-of transversal link that realizes the Tyrrhenian-Adriatic connection and connects two “terminal” SEZs, promotes the growth of intermodality, complies with environmental sustainability standards through the optimization of logistics, and promotes the prospect of circularity functional to the containment of emissions in line with the mandatory criteria set by the Euro, speeding up is essential. The Quadrilateral has opportunity to expand and establish a current and future logistical advantage as a priceless economic and cultural component thanks to its favorable location in connection to the rising markets of the Balkans, Africa, and the Middle East. One of the numerous current contributions to develop the south and southern SEZs is the recovery plan's finances, which from a fiscal and territorial perspective enable a broad distribution of investments by area. The goal is to encourage and enable entrepreneurship by concessions, simplifications, and incentives for a variety of factors.

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<sup>3</sup> TAV-TAC – High speed rail – High capacity railway

According to the Italian regulation, the SEZs are made up of ports, rear port areas, logistic platforms and interports, have a minimum duration of seven years, can be regional or inter-regional and include areas that are not contiguous but connected at an economic and infrastructural level, according to the implementing regulation of Legislative Decree 12/2018 [23]. Businesses operating in special economic zones enjoy a variety of tax advantages, such as tax credits, financial incentives, and administrative easements.

The primary goal of these incentives is to create “hubs of growth”, which will draw business investment and provide the land with additional benefits. The National Recovery Plan (PNRR) allocates 630 million euros among the eight areas to provide a sufficient development of connections between SEZ areas and the national transportation network, notably with the Trans European (TEN-T) networks. There are also 250 million euros set aside in the Fund for Growth and Cohesion for suitable development contracts that have been created to simplify and shorten the duration of interventions, in addition to the additional 1.2 million euros that the PNRR reserves for interventions on the major ports of the mid-century. The budget, based on 2 million euros, intends to improve the movement of people and goods, strengthen linkages to important European thoroughfares and upgrade infrastructure that is essential to the growth of the SEZ ecosystem. As a result, SEZs must be utilized in conjunction with other incentives in addition to tax deductions and penalties. To build essential supply chains for the area and solid collaborations with entrepreneurial reality, as well as with universities and research institutions, to establish true poles of excellence, it is required, on the one hand, to have a clear national strategic direction [24–29].

### *1.2. Land use investment and policy accessibility*

Free zones “FZs” and Special economic zones have contributed to increased trade and scale economies. Additionally, since trade and supply costs are lower inside FZs and SEZs, starting a trading enterprise requires less capital up front. These are only a few of the many situations in which FZs and SEZs significantly aid in both the execution of government policies and economic development. Investments implemented in the SEZs in Campania for real foreign investors received the following incentives:

(1) Labour: a significant incentive to establish a presence in SEZs was the availability of a huge labour pool promoted by tax breaks;

(2) Land use: SEZs were physically established as planned entities with infrastructure and access to a container port complex so that components and raw materials could be simply brought here for processing and the final product could be shipped to overseas markets;

(3) Tax Incentives: SEZs offer a reduced corporate income tax rate, including income tax exemptions for certain companies based on their production, and their strategies.

As far as national investments are concerned, the Campania SEZ counts on local resources, the National Resilience Plan (Recovery Plan) and the National Complementary Plan (NCP) [23] for which total investments of USD 9.2 billion are planned from the National Complementary Plan (NCP), the National Resilience Plan (Recovery Plan) and national resources [25,27,28].

The most recent projects funded by the NRP and NCCP received a special mention out of the total EUR 9.2 billion. Five different areas of the NPC each received financial support for interventions totaling EUR 2.8 billion. Technical and summary pages that detail these operations are included in the report. With a total of 22 projects in 14 ports, at least 52% of the resources (1470 M euros) will be

used to improve the port infrastructure's marine accessibility and climate resilience. Quay electrification (cold ironing), which entails 44 improvements in 34 ports, will require an additional 24% of the resources (EUR 675.6 M).

The evolution of SEZs at the regulatory level has also led to a change in policy. The National Strategic Plan for Ports and Logistics approved in 2015 [24] which outlined the strategic framework within which to carry out the reform of the port system, fits into this framework: it highlights the centrality of southern ports for the purposes of strengthening national competitiveness and territorial cohesion itself.

According to economic analysis estimation, the Centre-North receives about 30 cents (or 25%) of the additional value produced for every euro invested in the South, which amounts to about 1.3 euros overall. Given the declining returns as capital stock endowment rises, capital accumulation ultimately results in more sustained multiplier dynamics in the South than the Centre-North [12,18,19,30,31].

The strong process of strengthening traffic affecting the Mediterranean will lead in the medium term to a substantial reduction in shipping time and costs, involving ports in a functional reorganization. This growth is both an opportunity and a challenge, becoming a channel to enhance the traffic load on the Mediterranean basin, which is becoming more and more important to global trade traffic [18]. Within the Campania SEZs, the following commercial activities are permitted:

(1) production and processing; (2) logistics and distribution; (3) financial services; (4) digital economy, and technology.

While the cultural, well-being, and social promotion of liveability inside the SEZs are still being explored, the infrastructures envisioned in the Campania SEZs for activities 1–4, the incentive for digitalization activities, are currently under construction. The inclusion of social and community factors in the incentives under discussion is also recommended. The Campanian SEZs lack tasks carried out by the SEZs, including those linked to tourism, energy development, education, health, sport, and research and development. There are numerous gaps in the SEZs literature, and concerning Italian context, wide literature is still lacking comprehensive research on mobility, transportation, and economic effects. The relationship between transportation and SEZs is unknown, except for research on waterfronts in port districts. This study combines accessibility, externality, planning, land use, transportation, and SEZs to start a discussion about SEZs in Italy from a different perspective.

This study's goals are to understand the connections between the different land uses in the SEZs, how those areas are connected to one another, how measurements of transportation characteristics might be applied and how urban planning and SEZs development are related by evaluating accessibility.

To quantify the transport characteristics of the selected locations, assessments of accessibility and proximity to urban and logistic centers as well as to strategic transport structures are proposed. The case study of this article focuses on the Campania SEZs (Naples, Avellino, Caserta, Benevento, and Salerno). The five cities have different accessibility models such as job offer, companies, instructions, and the presence of infrastructure.

## 2. Methods and data sources

This section gives a description of the SEZs in Campania using three analytical lenses: the region's SEZs evolution, and SEZs typology and infrastructure network.

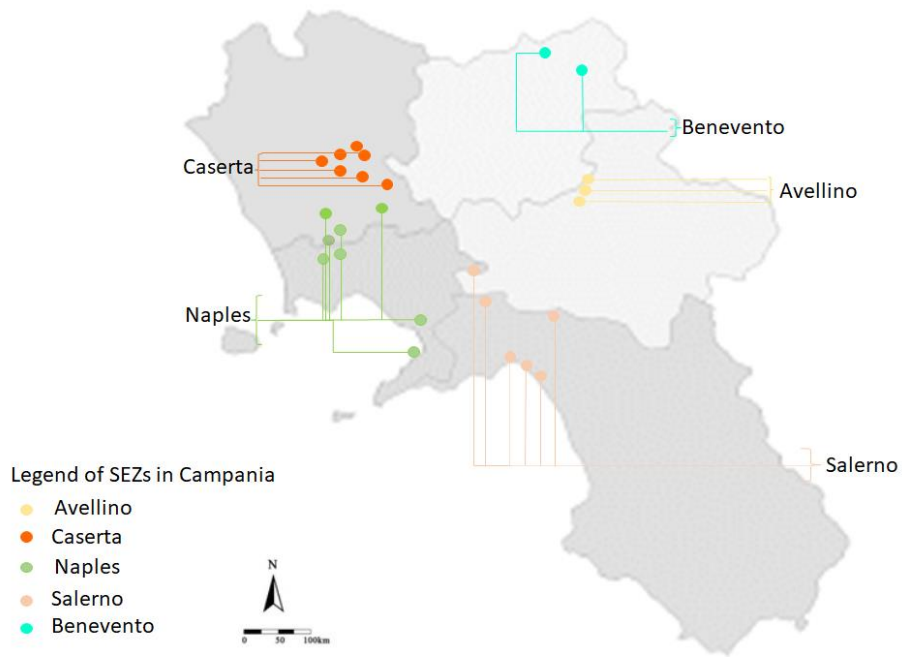
The applied methodology relates to a presentation of the SEZs and of the characteristics,

providing an identification of the areas, and as a result, the calculation of the spatial accessibility to identify the clusters in the current state: of the residential, commercial, and productive areas within the SEZs.

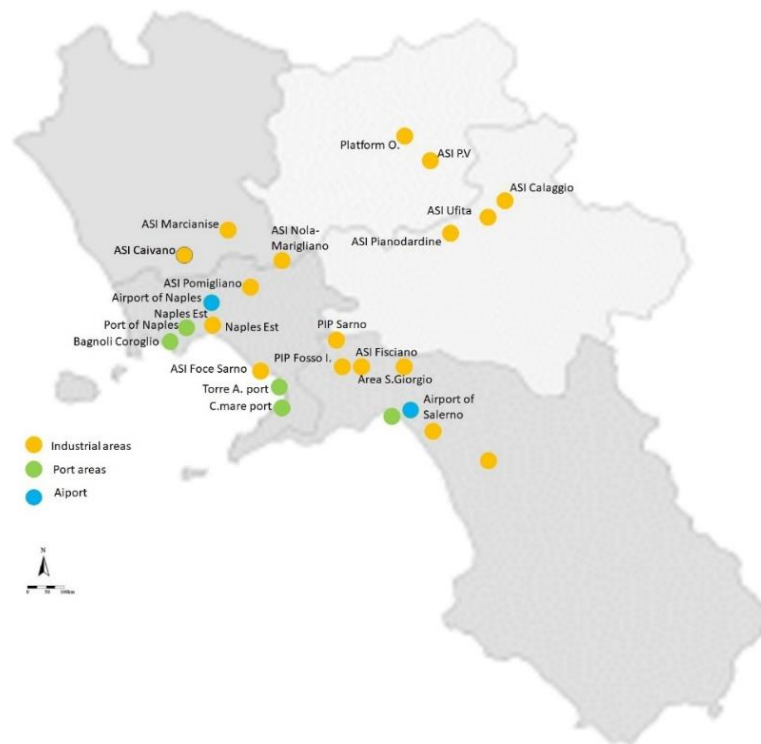
The investigation of accessibility is proposed as a way of understanding land use and the relationship with the transport sector, following the literature evidence [1,32–35] and reconnecting with current ongoing studies on SEZs in Campania [6]. The SEZs that fall into the three main port areas are part of the Campania SEZs, two of which are in the province of Naples (Naples, Torre Annunziata and Castellammare of Stabia) and one in the province of Salerno. Port infrastructures highlight the strategic and relevant role of investments in the port area for the economic development of the south. Regarding infrastructure, in the province of Naples are present two important interports. Naples and Salerno cities are the two most populous cities and are served by the two airports. The SEZs of Campania have been selected with criteria of proximity to the port areas or in which production, logistics and manufacturing processes reside (Table 1). This criterion has included the areas of Benevento and Avellino in the SEZs, even if they are far from the coastline.

**Table 1.** Analysis of land use.

Area	Latitude	Type	Infrastructures (road/railway)	present	Land use/ potential impacts	Economic investment	
Naples	8° N	Area industrial/portuale/aeroporuale	industrial/area	Airport = 1 3 main railway stations (1 is High Speed Railway)		Economic activities– residential-Shopping center-university-HSR Naples G	Naples harbour, railway intermodality, emissions reductions, reindustrialisation in Nola and environmental recovery
Salerno	7° N	Area industrial/port area/airport area	industrial/	Airport = 1 1 railway station (metropolitan/HSR)		Economic activities– residential-HSR Salerno	Port of Salerno: new metro station, redevelopment of the road system, Fisciano-San Severino will improve road redevelopment, upgrading of logistics area and road redevelopment in Battipaglia
Benevento	2° N	Industrial and logistics-production area		1 main railway station		Logistic firms, - manufacturing services	
Avellino	3° N	Industrial and logistics-production area		1 main railway station		Industrial manufacturing	Valle Ufita industrial area: freight terminal with sorting area
Caserta	2° N	Industrial and logistics-production area		6 railway station 2 interports		Economic activities– residential-Shopping center-university-HSR - TAV Afragola	Marcianise-Maddaloni: infrastructure for goods mobility, yards, and access roads



**Figure 1.** Campania SEZs, elaboration of author.



**Figure 2.** Cluster of port and industrial areas.



The inclusion of the port areas and industrial development zones run by the ASI consortia is made possible by the entrance of the Campania SEZs in addition to those of the South. Except for eight zones, all of Campania's industrial port regions are in the city of Naples. The area still clearly displays the basic concept that is now in use, industrial businesses and coastal ports for export-import (Figures 1 and 2).

The SEZs have undergone a temporal evolution of the SEZs in Campania. First, the industrial areas located in Benevento, Avellino and Caserta were production poles which later became logistics agglomerations. The port areas also served as free zones. Currently, the SEZs comprise free zones, which represent a contemporary system of trading zones of both an economic-market and industrial real estate. The last type, the industrial market estates, finds an advantage in the decrees mentioned above which support companies investing in SEZs and investing in the real estate market.

All forms of commercial activity and land use, including as residential construction, are permitted in the created SEZs. As expected, these SEZs have a particular set of features depending on the stage of economic growth, based on whether they are more oriented towards the real estate area or the commerce zone:

- Industrial Enterprises (IE): to promote the development of economic activity, industrial areas are places that are designed to draw industrial and logistical activities to a specific territory that is physically isolated from inhabited areas. Discounts on the cost of leased goods and potential incentives for the granting of licenses. Such measures are being promoted in the SEZs.

- Zones of Free Trade (FTZ): FTZs are enclosed and Secured areas, or warehouses, that provide logistical infrastructure geared at facilitating trade and house activities with capped added values. The tenants may benefit from a different set of rules than those that apply to terrestrial life, with incentives that are typically geared toward promoting trade. Additionally, they are situated in port areas. The model of government is not currently in place in the designated zones in Campania.

The various applications of freezones and SEZs can also be seen on the reference scale, where free zones (FZ) and special economic zones (SEZs) act as global platforms interacting with other international entities, such as interports, trading nodes and TEN-T networks, as opposed to industrial zones (IE) and free trade zones (FTZ), which both operate at a local level. Free zones and SEZs are typically found close to transportation hubs (ports, airports, and railroads). For instance, the present interports are close to the infrastructure, but the port regions still suffer from the lack of a railroad connection to the Italian national territory and the industrial sectors of Benevento and Avellino can experience problems due to a lack of communication with the larger poles. FZs and SEZs can be planned around several main activities, generally set according to the context and location in which they are developed:

- Trading (re-export): Import, export, re-export, transit, handling and application of low value-added services (e.g., labelling) for re-distribution, in bonded conditions. This section includes the areas around the port of Naples, the interport and the port of Salerno;

- Logistics: Provision of transport, storage and cargo handling services to other parties, whether for local or international, areas of Naples East, Salerno and Caserta;

- Light industry: Production of goods from semi-finished parts, in which the value of new goods does not exceed a certain amount. The areas of Caserta, Benevento and Avellino respond to this zone;

- Heavy/medium industry: Production of goods from raw materials or basic goods, typically through energy intensive processes. This includes the internal areas of Benevento, Avellino and Salerno and Castellammare di Stabia;

- Services: Provision of all types of activities of not involving the physical trade or process of goods, for B2B or B2C (e.g., consulting, repair and maintenance, etc.). SEZs falling between Caserta and Naples, Salerno and interports;
- Leisure: Provision of recreational areas, from parks, green areas, cinemas, restaurants, commercial centres, etc. This function of the SEZs is not yet present in any of the identified falling areas. Currently, the port areas of Salerno, Naples, Castellammare di Stabia and Torre Annunziata have a potential for leisure activities;
- Residential: Development housing for any kind of standards (from basic to high end), generating township and community. This function can find its place in more densely populated areas (service areas of Caserta, Avellino, Salerno, and Naples);
- Tourism/Hospitality: Provision of hotels, resorts, and other facilities aimed at attracting tourism and its related activities. It would be interesting to identify the relationship between SEZs and tourism. Currently, the SEZs areas which include the airports of Salerno and Naples allow the flow of passengers but do not have a targeted function for the development of sustainable tourism;
- Education: Provision of education at all levels, from schools to university campuses, research parks, knowledge centers, art, museums, etc. This function of the SEZs is still missing;
- Others: O&G support bases, financial services, IT and high-tech, media, agriculture, mining, quarrying, etc. On this aspect, the latest investments promoted in the field of the digitization of infrastructures and Companies 4.0 tend to bring the SEZs of Campania closer to this last function.

### *2.1 Accessibility and land use*

As an initial step of the accessibility analysis, Figures 3 and 4 describe the relationships that are present in the current SEZs. The analysis of the residential, commercial, and industrial areas is based on the subdivision between the coastal areas and the inland areas according to different spatial dynamics, creating two main regions, the first coastal and the second inland. The main transport corridors and urban corridors have been traced (in black, indicating the railway and road routes for northern Italy, towards the eastern coast with the Naples-Bari High-Speed Railway “TAV”, and towards southern Italy towards the port of Gioia Tauro) to understand the territorial dispersion of infrastructures, logistics districts, enterprises, metropolitan centers and smaller urban centers in which the areas fall.

In this study, we evaluate:

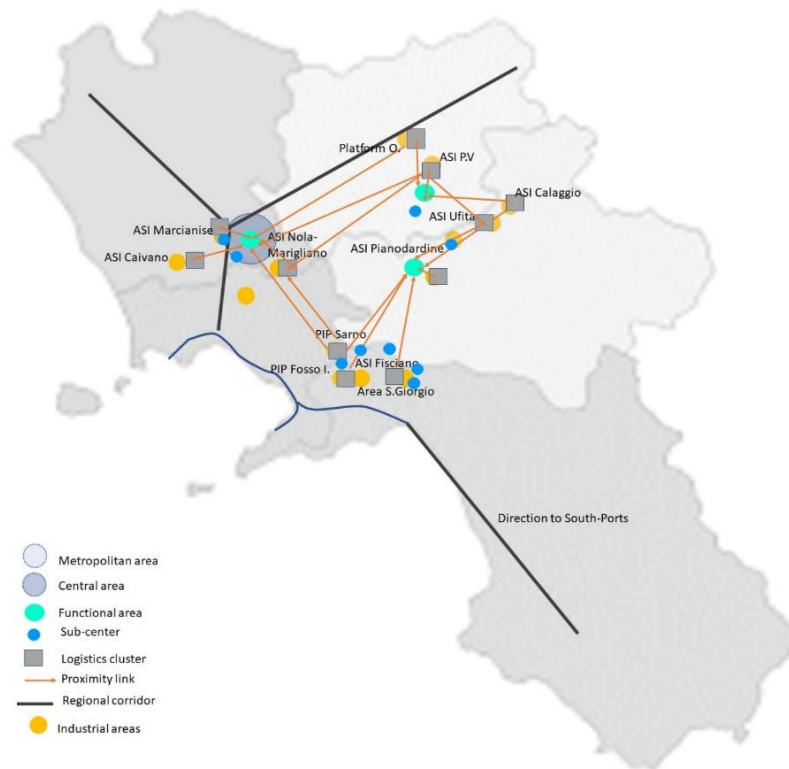
- The land use component reflects the land use system, consisting of the quality and territorial distribution opportunities provided in each destination;
- The transport component describes the transport system, related to the connection time between nodes;
- Identification of the key elements or areas against which the accessibility of the area under consideration is to be measured.



**Figure 3.** Land use map on the macro-areas Naples-Salerno.

The two main metropolitan areas of Salerno and Naples are delimited by logistic corridors and within them allow the exchange of information and economic communications, investments, and host small and medium-sized enterprises. The most developed areas are between Naples and Caserta (north of Naples) at the site of the railway meeting but also logistics (there are the two interpreters) and whose functions can be diversified (tourism, education, R&D, digitization of businesses). The possible connections “proximity link” provide clear evidence of the connection between the logistics hubs and the urban areas with the metropolitan areas. The areas defined as the central area and the metropolitan area are both highly residential and commercial, highlighting a land use component projected towards a certain type of minor activity, except for the port area of Naples, Castellammare di Stabia, and Salerno. Salerno represents a notable strategic point for the connection with the internal areas and with the direction of Gioia Tauro (towards Southern Italy). Logistical and economic activities are in close contact with the residential areas along the coast (Figure 3).

The connections between the SEZs of the inland areas provide clearer clusters than the coastal area with a denser network. The industrial and manufacturing areas are supported by little residential and slightly commercial areas, with the presence of medium-large establishments, but can support the connection with the railway line to connect with northern and southern Italy.



**Figure 4.** Land use map on the macro-areas Caserta-Avellino-Benevento.

### 2.1.1. Accessibility measures

The literature uses a few metrics for the calculation of accessibility to objectively quantify the connection between the land and the infrastructures and industry hubs. This article follows the suggested accessibility guidelines by [32]. To identify any potential problems with the connections between the SEZs and the main logistic nodes, it is essential to analyze the accessibility to and from the SEZs. This study is made accessible by the relationship between the main relief sites of the urban, industrial and logistic regions in the SEZs and the other areas included in the SEZs and not. Finding the infrastructural improvements necessary to address these issues will start with this research. When analyzing accessibility, the analytical approach is shown by looking for potential links between SEZs, transportation infrastructures, and industrial regions. In terms of assessing the rate of usage and the advantages offered by a land use/transport system, one approach to describe accessibility is as a place that can be reached from another location. The analysis of accessibility metrics as indicators of the effects of land use and transportation development policy plans on societal functioning is used in this study to establish land use. This means accessibility in case they relate to the role of land use and transport systems in society, which we believe will give individuals and companies the opportunity to participate in activities in different places. A classic way of assessing accessibility between nodes is to measure the extent to which land use and transport systems allow (groups of) individuals to reach activities or destinations with a (combination of) transport modes.

Rail transportation is essential for SEZs, taking intermodality into account in the transportation

operations. In terms of transportation infrastructure, the accessibility of the area can be described by the existence of hubs and journey times. The indicators of pedestrian and bicycle accessibility will also be analyzed because, as was originally predicted, the usage of the land and of the SEZs has a role in evaluating educational and recreational processes. The study takes up the classic theory of utility and proposes an analysis for all modes of transport, including cycling and walkability means.

Accessibility indicators were calculated and used in line with the literature as proposed by [1,28] [33,35] driving accessibility  $A^D_i$ , cycling accessibility  $A^C_i$  and walking accessibility  $A^W_i$  have the following equations:

$$[A^D_i = e^{-f^D(i)}] \quad (1)$$

$$[A^C_i = e^{-f^C(i)}] \quad (2)$$

$$[A^W_i = e^{-f^W(i)}] \quad (3)$$

where  $f^D(i)$ ,  $f^C(i)$  and  $f^W(i)$  are the travel time functions for driving, cycling and walking, respectively.

As indicated by [1,33,35], accessibility to logistics nodes must consider different impacts, such as traffic, an average value must be considered to take into account the value in peak and soft periods, such as the following equation:

$$[F^D(i) = \beta_{peak} * \sum_{j \in Z^D_i} t^D_{ij} (1 + \alpha_k) / N^D_i + \beta_{off-peak} * \sum_{j \in Z^D_i} t^D_{ij} / N^D_i] \quad (4)$$

$t^D_{ij}$  is the minimum driving time from origin  $i$  to destination  $j$ ,  $\alpha_k$  is the congestion parameter for roads in type  $k$ ,  $Z^D_i$  is the driving trip area of origin  $i$ ,  $N^D_i$  is the number of destinations in  $Z^D_i$ ,  $\beta_{peak}$  and  $\beta_{off-peak}$  are coefficients to measure the contribution of peak hours condition and off-peak hours condition to the whole day traffic performance.  $Z^D_i$  defines the movement scope of driving from origin  $i$ . For cycling,  $Z^C_i$  for cycling and  $Z^W_i$  for walking. The scope is determined by the movement capacity of different travel modes for each centers areas within SEZs. For driving, the trip area  $Z^D_i$  is the whole city and thus  $N^D_i$  is the total number of destinations in Eindhoven. The value of  $\alpha_k$  is determined by road type.

The cycling time function is given by:

$$[f^C(i) = \sum_{j \in Z^C_i} C_{ij} / N^C_i] \quad (5)$$

where  $t^C_{ij}$  is the minimum cycling time from origin  $i$  to destination  $j$ ,  $Z^C_i$  is the cycling trip area of origin  $i$  and  $N^C_i$  is the number of destinations in  $Z^C_i$ .

Walking accessibility is measured in a similar approach with cycling accessibility, except the trip area of origin  $i$  is a circular region of 800 m radius with center  $i$ . For each origin, only traffic zones within 800 m are used as destinations to calculate the walking accessibility. So, walking time function has the following equation:

$$[f^W(i) = \sum_{j \in Z^W_i} C_{ij} / N^W_i] \quad (6)$$

where  $t^W_{ij}$  is the minimum walking time from origin  $i$  to destination  $j$ ,  $Z^W_i$  is the walking trip area

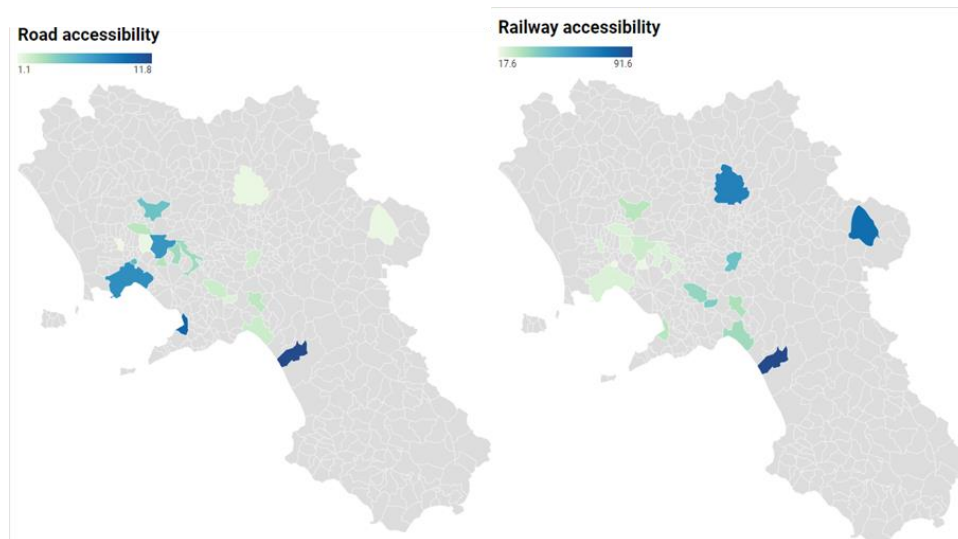
of origin  $I$  and  $N_i^W$  is the number of destinations in  $Z_i^W$ . The cycling speed was set as 15 km/h and walking speed was set as 5 km/h. Road speed limits were used to set the driving speed.

### 3. Results and discussion

The accessibility analysis is shown in Table 2 and mapped (Figures 5–7) according to the calculations set out in the previous paragraph. The accessibilities considered for this study relate to the residential aspect (cycling and walking) and service logistics (driving). The three accessibilities try to explain the spatial pattern in which the SEZs fall and the potential of the territory, including that of use. The SEZs include different areas, where such activities extend both in internal and central or edge urban areas. Therefore, accessibility is relatively different in the capital cities or in the provinces and in the small towns affected by economic strategies. The evident disparity from the first indicator is due to the conditions of the urban network being different, considering the coastal cities are very connected with the Caserta pole while reaching the areas of Benevento and Avellino sth have accessibility difficulties.

The identified results were mapped by infrastructure cluster. For the road and rail side, accessibility results in opposing results, where coastal areas favor accessibility by rail rather than by road, while inland areas disconnected by rail have more favorable connections with logistics areas.

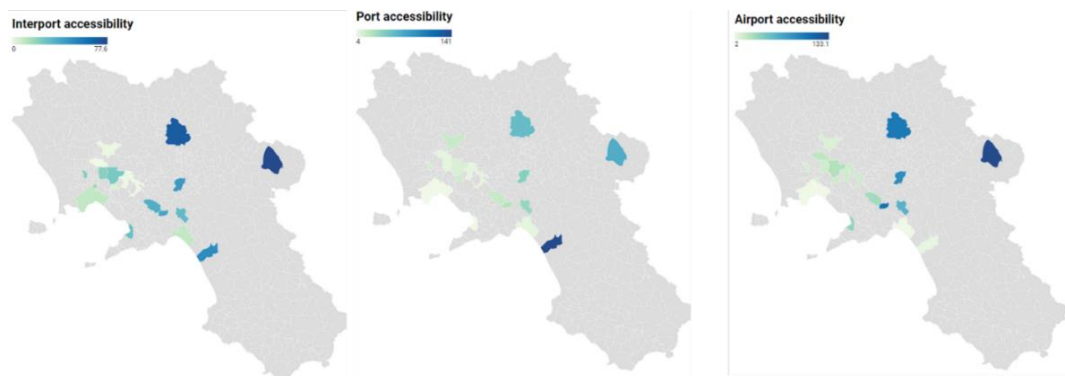
Port accessibility is nil in areas close to the coast, and inland areas behave similarly to each other, with the exception of inter-ports where there seems to be a greater connection between coastal and inland areas, highlighting that port connection is the weakest in these areas.



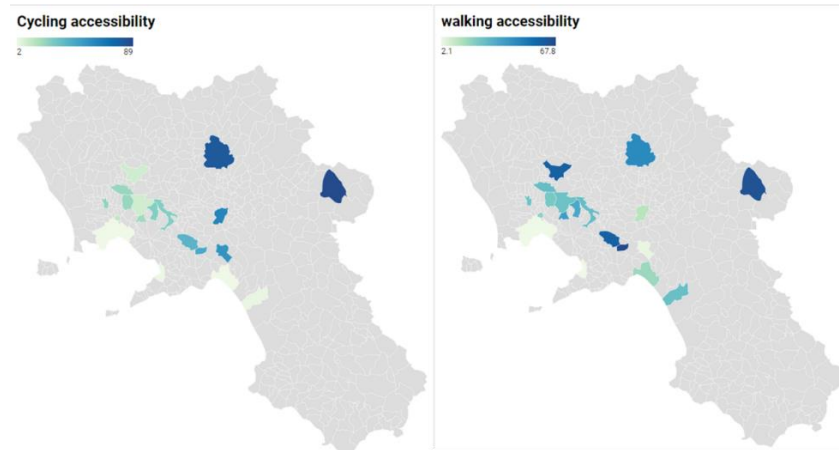
**Figure 5.** Spatial accessibility results in the SEZs for the transport system.

**Table 2.** Results of accessibility measures.

Type of infrastructure	Transport system					Mobility	
	Road	Railway	Port	Interport	Airport	Cycling	Walking
SEZs							
Bagnoli Coroglio	7,9	5,3	22	41	21	20,2	2,3
Napoli EST	5,5	4,5	4,3	22	10,3	15,3	2,1
Aeroporto di Napoli	5,7	6,5	9,9	23	0	80	8,7
Port of Naples	6,1	6,1	0	25	8,9	12	3,1
ASI Pomigliano	2,9	11,9	18,8	18	21	33	12,3
Porto of C.mare of Stabia	10,3	10,7	28,9	43	35	3,5	2,3
PIP Sarno	2,2	15,3	36,5	19,8	40	30,3	14,8
PIP Fosso Imperatore	2,2	8,6	37,8	26	42	106	28,9
Castel San Giorgio	1,7	7,3	40,3	27	45	104	67,8
Asi Fisciano	2,6	17,8	31,3	37	55	60,3	3,5
Asi Pianodardine	2,1	28	44,5	43	62	86,3	34,5
ASI Ponte Valentino	1,3	8,7	69,9	58	82	99,6	38,9
ASI Salerno	2,2	7,5	33,9	84	20	86,6	45,3
Port of Salerno	5,3	5,8	0	58	49,9	5,6	1,2
PIP Salerno	4,3	14,2	35,3	86	26	13,5	34,5
Airport of Salerno	22,8	13	58	105	0	116,3	15,2
ASI Battipaglia	11,8	14,2	91,6	141	39	26,7	26,8
ASI Aversa North	1,1	8,1	22,9	14,9	24	12,3	25,4
ASI Arzano	5,4	12,4	17,6	19,6	14	11,5	19,8
ASI Ufita	2,1	29,8	73,9	65,9	86	89,6	17,6
ASI Calaggio	1,3	37,3	77,6	68,9	89	133,1	64,8
ASI Marcianise	2,7	8,3	22	7,9	23	23,6	27,6
ASI Caivano	1,3	8,3	21,9	8,6	23	14,3	23,6
Interport South Europe	5,1	0,7	22,8	0	25	35,4	114,5
Interport Campano	4,5	0,8	28,9	0	32	38,7	59,6
ASI Nola Marigliano	3,5	5,9	22	7,9	27,8	25,6	27,6
ASI Acerra	7,5	8,5	25	13	25	24,9	25,8
Platform Olivola	4,5	8,8	71	56	76	140,3	135,4

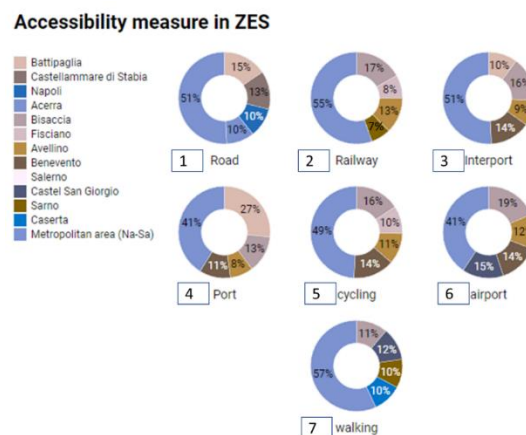
**Figure 6.** Spatial accessibility results in the SEZs for hubs.

The accessibility for soft mobility (cycling and walking) highlights the relationship between residential, commercial, and SEZ areas. Coastal areas were found to be more connected to pedestrian areas and businesses that are part of the SEZs. The walking activity requirements are also more prominent in the Caserta and Salerno area, where the metropolitan centers of Salerno, Caserta, and Naples give a greater potential for walking.



**Figure 7.** Spatial accessibility results in the SEZs for mobility.

With respect to accessibility to the guide whose travel area is the entire city, the coastline between Naples and Salerno, the area north of Naples (ASI Pomigliano), and the area strip between Salerno-C.Mare di Stabia, Torre Annunziata city, and inland areas of Salerno city, medium-distance cycling accessibility is vulnerable to areas with sparse roads, such as natural areas and open spaces. Consequently, the cycling infrastructure offers citizens more favorable cycling conditions in the central and eastern part of the study area up to Salerno, compared to the identified areas between Caserta-Avellino-Benevento, where there are large stretches of natural areas and open spaces. As for walking, the traffic areas with high pedestrian accessibility show a North-South distribution in the Naples-Salerno direction, which corresponds to the distribution of the residential and commercial areas (Figure 1) and logistics and production areas of the coastal (Figure 8).



**Figure 8.** Spatial accessibility results in the SEZs for mobility.



The clustering analysis (Figures 5–7) shows the analysis of the relationship between land use/accessibility and the transport ratio shows that there is a substantial relationship between types of land use/land use, with accessibility clusters showing similar percentages in terms of time for moving between the various nodes:

- Residential and commercial areas are mainly concentrated in areas with highly accessible agglomerations, in urban areas but closely connected (1, 2, 5, 7), cycling is also considerably high, as also the walkability indicator demonstrates that the coastal macro-area lends itself better for residential, education function or short trips (4–5–7).
- Industrial area and open space tend to favor clusters (4, 3–6) with adequate road accessibility; and accessibility to interprets, and above all the less accessible clusters (1, 2, and 3) confirm the high access times to the hubs, for the internal area on the transport service.
- Inland areas lend themselves well to road and rail travel but suffer from interprets. In addition, pedestrian and bicycle accessibility is at average levels (2–5–7).

Cluster mapping and accessibility models can identify gaps in mobility service coverage and land use efficiency/land cover model.

#### 4. Conclusion

The state of the art of Italian and Campania's SEZs is evolving. However, given their recent emergence, regions are currently still moving forward in establishing operational programs and understanding the misuse of social depreciation and funding to increase investment. Much study is still needed on SEZs, compared to the case studies of SEZs in China, Africa, Poland, and Southeast Asia.

What characterizes Campania's SEZs is the versatility of the sea-land relationship typical of the southern Italian region. This study aims to provide a study on the value of accessibility between SEZs, infrastructure, and port areas from the perspective of land use, to reconnect with international cases. The results analyzed are continually evolving and related to the transformation of looking at SEZs also with an approach of decarbonizing the supply chain process and reducing pollution emission to the territory due to the installation of activities in port and backport areas. The analysis carried out focus on accessibility considering the temporal and spatial connection between the nodes and the surrounding activities to understand an aspect of land use. As indicated, the SEZs are evolving, and the establishment of new businesses in the same areas analyzed changes the proposed scenarios. It should be emphasized that the results of cycling and walking accessibility can allow the launch of R&D, recreational, educational, and tourist activities in the SEZs to redevelop the coastal areas as well. The inland areas need a development of funding that aims not only to encourage railway transport but also the road transport and logistics hubs, such as investments in ASI areas (logistic agglomerations) and interprets. This work aims to lay the groundwork for an ongoing future discussion on the land use of SEZs [3], which are heavily dependent on investment.

The results obtained aim to provide an enrichment of the literature in the field by identifying poles to implement potential public/private strategies, evaluating I beneficiary delle politiche possono essere da real estate investors as done by [37] or whether the policies put in place will be more useful for industrial processes or promotion of sustainable agricultural land [38]. The results, enriched by the literature review highlight that it is necessary from the state of the art and early results on accessibility that we need to include improving the land policy-making among the objectives of the decision-making process.

## Conflict of interest

The authors declare no conflict of interest.

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