Planning Without Shared Strategies. Impacts and Perspectives Along the Abruzzo Adriatic Coastal Belt

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Abstract. The Italian legal framework for protecting land and curbing its consumption is currently very heterogeneous and complex. In addition to the outdated National urban planning laws, there are various regional and provincial laws on land management, each with its own technical and administrative peculiarities. This diversity is even reflected in the urban planning instruments of municipalities in the same region and affects the ability of regions to monitor and manage urban dynamics in line with strategic objectives. The issue of land take is an example of the challenges posed by the lack of a comprehensive national framework, leading to a multiplicity of regional regulations. This has led to ambiguities, uncertainties, and different interpretations of the phenomenon across regional boundaries. Despite the European Union's goal of achieving zero net land take by 2050, the Italian legal framework remains fragmented, as numerous legislative proposals have not received final approval at the national level. In the Italian spatial planning system, municipal planning plays a decisive role in understanding future settlement developments. However, the complexity of the legal framework and insufficient technological resources often limit planning to individual municipalities. This study presents the results obtained by analyzing the municipalities located along the Adriatic coastal stretch of the Abruzzo region, examining the contents of the current urban plans of the 19 municipalities included in this area. It uncovers critical issues and contradictions that could affect ecological connectivity and emphasizes the need for strategic planning to maintain environmental integrity in these areas.

Keywords: Land take · Territorial planning · Coastal urbanization

1 Introduction

The Italian regulatory landscape on the issues of soil protection and containment of its consumption is today extremely heterogeneous and highly articulated. An outdated national urban planning law (Law No. 1150/42) is flanked by regional and provincial land management laws, each with its technical-administrative peculiarities. This heterogeneity can be found within the urban planning instruments of municipalities in the

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O. Gervasi et al. (Eds.): ICCSA 2024 Workshops, LNCS 14820, pp. 309–322, 2024.
https://doi.org/10.1007/978-3-031-65285-1_20

same region and, inevitably, is reflected in the ability of the regions to implement the monitoring and control of urban dynamics, because of their strategic objectives [1]. The issue of land use provides a striking example of how the absence of a national framework law has led to a proliferation of regulations that have contributed to creating ambiguities, uncertainties, and ways of interpreting the phenomenon that changes according to regional borders. This system of distortions is particularly evident in Emilia Romagna, where ISPRA (Italian National Institute for Environmental Protection and Research) data indicates land take, while according to current regional law, such consumption is considered null due to exemptions granted. These exemptions often render measures to contain the phenomenon ineffective, as they allow authorities to maintain outdated and oversized urbanization forecasts compared to the actual needs of the territory [2]. The goal of achieving a zero soil balance by 2050 remains a cornerstone of European policies, but it is still far from being framed by the Italian regulatory maze. At the national level, as many as 54 bills were presented to the chambers (between 2010 and 2022) without ever reaching final approval. While many regional laws aim to limit land take, they have definitions that do not consider land use in urbanized areas or land designated for urbanization as such, even if it is still vacant. This approach, which differs from established definitions at the national and European levels, can encourage further urbanization disguised as the reuse of already occupied land, effectively contributing to land take and loss of ecosystem services. [3–6]. Several European countries have taken proactive measures to combat land degradation and promote sustainable urban development. The introduction of green belts, environmental constraints, ecological corridors, and green networks reflects an integrated approach to urbanization [7]. Through mitigation strategies and ecological compensation, these countries have effectively reconciled the need for urban expansion with the protection of the environment. Germany focuses on energy-efficient refurbishment and reshaping peripheral districts, while France pursues an ambitious goal of achieving zero artificial development by 2050. Spain prioritizes urban rehabilitation, and its Agenda Urbana Española encourages active local participation [8]. In the Italian territorial planning system, where the strategic level is either absent or weakly coherent, municipal planning plays a fundamental role in understanding potential trajectories of future settlement development. However, the heterogeneity found in the synoptic descriptions of various types of land use, as well as the complexity in articulating building regulations, does not allow for a framework beyond a single municipality's administrative limits. An approach that could overcome this limitation is to compile a mosaic of municipal urban planning tools in the area of interest (province, region, or specific geographic extensions). This approach allows for the construction of a tool capable of analyzing data and processing information on a larger scale than that of a single municipality, as well as representing a possible scenario of territorial evolution soon, through the classification according to zoning types, by Ministerial Decree No. 1444/68. The compilation of municipal urban planning tools is inherently a rather complex operation in both technical and informational terms for several reasons. Firstly, there is often a technological inadequacy in drafting the municipal tool, which requires the use of various techniques (and software) for final standardization. Territorial governance processes, regardless of the scale at which they operate, require a large amount of data and information from diverse sources, each of which often has a different encoding.

The lack of standardization generates problems not only of a technical nature but also economic and managerial [9–11]. The reading of the transformative potential of a territory expressed in plans, as already emphasized, represents indispensable information in the perspective of achieving sustainability goals imposed at the European level. This study presents the results obtained by analyzing the territories of municipalities located along the Adriatic coastal stretch of the Abruzzo region, examining the contents of the current urban plans of the 19 municipalities included in this area. This choice is linked to the environmental and ecological importance characterizing this territory. The absence of careful strategic planning and the limited action of Park Plans in these areas could generate negative effects, particularly in connection areas. Therefore, the proposed work reconstructed the basic mosaic of urban planning tools as well as an advanced one (analysis on volumes yet to be implemented) for some municipalities. The analysis conducted highlighted several critical issues and contradictions present in the different municipal tools that could significantly compromise the ecological connectivity of these areas.

2 Case Study

This work focuses on one of the most active geographical areas in terms of urban transformations: the coast. In particular, the analysis was conducted along the Adriatic coastal stretch of the Abruzzo region in Italy (Fig. 1). This system extends linearly for approximately 130 km and covers the territory of 19 out of the 305 municipalities in Abruzzo, totaling 640 km^2 (approximately 6% of the regional territory). These coastal communities have different geomorphologic features that mix maritime characteristics with terrestrial formations. Francavilla al Mare, in particular, is characterized by a maximum altitude of 169 m above sea level.

The importance of these areas is clearly and directly understood by examining the economic and demographic dynamics of the last 10 years: between 2013 and 2023, the Abruzzo region has seen an overall decrease in its population of almost 40,000 units, while coastal municipalities have recorded an increase of approximately 9,000 residents, equivalent to about 900 new residents every year. It's as if each municipality had registered an average annual increase of about 48 new residents. Almost all the municipalities analyzed have a population of over 10,000 inhabitants, among which certainly stand out the provincial capital Pescara, which, with its approximately 120,000 residents, is the most populous municipality in Abruzzo, as well as Vasto and Montesilvano with their approximately 40,000 residents. Only two of the 19 municipalities analyzed have a population of less than 3,000 units (Rocca San Giovanni and Torino Di Sangro). As for population density in coastal areas, the difference compared to regional and national values is substantial. Only the municipality of Casalbordino has a value comparable to the regional one (about 120 inhabitants/km^2), while the aforementioned municipalities of Rocca San Giovanni and Torino Di Sangro have values of around 100 inhabitants/km^2. However, in this area, there are municipal entities with population densities comparable to those of the main hinterlands of Italian metropolitan areas that have a population density greater than 1000 inhabitants per km^2. From a morphological point of view, the Abruzzo Adriatic coastline is quite uniform, with almost all of the municipalities' territory represented by flat formations, with low sandy beaches and a hinterland that is also

flat or low hilly, which has facilitated over time both the construction of infrastructure and productive and residential settlements.

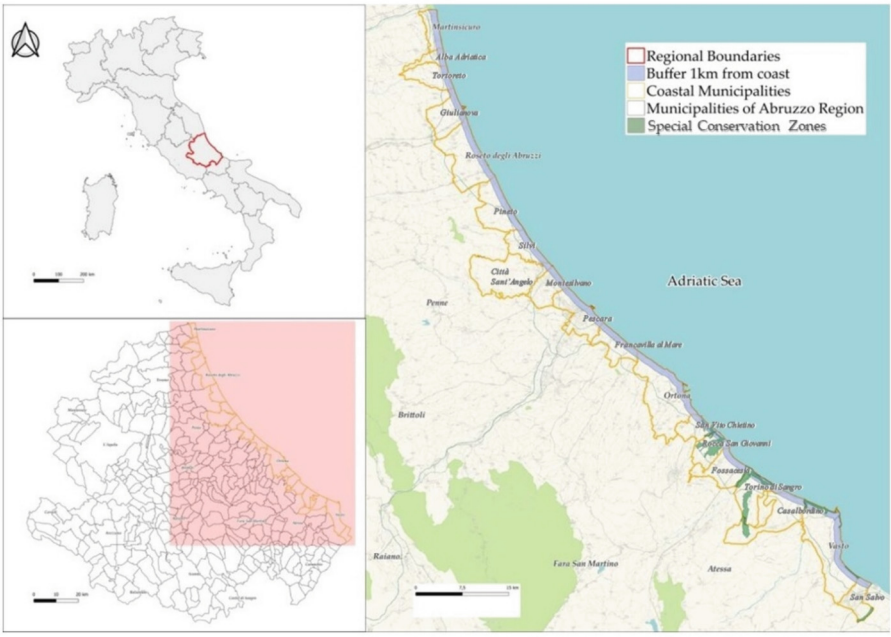

Fig. 1. Location map of the study area.

The presence of important communication axes (Highways A1, A24, and A25 together with the high-speed railway line) has allowed the growth and strengthening of urban centers over time. Apart from the morphologically disadvantaged areas (e.g., rocky promontories), the Abruzzo coastal settlement can be considered as a single linear stretch characterized predominantly by forms of urban sprawl (although with different modes from the European one) that dominated the settlement development of the 1960s-1970s, interspersed with manifestations of more recent interventions (sprinkling). From an economic point of view, coastal municipalities contribute to over a third of the regional taxable income, although only seven municipalities have a per capita income comparable to the national average value for the period (the reference year 2021). Even though the anthropic aspect (not only from an urbanization point of view but also agricultural) appears to be dominant, it is still possible to identify areas that preserve important natural features. It should be noted that apart from a couple of Special Conservation Zones (SCZs), there are no other protected areas; therefore, the safeguarding of these residual traits is often entrusted to other regulatory forms that nevertheless allow margins of transformability (e.g., Landscape Plan). These natural areas are mainly concentrated south of Ortona, where the morphology and the reduced sandy beach have slowed down the more intense forms of urbanization along the coast but also along the hydrographic network where well-structured riparian zones along the rivers are still present.

The presented work analyzes the 1 km coastal strip as this stretch is the most affected by urban phenomena related to maritime economies, as also demonstrated by recent studies. Starting from the current settlement configuration, the work then shows what could be the new urban layout of this area based on the predictions of the current municipal urban planning tools [12]. Since there is currently no strategic plan for the area, each municipality implements its transformative policies within its boundaries, seeking on the one hand to meet the needs of the communities living in these places and on the other hand to increase the tourist offer, which represents one of the main sources of the local economy.

3 Materials and Methods

The reconstruction of the geography of urban settlement and that envisioned in the urban planning instruments of the 19 municipalities under study required the use of data from various sources. The current level of soil sealing, as well as its evolution over time (2006–2022), was deduced from the ISPRA portal. The development of the Planning Tool Mosaic (PTM) involved thorough research into the current urban planning instruments utilized by the municipalities under study. This research was conducted using institutional portals where accessible, or by directly contacting the technical offices of the municipalities involved in the study. This facilitated the reconstruction of the trend scenario in urban planning as reported in them. The techniques for crafting this pivotal tool can be extrapolated from various articles in the literature [9, 11, 13–17]. In this specific instance, however, endeavors were made to streamline the transformative typologies incorporated in the plans, aiming for a clearer and more immediate comprehension of the land use associated with these areas, rather than solely referencing the zones outlined in Ministerial Decree No. 1444/68. The comparison with the zones identified by the Ministerial Decree and the typological macro-categories is delineated in Table 1.

Table 1. Areas identified by the DM and typological macro-categories.

Macro-Category	Zone typology
Residential	B, C
Productive - Touristic	D
Services	F, S

The exclusion of A zones was due to their complete urbanization, with coverage ratios nearing 100%, permitting only redevelopment or restoration interventions without the use of new land. Conversely, industrial zones and areas related to tourist-receptive land uses were incorporated into the productive-touristic macro-category. Utilizing specific GIS techniques, the residual plan was reconstructed, and the progress status regarding the predictions outlined in the plans was quantified as a percentage. This analysis encompassed all three identified macro-categories, offering immediate insight into the unrealized transformative potentials across the entire coastal strip and within each municipality.

This method proves highly advantageous, facilitating the delineation of individual entity policies and aiding strategic planning aimed at the protection and conservation of coastal environments.

Figure 2 shows a zoomed-in view of the analyzed study area is depicted, showcasing the Planning Tool Mosaic classified according to the macro-categories described in Table 1.. In Fig. 2.a), zooming in on the study area clearly distinguishes the different macro-categories and thus takes a detailed look at the territorial distribution. Figure 2.b) and Fig. 2.c) depict a schematic representation of a residential area. Specifically, in Fig. 2.b), the current urbanized area is illustrated (buildings in black, roads in gray, and public green spaces in green), while Fig. 2.c) highlights the so-called residual urban potentiality, which represents the area of the urban plan that has not yet been implemented. This visualization provides a detailed insight into the remaining urban potentiality of each municipality and highlights the areas that are not yet used according to the urban plan. In this study, the percentage of residential, productive-touristic, and service zones within each of the 19 coastal municipalities was analyzed, along with the percentage of these categories within the buffer zone established one kilometer from the coastline. Data from the land use plans of each municipality was then used to calculate the percentage of each category in the planned area within the one-kilometer coastal zone. These results were then compared with the residual urban potentiality of each municipality.

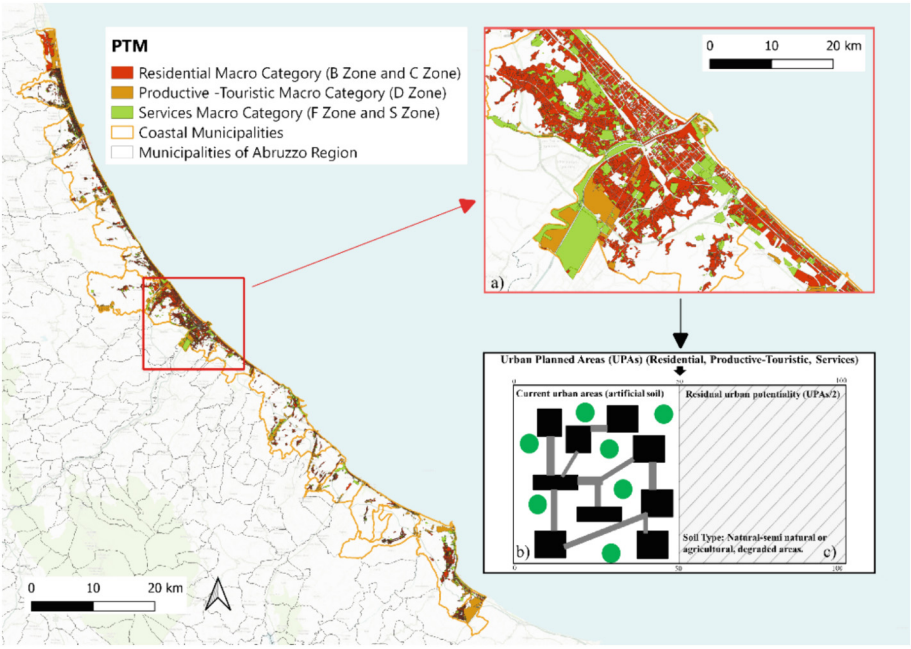

Fig. 2. PTM of coastal municipalities. a) Zoomed-in view of the analyzed study area. b) Schematic representation of a residential area. c) Residual urban potentiality.

4 Results

The first interesting result arises from the ISPRA land take data analysis for the investigated period. This result confirms what was previously reported about the importance of these municipalities in the Abruzzo regional context and their role in transforming the soil (Fig. 3).

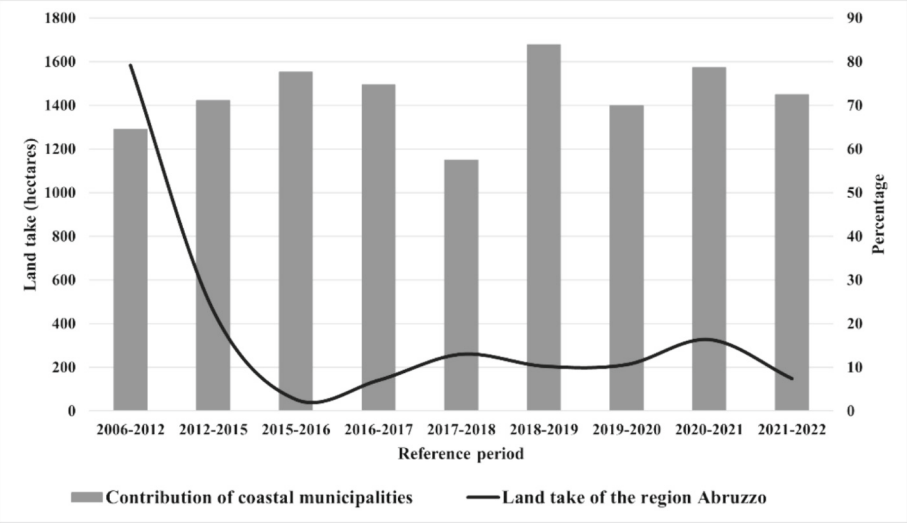

Fig. 3. The percentage contribution of coastal municipalities in Abruzzo (histogram bars) compared to the total land take of the region (black line).

The percentage relative to the total consumed has remained nearly constant, despite a fluctuation in land take levels in the region (from 2,60 km^2 per year in the initial period to 1,40 km^2 per year in the latest survey). Figure 3 was designed to provide an overview of the trend in land take in coastal municipalities compared to the entire region, highlighting both the absolute amount of land take and the percentage contribution of coastal municipalities. The graph is intended to clearly show the evolution over time of land take and the contribution of coastal municipalities. The choice to use hectares to represent land take and percentages for the contribution of coastal municipalities was made to highlight both aspects complementarily.

Figure 3 shows how coastal municipalities are responsible for an average of 70% of the entire regional land consumption, with a peak of 84% recorded between 2018 and 2019 and a minimum of approximately 60% observed in the previous year. It should be noted that these areas comprise approximately one-third of the regional population. The lack of a strategic vision for the entire coastal axis is evident from the analysis of municipal urban planning instruments. Despite maintaining the same morphological conditions (except for some specific areas), as one moves towards the inland, the plans concentrate a large part of the transformative provisions within the first kilometer from

the shoreline. Figure 4 shows that 38% of areas are designated for residential, 42% for tourist-productive purposes, and as much as 46% of services, are located in this zone.

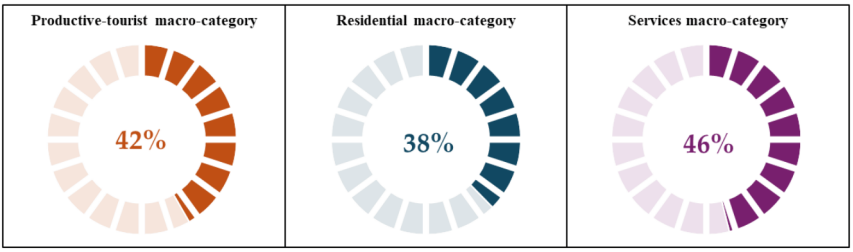

Fig. 4. Percentage share of transformative forecasts contained in plans located within the first kilometer from the coastline.

There is a total of 55 out of 136 square kilometers of the total land use allocations outlined in the plans within the first kilometer (Fig. 5). The municipal-level analysis reveals peculiarities, such as in the case of Francavilla al Mare, where almost all residential land use areas are situated within the first kilometer, along with 70% of those designated for productive-touristic purposes. Concerning services, the town of Pineto records the highest value (90%), followed by the aforementioned municipality. When analyzing the overall distribution of the three main categories of destinations, it becomes clear that 40% of the destinations are concentrated in only two municipalities (Martinsicuro and Vasto). It is also worth noting that these two municipalities, together with Ortona and Pescara, host 40% of all service-related destinations. The presence of important ports, both commercial and tourist, in these municipalities, has influenced the spatial planning policies reflected in the urban plans.

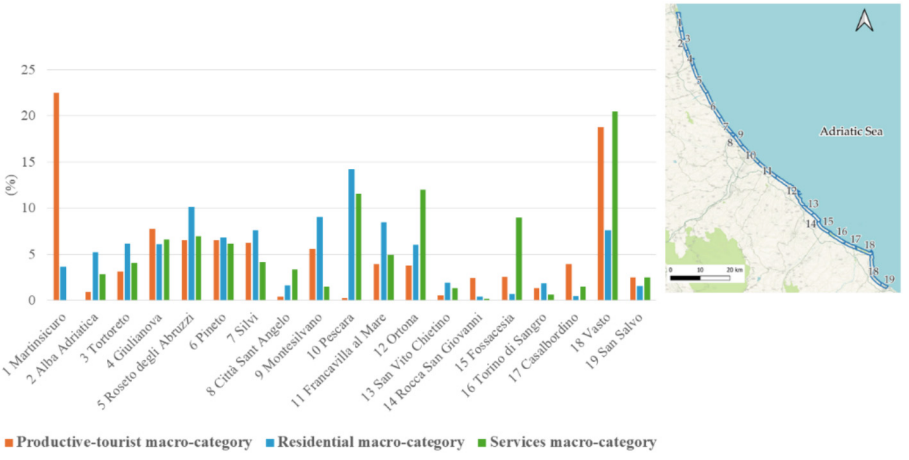

Fig. 5. Distribution of macro-categories into municipalities, ordered from north to south in a latitudinal direction.

After examining the orientation of urban development policies at the municipal level and within the coastal strip within 1 km of the coast, the existing plan was evaluated. This allows us to understand the transformation potential of each municipality and to visualize the possible reshaping of the coastal strip resulting from the implementation of the provisions of the current territorial governance instruments. For this reason, the current level of soil impermeabilization [3] (based on ISPRA 2022 data) and that of each zonal macro-category for each of the 19 municipalities included in the study were evaluated. Currently, there are just under 32 km^2 of impermeabilized surface along the coastal strip within 1 km from the coastline, with an impermeabilization density of 27%, three times the national value. Overall, 37% of macro-categories intended for productive-touristic purposes are implemented, along with 45% of those for residential use and 21% of those intended to accommodate various types of services (Fig. 6).

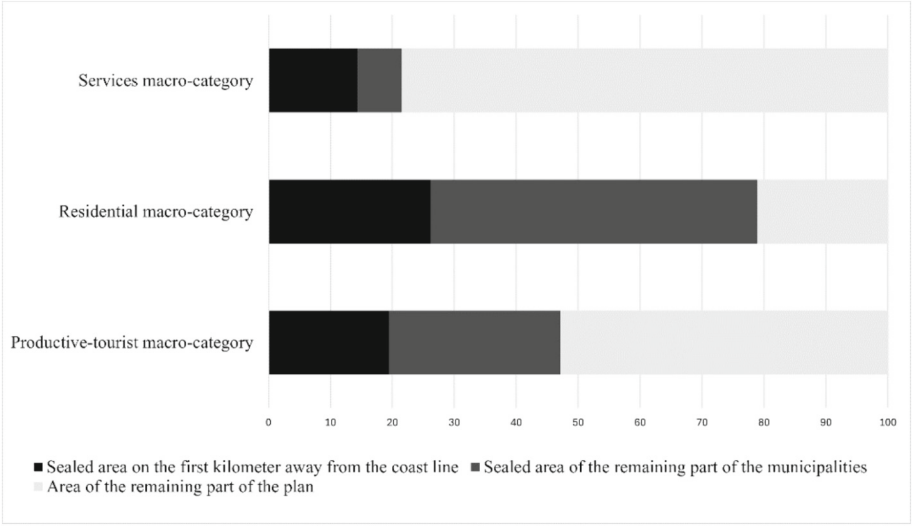

Fig. 6. Distribution of consumed land in the municipality with a focus on the first kilometer from the coast (black) and the remaining percentage still available (light gray).

The full implementation of all the planned provisions would result in the area under study reaching a 46% urbanization rate, which corresponds to almost half of the area earmarked for urban use. Here too, the picture varies considerably at the municipal level. For example, there are municipalities, such as Rocca San Giovanni, where only around 10% of the land earmarked for each macro-category of land use has been implemented. As far as the category of land earmarked for productive-touristic use is concerned, only a few municipalities have implemented around 50% of the planned areas, while the figures in other municipalities are over 60%, with peaks of over 90% still available. The same applies to land earmarked for residential purposes, with a larger number of municipalities achieving percentages of between 40% and 60%. However, the services category shows the highest availability of land still to be realized, with almost all municipalities showing values of over 70%. Figure 7 illustrates the development of these values in geographical

order from north to south and shows an interesting pattern. It can be observed that the curve in terms of services shows a similar trend in all coastal municipalities, with a slight increase in the municipalities of Vasto and San Salvo in the south of Abruzzo. The curve relating to the availability of land for productive-tourist use shows a higher availability in the first section (especially in the municipality of Alba Adriatica), followed by a decrease along the stretch from the municipality of Pineto to Montesilvano (values between 60% and 70%). From there, residual availability increases until it reaches a new peak in the area between the municipalities of Rocca San Giovanni and Torino di Sangro (values around 80%), which continues in the municipalities to the south up to the border with Molise. The curve related to residual residential availabilities follows a different trend from the previous ones. As depicted in Fig. 7 (in light gray), for most of the Abruzzo coastal sector (from Tortoreto to Ortona), values are below 60%, while greater residual availability characterizes the last stretch, the southernmost one between the municipalities of Fossacesia and San Vito Chietino. Values then decrease again in the municipalities of Vasto and San Salvo, with percentages falling below 60%.

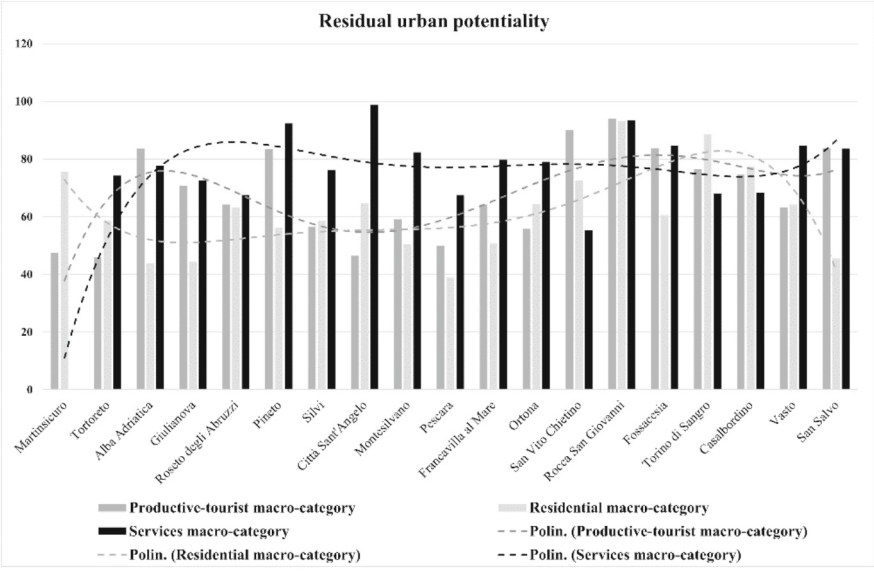

Fig. 7. Trend of the residual urban potentiality in the municipalities of the Abruzzo coast for the three macro-categories of intended use investigated.

5 Discussion and Conclusion

The plan to protect coasts from erosion, climate change impacts and pollution is critical to coastal zone management planning. It outlines the programmatic and executive framework for resource allocation and the approval and implementation of measures.

This tool addresses specific coastal protection planning issues by incorporating considerations of climate change mitigation and adaptation, coastal marine pollution, and beach activities. The main objective is to manage risks in the Abruzzo coastal area by anticipating potentially harmful events and planning measures to mitigate their effects. Despite the consideration of environmental aspects, the plan focuses primarily on coastal protection and aims to maintain the dynamic balance of the beaches and improve environmental quality [18]. However, the issue of coastal land take is not directly addressed, overlooking its potential role as one of the primary drivers of accelerated erosion, loss of natural habitats, water pollution, increased flood risk, loss of ecosystem services, and negative impacts on marine biodiversity. These phenomena can have significant environmental, social, and economic consequences for coastal communities, underscoring the importance of sustainable coastal land management. In contrast to other countries (e.g. [19]), Italy lacks active protective measures against the increasing transformation of coastal areas. Many regions are addressing this gap with integrated planning and management measures aimed at protecting public use and sensitive areas [20]. Coastal areas, characterized by high ecological value and significant human pressure, are inherently fragile systems subject to complex and delicate dynamics. Current planning often lacks a systemic view, which is exacerbated by oversized transformation projections by municipalities. To align municipal planning with environmental protection, a strategic approach that goes beyond regional boundaries is required. The territorial coordination plan can help to develop dynamic coastal scenarios and take preventive action. Urban rebalancing and sustainable management of coastal tourism could reduce the transformation pressure on the plans and bring them in line with European objectives to curb land take. Coastal environments are inherently fragile due to their high ecological value and intense human pressure. They are highly dynamic systems with delicate balances constantly threatened by human transformations [21].

The work carried out has shown that even today there is still an approach to planning without a systemic vision, which can be traced back to short-sighted policies and a lack of uniform perspectives. The high decision-making power of municipalities in urban transformations is certainly the cause of the observed state of affairs, and the overestimation of transformation projections found in all the municipalities studied only increases the risk of permanently losing the remaining natural assets and the essential ecosystem services they provide. The strong attraction of this coastal area leads to a high demand for anthropogenic use of these areas, which the municipalities continue to meet, with few forms of active protection [22] on the Abruzzo coast today (e.g. Natura 2000 sites, various protected areas). Forms of intensive tourism certainly accelerate coastal erosion [23], and every year there are numerous projects to dredge and fill sandy beaches (at considerable cost to the municipality) so that operators can start economic activities. The coastal protection plan itself aims to protect the integrity of the coast by providing for appropriate work in certain areas. Although it is equipped with a strategic vision, the forecasts of the municipal urban planning instruments are not taken into account or modified. Studies on erosion dynamics and wave propagation along coastal areas are well-documented. Coastal defense plans should transcend regional boundaries and work on physiographic units [3], guided by strategic visions for municipal planning in environmental safeguarding. Therefore, it is important to emphasize the absence of regional

planning that imposes a uniform approach to coastal management work. Although a coastal defense plan exists, it only intervenes in response to damages already occurred, without implementing preventive measures. This constitutes the core of the problem. The region, as the supervisory authority, lacks sufficient influence over local planning, particularly on individual municipalities. This lack of coordination underscores the importance of our work on physiographic units as a method to preserve the coast. It is clear that this requires broad involvement, unifying different regions and municipalities under a single strategy. If each municipality continues to act autonomously, significant progress will not be achieved. New political dynamics are necessary to transcend the logic of individual municipal interests. In this regard, the PTM is a crucial knowledge tool for building potential coastal dynamic scenarios and acting preventively [13]. Urban equalization measures and unified regional coastal tourism management can help reduce the ongoing transformative overload of plans, far from achieving important land take containment objectives set by Europe. In conclusion, it is evident that the synthesis employed, through both basic and advanced mosaic techniques, allows for a highly effective comparability among different municipalities. More importantly, it leads to a comprehensive measure of planning in the plans, potentially expressible over time as a transformative load on the territory and the environment. Essentially, it operates at a territorial scale of strategic level, which is certainly not at the municipal level, where often there is no awareness of the transformations planned or carried out in neighboring areas. Specifically, the advanced PTM mode becomes an essential knowledge level for the implementation of any future land consumption containment policies, in response to pressures from European bodies, as well as national and international sustainability policies. Such policies cannot disregard a detailed and thorough analysis of the implementation status of the current urban planning instrument; further urban transformations can only be justified by genuine urban needs, but their fulfillment requires a rational urban organization compatible with the territory's resources. This underscores the need to strictly avoid generic or contradictory design schemes that may arise in the absence of an overall strategic framework like that represented by the PTM.

Acknowledgement. This contribution is realized within the framework of PNRR project "Geo-SciencesIR" funded by the European Union Next Generation EU (PNRR "Geo-SciencesIR" - Missione 4, "Istruzione e Ricerca"- Componente 2, "Dalla ricercar all'impresa" – Linea di investimento 3.1, "Fondo per la realizzazione di un sistema integrato di infrastrutture di ricerca e innovazione". Finanziato dall'Unione Europea NextGenerationEU CUP 153C22000800006).

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