Managing coastal risks in the Mediterranean through participatory processes. Preliminary insights from the Metropolitan City of Bari (Southern Italy)

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Abstract
Coastal erosion is a critical issue in the Mediterranean Basin, heavily impacting vital coastal industries like tourism, agriculture, and fishing. Climate change compounds these problems, worsening floods and storms. To counteract the risk of erosion and flood, «hard» engineering-based approaches have been used, often prove ineffective and undesirable effects. Recognising the need for a shift, the international community advocates for Integrated Coastal Zone Management and Nature-based Solutions. Participatory actions involving local communities and stakeholders need to be provided to facilitate collaboration and consensus-building and to enhance peoples' perceptions. Through a case-study analysis in the Metropolitan City of Bari (Italy), this paper tries to understand if policy-makers and stakeholders acknowledge and consider the newly proposed methods for coastal risk management as a potential alternative or supplement.

Keywords
Coastal areas, Risk management, Participatory System Dynamics modelling, Italy

1. Introduction

The Mediterranean Basin faces huge challenges, mainly due to high anthropogenic pressures and its climatic borderline balance (EEA, 2020). It is defined as one of the most critical erosion hotspots in Europe, heavily affecting the main economic industries along the coast (beach tourism, agriculture and fishing activities) (EEA, 2020). Moreover, climate change exacerbates the impacts of other phenomena such as floods and storms (UNEP/MAP and Plan Bleu, 2020). Traditionally, to deal with such complexity and to reduce the vulnerability of the Mediterranean coastal areas, "hard" engineering-based approaches have been used to counteract the risk of erosion and flood (e.g. through the construction of groins and breakwaters). However, such measures have led to ineffective and, most of the time, undesirable effects (Motta Zanin et al., 2023).

As a matter of fact, the necessity to change perspective to manage coastal risks has been recognized by the international debate and new solutions have been identified as alternative or complement solutions (e.g. Nature-based Solutions) (Motta Zanin et al., 2024). Moreover, a more comprehensive and systemic approach, compared to sectoral perspectives, has been designed, namely Integrated Coastal Zone Management (ICZM). A key aspect of the ICZM Protocol refers to the need to define necessary measures to ensure an appropriate involvement of the various stakeholders, in all the phases of formulation and implementation of coastal and strategies, plans and programmes or projects (Turner and Bower, 1999).

For the effectiveness of the ICZM process, participatory actions involving local communities and stakeholders as well as techniques and analysis tools providing information necessary for the follow-up of projects and for decision-making, need to be provided (Motta Zanin et al., 2023). This would allow an improvement of communications and consultation, facilitating collaboration and consensus-building, enhancing stakeholders' and local communities' perceptions of the adopted solutions and, thus, their knowledge and understanding (Slovic, 1987).
Within this frame, this work tries to answer the following key-question:
Are policy-makers and stakeholders acknowledging and considering the newly proposed methods for coastal risk management as potential alternatives or supplements?
To answer the key-question, we selected a case-study in the Mediterranean basin: the Italian Metropolitan City of Bari in Puglia Region (Southern Italy). As the only Metropolitan City in Southern Italy facing the Adriatic Sea, we identified it for two main reasons: (i) the governance system at the metropolitan scale as the most efficacious level for the implementation of solutions for coastal risk management; (ii) the complexity of the City due to its physical, environmental, socio-economic and institutional characteristics.

2. Methodology
To analyse the case-study, we developed a Participatory System Dynamics Model (PSDM), by following the methodology described by Valencia Cotera, Egerer and Máñez Costa (2022). It consists of five incremental work steps (Figure 1) and allows to outline a shared understanding of a problem, within a complex and dynamic system characterised by wicked problems and, most of the time, multiple conflicting interests.
Within this frame, this paper focuses on the preliminary results of the first research phase, based on the first four steps of the process:
01) stakeholder analysis, identifying actors, representing public and private bodies, with different kind of responsibilities (management, regulatory, economic, social and environmental);
02) semi-structured individual interviews, guided by the building of individual mental model maps, to understand each actor's perception of coastal risks. The mental model maps represent the "status-quo" of the coastal area of the Metropolitan City of Bari, in which the social and ecological components of the coast, the main activities and uses, the existing regulatory and planning system, and the existing risks and impacts are correlated (causal links);
03) desktop work, consisting in the analysis of each individual model and the building of the collective preliminary model outlining a general overview of the system by ranking the recurring variables and relationships;
04) building of the group model through a workshop where all actors discuss the variables and causal links of the coastal risks for the Metropolitan City of Bari emerged from the individual interviews.

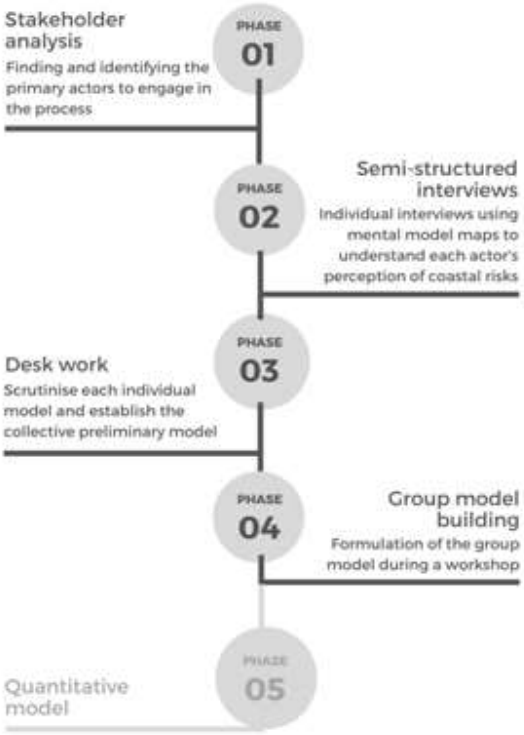

Figure 1 – The process performed to build the Participatory System Dynamics Model (PSDM). Source: Authors' elaboration

3. Framing the case study

The Metropolitan City of Bari is the only one in Southern Italy facing the Adriatic Sea. The coastline is heavily urbanised through medium and large-sized urban settlements (six municipalities including the capital and coastal towns) separated by limited undeveloped areas (Figure 2). The undeveloped zones are sensitive both for landscape and environmental reasons, as they are subject to hydraulic and geomorphological hazards, and for settlement reasons, linked to the pressure of tourist, productive, and commercial interests.

From a hydro-geomorphological perspective, the territory's structure comprises rocky terraces, gradually descending parallel to the coastline. The surface hydrography consists of incisions and river-karst valleys, called "lame", developed in the predominantly limestone or calcarenite bedrock. Due to the permeability of the carbonate substrate, the "lame" have an episodic hydrological regime, with flood events occurring during significant rainfall. The catchment basins of the "lame" form a fan-shaped surface with its apex roughly corresponding to the settlement of Bari (Borri and Calace, 2017).

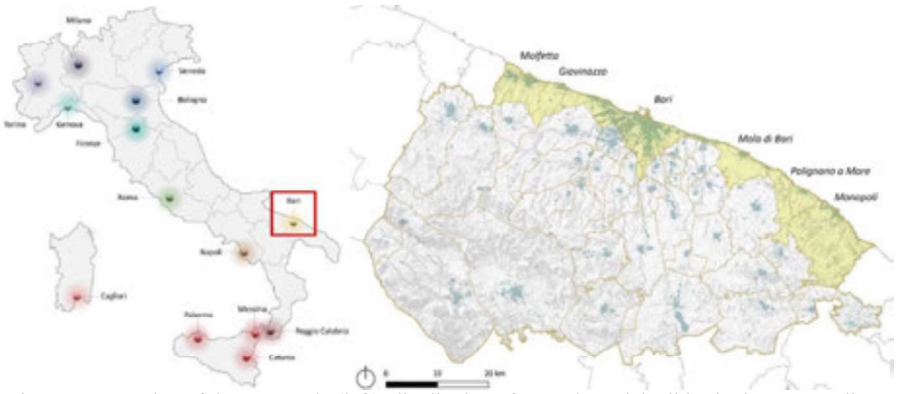

Figure 2 – Location of the case study (left); distribution of coastal municipalities in the Metropolitan City of Bari (right). Source: authors' elaboration

In addition to their hydraulic function, the "lame" today represent the main elements of naturalness along the metropolitan coast, as well as the ecological connectors between the sea and the hinterland. As described by the Territorial Landscape Plan of Puglia Region (2015), they host vegetational and faunistic habitats that have adapted well to changing environmental conditions. Along the Bari coast, there are few other natural areas, mostly located in peri-urban agricultural areas, while wetlands have disappeared.

Despite the high degree of artificialisation of the metropolitan coast, the seabed holds significant natural value, so much so that it is protected as Special Conservation Areas of the Natura 2000 Network. Indeed, the biocenosis of finely calibrated sands and the Poseidonia oceanica seagrass are of strategic importance for maintaining marine biodiversity (Regional Territorial Landscape Plan, 2015).

In general, the coastal morphology of Bari lacks articulations, except for those detailed ones due to localised erosive processes caused by karstification and marine action. The coast is predominantly characterised by low rocky formations (44.55%) with a rather homogeneous trend (Figure 3) (Regional Coastal Plan, 2012). Indeed, marine abrasion platforms gradually slope towards the sea and end with nearly vertical walls, typically not exceeding 1.5 meters in height. These surfaces have variable depths (about 10 meters) with widespread karst corrosion features such as caves, small basins, and coves. There are also stretches of high rocky coastline (23.42%) with cliffs of varying slopes, with elevations not exceeding 12 meters (Regional Coastal Plan, 2012).

The first settlements of the main centres aligned along the coast (Molfetta, Giovinazzo, Mola di Bari, Polignano a Mare, and Monopoli) with their related anthropic works (33%) were born in the coves of the rocky coast. There are also some stretches of sandy coastline (4.6%) or pebbly (0.97%), fed by weather and marine movements or by collapses of coastal banks: sandy beaches at the foot of the rocky coast within coves and small natural recesses or artificial beaches created through sand deposition; sandy stretches near the mouths of the "lame" (Regional Coastal Plan, 2012).

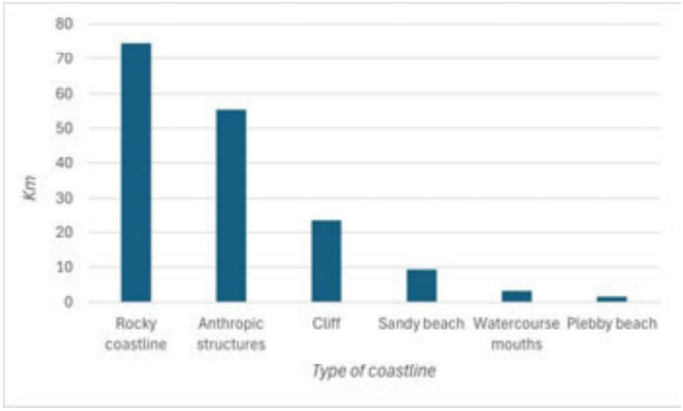

Figure 3 - Coastal morphology of the Metropolitan city of Bari. Source: authors' elaboration from data of Regional Coastal Plan, 2012

Considering the type of coastline, erosion of the sandy coast is only in a few stretches, mostly in the territory of Molfetta and Monopoli, while stretches of coast characterised by cliffs are at risk of landslides and collapses. Conversely, the orographic and geomorphological conditions of the territory produce significant hydraulic hazard phenomena that have repercussions on sediment deposition at the mouths of the "lame," as well as risks for existing urban developments (Mossa, 2010; Bisantino et al., 2016).

The Metropolitan City of Bari represents a unique settlement pattern resulting from a slow process of polycentric and articulated urbanisation, characterised by a strong "radial" dependence between smaller centres and the capital (Borri and Calace, 2017) and especially between inland centres and coastal municipalities of medium to large size (Figure 4).

Indeed, on the metropolitan coast, there are six medium to large-sized municipalities: Molfetta with 57,245 inhabitants, Giovinazzo with 19,232 inhabitants, Bari with its coastal areas with 316,212 inhabitants, Mola di Bari with 24,323 inhabitants, Polignano a Mare with 17,464 inhabitants, and Monopoli with 47,847 inhabitants (ISTAT, 2024). The urban load of these municipalities entails a dense network of water distribution with seven final outlets of wastewater directly into the sea. The strong settlement pressure has also been influenced by the dense network of road and rail infrastructure that characterises a clear separation between the coast and the hinterland.

Harbour infrastructures are another determining factor of anthropic impacts, as they generate large flows of goods and people. Indeed, on the metropolitan coast, there are 11 ports of various categories, which testify to old traditions related to fishing and trade, and new uses related to tourism, recreational boating, and water sports: one of international economic importance (Bari), one of national economic importance (Molfetta), eight of regional and interregional economic importance (Giovinazzo, the coastal areas of Bari, Mola di Bari, and Monopoli), and one tourist (Polignano a Mare) (Law No. 84/1994 "Regulating port organisation and activities").

Transformations of coastal areas for the construction of ports and docks often have not adequately assessed the induced effects on meteomarine equilibria, leading to significant alteration of sediment transport. In fact, the major harbour infrastructures (Molfetta to the north, Bari in the centre, Monopoli to the south) constitute the boundaries of the physiographic units[1] of the metropolitan coast.

[1] Physiographic Units are stretches of coastline where natural features or anthropogenic works do not allow the entry and/or exit of solid transport, due to wave motion and littoral currents.

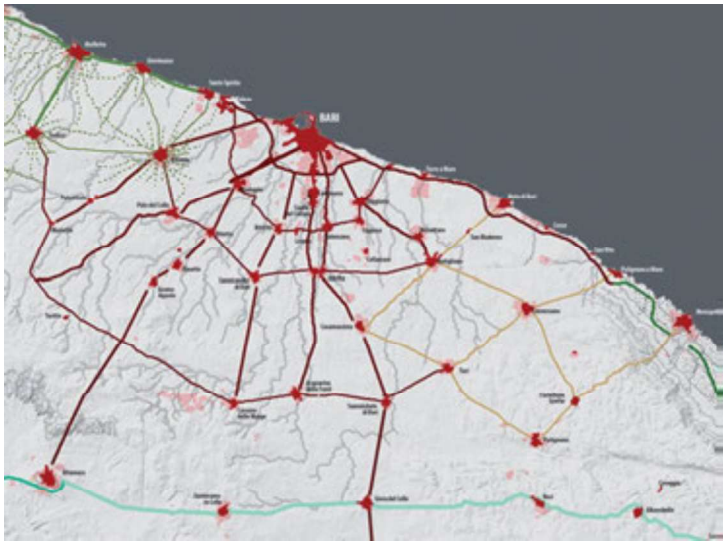

Figure 4 - Distribution of urban settlements of the Metropolitan City of Bari. Source: Territorial Landscape Plan of Puglia Region, extract from document 3.2.6

The stretches of coastline enclosed between urban centres have undergone significant transformations since the 1960s to promote local beach tourism, not only for residents but also for the population coming from inland centres. This has led to a strong privatisation of coastal zones through the construction of accommodation facilities, beach resorts, and seasonal holiday homes in agricultural areas and near the "lame", often in conflict with municipal urban planning instruments and hydrogeological structure plans. The dispersion of settlements along the coast has produced numerous impacts in terms of both use and accessibility and hydrogeological risk. In the last 10 years, tourist flows have grown considerably with visitors from both national and international territories (Potito and Quercia 2023), also thanks to the enhancement of historic centres and elements of the historical-cultural heritage scattered in peri-urban areas, and to the regeneration and creation of new public coastal spaces (public beaches, areas equipped for water sports, reuse of disused industrial buildings, etc.) (Calace et al. 2020).
Indeed, all coastal municipalities of the metropolitan city are implementing policies to enhance the coast while attempting to manage critical issues and impacts. From the analysis of policies and planning of municipal administrations, both common themes and objectives emerge, linked to environmental dynamics and the enhancement of urban identity related to fishing and trade, as well as specific aspects characterising individual territories: water pollution caused by sewage discharge and industrial waste disposal (Molfetta and Giovinazzo); saline contamination of agricultural soils (Giovinazzo and Monopoli); accessibility and use issues linked to high beach tourism pressure (Polignano a Mare and Monopoli); enhancement of areas that have resisted urban sprawl, rich in heritage stratifications and still linked to agricultural activities (Bari and Polignano a Mare); valorisation of different coastal urban identities (Bari) (Calace et al. 2020).

3.1 The governance system of the Metropolitan City of Bari

We have considered the case study of the Metropolitan City of Bari, because the governance system at the metropolitan scale could be the most efficacious level for the implementation of solutions for coastal risk management. The Metropolitan level of government, established in Italy with Law No. 56/2014, has competences for the governance of a vast area and for the promotion and coordination of socio-economic development. The statutory objectives of the metropolitan level can promote the implementation of integrated actions for the reduction of anthropogenic pressure on the coast, risk mitigation, and the enhancement and sustainable development of territories. So far, to date, the Bari system still struggles to practice true governance, understood as adaptive forms of multilevel and multi-actor collaboration in which actors, driven by divergent interests, interact to formulate and achieve common objectives (Torfing et al., 2012), in a 'trading zone' that allows for partial innovations attributable to strategies even in conflict with each other (Balducci, 2013). Instead, a highly planned yet fragmented system emerges, with multiple sectors and levels of governance that find it difficult to interact synergistically (Figure 5).

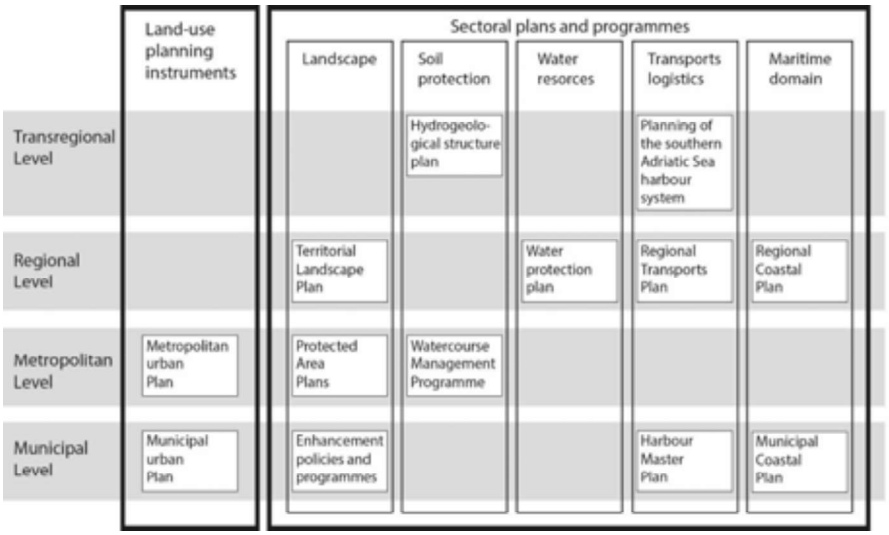

Figure 5 - Planning and programming tools for coastal management. Source: author's elaboration

The Hydrogeological Structure Plan, which came into effect in 2005, has a prescriptive content that establishes admissible interventions in areas prone to hydraulic and geomorphological hazards but does not provide project management guidelines. On the other hand, the Water Protection Plan, which came into effect in 2009, has a forward-thinking policy for wastewater discharges into the sea, foreseeing the relocation of discharges and promoting water reuse policies.

Port planning, according to national Law No. 56/2014, is the responsibility of municipalities or supra-regional authorities depending on the rank of the harbour, involving actions to expand port infrastructure and redevelop port-city interaction areas.

The Regional Coastal Plan, which came into effect in 2012, outlined the framework of coastal sensitivities and criticalities and defined the main choices for coastal management, in line with environmental and landscape constraints. Management rules must be further developed at the municipal level with Municipal Coastal Plans and only concern the strip of maritime public property, often very narrow due to erosion phenomena. These plans have very limited

competencies (coastal recovery and zoning of concessions for bathing establishments, fishing, trade, water sports) and are inadequate compared to the complexity and intensity of environmental and landscape dynamics.
The Regional Territorial Landscape Plan (RTLP), which came into effect in 2015, is now the only reference for an integrated coastal management approach. It adopts the concept of the 'coastal zone' as a transition area between sea-coast-hinterland encompassing cities, rural areas, infrastructure, and protected areas. The RTLP pursues the objectives of enhancing and redeveloping natural and anthropic elements, enhancing the resilience of the coastal ecotone, and safeguarding and enhancing undeveloped areas.
Urban planning and territorial planning instruments operate at the municipal and metropolitan levels. All municipalities still have very dated urban plans (from the 1970s-1990s) that envisaged intense urbanisation for residential, industrial, commercial, and tourist purposes but are promoting numerous projects for waterfront and public space redevelopment through ministerial funding (European Regional Development Fund and The National Recovery and Resilience Plan). Instead, the Strategic Plan for the Metropolitan City of Bari, still under development, proposes 11 strategic actions including the "Metropolitan Waterfront and Marine Economies" action. It assumes the following objectives: (i) coastal consolidation and enhancement of the entire Bari metropolitan area coastline; (ii) enhancement of the natural landscape characteristics to make it more attractive; (iii) the waterfront as an identity element for communities and an economic and social engine for territorial growth. At present, these objectives have not yet resulted in an organic programming of measures and actions for the territories and do not provide concrete answers for climate change. Nevertheless, these objectives can help municipalities align their planning and programming instruments, increasing the effectiveness of individual interventions on the coast.

3.2 Setting the PSDM process for the Metropolitan City of Bari

To set the Participatory System Dynamics Model process, we started by identifying the key actors to be involved (Phase 1). First, we defined a list of stakeholders including representatives of public bodies (at the regional, sub-regional, metropolitan and local scale), of economic activities (agriculture, tourism, fishing) and of NGOs (Table 1).
Our main goal was to include different typologies of actors with different responsibilities in managing the coastal area of the Metropolitan City of Bari (management, regulatory, economic, social, tourism and environmental). Moreover, we used the snow-ball sampling method to strengthen the stakeholders identification and reduce the chances of leaving out important parties.

Table 1 – Selected actors for the Participatory System Dynamics Model process in the Metropolitan City of Bari

Institution	Typology	Type of responsibility	Scale
Acquedotto Pugliese S.p.a.	Investee Company	Management	Regional
Puglia Region – Landscape protection and enhancement	Public	Regulatory	Regional
Puglia Region – Coastal and harbor public domain	Public	Regulatory	Regional
Puglia Region – Parks and biodiversity protection	Public	Regulatory	Regional

Apulian Water Authority	Public	Regulatory, management	Regional
Regional Agency for environmental prevention and protection - ARPA	Public	Regulatory	Regional
Basin Authority	Public	Regulatory	Sub-regional
Port Authority	Public	Management, regulatory	Sub-regional
Terre D'Apulia Reclamation Consortium	Public	Management, regulatory	Sub-regional
Superintendence of archeology and landscape	Public	Regulatory	Metropolitan
Metropolitan City of Bari - Environment	Public	Regulatory	Metropolitan
Municipality of Bari – Urban planning and development	Public	Regulatory	Local
Association of beach concessionaires	Trade association	Economy	Local
Coldiretti agriculture Association	Trade association	Economy	Local
I Gabbiani di Costa Ripagnola Association	NGO	Environment, social	Local
Litorali	NGO	Environment	Local
Pugliarte Association	NGO	Social, tourism	Local
ASD Lo Stroppo Association	NGO	Economy, social	Local
Mola di Bari Fisherman association	Trade association	Economy	Local
Confagricoltura Bari	Trade association	Economy	Local
Confcommercio Bari	Trade association	Economy	Local
Puglia Promozione	Public body	Economy, tourism	Metropolitan

To prepare Phase 2, consisting in the individual semi-structured interviews, we set a guide of questions divided in four main topics (Figure 6): i) definition of the socio-ecological system; ii) identification of the main activities and uses on the coast; iii) identification of the socio-economic rules/control on the coast; iv) existing threats and impacts on the coast.

Figure 6 – Structure of the individual semi-structured interviews. Source: author's elaboration

The individual interviews are conducted to build individual qualitative mental models. Each model is represented as a Fuzzy Cognitive Map (FCM), composed of oriented graphs with feedbacks, which consist of nodes (or concepts), being the variables, and weighted arcs (or connections) (van Vliet, Kok and Veldkamp, 2010). During the interview each participant is directly involved in the creation of the individual model by following the structure described in Figure 6. This phase helps to refine the perception of each stakeholder to represent their personal perspectives and to deepen the understanding of the issue and prepare for Phase 3.
Phase 3 consists in a desk analysis, necessary to build a preliminary qualitative model (PQM) based on the information gathered from the individual interviews. As stated in Valencia Cotera, Egerer and Máñez Costa (2022), this phase has the aims of i) forming a broad understanding of the system's behaviour and ii) compiling a comprehensive summary of stakeholder perceptions. In this phase, all components emerged from the Individual mental models are analysed and ordered. Only variables present in all individual models are considered and boundary conditions are set by classifying the components and relationships into tiers (Table 2).

Table 2 – Classification of components and relationships into Tiers

COMPONENTS	**TIMES MENTIONED (%)**
C-Tier 1	>50
C-Tier 2	25-50
C-Tier 3	<25
RELATIONSHIPS	**TIMES MENTIONED (%)**
R-Tier 1	>75
R-Tier 2	50-75
R-Tier 3	25-50
R-Tier 4	<25

We consider only components of C-Tier 1 and C-Tier 2 and relationships of R-Tier 1, R-Tier 2 and R-Tier 3. By incorporating only the components mentioned by the majority of stakeholders, we are able to build a basic framework to capture the collective perception of the system.
The last Phase consists in the Group Model Building (GMB), through a Workshop with the participation of all actors identified in Phase 1. During the Workshop and with the guidance

and moderation of two facilitators, participants discuss and decide the main components to place in the model, following the same structure used for the Individual interviews (Phase 2). The facilitators guide the workshop by taking into consideration the elements that emerged from the preliminary model to bring out any aspects that are overlooked. However, facilitators do not show the preliminary model to the participants because it could modify stakeholders' feelings and create bias and framing effects.

4. Results and discussion

The Participatory System Dynamics Model developed for the Metropolitan City of Bari helps us to understand if policy-makers and stakeholders acknowledge and consider the newly proposed methods for coastal risk management as potential alternatives or supplements.

First, we deliberately decided not to give a definition to the extent of the coastal area of the Metropolitan City of Bari to the actors involved, as we wanted to comprehend their own understanding of the system.

In fact, from the preliminary qualitative model (Figure 7) built in Phase 3 we realise that actors do not perceive the coast as a sea-coast-inland transitional zone as defined by the Regional Territorial Landscape Plan. They mention only the coastline and no reference is given to the relationships with the system of the ephemeral rivers "lame" and the inner territory of Murgia. Moreover, most of the participants give much attention to the predominance of beach establishments used for bathing by residents and tourists and less recognition is given to residential, agriculture, fishing and harbour activities. The touristic use of the coast, and mainly the management of the state property by beach concessionaires, is recognised to be cause of beach privatisation and consequently to anthropic pressures leading to an increase of hydro-geomorphological risk and coastal erosion. The coexistence of these activities results in land consumption, high water footprint, large amounts of solid waste, and pollution of marine waters, impacting seagrass and the attractiveness of beaches for bathing.

However, the presence of poseidonia is recognized only as a waste that produce pollution. Such aspect highlights the low level of actors' knowledge on the importance that poseidonia could have as a Nature-based solution for coastal protection, manly to reduce flooding and erosion risk. As a matter of fact, the PQM lacks in components related also to the presence of "hard" engineering-based solutions to counteract the risk of erosion and flood such as groins and breakwaters. Another aspect not emerging from the model is climate change and its negative impacts. This could be due to the fact that climate change is seen as a global issue that is not reflected on a local scale.

The actors perceive coastal erosion as a main issue for the Metropolitan City of Bari as directly caused by anthropic pressure (harbour activities, beaches privatisation, tourism).

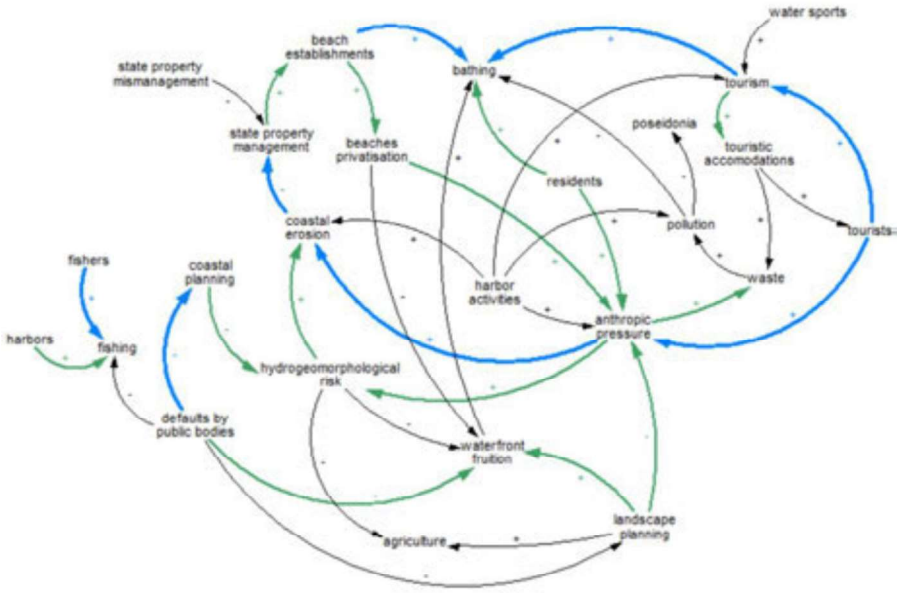

Figure 7 – The preliminary qualitative model - PQM (Phase 3) built from the analysis of the individual interviews (Phase 2) with the presence of C-Tier 1 components. The arrows' thickness represent the Tier level, R-Tier 1 with low effect relationships in black, R-Tier 2 with considerable effect in green and R-Tier 3 with strong effect in blue. The "+" and "-" indicate the positive or negative effect related to the cause. Source: author's elaboration

The strong perception of the problem is linked to episodes of collapses and landslides along the predominantly rocky coast, jeopardising the viability of economic activities regulated by state property management. Participants identify bathing and tourism as both a problem and activities at risk due to difficulties in management, routine maintenance, and coastal supervision. Hydrogeological risk is also perceived as one of the main issues along the coast, especially as actors recall past flood events that caused severe damage to settlements and populations. This risk is mainly attributed to urbanisation in flood-prone areas and widespread soil sealing, resulting in challenges for waterfront enjoyment and agricultural production.

Landscape planning, with relation to the Regional Territorial Landscape Plan, is recognised to be a relevant instrument to counteract anthropic pressures and to allow a better fruition of the waterfront. On the contrary, the fruition of the waterfront is perceived as hindered by defaults of public bodies. In particular, this deficiency leads to problems related to the difficulty of implementing coastal planning at the local scale.

This is in line with the reality, as no municipality in the Metropolitan City has a current Municipal Coastal Plan. Furthermore, participants widely share dissatisfaction with the current planning systems, which are too fragmented and sectoral. The complexity of regulations and defaults by public bodies cause many problems in the management choices of coastal uses (fishing, ports, bathing), interfering with coastal redevelopment scenarios promoted by landscape planning.

During the workshop, participants ignored the emerged themes from the Preliminary Qualitative Model (PQM) to enable an objective and unbiased formulation of the Group Model Building (GMB).

From the Group Model (Figure 8) built during the Workshop with all actors involved in Phase 2, we can say that most of the components and relationships deriving from the PQM are confirmed. In this phase, the actors have deepened the correlations between uses, impacts, role and plans, highlighting the following aspects.

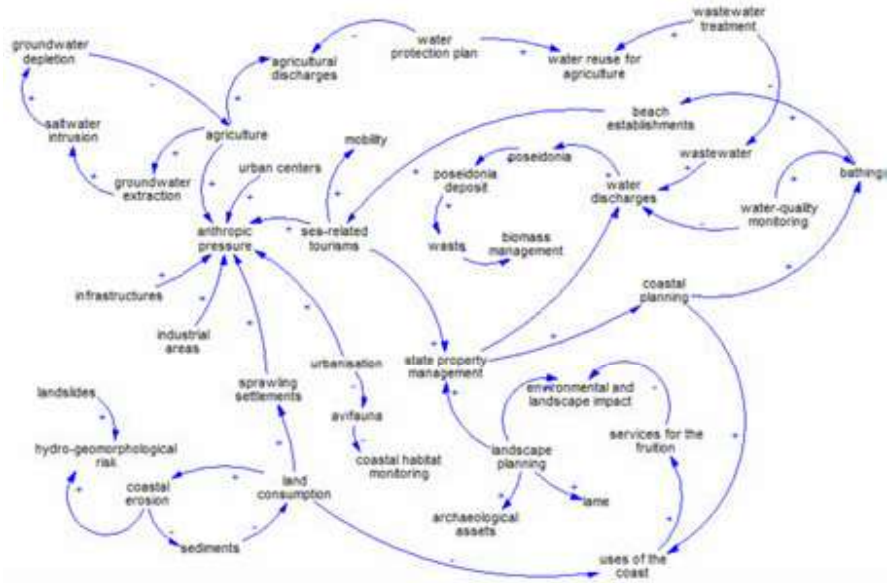

Figure 8 – The group model – GMB (Phase 4) built during the Workshop with the actors involved in Phase 2. Source: author's elaboration

The actors have undoubtedly produced a more organic vision of anthropic pressures, linked not only to sea-related tourism and urban centres in general, but also to infrastructure, industrial areas, settlement sprawling and agriculture. In particular, they pointed out that settlement expansion is the main cause of land consumption, with direct repercussions on coastal erosion, hydro-geomorphological risks and sediment management, and that urbanisation results in the reduction of birdlife and coastal habitats. The actors also deepened the impacts caused by agriculture: (i) extraction of groundwater for agriculture causes saline intrusion into the underground aquifer and its depletion, to the disadvantage of agricultural production; (ii) agricultural discharges into the sea that require the implementation of water protection plan policies and measures related to the reuse of purified wastewater and waste treatment efficiency systems.

The topic of the state property management, already extensively emphasised in the PQM, was further explored for the following issues: (i) the need to improve the management of water discharges because they change the balance of the poseidonia, causing it to be deposited on beaches and making it difficult to manage biomass; (ii) the need to improve coastal planning through integration with landscape planning (protection of the biodiversity of lame and archaeological assets) and a more correct distribution of uses, because supporting services for the fruition (mobility and parking) cause impacts on the environment and landscape.

5. Concluding remarks

The initial findings deriving from the Participatory System Dynamics Model process set for the Metropolitan City of Bari indicate that decision-makers and stakeholders do not perceive the

complexity of the coastal zone as a sea-coast-inland transitional zone. Although hydro-geomorphological hazards, and coastal erosion in particular, are mentioned, there is no reference to approaches to manage them. Moreover, there is no recognition of climate change as the primary cause of risks and pressures on their coastal areas. This perception is conditioned by the vision of the existing problems related to the equilibrium of the coastal system and may be influenced by the absence of detailed predictive scenarios.

In the meantime, they are aware about the risk of erosion and of pollution caused by the urbanistic transformations, both caused by the "hard" engineering-based approaches used for the last decades, and by the future impacts caused by the touristic, residential and commercial development.

Furthermore, actors view Nature-based Solutions positively in an abstract sense, but they may not be applicable in highly anthropised contexts with significant socio-economic conflicts. Especially stakeholders at the regional level, with regulatory and management responsibilities, demonstrate knowledge of Nature-based Solutions, including those projected to circular resource management. However, they do not consider them applicable for several reasons: (i) the economic-settlement development interests of an already highly populated territory that does not allow for short-term relocation hypotheses; (ii) the difficulty of intervening in the adaptation or replacement of existing infrastructure, networks and facilities; (iii) and the coexistence of too many sector planning tools along the coast, with sometimes conflicting interests, which do not allow for the experimentation of innovative and forward-looking management solutions.

To overcome the approach of resolving specific conflicts in the short and medium term, a comprehensive framework is necessary. This framework should combine methods, data sources, and theories, detailed climate change scenarios to address the partial perception of stakeholders and change perspective to manage coastal risks.

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