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From the lagoon-city to the lagoon of adaptive cities

Methodological approach to support trans-municipal and multilevel governance for climate adaptation in the Venice lagoon

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Abstract
The impacts of climate change and the increasing occurrence of consequent extreme events in recent years have led to significant environmental, social and economic consequences in a fragile and highly vulnerable territory such as Venice. It is precisely in this perspective, which considers areas particularly vulnerable to the effects of climate, that the scientific research program Venezia2021, coordinated by CORILA - Consortium for Coordination of Research Activities concerning the Venice lagoon system, is inserted. The research in question involves a complex process of identification and integration of innovative tools, data processing and analysis and assessment of impacts, in order to contribute to the maintenance of a proper balance of the lagoon ecosystem in a perspective of increased climate resilience. The overall objective of the research was to build a strategic, accurate and shared vision with respect to the challenges that await the preservation of the city and its lagoon, (a World Heritage Site), in consideration of climate change scenarios. Specifically, this paper analyzes the research experience of thematic axis No. 5 that led to the drafting of the Climate Change Adaptation Plan for the Venice Lagoon. The operational path that led to the construction of the plan was guided by an in-depth spatial study and development of an integrated system of analysis, assessment, planning, management and monitoring of the Venetian area capable of supporting the city and the activities that operate in it, through coordinated adaptation actions aimed at increasing sustainability and resilience as a whole.

Keywords
Climate change; Spatial planning; Innovation; Climate adaptation; Fragile territories.

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1. Introduction

The impacts of climate change in recent years have widely manifested their effects on different aspects, ranging from hydrogeological risk, overheating in urban areas (UHI), coastal and lagoon defense issues, and deterioration of historic buildings (EEA, 2017). In addition, there has been an increasing occurrence of extreme weather events, especially affecting Italian coastal areas and cities (Spano et al., 2020).

These events have caused significant losses in social, economic, environmental, and tangible and intangible cultural heritage (SNPA, 2021). One of these coastal hotspots is precisely the territory of the metropolitan city of Venice, which is historically recognized as a fragile and highly vulnerable territory (Bassan et al., 1997; Gasparoli et al., 2014; Menegazzo, 2018).

In a scenario of climate change, the management of the fragility of this environment will have increasing environmental, social, and, above all, economic consequences that, if not adequately managed, may severely affect the development of economic activities and the well-being of citizens. In this context, the scientific research program Venezia2021, coordinated by CORILA - Consortium for Coordination of Research Activities concerning the Venice Lagoon system - and financed by the Provveditorato alle OO. PP. del Triveneto, as part of the works for safeguarding Venice and the lagoon, has been included.

With the conclusion of the construction of MOSE, a major experiment, never conducted elsewhere at this scale, related to the management of a large "regulated" lagoon begins.

The scientific research, which started in 2018 and ended at the end of 2022, was intended to accompany the testing phase of the tidal regulation works, assessing their impacts, environmental, social, and economic from a sustainability perspective. It aimed to develop, in a short time, an accurate and shared strategic vision concerning the challenges that await the preservation of the city and its lagoon, a world heritage site, in consideration of climate change scenarios.

CORILA coordinated the scientific community in conducting the research, organized around five themes, to establish an effective interdisciplinary dialogue and develop every possible synergy:

- Topic 1: Lagoon interfaces: exchanges with sea and drainage basin;
- Topic 2: Sediments, chemical pollution and interaction with lagoon organisms;
- Topic 3: Lagoon aquatic forms, habitats and communities;
- Topic 4: Ecological connectivity and ecosystem services;
- Topic 5: Climate change and adaptation strategies for safeguarding the cultural heritage of Venice and its lagoon.

The research program also set out to provide strategic directions for climate change adaptation useful to the Venice Lagoon and to provide a complex and integrated portfolio of observation and data processing tools to ensure protection for the natural ecological functioning of the lagoon while safeguarding the benefits of society (ecosystem services) provided by the lagoon itself.

Within *Venice2021*, Research Line 5.3 "Climate Change Adaptation Plan and Implementation of Intervention Strategies to Safeguard the Architectural Heritage" focused on the development of an integrated system of analysis, assessment, planning, management, and monitoring of the Venetian area and its historical, artistic and cultural heritage, capable of supporting the city and the activities that operate in it, through coordinated adaptation actions aimed at increasing sustainability and resilience as a whole.

Therefore, develop methodologies and approaches capable of capturing climate change-induced changes and consequently prepare actions aimed at adaptation, impact mitigation and risk prevention in a *Climate Change Adaptation Plan for the Venice Lagoon*.

The work presented here will also enable greater awareness of local governments concerning adaptation, thus helping to convert the approach of spatial planning from sectoral-individual to holistic-integral-shared.

2. Materials and methods

Setting up actions and measures aimed at adaptation required in-depth study and analysis of the reference context to ensure suitable choices concerning the specificities and priorities of the territories.
Knowledge of the geographical context is essential to adopt tools such as suitable strategies or actions. The Guide prepared by the National Plan for Adaptation to Climate Change (PNACC, 2017a), outlined the basic steps for the identification of climate adaptation actions and proposed an ordered sequence of "methods" that can be used at each stage of the process: from the initial ones related to climate studies, the identification of vulnerabilities and the involvement of the most affected actors, as well as the reconnaissance and study of existing Plans to identify any measures already planned (PNACC, 2017b; Zucaro et al., 2018) (Figure 1).

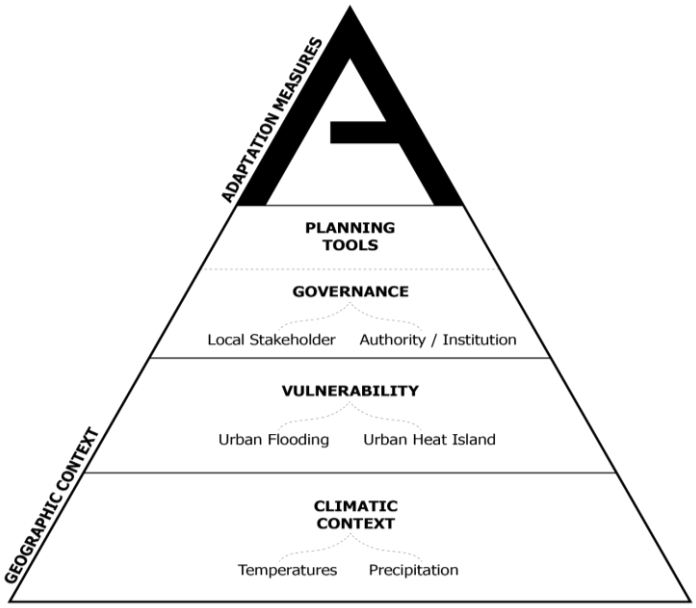

Fig.1 Methodological scheme for the identification of useful materials for research

2.1 Geographic context: identification of possible impacts attributable to climate change

The definition of the area under research considered the boundaries of the last existing lagoon boundary, decreed in 1990 by the Ministry of Public Works. This delimitation includes the inlets of San Niccolò, Malamocco, Chioggia, and the island of Sant'Erasmo. It was deemed appropriate to add a buffer area of 1 km inland (mainland) to consider the spatial system as a whole and more correctly identify possible impacts attributable to climate change. Such delimitation is important both to enable the development of an inter-municipal adaptation strategy and because of the need for a governance system that can respond effectively to the needs of each administrative entity. The (11) municipalities selected for the study are Venice, Campagna Lupia, Cavallino-Treporti, Chioggia, Dolo, Jesolo, Marcon, Mira, Musile di Piave, Quarto D'altino, and San Donà di Piave (fig. 2). The materials useful for research and later explicated focus on this identified area.
The area being researched, included in the territory of the Metropolitan City of Venice, is largely occupied by the Venice Lagoon, one of the largest and most important coastal ecosystems in Europe, and with an arrangement characterized by continuous change.

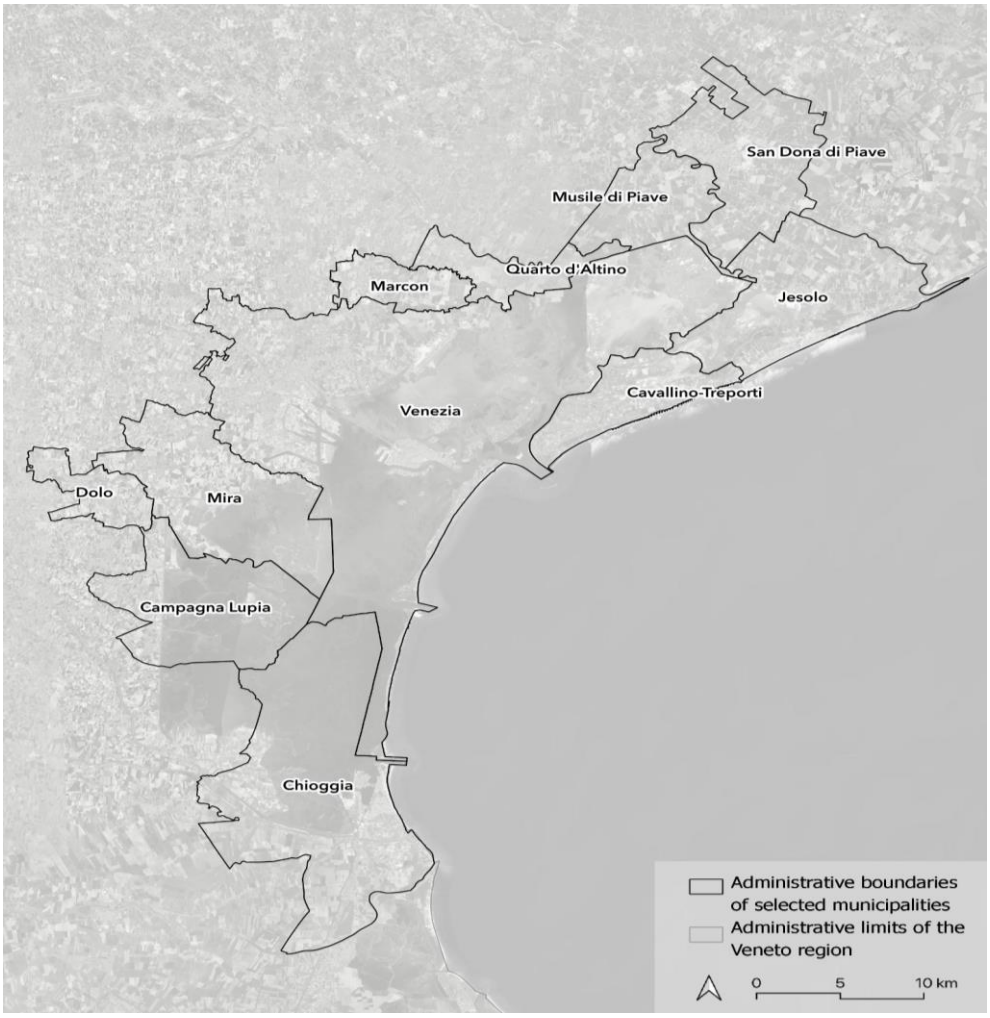

Fig.2 Study area map

2.2 Climate context: tailoring optimal choices for the specificities of territories

From the climatic point of view, as has happened in much of Europe, significant changes have occurred in Veneto and the area of the Metropolitan City of Venice over the past 70 years: the Region is positioned in a transition zone between the continental area of Central Europe and the Mediterranean area, presenting peculiar characteristics resulting from the mitigating action of the Adriatic Sea and the influence of the Alpine chain. In particular, the territory of the Metropolitan City of Venice has two major zones, one coastal and one inland, with different climatic characteristics. According to the PNACC, the territory falls into two of the six climate macroregions:

- Macro-region 1 - Prealps and Northern Apennines, characterized by intermediate values for cumulative winter and summer precipitation values and high values, compared to the other areas, for extreme precipitation events (R20 and R95p).
- Macro-region 2 - Po Valley, upper Adriatic and coastal areas of central-southern Italy, characterized by the highest number, compared to all other areas, of days, on average, above the threshold selected to classify summer days (29.2°C) and at the same time by high average temperatures (PNACC, 2017).

Regarding the analysis of temperatures in the Veneto region, the 1993-2021 mean reference values collected by ARPAV, over the whole territory show increasing temperature values between 0.5 and 1.5 °C. Average daily mean temperatures in 2022 show values everywhere over the region that are higher than the 1993-2021 average (fig. 3). These differences are generally between 0.7 °C and 1.9 °C (ARPAV, 2022). The analysis records a trend of increasing average temperatures, particularly in the autumn period (CMCC, 2021).

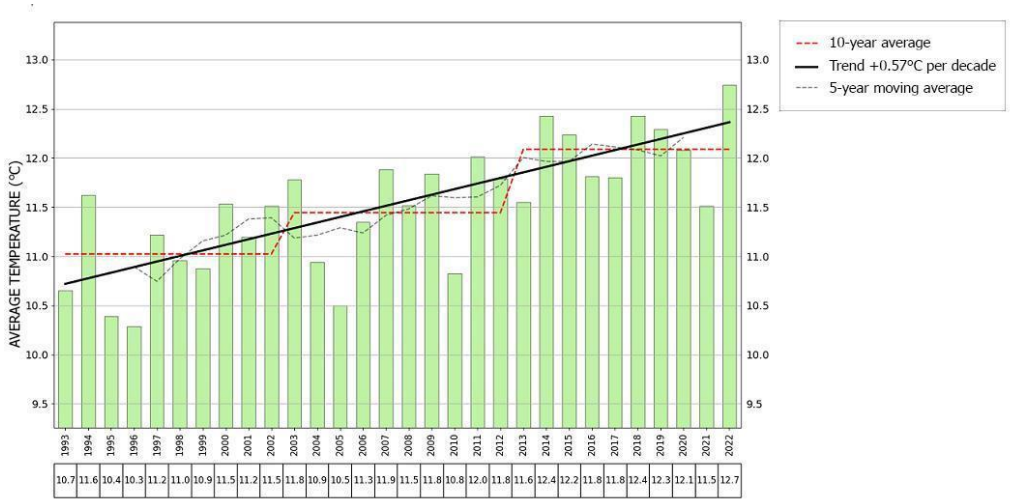

Fig.3 Average temperature in Veneto from 1993 to 2022

Concerning precipitation, if the trend in Veneto in the years from 1955 to 2004 showed a slight downward trend in annual and winter events, an increase in autumn precipitation is reported in the Region, with significant instances of increases over the annual maximum values of short-lived precipitation.
Nonetheless, compared to the temperature and precipitation data, statistics on extreme events are more limited, an intensification of their frequency also emerges in the Venice Lagoon area, in the form of heat waves, increased precipitation intensity, strong winds and tornadoes. About intense rainfall, there is a greater number of events in the 2003-2012 decade than in the 1993-2001 decade (fig. 4) especially for those of short duration, both in terms of increased frequency and intensity (ARPAV, 2022).

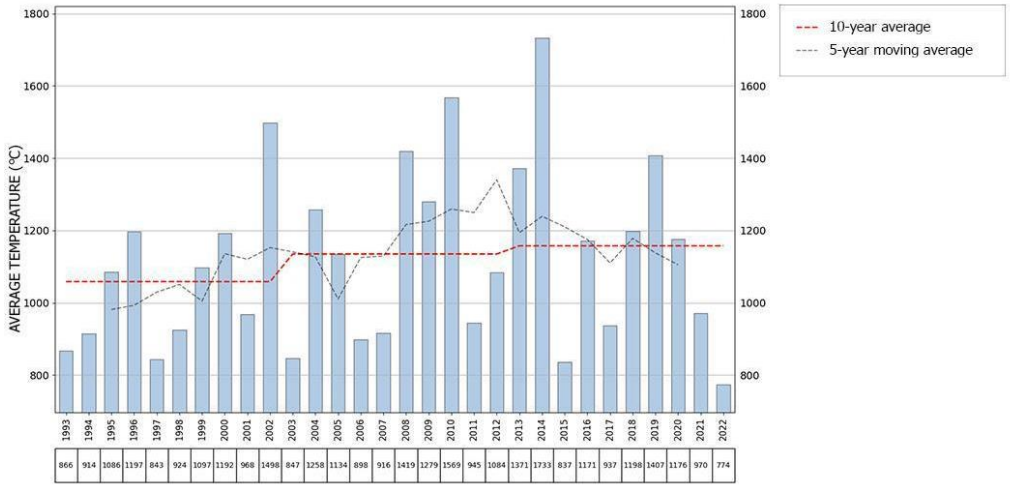

Fig.4 Average rainfall in Veneto from 1993 to 2022

2.3 Stakeholders and governance: involving different actors in the development of adaptation processes

Regarding the aforementioned climate conditions, the analysis of governance, aimed to highlight the sectors, specific tasks and competencies of each municipal structure regarding the issue of climate change and the territorial repercussions it has in environmental, social, economic, and political terms. In addition to institutional governance, an attempt was also made to schematize the system of stakeholders present within the communities, i.e., that complex and extremely diverse multiplicity of stakeholders who are involved and can be involved in the development of adaptation processes (Magni et al., 2021).

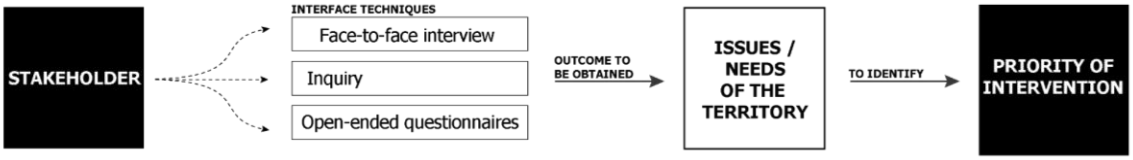

Fig.5 Reconnaissance scheme of interviews to identify problems, needs, and priorities for action

The involvement of stakeholders and other strategic parties had positive effects on the research, as broad cooperation was demonstrated through the availability and expertise of officials and managers from the technical areas of the municipalities themselves. The instrument used during the meetings (fig. 5) was that of the open, discursive interview, characterized by considerable flexibility, which allowed more information to be gleaned, simply by directing the reflections toward insights useful to the study, aimed at highlighting and clarifying the system of relationships, which only partly emerged from the prior stage of stakeholder reconnaissance.

The outcome of the meetings thus allowed for the verification and co-definition of administrative structures (fig. 6), their internal connections, but also the system of external relations, particularly through the referral of locally active stakeholders, such as trade associations and citizens' groups (which only direct knowledge of the territory can allow). In addition, the interviews provided information on:

- perceptions of the Entity for climate change risks;
- existence of norms or measures attributable to adaptation contained in municipal plans already adopted;
- socioeconomic characteristics of the local productive fabric also tying them to the presence of monitoring, carried out following extreme weather situations, to quantify the damage.

2.4 Planning tools and regulatory references: identifying measures already planned for climate change impacts

The first part of the work focused on the analysis of the vulnerabilities of the lagoon, on reconnaissance and study of the Plans in force (PNACC, 2017), to identify any measures already planned for the impacts of climate change and capable of supporting adaptation and mainstreaming measures.

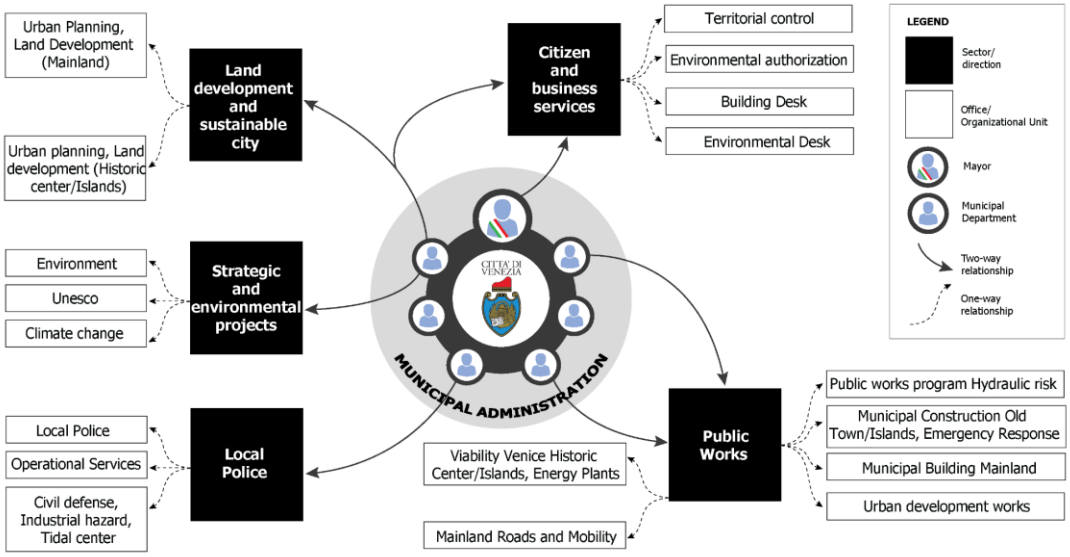

Fig.6 Stakeholder identification scheme. Example related to the Municipality of Venice

Given the inherent complexity of the Venetian context, this phase of the study also included the analysis of the present European regulations and projects, to comprehensively identify the totality of the overall forecasts of the lagoon eaves. It then moved on to a phase of data and information retrieval on environmental-climatic, socio-economic and relational aspects of governance, through various tools, made available by municipal, provincial and regional public administrations, as well as by trade associations, Chamber of Commerce of Venice and Rovigo and other sources, including territorial information systems and geo-portals. At the same time, a review of the scientific literature related to the different types of the most widely used adaptation measures (Laukkonen et al., 2009; Jabareen, 2013; Magni et al., 2019; Maragno et al., 2022) was initiated, preparatory to the drafting of the project framework (including an abacus of actions, measures and policies). The research also focused on the study of existing planning instruments and the regional regulatory environment to gain a systematic and broader understanding of the area's awareness in dealing with the concept of adaptation to Climate Change (Annex 1).

2.5 Spatial vulnerabilities: criticality and perception to understand the main socio-economic and spatial sectors exposed to impacts

The study of environmental and climatic aspects in a territorial context characterized by events of a calamitous nature has been particularly focused on certain impacts, which better than others represent elements of vulnerability and risk. This was carried out to provide information that is fundamental to understanding which major socio-economic and territorial sectors are exposed to impacts.

The cognitive framework on the impacts, vulnerabilities and risks induced by climate change on the Venice lagoon and its metropolitan city to support the initial environmental analyses useful for the definition of the climate change adaptation plan were derived from Research Line 5.2 "Impacts, vulnerabilities and risks induced by climate change". The methodology developed in Research Line 5.2 provided an estimate of the risks induced by the multiple impacts of climate change such as urban flooding (Urban Flooding - UF) and heat waves (Urban Heat Island). By the methodologies proposed by Maragno et al., (2021), the approach proposed in Research Line 5.2 uses a geo-database that integrates a set of morphological-environmental indicators and estimates surface runoff coefficients related to flooding and urban heat island causes.

The territory of the lagoon contermination is particularly fragile and vulnerable to flooding of river bodies (too much water) and droughts (too little water), as shown with a progressive trend in recent years (CMCC, 2021). The study of climate dynamics in recent years, together with the analysis of extreme weather events that have occurred in the territory, confirm the intensification in terms of frequency and intensity, of extreme events of this type (peaks of large amounts of water and almost absolute absence) (ISPRA, 2022; Giuda et al., 2022). Awareness of territorial fragility, manifested by the increase in unaccustomed extreme phenomena, is leading to a radical change of approach in addressing the issue and the multiple impacts on the territory (Fritzsche et al., 2014). The study conducted on urban flooding (UF) phenomena for each municipality was taken into greater consideration based on a common perception of criticality (extreme weather events, flooding, overflows...). In consideration of the analyses performed, and confirmed of the meetings with the municipalities, recent tangible disasters in the studied territories play a decisive role in the perception of the phenomena. For these reasons, special attention was paid to the analysis of the vulnerability of impacts from UF. The phenomenon of urban flooding is the most perceived in the territorial context of the lagoon eaves. The issue of water, as already anticipated, has a twofold characterization: on the one hand the concentrated excess of water, and on the other hand the prolonged absence of water.

Flooding and drought are two sides of the same coin with which Venetian municipalities will increasingly have to interface. The phenomenon of water runoff from urban areas is one of the main issues related to flood risk.

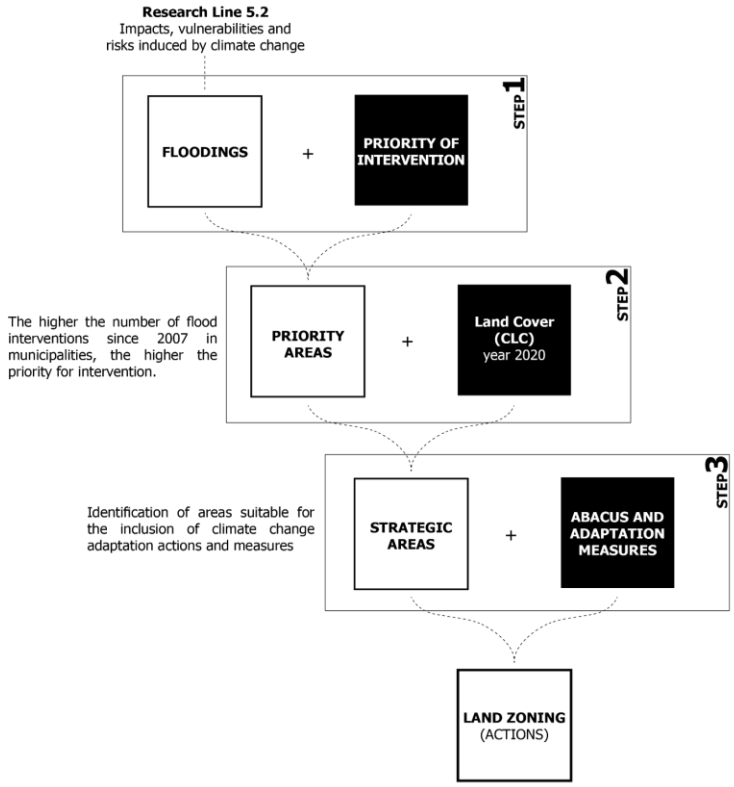

Fig.7 Methodological scheme for identifying areas suitable for the inclusion of climate change adaptation actions and measures

The issues arise from the degree of impermeability, where in natural environments stormwater is washed and filtered slowly to and through the soil, while in urban environments impermeable surfaces promote rapid runoff to receptor bodies (ISPRA, 2014; Arnbjerg-Nielsen et al., 2013). Climate change, therefore, places urban drainage systems in inefficient conditions during extreme weather events, and the problem takes priority as extreme rainfall events are expected to intensify (Lerer et al., 2015).

To reduce urban flooding and protect surface and groundwater quality, runoff must be limited and pollutant loads from urban run-off reduced. This research proposes an analysis of the main shock and stress factors related to flooding phenomena affecting the 11 municipalities of the lagoon eaves.

The study in question was conducted by Research Line 5.2 "Impacts, vulnerabilities and risks induced by climate change", returning to the chronological study of post-event safety interventions. In this sense, the presence of an inherent fragility in the territory is emphasized regardless of the severity of the verified phenomenon. The level of information acquired refers to reports received by the Fire Department since 2007. The information, originally collected in a punctual manner, recording place and date of intervention, was synthesized using a geo-database, through the arrangement of a regular hexagonal mesh with 600 m side. The result shows a count of interventions distributed over each mesh portion.

The territory subject to the greatest vulnerability was divided into classes (5) representing the priority of intervention (fig. 7: step 1). Thus, the result was based on the intervention count distributed over each portion of the mesh about the intervention priority (the higher the number of flood interventions since 2007 in the eave municipalities, the higher the intervention priority). The methodology subsequently used to identify areas suitable for the inclusion of adaptation actions and measures made use of the use of the Land Cover map referring to the year 2020 and in particular to the III level of detail of the same map (fig. 7: step 2).

A macro-class of actions was associated with each level of detail, based on both priority level and soil prerogatives, to obtain the zoning of the territory (fig. 7: step 3).

3. Results

3.1 Identification of adaptation actions and measures about the specific socio-economic and morphological vocations of the territory

The analysis of the Lagoon and the metropolitan city of Venice that occurred in the first part of this work and the delineation of a large-scale cognitive framework made it easier to define adaptation measures for the specific socio-economic and morphological vocations of the territory. Adaptation must necessarily have as its starting point the needs of the territory in which climate change will produce its effects.

The abacus constructed within the project (fig. 8) proposed a series of measures that can be identified and selected according to the specific need required, such as the socio-economic implications or the impact to which it is called to respond. This synoptic framework will be able to facilitate municipal engineers and public administrators in adopting measures that can adapt their territories to the urgency of responding adaptively to the weather and climate changes that are increasingly affecting Venice and its lagoon. The abacus can be interrogated according to the territory's specific needs, as the zoning classification to which the specific measure can be fine-tuned is also present. Other suggestions are also present, such as limitations/benefits that the specific measure presents, whether it is a temporary or fixed measure and even the SDGs to which they respond. These will be able to best direct administrators and technicians in identifying the measures best suited to the needs presented by the territories.

The abacus intends to spatialize the measures identified in a place according to multiple factors, such as socio-economic implications (which include susceptible households, insufficient average disposable income per capita, low housing quality, etc.), impact to which it responds, expected effect, typology (i.e. green, grey, blue or policy-related measures) and characteristic, i.e. whether they are physical or organizational measures.

Socio-economic exposure translates, especially in urban environments, into a decreased capacity to respond and resilience to shock and stress situations. Adaptation, by its very nature, must necessarily refer to the localized needs in the area where climate change will produce its effects, for these reasons, to make it easy to define adaptation measures for the specific vocations and morphologies of each area, specific measures suitable for the local level are identified from the Abacus of Climate Change Adaptation Actions and Measures, to direct municipal technicians to adopt the most suitable measure for the prerogative of the area.

3.2 Spatial declination of adaptation for the Venice Lagoon area: the territorialization of plan measures

Considering the now scientific consensus that adaptation must necessarily refer to the localized needs in the territory where climate change is producing and will produce its effects, to make it easy to define adaptation measures for the specific vocations and morphologies of each area, specific measures suitable for the local level (Salata et al., 2016) were identified by the Abaco, to direct the technicians of the municipalities to adopt the one most suitable for the territorial emergency.

Following the study of adaptation actions and measures, we moved on to the identification of areas suitable for their inclusion, thus constructing specific zoning based on the morphological characteristics of the lagoon eaves and the system of the Metropolitan City of Venice. Adaptation to climate change begins with a city's ability to respond adequately to environmental shocks and stresses (Maragno et al., 2021).

The macro-classes of actions identified are:

- Typology 1: Urban Furniture (Nebulization, Drinking water fountains, Water basins, Water squares);
- Typology 2: Communication and Awareness - being organizational actions, thus interventions that do not involve spatial modifications, no mapping entries were planned - (App development, Early warning systems, Widespread speakers in the City, Promoting meetings on sustainable climate issues, Technical skills development);

- Typology 3: Risk Management (Breakwaters, Groynes, Private floodgates, Protection walls, Upgrading existing water pumps, Raising power packs for water pumps, Lightning guards, Gates to protect against storm surges, Reef reinforcement, Nourishment of emerged and submerged beach);
- Typology 4: Water Management (Permeable portions in areas used for parking, Draining asphalts, Stormwater collection in underground siphon, Stormwater collection in external siphon, Leaky or infiltration wells, Filter trenches, Infiltration and bioretention basins, Detention basins, SuDS in street environment, Construction of buffer strips, Restoration of floodplains);
- Typology 5: Urban Greening (Tree-lined boulevards, Lowland woodlands, Urban gardens, Climatic facade, Depaving, Intensive green roofs, Practicable green roofs, Productive green roofs, Extensive green roofs, Green roofs on canopies, Functional connectivity of ecological networks);
- Typology 6: Coastal Protection (Vegetating dunes, Covering dunes, Screen dunes, Establish marine protected reserves);

Typology 7: Cold Surfaces (Increase albedo of the road surface).

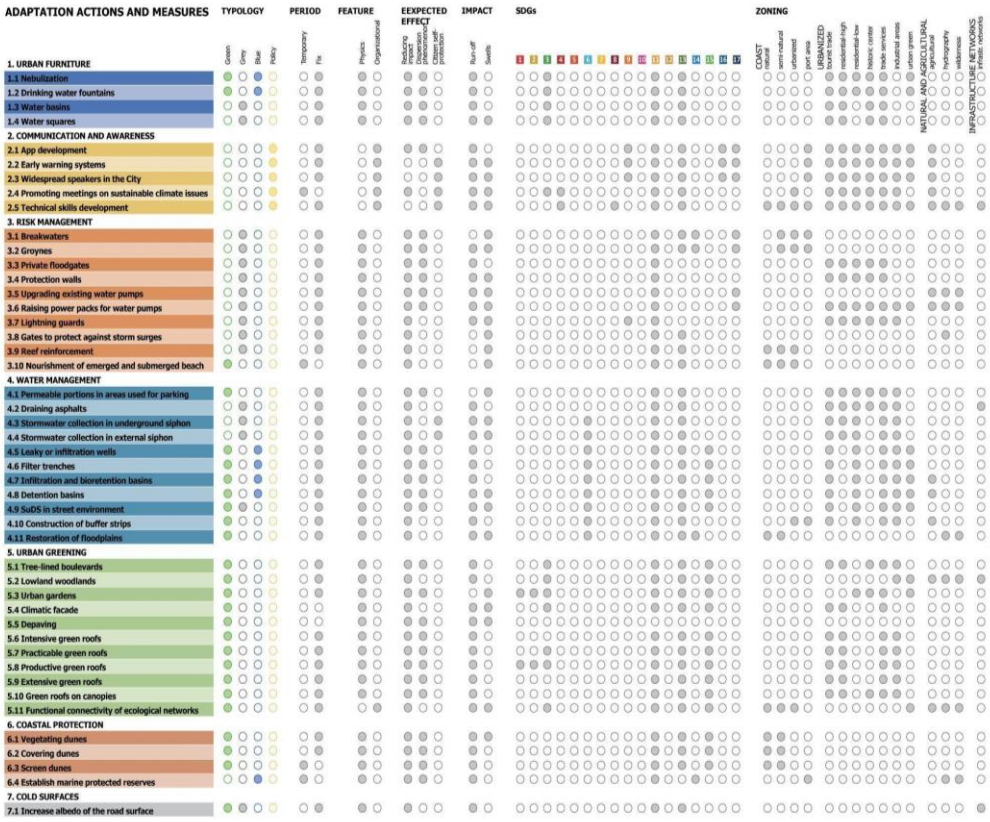

Fig. 8 Summary diagrams of adaptation actions and measures

4. Discussions

The research process that led to the drafting of the Adaptation Plan was moved by a consideration/assumption made explicit from the outset: that urban planning and the dynamics of territorial government must confront the now inevitable consequences due to climate change.

This work inevitably orients in the direction of the quality and improvement of the population's living conditions the change that local governments that insist on and relate to the Venice Lagoon are now called upon to face. The adaptation plan has clearly and directly outlined what the future involvement of urban planning processes will have to be, both of a single local scale and of an integrated system of lagoon matrix, the latter being levels

where land-government initiatives have so far neglected (or left to voluntary and punctual actions) the relationship between climate and land-use planning.

However, the initiatives implemented in recent years, despite confirming a stance by some actors to want to take new paths, have not led to adequate policy responses, both in qualitative (types of tools and policies) and quantitative terms (extension of involvement to the population or the main local and supra-local economic systems). As elucidated in the presented article, the methodology employed in the work serves as a replicable support system for diverse multi-scale and multi-level contexts. Particularly apt for expansive yet fragmented governance environments, this methodology shares the commonality of impacts and underscores the need for a unified framework in integrated management. Furthermore, the actions proposed in section 3.2 are measures strategically designed to seamlessly integrate and update existing urban planning tools.

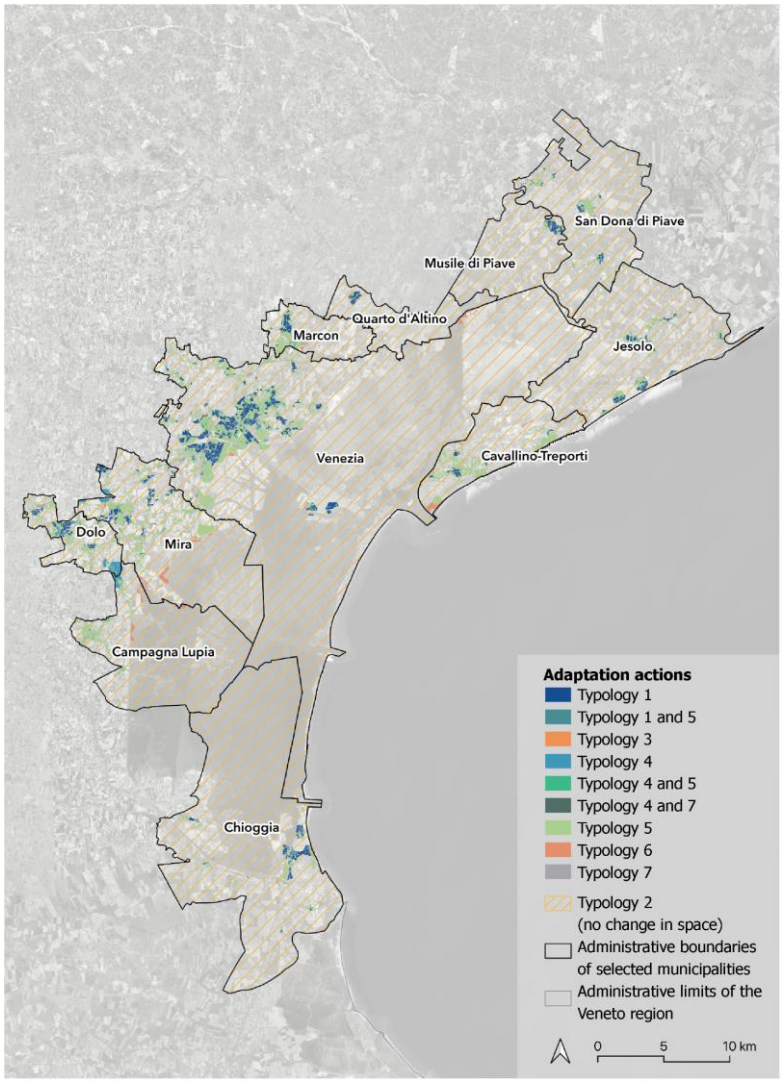

Fig.9 Zoning related to the identification of areas suitable for the inclusion of climate change adaptation actions and measures

Notably, these actions are tailored to prevent overburdening governance structures and eschew the creation of entirely new instruments, fostering a pragmatic and sustainable approach. Among the findings highlighted by this research for the initiatives of the lagoon gutter administrations is certainly the recognition of the need to overcome the specificity of partial planning, exclusively aimed at energy consumption, often without a real relationship to binding urban planning. The main reasons for this can be traced to a lack of public and shared awareness of climate variability and its spatial repercussions, a delayed response to climate disasters due to a lack of capacity and resources, and a lack of public policies and regulations in urban and environmental

planning designed to manage climate change. However, if one casts one's gaze beyond these limitations, one can then recognize the potential that resides within the territory of the Metropolitan City of Venice: the latter, thanks to its broad thematic experience and its increasing role in supporting local climate planning processes, can help reduce the causes of climate change (mitigation) and to effectively protect itself from expected local impacts (adaptation).

5. Conclusions

The Adaptation Plan designed within the Research Pathway "Venice 2021 - Scientific Research Program for a Regulated Lagoon," together with the experiences carried out by the territorial entities that relate at different scales to the Venice Lagoon (Municipal Administrations, Reclamation Consortia, Basin Authorities, Metropolitan City, etc.) provides fertile ground from which to take inspiration to try to outline a roadmap for the future of the lagoon territory, imagining this tool as:

- a catalyst for adaptation mainstreaming processes: for climate change mitigation and adaptation to become structuring and structural development processes for the lagoon territory, they must be incorporated or added to any plan or strategy that the administrations belonging to the lagoon gutter are to equip themselves with or have equipped themselves with in the past, thus making the issue of climate change mainstream within the process of territorial governance. The strategic and operational proposals presented by the plan both for the entire lagoon area and for each local government thus propose new policies and actions that enter an existing framework, sometimes initiating new strands of implementation and, very often, intervening with indications for already existing plans or programs. Consequently, these strategic guidelines serve as a starting point for land-use governing bodies to address and either initiate (in the absence of comprehensive measures) or enhance (in the case of ongoing initiatives) their consideration of climate-related concerns within the dynamics of land-use planning;
- an example of thematic integration and operational interdisciplinarity: these types of plans - remaining in their nature as voluntary instruments - fit into an established context made up of multiple initiatives that touch on the issue of energy and environmental sustainability in a more or less direct way. If these (often also very heterogeneous) processes are carried out independently, they tend to weaken, generating inefficient use of resources within local governments, if not even entering into open conflict (where, for example, overlapping competencies are created). Precisely to avoid such externalities, the Adaptation Plan considers it a priority to coordinate climate initiatives with the framework of other environmental protection strategies/plans that are already in place (energy programs, sustainability programs, etc.), both at the local and macro-regional levels;
- good practice in inter-scalar planning: for the adaptation plan, the issue of scale, both in terms of time (as short- and or long-term planning of actions) but especially in spatial-administrative terms, is one of the aspects to which adequate attention should be paid in the future. If some policies or measures, especially those regarding the technological quality of facilities and buildings, are predominantly a-territorial, urban planning choices regarding land use, density, and mobility systems, key variables for energy efficiency and territorial resilience, cannot be placed indifferently under the control of a single local-level administrative entity. For this reason, the achievement of these objectives in the lagoon context has required during the drafting and will require during future implementation, an approach capable of always maintaining a strong link between scales of intervention, allowing individual local governments to govern their specific emergencies and criticalities, but without losing the strategic coherence and balances guaranteed by the large-scale strategic framework;
- an exercise in methodological and operational coherence: as is the case with any research avenue that sets out to address issues that have only been weakly explored, some findings prove to be acquired, while others need more time and deeper investigation to become an integral part of public discourse and

operational land management processes. New challenges in many cases require new approaches to arrive at new solutions. From the operational landscape and the cognitive heritage investigated within the context of the Venice lagoon, it emerges how the land planning process is certainly enriching its design, lexical, and operational vocabulary. This is an evolution that acts on the continuity of knowledge that has traditionally influenced lagoon governance practices and is now being taken up in innovative ways. It is, therefore, possible to say that the increasingly urgent issues regarding climate change are leading urban and territorial planning to a partial updating of disciplinary apparatuses by taking advantage of opportunities such as the research path "Venice 2021 - Scientific Research Program for a Regulated Lagoon." The originality of the approach used for the formulation of the Adaptation Plan lies precisely in the conversion of environmental risk into an opportunity for the transformation and development of the Vast area. That is, it appears that today's environmental crisis offers an opportunity to take a different point of view, a more attentive and far-sighted look at the processes and related consequences that affect urban and territorial transformations while respecting those balances that make the lagoon "a man's environment".

Through the experiences investigated by the research, in addition to the possibility of expanding the concept of climate planning, it was also possible to critically reflect on the very use of emergency planning and decision-support practices, both for research purposes and for spatial planning practice. Learning from practices means, by inductive process, extrapolating key concepts to reformulate methodological approaches, and recognizing the potential for innovation inherent in these processes.

In conclusion, these theoretical-methodological advances allow them to be used again to direct and support the innovation of other practices, thus qualifying the planning process as circular, flexible, and adaptive.

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Image Sources

Fig.1, Fig.2, Fig.5, Fig.7, Fig.8, Fig.9 processed by authors

Fig.3 and Fig.4: Arpa Veneto 2022;

Fig.6: Dr. Gianmarco di Giustino's elaboration for the Plan drafting process

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