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The Emergency Plan for the use and management of the territory

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THE EMERGENCY PLAN FOR THE USE AND MANAGEMENT OF THE TERRITORY

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The cover image is a photo of the landslide that hit the municipality of Amalfi (Italy) in February 2021.

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Water-related risk reduction in urban development plans

Recommendations for resilient planning practices from a Sicilian case study investigation

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Abstract
The goal to create hazard-resilient communities through sustainable land-use planning requires a fundamental change to the way in which planning is conceptualized and practiced. This implies a deep revision of the operationalizing policy and legislation at local levels and a clearer interpretation of the in-between domain of risk and emergency assessment and management. This study deals with the complex relation existing between land use planning and disaster risk reduction and focuses on water-related risks. It aims to explore and define a set of proposals for increasing the effectiveness of actions taken by local administrations, at the stage of drafting and implementing local land use masterplans, so to enhance all aspects of disaster risk reduction in the planning practice. In particular, novel contents for the local urban masterplans are investigated based on a case study located in eastern Sicily, Italy: considerations concern urban key criticalities analysed within the catchment of the Lavinaio-Platani, the latter being one of the most dangerous stream in the considered area. Although focused on a specific context, the outcomes of this research may be relevant for a wider range of urbanized environments, especially if prone to flooding risk, by providing targeted recommendations and cross-sectoral perspectives to profitably inform innovative masterplans.

Keywords
Land use planning; Urban resilience; Water-related risk reduction.

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1. The in-between topic of risk and spatial planning

1.1 Land-use planning as best practice for disaster-risk-management

Disaster risks from extreme natural hazards or man-made sources, result in a process of "risk accumulation" specific to urban areas, where risk is amplified by human activities (UNDP, 2010). The UNDRR report (2020), published to mark the International Day for Disaster Risk Reduction on October 13, 2020, confirms how extreme weather events – among which floods and storms were the most prevalent - have come to dominate the disaster landscape in the 21st century, with the last twenty years having seen the number of major floods more than doubled and the incidence of storms importantly grown. Risk level can be amplified by inappropriate human behaviors such as negligence, weak or bad land use planning and exposure of human settlement to not recognized hazards (Roy & Ferland, 2015). This is particularly true with regard to water-related hazards and urban flood risks (Zhou et al., 2019; Barredo & Engelen, 2010).

At the city scale, an effective opportunity to build resilience and to mitigate risks is given by urban planning: a discipline which deals with the development and the control of land and the management of spatial configuration and activities within urban areas. Planning practice has always been central to public interests and concerned urban areas as scenarios for future change and as the preferential place to adapt to climate change and to mitigate its impact (La Greca, 2017; Barbarossa, 2017). Urban planners have the responsibility to drive communities through a path of risk reduction, allocating safe land use categories and setting proper development plans, identifying and mapping all kind of risks, supporting preparedness and public participation as well as social acceptance, providing geospatial information, land use regulations control and implementation monitoring. Furthermore, suitable land use planning and development plans were identified as priority actions for risks reduction and to contrast the growing number of natural disasters as well as the related deaths and economic costs. (UNISDR, 2007; UNISDR, 2015).

As matter of fact Land Use Planning (LUP) should be considered itself as a Disaster Risk Reduction tool (UNISDR, 2015) that could be exploited by local authorities and communities to reduce risks due to the capability to increase urban resilience and sustainability (Saunders & Kilvington, 2016).

That is in order to implement policies, guidelines, plans and design standards, oriented to integrate disaster risk reduction actions into land tenure and management practices. Despite this potential, most cities are not devoting adequate efforts to handle risk issues and seem not interested or not enough well prepared for a fully implementation and achievement of climate changes adaptation and mitigation and for the implementation of urban plans based on risk reduction.

Notably in Italy, the planning practice mostly shows a limited awareness of risks issues, mainly expressed through few inadequate measures encompassed in city masterplan provisions, rather than strategic approaches to define planning actions (Galderisi, 2020; Menoni, 2020). There is a gap in understanding how DRR themes can be included in urban plans, policy and legislation and what best practices might look like (Hurlimann et al., 2020). Especially in South Italy, the analysis of how risk issues have been addressed in city masterplans, starting from strategic approaches to land use choices and regulatory issues, makes it clear that DRR themes have been seldom effectively included in urban planning process undertaken by local governments, which have rarely considered the risks reduction issue in their urban policies and land use choices in a proper way (Barbarossa et al., 2018). This outdated approach is mainly the consequence of traditional planning practices that have suffered from poor co-ordination and integration between spatial and sectoral decisions caused by the separation existing in practice between urban development plans and other sectorial plans, both at the regional and local scale (Di Giovanni, 2016). The latter is also due to the Italian planning tools that are hierarchically structured on three levels of plans: regional plans, supra-municipal plans and municipal plans that are implemented by different authorities (regional or local) and could be referred to different categories, such as development plans (regional plans, city masterplans, land use zoning plans,

detailed plans, etc.), regulatory plans (landscape protection plans, etc.), infrastructures plans (transport, energy, telecommunications, etc), risks plans (emergency plans, geomorphological and hydrogeological plans, etc.).

1.2 Municipal emergency plans and urban development plans

In Italy, issues related to risk assessment and management have been primarily addressed by the Emergency Plan, which is the most relevant instrument containing prescriptions and limitations under a comprehensive strategy for emergency regulated by national laws and guidelines.

At the local scale Mayors are identified as the main authorities of Civil Protection and therefore responsible for the implementation of the Municipal Emergency Plans. These plans are issued following the National Civil Protection Department guidelines and rules, which contain the methodology for defining their contents and for the implementation of projects and activities.

In terms of approval procedures and controls, the same plans present some weakness and result in being partially inadequate to cope effectively with risk management.

As a matter of fact, they mainly deal with the immediate response to emergency, without providing wide-ranging strategies or measures or comprehensive approaches to reduce risks and increase the safety level of the territory. On the contrary, through the analysis of singular risk scenarios that may affect the urban environment, the focus of these plans is very often limited to the emergency management and rescue operations (Menoni, 2020). In particular, the Emergency plans define monitoring activities, intervention models, operational procedures, and areas suitable to allocate operative procedures for a correct emergency management (Galderisi et al., 2020). This kind of planning has proven to be useless several times, especially in case of high disastrous events. Many times, although equipped with specific emergency tools, urban areas were not able to properly face and manage extensive impacts.

Moreover, authors such as Pirlone et al. (2020) highlight that the lack of proper connections between Emergency and Land Use Plans makes the emergency management less effective to achieve territorial safety. Indeed, local governments are directly responsible both for urban development plans and emergency plans.

Considering that both plans are implemented by the same planning authority, the emergency plan should share inputs and provisions with the development plan that aims to promote desirable social and environmental outcomes as well as regulate urban and land functions and manage spatial configuration of the city (Neuvel & Van den Brink, 2010). Those functions should be carried out according to the needs of urban development, while safeguarding natural resources and in respect of site-specific features of the territory (geomorphological, hydrogeological, etc.) and above all, taking into account hazard prone areas and their vulnerability characteristics. Both plans should therefore provide synergic planning measures based on the improvement in processes of risk assessment and management, also taking into account sectoral hierarchical plans (seismic, hydrogeological, etc.) at different scales.

For example, focusing on water-related risks, the assessment and management of floods are among the main topics of the (River Basin) Hydrogeological Plans (PAIs), which are sectoral plans addressed to the assessment of hydrogeological hazards and exposure and to the management of resulting risk, approached at the river basin scale. Currently, these plans are basically included and integrated into the Flood Risk Management Plans (FRMPs), which are the result of the Flood Directive (Directive 2007/60/EC). In Italy the maps prepared by the PAIs, used the same, and sometimes more exhaustive, information required by the preliminary flood risk assessment, including the identification of the areas at significant flood risk. Therefore, Flood Hazard and Risk Maps of the FRMPs, enhanced and integrated the contents of the PAIs, according to the national guidelines provided by the Environmental Ministry of Land and Sea, with the input of ISPRA, River Basin Districts and the technical board State-Regions. The Legislative Decree 49/2010 provides for the FRMPs to be prepared as part

of the planning activities of the basin districts and taking into account, among various other aspects, spatial planning and land uses.

1.3 Barriers to an effective integration of DRR actions into urban plans

Unfortunately, the coverage of DRR actions in urban planning and policies, seems to be rather fragmented and disorganized, and often affected by undesirable difficulties associated to data collection, analyses changes of scales, and regulatory issues, or other (Galderisi, 2020). For example, a proper integration of sectorial plans' contents into urban development plans is often affected by typical constraints related to the adjustment of data and results of analyses provided for a larger scale and adapted to the city one, compromising the availability of fundamental information.

In addition, contents of larger scale and sectoral plans could become quickly obsolete due to the long time required by urban development plans' implementation and approval procedures and, above all, for the slowness or inactivity of local administrations in implementing urban plan provisions. At the same time, local short times changes might occur despite minor implementations and land use changes, and this could affect vulnerability exacerbating potential negative.

Other barriers are caused by the fact that urban development plans and emergency plans usually include outcomes coming from different large scale sectorial plans and obtained from different type of hazards investigations. Large-scale plans (supra regional or regional) usually concern a single type of hazard, and rarely assess the possible effects of combined risks (Menoni, 2020). Consequently, those issues are not taken into account also in local plans, whose risk assessment could result largely underestimated.

Finally, large scale sectoral plans, usually provide recommendations and prescriptions about risk reduction but rarely directly impose restrictions on the territory, demanding the regulatory functions to the urban plans, whose planners often meet much difficulties in justifying proper actions and regulatory choices concerning risk mitigation (MacAskill, 2019).

According to Pilone et al. (2016), neither large scale sectoral plans with related legislation, nor local planning tools provide local authorities with adequate means to address high risk situations, especially in cases of incompatibility or coexistence between hazards and urban functions.

All the factors mentioned could potentially undermine contents, scopes and provisions addressed to risk reduction in urban development plans. This matter becomes particularly unfavorable if we consider that municipalities and their planning instruments remain in many cases the only forefront towards the risk management, the prevention and the protection of the population.

To solve these critical issues new integrated approaches for emergency plans and land use plans have been already advocated.

Starting from these considerations, the aim of the present research is to define an effective practical framework for including the risk assessment into urban planning and land use practices and to provide the local government with innovative and specific procedures, design strategies and tools, useful to put in practice an effective DRR approach at the local scale.

In the introduction section above, the paper firstly argued about the complex relation existing between urban and land use planning and disaster risk management, touching upon contents of traditional emergency and sectoral risk management plans and underlining weakness and conflicts of their co-existence and parallel evolution with urban development plans, focusing on water-related risks.

In the following Section n.2, the case study is described along with the methodology used to approach it and results of analyses performed. Section n.3 encloses a broader discussion on the urgent need and related barriers of enabling the Sendai Framework at the local level through land use best practices.

The discussion originates from the case study and the proposed set of potential solutions for the transfer of DRR principles into urban planning and practices. Finally, conclusions are intended to return basic take-home lessons to readers.

2. Novel contents for the local urban Plan: tips for water-related risks reduction from the Sicilian context

2.1 Novel contents for the local urban Plan: tips for water-related risks reduction from the Sicilian context

The Lavinaio – Platani is acknowledged as the most dangerous in the Acireale area, which is located along the east coast of Sicily, fifteen kilometers north of Catania. The stream's natural catchment is about 65 square kilometers with elevation higher than 200 meters on the sea level. The Lavinaio-Platani is about 18 km long and reaches Acireale close to its southern municipal boundary after flowing across rural, urban and peri-urban contexts belonging to several municipalities located on the north - east slopes of Etna mount. The basin is thus a steep and broad area not proportional to the stream hydraulic section at more than one cross sectional area and mostly with regard to its downstream segments in the city of Acireale (Orlando et al., 2014). The watercourse shows different shape configurations with alternation of natural riverbed and artificial open or underground channel cross sections, and flows into the sea passing through one of the small villages built along the coast.

Also known as "the killer" due the several deaths occurred during major damaging floods, the watercourse is mostly classified with the highest hydraulic hazard level by the Sicilian PAI (2018).

Despite the recognized hazardous conditions, local land use plans have never imposed for the flood prone areas clearly stated limitations to the uncontrolled development of farmland nearby to the riverbed, with the result of failing in preventing impacts of flooding occurrence. On the contrary, the process of urban growth characterized by the pervasiveness of the agricultural or fishing activities, which have conditioned for centuries the progressive shaping of the Acireale territory and its local economy, was swiped out by recent processes of low-density urbanization of peri-urban and rural areas speeded up between 1970 and 2000. Urban growth during the last fifty years was governed by inadequate urban plans that did not take into account agricultural land protection and sustainability. These plans produced the new medium and low-density settlements, developed close to the historical villages as well as in rural areas, overwhelming and jeopardizing the fragile rural ecosystem with the loss of landscape values and ecological relevant features.

This unfavorable scenario, has suffered from hydrogeological and hydraulic calamities, very often due to the conflicting compresence of the hydrographic network and the anthropogenic activities.

Both the Civil Protection and the local Civil Engineering Department, which have competences in risk assessment and management at the scale of the entire Province, have repeatedly dealt with the complex challenge of solving the recurring problems of insufficient discharge capacity, local overflows, infrastructure breakdown by means of hydraulic analyses, interventions on the riverbed, engineered channeling and projects for construction of artificial storm-water basins.

Despite the numerous technical interventions, catastrophic events have taken place with dramatic impacts (recently in March 1995, September 2005, October 2006, September 2013), widespread dissatisfaction and indignation of the local community and responsibilities rebounded among politicians, local authority and technical offices representatives. Moreover, the urban development plan currently in force, does not properly consider the hydraulic hazard related to the Lavinaio – Platani. With the exception of the developing constraints for riverbeds, imposed by a national act, the plan does not contemplate any other tool or regulation oriented to cancel or limit the development index for the areas surrounding the stream and prone to flooding. As a consequence, there is no land use provision specifically oriented to risk reduction.

2.2 The case study: a methodological approach

A proper analysis of socio-hydrological territorial dynamics should be extended to the scale of an entire catchment. In fact, strategies for risk management through prevention, protection and preparedness are traditionally assigned to flood risk management plans, which should strategically include also the promotion of sustainable land use practices, nature conservation support and the definitions of all those structural and non-structural measures able to reduce the likelihood of flooding and to prevent from the potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity.
Similarly, considerations on hydrologic systems landscape values are among contents of Landscape Protection Plans, developed at the large scale.
Otherwise, the development of masterplans is inevitably limited to the area delimited by municipality boundaries. Accordingly, the extension of analyses at the scale of the entire catchment is out of the purpose of this study, which rather focus on the municipal masterplan dimension.
The method used to approach the case study is designed in three phases in order to better understand the dynamics and the co-evolution of the coupled human-water system, focusing in particular on the changing relations between hydrological regimes and the urbanization processes.
The first stage corresponds with an analytical phase.
In order to define a precise area for investigations, the stream buffer area of 300 meters as reported in the regional Landscape Protection Plan was considered together with an enlarged buffer zone of 500 meters.
To analyse the likely conflicting elements of the stream-urban features' coexistence, a spatially explicit, GIS-based approach was applied to map the urban growth process, the mobility system and the current land uses next to the water course. Moreover, all needed information derived from the PAI and the (civil protection) emergency plan were considered for a proper definition of the existing risk scenario.
The first analysis qualitatively detects the stream crossing density and the proximity of roadways to the stream bed. The streets' network is the direct consequence of land development and often by far a greater source of sediment to watercourses than all other land-uses combined. A further analysis evaluates the urban growth process in the last decades by examining and comparing historical and up-to-date cartographic sources and by the means of aerial photographs' interpretation. Patches of developed areas have been identified based on six representative time thresholds of urban growth, namely 1924, 1964, 1985, 1999, 2007 and 2014. This preliminary analysis was performed in order to obtain a qualitative indication on the transformations that the urban growth process has determined in land use modifications and soil sealing progress nearby the watercourse, which is likely to result in deeply influencing the catchment's hydrologic response. Finally, land uses analysis was performed by interpretation of aerial photographs, and defining a proper classification system to distinguish natural and man-made features and so the existing landscape patterns along the Lavinaio-Platani. A range of considerations is provided in the following by describing some specific features that have resulted in being characterizing for the considered stream buffer areas. In fact, the second stage of the methodological approach reads into the results of the performed analyses to recognize and classify key criticalities, for which comparable examples have been also depicted out of the Acireale municipality borders, following the Lavinaio-Platani to its source, thus proving their connotative and recurring occurrence along the watercourse. The last stage correlates the identified key criticalities with a number of planning objectives that should inform the planning process for designing an urban development masterplan very much focused on integrating water-related risk reduction guiding principles through better planning choices, land use and zoning decisions and practices.

2.3 The case study: reading out the results

Fig.1 maps the results of the analyses carried out under the first stage. The stream section crossing Acireale flows through different land use patterns, which range from crop fields, citrus grove and sparsely vegetated

areas to commercial-industrial units and medium density continuous residential urban fabrics. Apart from scattered rural buildings and historical centres already existing at the beginning of the twentieth century, the most significant increase in urban development has occurred between the eighties and the early nineties, following unsustainable planning trends which now seem totally foreign to the culture of sustainable development, yet already internationally acknowledged since the nineties.

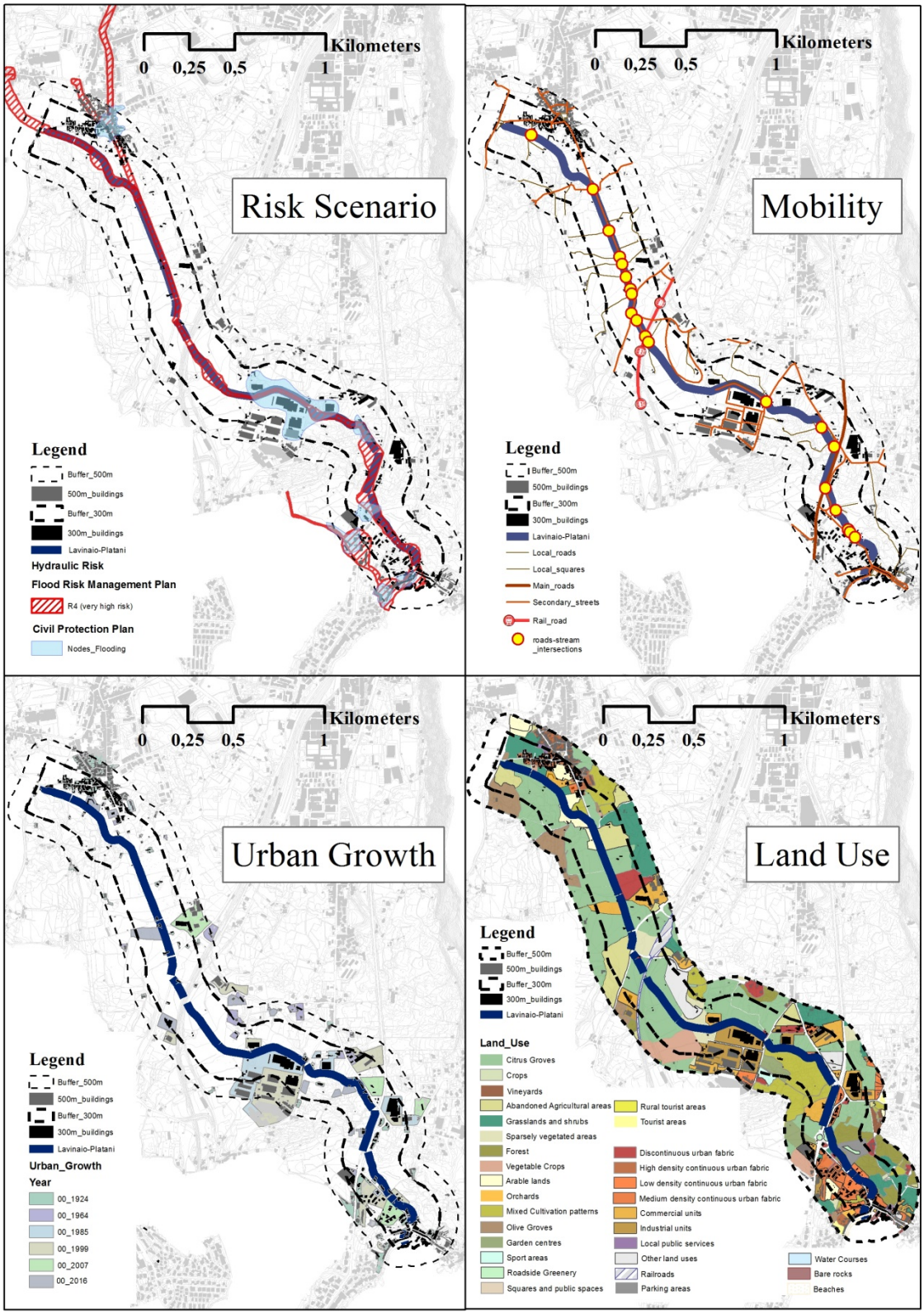

Fig.1 Analyses of "Risk Scenario", "Mobility", "Urban Growth" and "Land Use" next to the Lavinaio-Platani, Acireal

According to the sectoral Risk Management Plans (PAI, 2008; FRMP,2018), a very high level of hydraulic risk outlines the entire section, with some particularly dangerous nodes within the urban areas prone to flooding. Figure 2 presents some other examples of the likely conflicting coexistence of the stream and urban features within the Lavinaio-Platani catchment, upstream of the Acireale municipality.

A first consideration coming out of the two representations is related to "land use practices" that here are intended to include both planned land uses and autonomous usage within the private parcels.

Surprisingly, quite often along the Lavinaio-Platani, from upstream to downstream, a number of new urban micro and macro expansions have progressively grown (Fig.3) and many new buildings close to the riverbed have been built together with floodwalls, constructed close to property boundaries. Moreover, autonomous and not authorized modifications to the stream have been determined by not compatible human uses and activities with the consequence of the original natural floodplain being altered, potentially causing negative impacts on local drainage patterns and the unpredicted transfer of flow rates and volumes in time and space. Over time, localised engineered interventions not supported by a strategic spatial planning approach may have resulted in unpredictable burden caused downstream in terms of soil erosion, higher and more rapid peak discharges and higher runoff volume, the damages to in-stream and streamside habitats as well as co-detriments such as loss of water quality, water resources, amenity and biodiversity.

Fig.2 Examples of potentially conflicting coexistence of the stream and urban features within the Lavinaio-Platani catchment

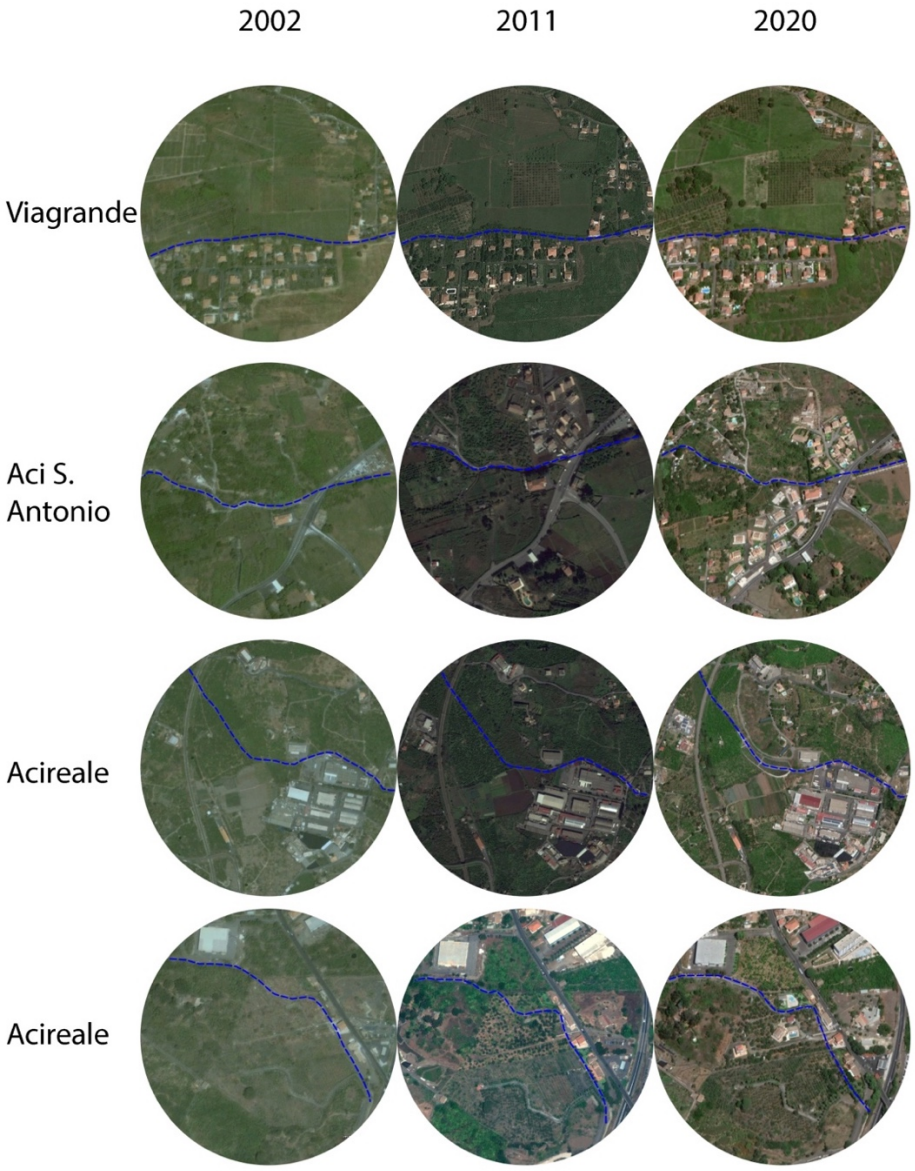

Fig.3 Examples of urban development with land cover modifications within the Lavinaio-Platani catchment

The occurrence of flooding events along the downstream portion of the stream have suggested additional hydraulic work interventions such as those for redirecting the natural stream in an artificially constructed stream bed through channelization, or the recent construction of an important catchement basin in Acireale nearby the railway crossing.

Urbanization processes have been also implicated the development of new local and secondary roads to infrastructure additional urban areas and to serve private properties. These roads have been traced on previous rural paths, which followed the course of the stream and overlapped to the dry riverbed. The numerous intersections between the road system, the private properties' accesses and the water course generate a complex scenario of potential diffused flooding risk. Nowadays, the roads network shapes a disorderly urban pattern, characterized by the loss of ecologic and landscape values, critical nodes of intersection with the stream, paved and altered portions of the bed and modifications of the hydraulic sections. The following categories of key criticalities have been thus identified as especially typifying the case study:

- Conflicting land use practices and urban sprawl;
- Conflicting intersections between the watercourse and the roads network, and in particular: Road/watercourse intersections and stream crossings to access private properties.

Proximity of parallel streambed and roadway or coincidence of streambed and roadway.

The abovementioned points were considered as the reference to set the planning objectives underlying the framework presented in the next section, which is intended as tangible proposal for inspiring better local decisions addressed at the enhancement of the existing conditions, especially in risk prone areas.

3. Novel contents for the local urban Plan: tips for water-related risks reduction from the Sicilian context

3.1 Resilience in practice: setting a framework of potential solutions

The spatial planning and policy transition to alternative storm-water management approach is clearly not yet started.

Indeed, spatial planning trough land use control should be directly related to exposure and vulnerability, but also to water-related hazards, which can be both naturally and anthropogenically driven (White, 2010).

Namely, urban morphology, greenspaces provision and distribution, building and hard infrastructure design, information on flood prone areas and engagement polices of vulnerable groups, do provide rooms for successful risk adaptation (Codemo et al., 2021). At the same time, localized mitigation approaches become possible based on the consideration that water-related hazard depends on rainfall-runoff transformation processes: the interaction between precipitation and surfaces, the latter both natural or manmade, is the key to explore how to lessen the water-related hazard in the city (White, 2010).

Not surprisingly, the green infrastructure (GI) planning and the adoption of Sustainable urban Drainage Systems (SUDS) as components of GI in urban contexts are increasingly being recommended both at the strategic planning level and at the practice stage for addressing a more sustainable management of urban flood risk while providing a wide range of ecosystem benefits (Gimenez-Maranges et al., 2020; Pappalardo and La Rosa, 2020; Alves et al., 2019; Thorne et al., 2018). However, none of current local planning tools refer for example to the use of these nature-based solutions to manage storm-water, or to the principle of hydraulic invariance. The upstream control of runoff volume and flow discharge as well as strategies for collecting and reusing the rainwater, for reducing impervious surfaces, for landscaping and vegetation struggle to enter the urban planning and decision-making domains (O'Donnell et al., 2017).

To partially overcome these limitations, this study presents the framework of Table1, in which risks concerns are integrated with the establishment of new rules, legal restrictions and alternatives ways for using land rights on hazard prone areas and/or in vulnerable and exposed settlements, in order to make settlements more resilient.

The framework provides, for the local urban development plan, site-specific solutions and tailored recommendations to private developers for existing and developing urban built areas to specifically address the issues aroused from the analysis of the case study, starting from the definition of planning objectives that could easily apply to similar contexts and are inspired by common acknowledged risk reduction guiding principles.To solve issues caused by the conflicting land use practices and urban sprawl as well as by conflicting intersections between the watercourse and the road network, thus defining new land uses and compatible transformations procedures according to each identified risk-based buffer zone, urban planners should be supported by the contemporary acquisition of both knowledge and public consensus, which together allow to embrace and justify a new and effective DRR zoning approach.

Clearly, the proposed framework cannot be considered comprehensive nor exhaustive of solutions for planners and interested local stakeholders, especially considering the complexity of urban issues concerning the water-related risk management and specificities of urban contexts. Forasmuch as the determination of normative rules and the consequent prohibition or land use modification may result in influencing the catchment hydrologic response in depth.

	Guiding Principles	Integrate sectoral and emergency plans into master plans	Start from guidelines and provisions of the FRMPs/PAIs and the Emergency Plans, to outline enlarging buffers by the stream axis	
		Detail the risk scenarios at the local scale	Advocate for stakeholders and experts involvement to provide risk assessment studies, hydraulic simulations and contextual evaluations of flood prone areas, urban land uses and morphologies at the local scale	
		Overcome traditional zoning in favour of risk-based zoning	Define new land use and compatible transformations procedures under a DRR approach and according to rules and restrictions coming from sectoral planning tools and results of risk scenario modelling	
Key criticalities	**Planning objectives**	**Recommendations**	**Expected results**	
Conflicting land use practices and urban sprawl	Nullify the sprawl in peri-urban and rural areas	-Apply the transfer of development rights mechanism according to risk-based zoning and land use/urban development susceptivity; -Issue specific "risk permission" for every planned urban transformation to be granted on the base of detailed hydraulic certification.	-Reduction of soil sealing and land cover modifications within the stream basin; -Diminution of human and goods exposition to hazardous events, with lower demand for hydraulic works and man-made alteration of the natural water course, due to rainfall shifting; -Public consensus and support due to developers financial compensation.	Developing areas
	Increase the resilience to flood risk	**In high-risk areas**: *Regulations* -Deny the issuance of new development rights; -Allow only ordinary and extraordinary maintenance activity under the condition of partial parcel de-sealing -Prohibit procedures for building amnesty. *Incentives* -Monetary and non-directly-monetary incentives to implement nature-based solutions with particular focus on sustainable urban drainage measures; -relocation zoning plan. **In lower risk areas:** *Regulations* -Deny the issuance of new development rights; -Ordinary and extraordinary maintenance activity allowed under the condition of partial parcel de-sealing -Procedures for building amnesty under condition of flood-proofing. *Incentives* -Monetary and non-directly-monetary incentives to implement nature-based solutions with particular focus on sustainable urban drainage measures.	-Induce the progressive transition towards conditions as much similar as the pre-development ones; -Provide a range of mechanisms according to risk levels encompassing alternatives from minimum single-owner actions to highly efficient multi-owners operations; -Create basic conditions for an extensive stream bed re-naturalization.	Existing areas

Conflicting intersections between the watercourse and the road network	Increase the resilience to flood risk	**In high-risk areas**: *Regulations* -Impede vehicular fruition conflicting with water flows **In lower risk areas:** *Incentives* -Provide an alternative to the existing road network, considering monetary and non-directly-monetary incentives, different form the traditional compensation for expropriation, for those private owners whose parcels would be potentially affected by the proposed mobility plan	-Diminution of human and goods exposition to hazardous events	Existing areas

Tab.1 Tailored recommendations to private developers for existing and developing urban built areas

Many limits could potentially hinder a proper land policy formulation, encompassing legal and technical barriers related to the implementation of the local urban development plan and zoning. For example, the difficulties in regulating existing built areas and in creating favourable conditions for encouraging retrofitting of private properties by eliciting landowners' willingness to pay for devoting a portion of their property to a green infrastructure measure (Pappalardo and La Rosa, 2020).

Moreover, best practices addressed to land safeguard and protection are challenged by the lack of political will, which is greatly influenced by the search for social acceptability, traditionally linked to the defence of the bundle of property rights.

Furthermore, in order to positively and properly impact, proposed regulations and incentives should be part of a scrupulous process through which the general compliance and consistency among other already existing regulations, ordinances and codes with regard to the whole aspect of municipalities assets must be verified. In this way, it is easier for developers to meet multiple requirements all together. In addition, this codes review process must rely on a sound coordination among the various departments involved in development permitting and could be easily nullified by the inertia of local interested stakeholders.

Most importantly, local planning needs legislative support from the institutional context and the normative and regulatory system.

3.2 The need of a risk-based approach in land use planning in Sicily: opportunities and barriers

Up till now, the local and regional planning laws in Sicily, have not paid a relevant attention to the risk issues. As a consequence, the planning practice did not take into account and include strategies oriented to DRR, both at the regional and local scale.

The only actions imposed by regionals act were related to restraints on new development in hazard prone areas based on sectorial plans such as PAIs or FRMPs, issued at the scale of the river basins.

A little step forward was done in June 2020, when the Regional Government enacted a new planning law, with the aim to overcome the 40 years old existing law in favour of a new act all-encompassing latest challenges of the contemporary planning practice.

Among the main principles, the control on a fully match between urban transformations and risk reduction, is recommended both for local and regional planning practices through a set of measures and actions that should be necessarily included in plans.

In particular, at the regional scale, the Metropolitan Plans should define a set of analyses concerning land transformations, taking into account natural risks such as volcanic, seismic, hydrogeological etc., and should provide measures oriented towards coping with risk prevention. In particular, the hazard prone areas must be identified, classified and mapped, using survey and data from Regional and local Authorities.

Likewise, city masterplans should identify hazard prone areas and buildings, specifying the different instruments and tools for risk mitigation. In this case, it is mandatory to prepare preliminary studies concerning geologic, hydrogeological and geomorphological issues, on the base of PAIs and FRMPs plans.
Concerning land use choices, the law provides planning tools and land use categories specifically related to risks management, such as urban regeneration practices oriented to risk reduction, and the total protection of vulnerable farmland.
In addition, the law includes for the plan the possibility to provide volume incentives, to transfer development right policies and to reduce taxes, in response to planning actions carried out by private landowners.
According to the new law's contents related to risk assessments, and in the light of the presented practical framework, the planning practice should definitively enhance the prevention culture as well as an administrative awareness concerning the risk issues under the DRR approach, in order to envisage new planning processes fully oriented to integrate land use plans with emergency ones.

4. Conclusions

Several researches assess the escalation in severity and frequency of climate driven hazards as consequences of climate change (IPCC, 2014, Banholzer et al., 2014), while others analyze and discuss the role of the anthropogenic factors, such as unplanned expansion of cities to accommodate rapid population growth, combined with inappropriate land-use planning and the lack in regulation of building standards, in determining the increase of risks levels for urban population (Gill & Malamud, 2017, Fidelis & Rodriguez, 2019). Despite full disciplinary awareness on the huge potential of cities for influencing improvements in the risk management, the issue of hazard prone areas is often not properly addressed in the planning practice. (King et al., 2016).
Due to the well know conditions of fragility of territories, there is an immediate need to adopt and put in practice a new integrated approach for urban planning and risk mitigation, with the aim to implement successful measures and actions based on site-specific risk reduction policies.
According to this emerging instance, this contribution has defined a set of proposals for increasing the effectiveness of actions taken by local administrations, at the stage of drafting and implementing local urban development plans.
The real challenge is thus to transform the risks in opportunity through the transition from emergency plans to new land use plans oriented to risk reduction (Sargolini, 2020). Many criticisms still burden local emergency plans, which may turn out to be too limited, to provide temporary buffer solutions, and cannot deal with the complexity of a comprehensive territorial vision nor have effects on the risk sources (Pilone et al., 2016).
Changing the old-fashioned established attitude that has generally characterized both those plans, means to abandon the actual partial vision borrowed from traditional disaster management, in favour of new comprehensive strategies and complex actions oriented to enhance risk reductions through the provision of specific land use categories and innovative planning tools for hazard prone areas.
Those provisions should be identified according to planning policies and related land use plans. Furthermore, the necessary integration can be achieved through a deep revision of management models and processes of both plans (Menoni, 2020).
The discussion opened up on the case study clearly shows how land use planning and practices may help in preventing future water-related risks. In particular, urban development plans can be profitably informed through targeted recommendation and inspired by cross-sectoral perspectives concerning land use and water protection, like reducing soil sealing, preserving river basins and enhancing water retention with nature-based solutions. The traditional approach related to land restriction has to be overcome by means of the development of integrated plans, in favour of the definition of more creative strategies. The latter, although unpopular, can effectively readdress mitigation principles towards new primacy objectives related to land protection, public interest and safety of citizens. It is also necessary to enhance the institutional and administrative culture of

risk reduction in terms of skills and awareness, in order to fully integrate risk reduction policies with other political choices related to the regional and city planning government, making the risk issue non-negotiable.
This paper, by approaching an emblematic case study for investigating the complex relation existing between urban and land use planning and water-related risk management, would also like to suggest some conclusions as take-home-lessons on which further researches need to be opened and conducted.

- Riverine flood risk in urbanizing watersheds evolves according to land use projections and impacts on the entire floodplain extent. There is a limited understanding of floodplain sensitivity to increases in overland runoff rates and volumes, since topographic factors, stream characteristics, and the presence of existing flood infrastructure influence the ability of a watershed to accommodate (Gori et al., 2019);
- It is important to re-define the weight of the technology, particularly the domain of hydraulic engineering, in shaping the future dynamics of the catchment. Few authors explore the influence of existing and planned hydraulic works, in mutual interaction with social responses and environmental processes, on the development of the entire territorial system over time and discuss options to realign unsustainable pathways with more desirable ones (van Staveren and van Tatenhove, 2016);
- No consideration of site-scale development policies, land use modifications, historical transformation of transport networks as well as of settlements models hinders the gain of a comprehensive knowledge on urban risk, which would allow to understand more on causes without limiting the concern to the visible effects of the damage during an emergency phase;
- Pursuing resilient urban development and design passes through a policy of careful decision making and land use planning, both informed by the knowledge gained on current and future risk scenarios, including the understanding of hazard, exposure and vulnerability of urban areas and how they combine when talking about water-related risks;
- While sectoral plans are important to prevent, limit and forbid, the alternatives in zoning, land use transformations and urban spaces configuration are intrinsic to the local development plan realm. Accordingly, despite being compulsory adopted by the masterplan, all safeguard/hydrologic/land use restrictions defined at the regional/basin scale should be understood such the necessary conditions, yet not the sufficient, to manage urban transformation at the local scale;
- New integrated plans should include general information about the main characteristics of the territory or the urban settlements interested by planning actions. They should be created through a considerable survey campaign, at the local scale, oriented to build a detailed analysis including risk scenario modelling and considering the combination of different types of hazards and vulnerability conditions (Barbarossa et al., 2020). They should set effective tools that, on the basis of an exhaustive and in-depth multi-risk analysis could be able to provide not only indications, but also a range of mechanisms for interventions and appropriate planning rules in the most vulnerable and exposed areas. In particular, plans should be able to categorize the main risks of the territory, highlighting where possible interactions between the hazards, and land use transformations, can provoke risk for population, structures and environmental and cultural heritage. City masterplans should also indicate the prevailing situations that require an immediate intervention to avoid serious damages and define proper tools intervention based on singular vulnerability;
- The masterplan must add creative and tailored solutions based on site-specific urban and environmental constraints as well as potentialities that might finally keep the local spatial planning stuck in its responsibilities towards the safe and resilient city target. Understanding potential effects of the act of planning, not only in altering property and tenure rights but foremost in affecting water-related risks, remains a crucial issue (Pappalardo et al., 2017).

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Image Sources

Fig.1: Authors (Data sources used for the analyses: "Risk Scenario" - Piano Comunale Protezione Civile, Città di Acireale; Aggiornamento del Piano Stralcio di Bacino per l'Assetto Idrogeologico (P.A.I.) - Carta del rischio idraulico per fenomeni di esondazione, Comuni di Aci Castello e Acireale; "Mobility" – orthoimages ATA, year 2007-2008 – Google Earth images; "Urban Growth" – IGM Italian Geographic Military Institute cartography, year 1924 - orthoimages STR, year 1964 – CTR sicilian Regional Technical Cartography, years 1985/1999/2007 - orthoimages ATA, year 2007-2008 - Google Earth images; "Land Use" – orthoimages ATA, year 2007-2008 – Google Earth images)

Fig.2: Authors (base maps: Google Earth)

Fig.3: Authors (base maps: Google Earth)

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