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**Strategies and Actions to Recover the Landscape after Flooding: The Case of Vernazza in the Cinque Terre National Park (Italy)**

by Rosalba D'Onofrio and Elio Trusiani  
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# Strategies and Actions to Recover the Landscape after Flooding: The Case of Vernazza in the Cinque Terre National Park (Italy)

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**Abstract:** European territories are fragile places in which landslides and flooding have occurred with a high frequency in recent decades, risking the safety of settlements and people and the integrity of the landscape. In many cases, recourse has been made to geotechnical and hydraulic interventions that have been rather non-uniform and partial and which, in prestigious areas, have made intervention after the fact problematic in recovering/mitigating what was done with extreme urgency. This paper reports on theoretical/applied research that implements methodological, multi-system experimentation and interdisciplinary skills for a project to recover the landscape within the Cinque Terre National Park (World Heritage Site, Italy). This recovery is capable of responding to the demand for protection, conservation, transformation and management of this cultural landscape par excellence. The methodological approach, the results of the research and the planning solutions span two scales—territorial and local—thereby highlighting the need for an approach to both micro- and macro-scale knowledge of the cultural landscape system to understand its structure and elements and to intervene with the proper planning sensitivity. Guidelines, masterplans and profiles of the types of intervention constitute the large- and small-scale results of the research, translating the strategies of the guidelines into planning actions.

**Keywords:** World Heritage Site; climate change; cultural landscape; risk and flood; guidelines and design; Cinque Terre National Park; rural landscape

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## 1. Introduction

A conference was held in May 2017 entitled "La Cultura da salvare: beni culturali e rischi naturali. La Mappa e il Piano nazionale degli interventi" The Culture to Save: cultural goods and natural risks. The national map of and plan for interventions. In it, the structure of the Presidency of the Council's "Italia Sicura" (Secure Italy) Mission against hydrogeological instability noted some impressive data for a country that holds the world record in cultural goods (51 World Heritage Sites of United Nations Educational, Scientific and Cultural Organization—UNESCO—and more than 200,000 architectural and archaeological goods and monuments, 3400 museums and about 2000 archaeological areas and sites). There are 40,393 cultural goods at risk of flooding in Italy and another 38,829 at risk of landslides, of which 10,909 are classified with a high and very high level of danger. In addition to the goods in the large cities (more than 3000 in Rome and nearly 1300 in Florence), dozens of towns are affected by the serious phenomenon of instability (Civita di Bagnoregio, Volterra, Pienza, Rupe di San Leo, etc.). Many territories have a widespread presence of goods, including those that are well-known (La Valle dei Templi, in Agrigento; the Cinque Terre National Park; the Amalfi Coast) and lesser known (Roccascalegna) [1]. Through the "Italia Sicura" National Plan, the Italian state aims to prepare a large endeavour to prevent hydrogeological instabilities and mitigate the risk to cultural goods, with about

10,000 works expected, of which about 1300 are already underway. All of these interventions should be inspired by the “Linee Guida per le attività di programmazione e progettazione degli interventi per il contrasto del rischio idrogeologico” (Guidelines for planning and designing interventions to counter hydrogeological risks) [2]. The guidelines are aimed to provide operational indications when planning interventions and to open interaction between technicians and the Regions, considering the territorial context and the economic and social sustainability of the interventions. This approach, which is very focused on the multi-functional nature and quality of the interventions, risks being ineffective if it does not address all the natural and anthropic elements that come together to define the conditions for risk and to prefigure the different mitigation strategies. As highlighted by Roberto Gambino [3], when choosing interventions to perform on the territory, the different problems (hydraulics, hydrogeology, ecology and landscape, economy, production, society and culture) should be considered contextually, with inclusive reasoning that foresees recourse not only to regulatory actions but also activities that stimulate, promote and direct the interventions. It is also necessary to prevent the fragmentary nature of proposed and/or completed risk-mitigation interventions. While at a good level, in their implementation, the interventions have often taken for granted the limitation of being too narrow with respect to factors of very significant, extended pressure [4]. In other cases, and not only in Italy, moves to prevent hydrogeological risk have been concentrated instead on securing territories through interventions that are too invasive, such as canal systems, levees, dams, or detention basins. The consequences of this form of intervention include the inevitable impoverishment of the ecosystem, the ceaseless increase in management costs, periodic maintenance and substitution and the risk that this increasingly artificialized environmental and landscape system will collapse [5]. In choosing an intervention to counteract and manage the risk, the question of the culture and the landscape is not at all marginal. This is particularly current in territories where there is a consistent presence of cultural and landscape goods, where the balance between the different systems (environmental, cultural, socio-economic) are more fragile and complex. Hardly ever in situations of hydrogeological instability is it, for example, only the waterway that causes problems, even in conjunction with extreme phenomena due to climate change. It is often a combination of factors whereby the causes of environmental and landscape disasters result in deforestation, thinning of vegetation along the slopes, the abandonment of agricultural lands, and, obviously, the wild covering of land in concrete. In the 2014 National Conference on hydrogeological risk, it emerged, for example, that 28% of the land used for agriculture was lost between the beginning of the 1970s and 2010. As well, it was shown how the abandonment of open spaces is a phenomenon that heavily and cumulatively affects flooding and landslide risks, the loss of biodiversity and the landscape. This is seen in the Region of Liguria, in which 60% of the territory is at risk of landslides, one of the highest percentages among Italian regions [6]. In this region, the abandonment of agricultural cultivation has notably increased the instability of the land, provoking repeated environmental catastrophes over time with very serious damage to people, cities and the landscape. One area particularly affected by these phenomena is the Cinque Terre National Park, a World Heritage Site, along with the town of Vernazza (Figures 1–3). In the area of Vernazza, the characteristic agricultural terracing has experienced progressive abandonment since the end of the Second World War. At first, the terraces were left uncultivated and then the least accessible areas were abandoned definitively. These were generally located at the tops of the slopes or where the inclination was very steep, such as along the coastal sector. Then it was the turn of the zones with less favourable exposure followed by those farthest from the inhabited centres and from vehicle-accessible streets. The territory then began a process of degradation and widespread hydrogeological instability. In place of terraces that were no longer cultivated, secondary succession of plant life occurred, with primarily Mediterranean *macchia*. Contrary to what one would think, the uncontrolled increase in forested areas and inattentive renaturalization—to the detriment of ancient arrangements that saw the presence of containment walls in dry stone, old practicability and hydraulic works—represents particularly critical situations.

As hoped for from the project “Terre d’Acqua-Metodologie di progettazione per interventi di riqualificazione e di restauro paesaggistico in aree a rischio per fenomeni di dissesto idrogeologico” (Water lands–Design methodologies for interventions to rehabilitate and restore the landscape in areas at risk of hydrogeological instabilities), it is necessary to implement a policy for the territory and landscape restoration aimed at new growth in the use of the territory and in defensive works [7].



**Figure 1.** Vernazza in the Cinque Terre territory and the UNESCO site (outlined in green).



**Figure 2.** View of Vernazza from the terraces and the main road.

In this sense, restoration and conservation grow in importance, not only in a landscape key but also in a functional key, of the historical/traditional works for systematization. It is telling that the “state of conservation” section in the proposal for registration as a UNESCO Heritage site for Portovenere, Cinque Terre and the islands (Palmaria, Tino and Tinetto) states that it is “[ . . . ] unthinkable to abandon terracing to itself, since the terraces are the expression of experienced architecture with a monumental character, an exclusive sign of the material culture of the people that produced it.” Various experiences evidence how managing the flooding risk means going from undifferentiated defence of floodable spaces to a territorial project based on recognizing different existing relationships between floods and the territorial context and on the definition of new landscape structures [8]. This step is also inspired by the same EU Floods Directive that encourages national governments to adopt prevention measures based above all on reducing the vulnerability of anthropic structures [9]. In an attempt to develop this aspect, the urban-planning discipline and the discipline of design assume the responsibility of contributing to preventing damage and increasing the resilience of the landscape—meant as the capacity to absorb the modifications made by calamitous events [10]. At the same time, the need for a pragmatic attitude emphasizes active policies rather than the reactive policies that emerge after a catastrophic event. This constitutes a good warning for interventions established by the “Italia Sicura” National Plan. The interventions cannot be limited to mitigating each work for defence or to prevent

hydrogeological risk but it is necessary to design the defensive work so it can become a generator of the landscape. Therefore, policies to reduce impacts are not enough. Actions aimed at the overall renovation of the landscape are required, intended as resulting from the multiple processes that occur between components and processes, both environmental and anthropic. This approach requires a vision of the whole, integrated with the project, which foresees: (a) in a preliminary and priority way, the analysis of the landscape system, the characteristics and criticalities that characterize it on different scales. It is from this fundamental exploratory activity that the means of intervention useful to improving the background conditions on the level of the system can be triggered, profiting from the new infrastructure defensive works; (b) activation of a project-construction process, which, in light of the environmental and landscape objectives defined in the preliminary phase, can determine the necessary interventions for mitigation and compensation. The process is composed of an organic system of: criteria, guidelines, good practices for mitigation and compensatory interventions and maintenance and management practices that pursue the landscape, ecological, environmental and socio-economic efficiency of the planned interventions.



**Figure 3.** The settlement along the Vernazzola stream and the hillside terraces.

The results of the applied research “Studio di massima per il recupero paesaggistico ambientale del tratto periurbano del Torrente Vernazzola” (Principle study to recover the environmental landscape of the peri-urban tract of the Vernazzola stream) are the object of the present text. This project originates in the drafting of the convention between the secretariat (former regional director) for Cultural and Landscape Goods of Liguria and the School of Architecture and Design “E. Vittoria” (SAD) at the University of Camerino, with Principal investigator E. Trusiani and Technical coordinator R. D’Onofrio. It aims to identify guidelines to define the principles of, and indications for, the landscape recovery and mitigation of completed or expected works to secure the Vernazza stream. The territory under study is found within the Cinque Terre National Park, in the Region of Liguria and is a UNESCO Heritage Site. In 2011, this area was affected by a dramatic weather event characterized by prolonged heavy precipitation. It is estimated that the precipitation, with peaks above 140 mm/h, measured up to 500 mm in little more than 8 h, causing enormous material damage and claiming several victims. More than 2 million cubic meters of debris buried the main road of the town in nearly 3 m of material; 580 people were evacuated by sea; 3 victims were counted and the landscape was destroyed.

## 2. Materials and Methods

The reasoning and means of approach specified in the introduction form the basis for the analysis related to the first part of the study to recover the landscape of the Vernazzola stream. Primary importance was given to reading and understanding the landscape in which the waterway is inscribed, both from a merely landscape—and therefore morphological, historical and natural perspective—and from the engineering point of view. The methodological approach adopted is multi-system in nature, which allows an integrated reading of the different structural components to be made, highlighting the existing relationships for integrated design and management of the cultural and landscape heritage. The methodological approach adopted is therefore a reading via “systems.” In fact, a systemic

approach that shows the existing correlations and interrelationships among the various elements of the system is deemed to be more in agreement with the study of landscape planning. Understanding the landscape system of Vernazza means identifying the systems underlying its structure and the multiple relationships that govern and modify it. The knowledge is obtained through a course of interpretation and an interdisciplinary methodological approach capable of providing the basis for a critical understanding of the territory. This is substantially the first moment in the analytical design process and, in its innumerable facets, constitutes knowledge and design at the same time. Reading the territory therefore means reading its structural, anthropic, natural, historical/cultural and landscape elements, which have contributed to its formation and transformation through a process of historical stratification in which human and natural action are integrated, overlap and sometimes interfere with each other.

It seems evident how the method adopted requires a vision of the whole that is integrated with the project, essentially foreseeing two phases. The first, in a preliminary, priority way, is the analysis of the landscape system, its characteristics and criticalities, which characterize the different scales. It is, in fact, from this basic exploratory activity that interventions useful to improving the background conditions on the system level can be initiated, profiting from the new infrastructural defensive works.

The second phase regards the activation of a project-construction process, which, in light of the environmental and landscape objectives defined in the preliminary phase, can determine the necessary interventions for mitigation and compensation. The process is composed of an organic system of criteria, guidelines, good practices for mitigation and compensatory interventions and maintenance and management practices that pursue the landscape, ecological, environmental and socioeconomic efficiency of the planned interventions. Therefore, the landscape was read on the territorial scale, starting from the geomorphological and structural characteristics and followed by coverage and land use, in relation to each other. After this initial evaluation, intended as an all-encompassing synthetic reading, it was deemed necessary to expand on the elements that compose the landscape itself, reading the reciprocal connections and relationships. This allowed the structure of the landscape to be identified: the strong signs characterizing the territory on the morphological, hydrographical and anthropic levels, read on the various scales of investigation.

All the other elements that compose and define the landscape are added hierarchically to these signs, which allows some landscape areas that are uniform in form and character to be defined objectively. A detailed description, interpretation and assessment of these elements allowed the landscape resources to be gathered on the different scales of investigation. The analytical process began in the field by recognizing, through direct inspection, the first impressions and considerations. These were reported in appropriate themed maps in which technical/scientific knowledge joins the results of field surveys. Specifically, the salient elements of the cultural landscape, the object of study, were encompassed in the considerations reported below and were divided into the thematic maps that follow.

### *2.1. Reading the Physical, Geomorphological and Botanical Characteristics*

By reading a vast area, the study is aimed at the main physical aspects of the territory, related to its geology and geomorphology. The primary aspect is a narrow coastal band, on which the town of Vernazza rises, immediately interrupted by background geographical features characterized by strong acclivity and altitudes that reach 700 m above sea level. The hydrographic network is characterized by mountain streams pertaining to the Vernazzola River basin, which flows primarily NE-SW, with steep slopes and recessed valley floors set in rock. Information related to the morphology of the territory was investigated and integrated with specifics on the land coverage from the agricultural and botanical point of view. The two aspects are closely connected. In terms of the substrate, acclivity and exposure, the geomorphology determines the type of natural and cultivated vegetation. Agricultural techniques are also strongly influenced by the morphology of the terrain. In this sense, one sees the typical use of terracing that allows even the steepest slopes to be cultivated. The cultivation of grapevines and olive

trees prevails, even mixed together; numerous areas are occupied by the same cultivation, in a state of abandonment. Among the natural vegetation, the conifer forest prevails, extending mainly to the south of the Vernazzola stream, with xerophyte- and mesophyte-covered areas. This is mainly secondary vegetation in different phases of succession. At some points, the vegetation is still bushy, while in other areas it has reached a greater level of complexity, with the formation of secondary consolidated forests.

Nature is mostly represented by the Mediterranean evergreen, high macchia forest, among which the following are revived:

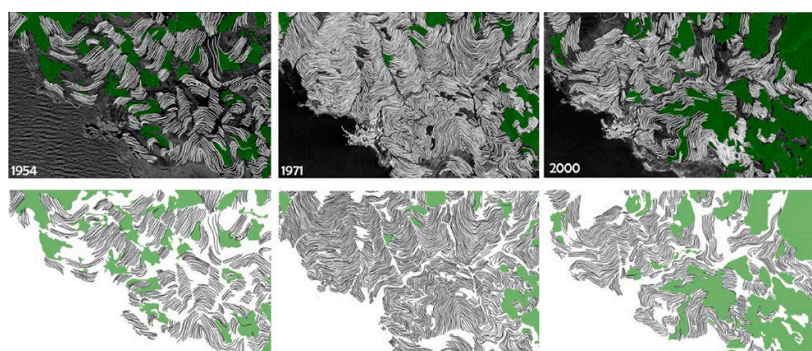
- Areas of natural recolonization with macchia composed of *Quercus ilex*, *Myrtus communis*, *Pistacia lentiscus*, *Smilax aspera* and *Hedera helix*.
- Conifer forest with predominantly *Pinus pinaster* and *Erica arborea*.
- Sclerophyll forest with predominantly *Quercus ilex* but also *Erica arborea*, *Arbutus unedo* and *Pistacia lentiscus*. (Source Cinque Terre National Park, Park Plan, Natural Vegetation).

The agricultural part sees vineyards, mixed vineyard and olive trees and olive trees all on terraces.

## 2.2. Critical Reading of the Historical Evolution of the Landscape: Structure and Signs

In this study, the structure of the landscape was considered in its historical evolution, from the 1950s to today. The diachronic reading of aerial photos from the Italian Military Geographical Institute enabled the dynamics of expansion and subsequent contraction of the terraces to be reconstructed. The terraces constitute the dominant landscape of geographical features on the small scale, in the town of Vernazza and on the large scale, in the wider context of the Cinque Terre Park.

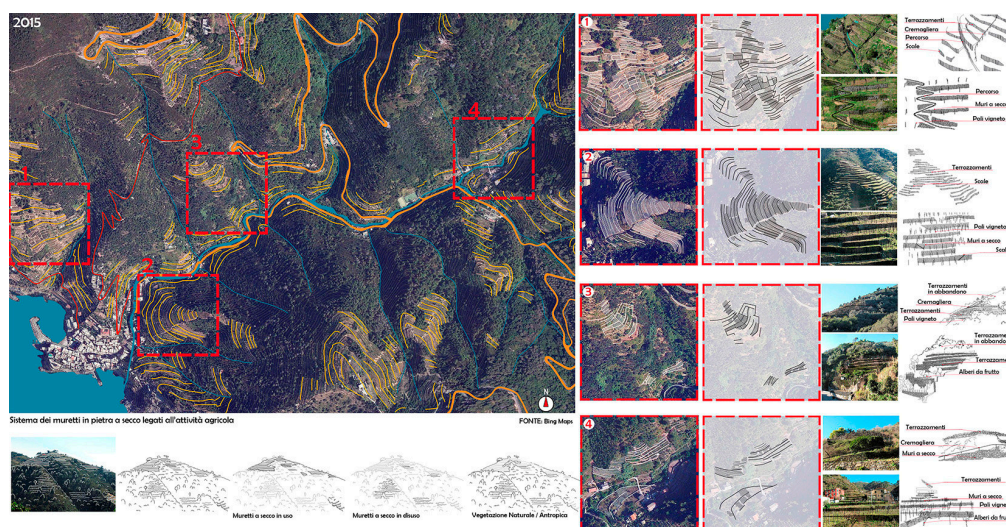
The 1954 flight renders a territory widely used for agriculture with the technique of terracing. However, natural areas with forest vegetation can be seen. With the 1971 flight, a strong expansion in terracing can be seen, which extends throughout the territory, eliminating nearly all the natural areas. Starting in 2000, a decided decrease in cultivated areas can be seen, with the consequent abandonment of terraces and their degradation, along with the growth of uncultivated green areas. The orthophoto of 2015 shows the current situation: numerous abandoned terraces, with evident degradation and current or potential instability phenomena (Figures 4 and 5). Vegetation has overtaken these areas in secondary succession, leaving the olive trees abandoned, mixed with the Mediterranean macchia. A subsequent part of the study on the territorial signs was dedicated to identifying some types of terracing among the most evident or repeated.



**Figure 4.** Historical evolution of the landscape. Aerial photos from the Italian Military Geographical Institute flights: 1954; 1971; 2000.

The discriminating factors mainly consisted in the type of cultivation, in relation to the depth of the terraces and the means with which these were connected together. The steep stone steps tangent to the containment wall, traditionally always in dry stone, were substituted in newer terraces with a path of small ramps. These are certainly more functional in that they can also be traversed by small farming implements but they are potentially dangerous due to streams of rainwater and therefore possible flooding or landslide phenomena. Different types of terracing can be seen depending on the cultivation

practised. Grapevines are mainly cultivated on narrow terraces on very steep slopes, held back by containment walls in dry stone, flush with the plane of use. Olive trees and citrus trees are instead cultivated mainly on deeper terraces. The objective of the critical/exploratory investigation was to understand the evolution of the territory regarding land use and the related agricultural techniques. This revealed a tendency toward the progressive abandonment of the typical agricultural terraces, with possible resultant episodes of hydrogeological instability. The importance of maintaining the terrace structures not only relates to the history/landscape; it is also practical for protecting the stability of the land.



**Figure 5.** The landscape: current state. Orthophoto from 2015. In blue the Vernazzola stream and in red the different types of terracing.

### 2.3. Perceptual Landscape Reading: Structure and Signs

In this investigation, three categories of landscape aspects were analysed: settlement, land use and morphology. Each category was examined based on three fundamental aspects: form, sign and material. With respect to the form, a very active territory can be seen. Very steep geographical features follow in succession, compressing settlement towards the sea or against the rock walls, with the characteristic horizontal cuts of the terraces underlined by the dry stone walls. The study of the signs allows a few decisive traces to be extrapolated from the set. Almost by extension, these represent the entire landscape where they are found, situated in a manner that rather contrasts with the horizontal and vertical planes: the elongated, compressed forms of the settlement, which extend from the sea inland, the twisted course of the stream, the clear horizontal cuts of the terraces and the dense slender poles supporting the grapevines that rise orthogonally. In studying the material, attention was focused on the plastic components of the landscape: the dry stone of the walls and some extra-urban paths, the coloured plaster of the homes in Vernazza, the masses of olive trees, the Mediterranean macchia, more dense and compact and the fruit trees or the thin grapevines. The study yields the material making up the landscape. This reading highlights more formal aspects, typical aspects or those that are in some way historicized, a certain invoice of the dry walls, a certain stone, a specific type of vegetation, a typical terrace, which contrast with non-uniform elements that stand out from the classic context.

It is precisely the system of agricultural terracing, as already mentioned, that characterizes the territory of Vernazza and the entire cultural and landscape heritage of the Cinque Terre Park. The term terracing refers to the artificial systematization of hillside and mountainous geographical features that enable the creation of horizontal or weakly inclined planes on very steep slopes. The artificial systematization of the slopes consists in remodelling the natural profile of the hillsides, which would otherwise not be usable for agricultural purposes, constituting a primary need for the life of the



inhabitants. This practice has allowed not only the development of economic activity over time but has ensured a fundamental defensive action against hydrogeological instability. The terraces are created from stone elements that were uncovered during the terracing, thereby allowing the recovery of the stones that emerged when the land was tilled. Since the end of the 1970s, the use of terracing for agricultural ends has been progressively abandoned, due to the difficulty of managing the cultivation and the high cost of maintenance. The landscape has therefore slowly changed, with the secondary succession of plant life—the advancement of uncultivated areas with Mediterranean macchia and forests—to the detriment of agricultural terracing. One important consequence is the high instability of the slopes, which are no longer maintained by agricultural practice and are therefore exposed to the risk of landslides.

From the typological/form and agricultural points of view, some categories of terracing can be distinguished: (1) Terracing that is shallow, regular and planted with vineyards; (2) Terracing that is deeper, with nearly horizontal planes and tree cultivation (olives, lemons); (3) Terracing that is more or less deep, planted with vineyards mixed with olive trees, partially abandoned; (4) Deep terracing with olive trees that are clearly abandoned.

#### *2.4. Perceptual Landscape Reading: Types of River Levees*

This investigation comes down in scale, concentrating on the levees of the Vernazzola stream, analysing their different components and characteristic structures. Three different types of levees were identified: constructed/constructed, constructed/renaturalized, renaturalized/renaturalized. Levees with built walls fall under the category “constructed.” In the first case, both levees in the stream are constructed, although with different materials. In the second case, the levees show banks treated in different ways: a constructed levee on one side and a renaturalized one on the other. In the last case, both levees are renaturalized and contain no constructed tracts. The difference in the levees is very important from the landscape/perceptual point of view, since differences can be seen in the treatment of the levees, suggesting unifying and uniform activities to be proposed in the design phase.

Three types of artificial levees were found: those built of reinforced concrete on both riverbanks, those in reinforced concrete on one bank and historical stone walls on the other and those in reinforced concrete/historical walls on one side and large masses on the other. Following the flood of 2011 with the removal of the structures present, the process of renaturalization left the levees in bare rock with the recolonization riparian vegetation. These levees undergoing renaturalization can be found on both banks or set against walls in reinforced concrete or dry stone.

#### *2.5. Assessment of Works Realized with Extreme Urgency and on Interventions Set out in the Preliminary Project*

One last step in the multi-system methodological approach consisted in evaluating the works realized with extreme urgency and the interventions set out in the preliminary project to support some qualitative assessments on the hydraulic functionality of the works (completed or planned) in relation to their insertion in the landscape. It could be seen that the works designed to mitigate hydrogeological risks were useful to the following two strategies:

- increasing the hydraulic officiousness of the Vernazza canal, that is, the maximum carrying capacity of the canal without overflowing;
- intercepting part of the solid material transported by the current upstream of the Vernazza canal through the creation of selective weirs where the overflow can be contained.

In detail, the following criticalities can be seen: an absence of construction expedients that could increase the hydraulic officiousness at low cost; extreme variation in types of pedestrian crossings; realization of elements to protect the roadway from possible obstacles with respect to the water flow; use of lithoid material extraneous to the environment of Vernazza to create the crests and reefs; the presence of small stone bridges of cultural interest to demolish or bypass and to re-evaluate as a function of their hydraulic function and associated risks; plans to reconstruct the embankments on

the right bank, evaluating them precisely in relation to the increase in risk that they determine for the canal zones further downstream.

These are certainly small-scale questions; however, they structurally and perceptually affect the entire landscape system and the cultural value of the territory itself, altering in many cases some of the elements that structure its overall image, i.e. form, sign and material.

### 3. Results

Some recurring types of intervention and various criticalities (infrastructure, environment and landscape) came out of the qualitative assessment of the hydraulic quality of completed or forthcoming works along the Vernazzola stream in relation to their insertion in the landscape. These can be summarized as follows: (a) infrastructure criticalities regard: elements to descend to the riverbed made without considering the hydrodynamics; and little attention to shaping some works (tunnel) that could lead to a notable decrease in the maximum outflow capacity; (b) landscape criticalities regard: a lack of attention to guaranteeing the continuity of stone coverage; the erratic attention to detail in building new protective walls in dry stone; the use of boxy iron elements for balustrades, whose makeup and size do not pertain to the types present in Vernazza; and the recurring use of visible cement elements (banquettes or the tops of the walls) combined with dry stone walls, which are again incompatible with the types present in Vernazza and which lead to an evident compromise in the urban and landscape quality of the access along the stream; (c) in addition to the landscape, environmental criticalities are also represented by the presence on the left bank of signs of erosion left by recent landslide events and by the presence of different materials stored along the course of the stream, as well as erodible material, which could be easily carried away when the river is full. Along with this, an advanced state of degradation can be seen in some stone constructions designed to regulate the water at the confluence of a side trench on the right bank. These constructions hold great prestige for architecture and the landscape; (d) the presence of works in reinforced concrete that act to check and/or support the necessary street access on one side (left bank), to ensure the functionality and durability of the interventions. Instead, those planned for the right bank should be evaluated, particularly where they coincide with the left bank, which would lead to the total artificialization of the Vernazzola stream. In addition, in some cases, the consolidation of the existing control walls was made in tracts of stone masonry with an appreciable texture but with the insertion of wooden elements, likely to support a railing, which are relatively dangerous and not very effective. The expansion of the wood due to hygrometric variations makes the wall crack where it is anchored. As well, the wood rots over time, precisely where it is seated, producing serious risk for anyone who might lean against it. Following the flood of 2011, a lot of natural material or dam masonry was carried away in some parts of the stream near the riverbed. The consequences include a lack in rigid protection that would guarantee the safety of pedestrians on the road side or the presence of constructions affected by structural collapse with the evident danger of their falling into the riverbed. In consideration of the fact that the interventions for control constitute in and of themselves a factor aggravating the hydraulic criticality of the downstream zones, before proceeding to reconstruct the dams, even as an extension of the residual portions, their current functional need must be ascertained in relation to current land use and the lithologic quality of the land and the rocks present. The use of materials extraneous to the context is seen repeatedly in different interventions, either to complete the stone walls supporting a terrace or for small walls to protect the banks. The selective weir is of notable visual impact, with its function of laminating the solid capacity. This transverse work could be strongly mitigated with a covering in local stone of the appropriate size. The application of the methodology described above produced the profile and critical evaluation schemes that constituted the basis for the development of the principal proposal for the environmental landscape recovery. The methodological and meta-project anchorage among the various phases of applied research was the identification of the river areas with the specifics of the criticalities present. This initiated the theoretical/design reflection to establish: (a) operational guidelines; (b) masterplan; and (c) intervention specification sheets. In an overall design,

these documents render and make coherent what was displayed in the guidelines and the specification sheets, as well as the spatial prefiguration suggested when comparing the situations before and after the project. The interventions proposed to enhance the landscape aim to make the peri-urban tract of the Vernazzola stream usable and accessible, allowing visitors to directly and simultaneously read all the characteristics and cultural and landscape values present in the territory. This is in coherence with what was set out and established by national and regional standards in terms of protection and conservation of the Cinque Terre landscape, as well as urban-planning and landscape prescriptions in the existing urban-planning/territorial tools, including the directives of the Cinque Terre Park and what is established under UNESCO recognition. To this end, a path parallel to the waterway was proposed, passing mainly on the right bank. From preliminary considerations, the realization of the project does not foresee an obstacle of the streambed, which is advised against for correct hydraulic operation and the prevention of further hydrogeological risks. In addition, the path lies directly on the rocks already present on the right bank, thereby avoiding excavations or the removal of dirt, as requested by existing urban-planning tools.

3.1. Operational Guidelines

The operational guidelines aim to identify the best planning solutions related to contrasting/mitigating the hydrogeological instability, in reference to both the cultural, morphological and vegetation characteristics of the places and the main criticalities revealed and the categories of intervention hypothesized in the construction of the project. Within the territory examined, three main areas of reference were identified to locate the completed/planned/hypothetical planning interventions aimed at resolving/mitigating the hydrogeological risk in close relation to the river environment: the agricultural areas of traditional cultivation; the peri-urban areas; and the valley floor. Each area of reference is classified considering: the physical morphology; the characteristic component (vegetation coverage of the land or constructed works); the main elements of criticality revealed; the evolutionary trend without intervention to resolve/mitigate the risk; completed or expected interventions that are not in line with mitigation of hydrogeological instabilities, the hydraulic risk, or with the enhancement of the landscape; the categories of intervention established; and the planning solutions proposed with reference to the intervention sheets, the masterplan and the chart of photomontages in the masterplan. What follows is an extract of the table of guidelines with the related descriptive and design content (Figure 6).

Local use and morphology	Component or element	Main critical elements revealed	Evolutionary trends without intervention	Interventions not in line with the mitigation of hydrogeological instability, hydraulic risk, or with the enhancement of the landscape	CATEGORIES OF INTERVENTION		
					Ordinary maintenance	Extraordinary maintenance (and/or restoration)	Examples of good practice and planning solutions
<p>CONSTRUCTION AND REPAIRS OF THE VALLEY FLOOR AREA</p> <p>In the river environment above the flood plain</p>	<p><b>PERI-URBAN AGRICULTURAL AREAS</b></p> <p>THE RIVERBANK</p>	<p>The particular situation was revealed through the presence of a historical building in the situation that was heavily damaged following the most intense river flow</p>	<p>This and the historical buildings built near the river will undergo adequate consolidation of the most exposed parts to water flow</p>	<p>Location of elements and materials consistent with the historical characteristics of the landscape was highlighted.</p>	<p>Preserve the existing structures to ensure an authentic character of the building using materials, details, and colors that harmonize with the means typical of the territory SC 6</p>	<p>Consolidation and restoration of historical structures in line with the guidelines and categories revealed in the intervention sheets and the masterplan (see Figure 6)</p>	<p>Integration of works to enhance the area highlighted in the chart, using spaces for landscaping.</p>
	<p><b>SMALL CONSTRUCTION ELEMENTS</b></p> <p>REPAIRS</p>	<p>Numerous abandoned structures are present. Remnants of materials in the landscape consist of masonry.</p>	<p>Disappearance of types of construction and their color and their value in the landscape and historical value of view</p>	<p>New construction of buildings close to the abandoned structures, or intervention with materials obtained from traditional practices</p>	<p>Consolidation and restoration of the construction and works of any type and materials obtained from traditional practices in natural conditions and in conditions of heavy rain SC 5.</p>	<p>Demolition of the construction elements in the situation that have completely lost the substance and structure. Demolition of abandoned constructions. Building restorations with materials and techniques typical of Vernazza (style covered in stone, plaster and colors in reference to the Urban Plan, etc.).</p>	<p>Substitution of constructions in stone, masonry and in traditional aggregate for the landscape in which they are found with other constructions in line with the typical colors of the place (see Vernazza Urban Plan).</p>
	<p><b>PERI-URBAN AREAS</b></p>	<p>Use of materials and forms not typical of the typical structures, colors, and materials of Vernazza and its present use</p>	<p>Perturbation of forms and materials in the landscape of the historical center of Vernazza</p>	<p>Avoid difficulties of open and construction techniques for bridges and those in visual continuity</p>	<p>Use of materials and colors in line with traditional techniques existing in the historical center of Vernazza</p>	<p>Use of materials in steel for structures and colors of the building facade or painted with traditional colors existing in the historical center of Vernazza</p>	<p>Use the construction considering the kinetic presence of the water in the water flow. Make a preliminary assessment of the possibility of creating a natural flow.</p>

Figure 6. Guidelines.

### 3.2. Masterplan

The masterplan spatially specifies the guidelines and also systematizes and makes coherent specific actions and categories of intervention. It represents a single technical/operational design that conceptually and graphically renders the works to be realized. Coherent with the type of area identified in the critical/evaluation phase, the masterplan identifies the technical interventions to be made, in harmony with the appearance and historical/cultural values of the entire territory. Each individual intervention resolves a problem technically and contributes to recovering and enhancing the wider landscape. This links to the system of terracing, pedestrian crossings, the mitigation and environmental/landscape character of the natural engineering works realized. It leads to a role of design synthesis between the large and small scales of cultural values of the UNESCO heritage under consideration and of the entire methodological and cultural approach of the research (Figure 7).

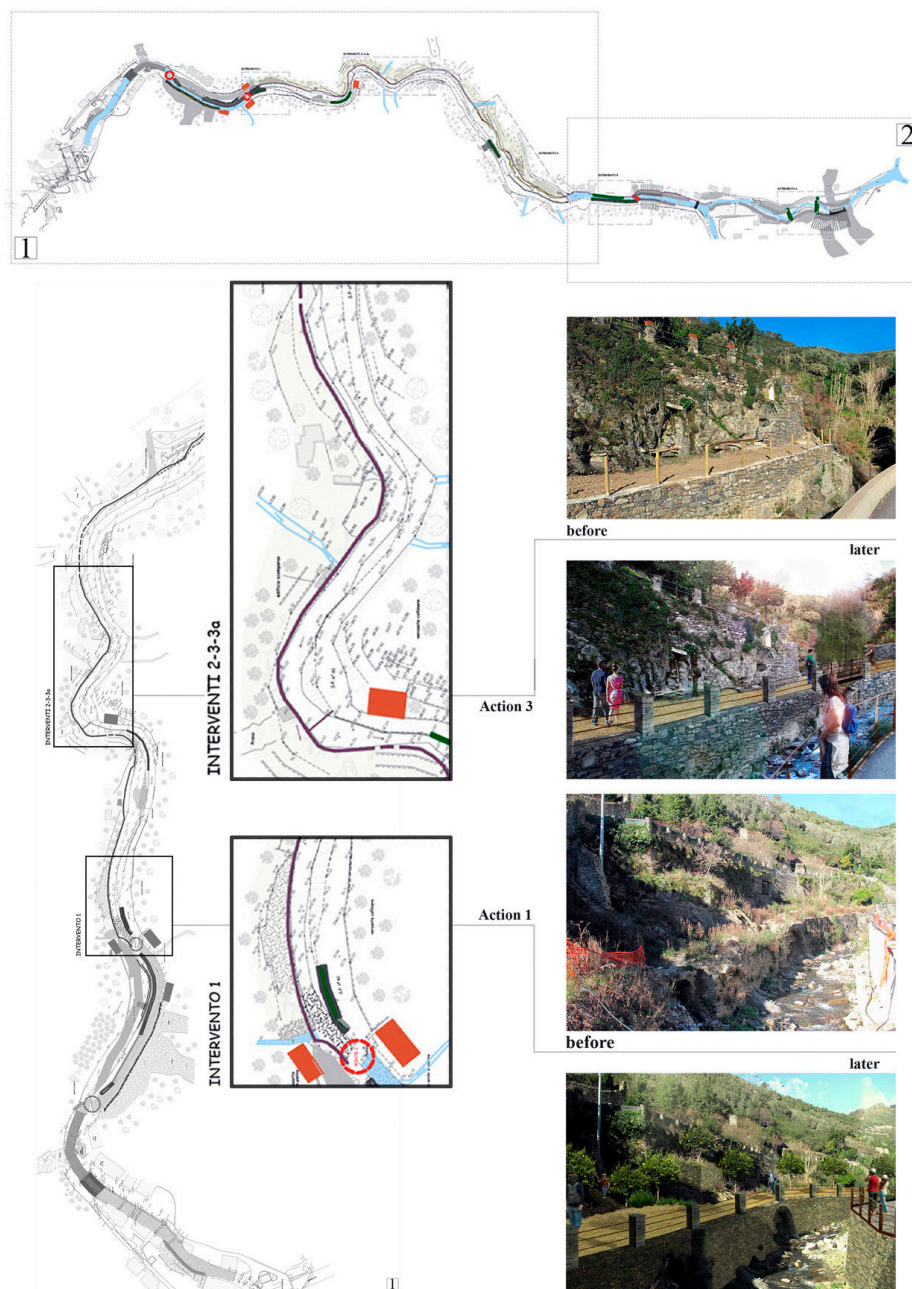
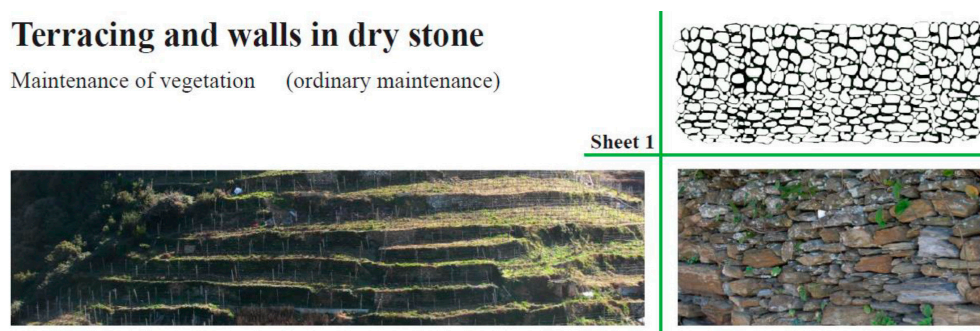


Figure 7. Masterplan.

### 3.3. Specification Sheets of the Intervention Types

These sheets identify the different types of intervention possible as a function of the instability to be counteracted. They also describe the main details of the project, indicating the materials used and the finishing works, always following the general strategy of protection, conservation and enhancement of the cultural and landscape heritage of the territory. In this sense, the types of intervention possible as a function of the instability to be counteracted do not foresee excavations or other modifications of the local morphology. In harmony with what emerged in the analytical/exploratory and critical/assessment phase, the specification sheets were drafted for the following types and elements of the anthropic/landscape system: terraces and walls in dry stone, traditional agriculture, historical constructions/buildings, railings, levees and riverbanks, weirs and crests. By way of example and methodology, the following lists the planning actions suggested for the type of terrace and dry stone wall (Figure 8a,b).



#### GENERAL ASPECTS:

All the interventions listed below are aimed at the correct structural and architectural maintenance of dry containment walls for agricultural terraces. Their maintenance is of primary importance in securing the hillsides from landslides. It is also important to maintain the original structures and propose traditional techniques for building new walls in order to maintain the identifying characteristics of the territory.

##### 1. CLEANING THE DRAINAGE CANALS AT THE FOOT OF THE WALL

It is necessary to remove weeds and brush at the foot of the wall, where the small canal is located to collect and remove superficial stream water flowing on the terrace planes. To correctly maintain water runoff, this should be free of obstacles (stones, vegetation, various other material).

##### 2. REMOVAL OR PRUNING OF VEGETATION GROWING IN THE CRACKS

In order to ensure the stability of the wall, the possibility of removing brush growing in the cracks of the wall should be carefully evaluated. Uprooting it could, in fact, cause structural failure or collapse. In this case, protruding branches can simply be pruned.

##### 3. CLEANING THE LEVEL SURFACE TO ALLOW FOOT TRAFFIC AND FACILITATE THE FLOW OF SURFACE RUNOFF

It is of primary importance that the level surface of the terrace be maintained in conditions suitable for foot traffic, as well as to facilitate the flow of rainwater by removing various extraneous materials (vegetation, stones, etc.).

It is likewise necessary to plant the surface with grass to facilitate water drainage and to prevent the soil from washing away.

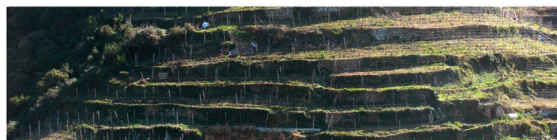
(a)

Figure 8. Cont.

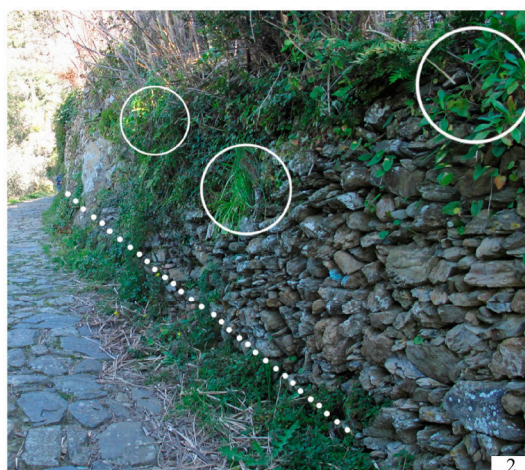
### Terracing and walls in dry stone

Maintenance of vegetation (ordinary maintenance)

Sheet 1



**1. Weeds growing in the cracks.**  
To be removed.



**2. Weeds/brush**  
The vegetation growing at the foot of the wall and on the coping should be pulled out to enable the drainage of rainwater and maintain the strength of the wall itself.

(b)

**Figure 8.** (a). Sheets of the intervention types. List of actions; (b) Sheets of the intervention types. Ordinary maintenance actions of the walls.

#### 4. Discussion and Conclusions

Today, interventions to secure the territory from risks caused by climate change certainly constitute an opportunity to experiment with innovative construction techniques. Even when inserted in contexts with great landscape and cultural prestige, these techniques have rarely managed to become “landscape projects,” instead providing only partial responses. Often, in the case of river areas, constructions and engineering works to secure the territory were often required to be masked, as if they were something incongruous to hide. In many cases, the transformations of the environmental and landscape system that caused the instability were ignored and the concentration fell mostly on point-like interventions for security with limited importance.

The planning experience of the Vernazzola stream in the Cinque Terre National Park demonstrates how the need to secure a territory can constitute an opportunity to change approaches. Engineering-type interventions for security can serve as the starting point to construct/reconstruct the organization of the landscape, aiming at more extensive operations to “control” and “recover” the resources and the history of the places, to preserve the signs characterizing the urban and rural landscape that risk disappearing. It is hoped that this type of approach also be pursued by the “Italia Sicura” Plan discussed in the Introduction. With reference to this plan, which commits Italy in the coming years, the experience of the Vernazzola stream can serve as a useful example, with particular reference to two questions: (a) the methodology, since the choice of field adopted in the multi-system approach to the territory allows the overall cultural heritage to be investigated in its different values (historical, natural, landscape, productive/agrarian, social, etc.). It also highlights the relationships between the individual elements and systemic ones, prefiguring solutions to the dual territorial/local scale. It is a macro- and micro-scale attempt. This approach implicitly entails the involvement of different skills and different actors in the entire theoretical/planning process. Called to manage the individual territorial and landscape aspects from their various sectors, these players are the real managers of the cultural heritage, together with economic players and territorial inhabitants. The interdisciplinary nature and a “broadened” glance beyond the area of intervention allows direct and indirect participatory actions to be recognized and registered: those that are able to provide useful indications for active protection and, especially, for managing landscape transformations of the heritage under study; (b) planning and management, in the view that the guidelines are intended as a checklist with the dual function of guiding planning for designers and serving as a reference to control the planning proposed by decision-makers and managers of the cultural heritage (public entities and administrations), always while respecting the existing system of protection.

These two elements constitute the added value of the experience presented and the basis to work to refine content and application modes. In this sense, the planning choices can respond to what is requested by UNESCO in managing the cultural heritage. This is: collective responsibility for maintaining universal values unchanged for the benefit of future generations; a commitment to performing concrete actions with a management plan that respects UNESCO’s criteria and expresses governance with which one can develop the good through its active protection; the involvement of players representative of the interests in play (institutions/economy/culture/environment) through participatory and sharing activities that express a continual process and unanimous commitment; and raising awareness of the existing legal protections (since UNESCO does not add any restrictions) that express the local and national awareness of the recognized value.

Methodological investigations implemented for the system of terracing and the differences that emerged between the historical and new terraces with respect to the different construction techniques, agricultural production and management of the piece itself, move precisely in this direction. In this case, the detailed methodological approach is necessary to understand the phenomena of territorial stability, the productive/agricultural aspects and aspects that are merely aesthetic/perceptual that the image of the individual terrace gives to the overall patchwork. The result is the framework of a landscape in which it is possible to trace rules of internal “particle” composition and the “aggregate” composition of the more general system—the distinctive character of this UNESCO heritage—as well as the aspects to guarantee and transmit to future generations.

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