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Land capability classification of Vernazza catchment, Cinque Terre National Park, Italy

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ABSTRACT

Land capability classification is based on chemical and physical properties of soils for agricultural purposes. Objective of this study is the realization of the land capability map in the Vernazza catchment, an historically terraced landscape in the Cinque Terre National Park, recognized as a World Heritage site by UNESCO since 1997. A pedolandscape map with a descriptive legend, based on the soil-landscape paradigm for the prediction of soil classes and their spatial distribution, was produced. After, a land capability map was created by classifying the pedolandscape units to aid the sustainable territorial planning in the National Park. The results were plotted on a 1:4000 scale map with a descriptive legend. Land capability map is dominated by lands with severe limitation and only the 30% of the study area may be used for crops but it requires very careful management and conservation practice.

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KEYWORDS
Soil evaluation; soil mapping; pedo-landscape; GIS; Liguria

1. Introduction

Land capability classification (LCC) may be defined as a system of grouping land into various classes based on inherent limitations imposed on sustained use by soil attributes, topography, drainage and climate (Klingebiel & Montgomery, 1961). An LCC map is a valid tool in helping land managers and land use planners to read the soil maps, to manage land considering soil proprieties and potentialities, to identify areas with physical constraints for a range of nominated land uses. In contrast to the FAO's (1976) land suitability classification, which is a widely used framework for assessing physical land suitability for a specific use based on expert knowledge (Rellini et al., 2011), LCC is a broad evaluation for determining suitability for agro-silvo-pastoral use in general.

The objective of this study is the realization of a land capability map (Main Map) in an historical terraced coastal agricultural landscape in the Cinque Terre area, the Vernazza catchment, in northwestern Italy (Liguria Region, Figure 1). Because of its historical and environmental importance, Cinque Terre area is a National Park recognized as a World Heritage site by UNESCO since 1997.

The Vernazza catchment, located along the Tyrrhenian side of the northern Apennines, shows typical geomorphological features characteristic for most of the Ligurian coastal catchments such as a small area (about 5.7 km^2), very steep slopes due to the proximity of mountains to the sea and short streams.

The bedrock is mainly composed of a sandstone-claystone flysch (Macigno Formation, Late Oligocene–Early Miocene) and a pelitic complex (Canetolo Shales and Limestones, Canetolo Unit, Cretaceous), (Figure 2a). One particular land-use characterized all the Cinque Terre area and the slopes within the Vernazza catchment (Cevasco et al., 2013; Figure 2b). These slopes have been almost completely terraced for vineyards and olive groves during the past millennium. Following the exodus of farmers in the last century, terraced slopes have been progressively abandoned and covered by Mediterranean scrub and pine. In the upper part of the catchment, where the slopes were not terraced, the mixed mesophylls wood is dominant.

The aim of the land capability analysis in the Vernazza catchment is to provide useful information for territorial planning in the National Park. There is a growing need for interpreted soil information for policy making. New emerging policy areas are demanding detailed, updated and policy relevant soil information that can underpin the decision-making process (Montanarella, 2010).

2. Materials and methods

2.1. The pedo-landscape map of Vernazza catchment

The pedo-landscape map in this study was developed following a strategy based on the concept of soil

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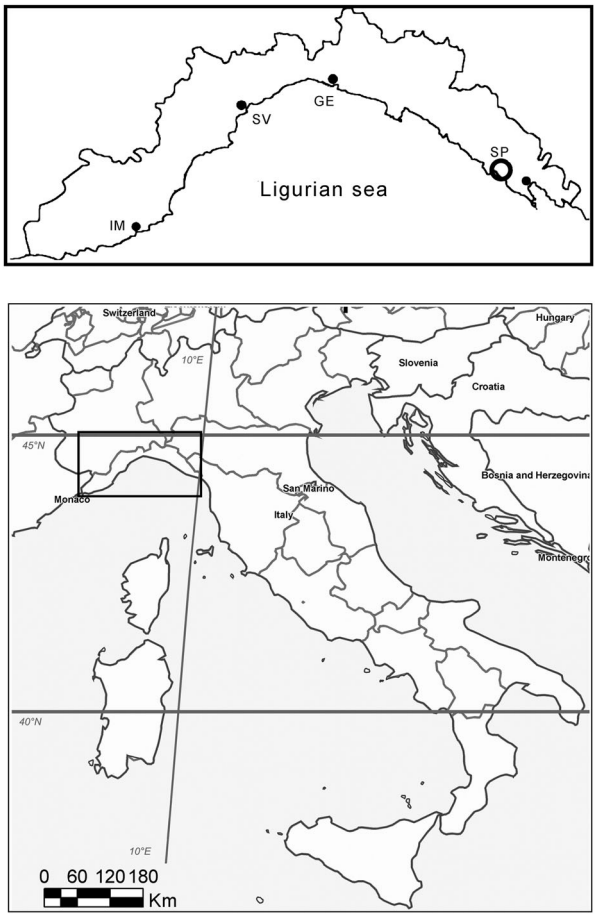

Figure 1. Location of the study area in the region of Liguria (north-western Italy).

formation factors coupled with soil-landscape relationships (Hudson, 1992) and using a GIS approach (Rellini et al., 2017). In these terms, the local patterns of topography or relief, parent material, and time, along with their relationships to land use and microclimate, can be used to predict the types of soils in small areas (USDA, 1993). To create the map unit, we superimposed the topographic information layer derived from the DEM and all the layers related to the accessory information traditionally collected in soil surveys and now available in digital form (such as vegetation patterns, geomorphology, geology, and land use). In a GIS environment (ArcGIS 9.2 Desktop©, ESRI, 2006) all these environmental data of the area were analyzed: first, we processed a 5-m-resolution digital elevation model (DEM). The DEM was based on an interpolation of contour lines from a 1:5000 topographic map (Regione Liguria, 2007) using a thin plate spline algorithm proposed by Hutchinson (1996). The DEM was preprocessed with low-pass filtering to artefacts and errors, such as local noise and terraces (Vorpahl et al., 2012), using SAGA GIS (Saga 6.3©, Conrad et al., 2015). The DEM was then hydrologically corrected to eliminate sinks using the algorithm proposed by Planchon and Darboux (2001). Then, derived attributes, such as slope gradient and wetness index, were calculated from DEM by using SAGA GIS (Saga 6.3©, Conrad et al., 2015).

One or more representative soil profiles were described for each map unit following Costantini (2007). The laboratory soil analyses were performed by the Regional Soil Analysis Laboratory in Sarzana (Spezia, Liguria) (ISO 9001 certified). For each soil sample from each horizon, the routine laboratory procedures and analyses were performed according to the Ministero delle Politiche Agricole e Forestali (2000): particle size distribution, pH, total carbonate, total organic carbon, cation exchange capacity, concentrations of extracted chemical elements.

Thus, after linking the soil information to the first draft of the map unit, the spatial distribution and variability of the most extensive soil types were reproduced

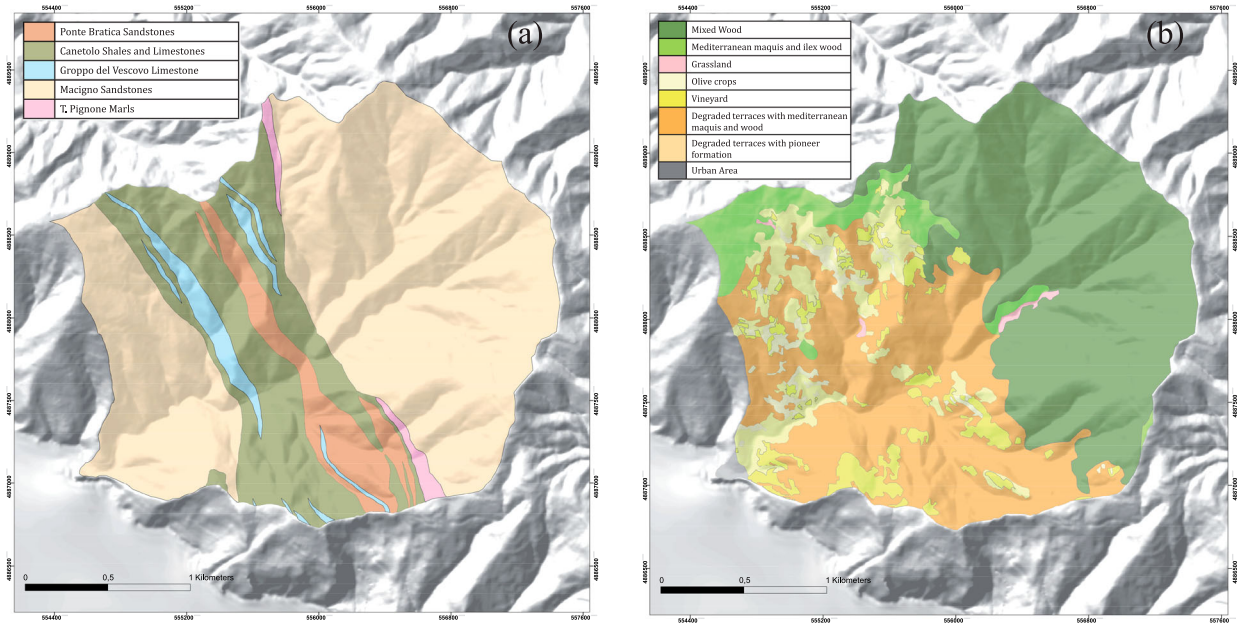

Figure 2. Study area: geological map (a) and land use types (b).

in GIS and presented in a pedo-landscape map, with a descriptive legend based on World Reference Base (WRB) classification (IUSS, 2015).

2.2. The land capability classification map of Vernazza catchment

To draw the LCC map (Main Map), we followed the LCC procedure manual (Klingebiel & Montgomery, 1961). For each pedo-landscape unit, we analyzed the parameters in Table 1. Parameters analyzed were: proprieties of land (as erosion rate, runoff, climatic limitation etc.) and soil proprieties (as texture, presence of gravel, pH, Cation Exchange Capacity and Base Saturation of superficial horizon etc.). Land capability class of a specific unit is determined by its most limiting parameter. There are eight classes and the numbers indicate progressively greater limitations and narrower choices for practical use (Table 2 – classes LCC).

Land capability subclasses were defined adding a letter E, W, S or C to the class numeral to indicate the main restrictive parameter. For example, the letter E shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; W shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); S shows that the soil is limited mainly because it is shallow, droughty, or stony; and C, shows that the chief limitation is climate that is very cold or very dry.

In our study we classified all the map units; for the pedo-landscape unit map with a soil association, we gave to soil map the class of dominant soil. Results are presented in Table 3. In this perspective, the pedo-landscapes represent homogeneous areas by type and intensity of the pedogenetic process where the same type of sustainable use is conceivable.

3. Results and discussion

As shown in the pedo-landscape map (Main Map), soils in the area are identified in three Reference Soil Groups (RSGs) among the 28 soil profiles: Cambisol, Regosol and Leptosol.

Cambisols include soils with at least incipient subsurface soil formation. They are characterized by moderate weathering of the parent material, early stages of horizon differentiation and evident changes in soil structure, color and clay content. Cambisols are the most extensive RSG in the study area (45%) on linear slopes, but it is possible to find them also on terraced slopes with vineyard cultivation; they are deep soils with high useful depth (150 cm).

Regosols are very weakly developed soils in unconsolidated material originating from different rocks types (see pedo-landscape map legend) and have no diagnostic horizons. Regosols (36%) are a common

Table 1. Parameters used for LCC.

	→ LCC CLASSES →								LCC SUBCLASSES
PARAMETERS ↓	1	2	3	4	5	6	7	8	S
	Soils suitable to agricultural use				Soils suitable to pasture and forest		Soils not suitable to agricultural and pasture use		
Useful depth (cm)	>100	>60, ≤100	≥25, ≤ 60		<25				
Texture of upper horizon	Clay + Silt <70 or Clay <35 or Silt <60 or Sand <85	Clay + Silt ≥70 or ≤ 35 Clay <50 or Silt <60 or Sand <85	Clay ≥ 50 or Silt ≥ 60 or Sand ≥ 85						
Coarse fragment of upper horizon (%)	≤ 15	>15 and ≤ 35	35 and ≤ 70		> 70				
Stoniness (%) ? 7,5 cm	≤ 0,1	> 0,1 and ≤ 3		> 3 and ≤ 15		> 15 and ≤ 50	> 50		
Presence of continuous rock (%)	≤ 2			> 3 and ≤ 15		> 15 and ≤ 50	> 50		
Fertility of upper horizon	5,5 < pH < 8,5 or TSB > 50% or CSC > 10meq or $CaCO_3$ ≤ 25%	4,5 ≤ pH ≤ 5,5 or 35 < TSB ≤ 50% or 5 < CSC ≤ 10meq or $CaCO_3$ > 25%	pH < 4,5 or pH > 8,4 or TSB ≤ 35% or ≤ 5meq						
Drainage	Good	moderately fast	moderately low	Very low	Not possible				W
Flooding	Absent	Low	Moderately	High	Very High				
Climatic limitation	Absent	Low	Moderately			High	Very High		C
Slope (%)	≤ 2	> 2 and ≤ 8	> 8 and ≤ 15	> 15 and ≤ 25	> 25 and ≤ 45	> 45 and ≤ 100	> 100		E
Erosion rate	Absent		Low	Moderately			High	Very High	
AWC (cm)	> 100		> 50 and ≤ 100	≤ 50					S

Table 2. Classes of LCC.

Class number	Capability class description
1	Lands have few limitation: this class is suitable for cultivated crops, pasture, range, production forest, woodland and industrial plant.
2	Lands with some limitation that reduce the choice of plant can be cultivated and needs moderate conservation practice. This class is suitable for cultivated crops, pasture, range, production forest, woodland and industrial plant.
3	Lands have more severe limitations than Class II and need special conservation practice. This Class may be used for cultivated crops, pasture, range, production forest, protection forest and wildlife reserve.
4	Lands have more severe limitations that make the choice of plant more limited and require very careful management. This Class may be used for crops, pasture, range, woodland, production forest, protection forest and nature reserve.
5	Lands have little or no erosion hazard but have other limitations impractical to remove that limit their use largely to pasture, range, woodland, production forest, protection forest and nature reserve.
6	Lands have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, production forest, protection forest and nature reserve.
7	Lands have very severe limitations that make them unsuited to cultivation and that restrict their use argely to grazing, woodland/ or wildlife, protection forest and nature reserve.
8	Lands have limitations that preclude their use for commercial plant production and pasture and restrict their use to wildlife, protection forest and nature reserve

soil type within the study area, found on the terraced slopes and in highly eroded areas in the upper parts of the catchment.

Leptosols are very shallow soils with continuous rocks very close to the surface or soils that are extremely gravelly. Leptosols are also a less common soil group in the study area (20%), found in areas with very steep slopes with severe erosion or in long abandoned terraces.

As regards the land capability analysis, the results can be seen in Figure 3. They show that, in the study area, Class I, II, V and VIII are not present; Land capability class in the study area is dominated by land capability classes IV (30% of the area) and VII (45% of the area) whit various limitation factors namely percent of stoniness, presence of coarse fragments, useful depth and slope gradient.

The absence of Class I and II, which are classes with few limitations and suitable for crops, pasture, range, forest production, woodland and industrial plant (Klingebiel & Montgomery, 1961) can be explained with the fact that in the study area not all plantations are possible. The study area is not suitable for extensive agriculture: the presence of steep slopes, stoniness, coarse fragments and low useful depth had allowed, in time, only the cultivation of grapes and olive on terraced slopes. These two crops have not particular requirement in soil characteristics, and they grow well in poor soil with superficial stones and gravels in the soil.

Table 3. LCC of the pedo-landscape unit map.

Soil map unit ↓	Useful depth (cm)	Texture of upper horizon	Coarse fragments of upper horizon (%)	Stoniness ≥ 7,5 cm (%)	Presence of continuous rock (%)	Fertility of upper horizon	Drainage	Flooding	Climatic limitation	Slope (%)	Erosion rate	AWC (cm)	FINAL class	SUB class
Soil association	1	1	2	3	1	1	1	1	1	1	1	1	**3**	**S**
UC 1	1	1	2	2	1	4	1	1	1	2	1	1	**4**	**S**
UC 2	1	1	2	4	1	1	1	1	1	2	1	1	**4**	**S**
UC 3	3	1	3	3	3	3	1	1	1	1	1	3	**3**	**S**
UC 4	3	1	2	4	1	2	1	1	1	4	1	2	**4**	**S E**
UC 5	5	1	3	2	6	3	1	1	3	3	1	3	**6**	**S**
Soil association	5	1	3	4	7	3	1	1	4	3	1	3	**7**	**S**
UC 6	4	1	4	4	1	2	1	1	7	4	1	3	**7**	**E**
UC 7	5	1	2	3	4	4	1	1	7	3	1	2	**7**	**S**
UC 8	1	1	3	4	3	2	3	1	1	2	1	1	**4**	**S**
UC 9	1	1	2	4	3	1	1	1	1	1	1	1	**4**	**S**
UC 9	2	1	3	1	1	1	1	1	1	1	1	1	**3**	**S**
UC 10	2	1	3	4	1	1	1	1	1	1	1	1	**4**	**S**
Soil association	4	1	2	3	6	3	1	1	1	2	1	4	**6**	**S**
UC 11	1	1	2	2	4	2	1	1	1	6	1	4	**6**	**E**
UC 12	1	1	3	1	1	1	1	1	1	1	1	3	**3**	**S**
UC 13	5	1	2	4	4	4	1	1	6	3	1	1	**6**	**S**
UC 14	4	1	4	3	1	1	2	1	3	3	1	2	**4**	**S**
UC 15	3	1	2	1	1	1	1	1	1	1	1	1	**3**	**S**
UC 16	3	1	3	5	6	1	2	1	1	3	1	2	**6**	**S**
UC 17	1	1	3	5	5	1	2	1	7	3	1	2	**7**	**S**

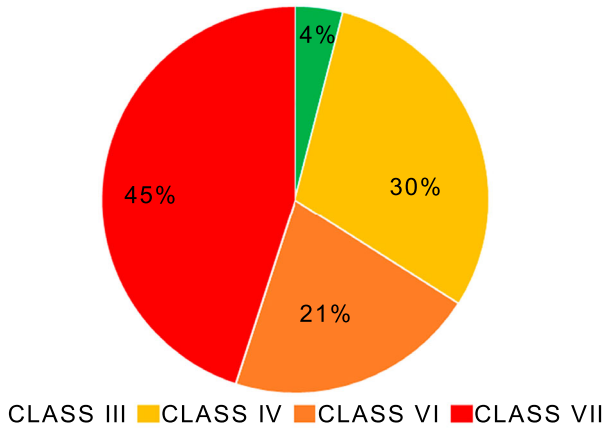

Figure 3. Results of land capability analysis.

The grapevine is a fairly tolerant plant, growing on both alkaline soils and acidic soils. Poor nutrient soil enhances quality while rich nutrient, deep soil is more favorable for quantity. Root growth depends on soil depth, texture and the proportions of fine soil and pebbles. However, soil is rarely a limiting factor. The quality of the soil has an influence on the kind of wine production, but not on grape growing (Costantini, 2006).

Olive trees are more tolerant than other fruit trees, generally requiring shallow, sandy soil with stones and gravels. Above all, the presence of stones, considered for other crops a restrictive parameter, guarantees a better drainage condition for olive growth (Costantini, 2006).

This is the reason why, for millennium, the production of wine and oil has been the only production possible and present in the area.

As consequence, in our study area, land capability Class III (4% of total area) and IV (30% of the area) are generally located on terraced slopes with vineyards and olive crops or abandoned terraces from recent time, with shrub or scrubland (maquis). For a correct and suitable management of these lands, land capability results suggest to keep cultivating the terraces with vineyard and olive trees. In fact, the presence of cultivated terraces allows the conservation of soil depth, the reducing of erosion rate, the removal of big rocks that are the limiting parameters present in Class VI. In this class (21% of total area), we find land generally located on degraded terraces from a long period, with scrubland and wood, or land without terraces with a scrubland as vegetation cover. The conservation of terraces in the lowest part of the area, corresponding to LCC III and IV, is strongly recommended also for the valorization of the landscape, leading to the protection of cultural history and local economy. Above all the vineyards in Cinque Terre, represent a strong resource for small or medium-size holdings, producing famous local wine with the denomination DOC – Controlled Designation of Origin 'Cinque Terre' and 'Cinque Terre Sciacchetrà' (Rellini et al., 2019). Moreover, olive groves must be preserved, also as a non-productive olive, just to protect soil and terraces.

Class VII, which is the most representative class with more than 45% of area, is a class where lands have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland or wildlife, protect forest and nature reserve (Klingebiel & Montgomery, 1961). In our study area we find mainly above all on linear slopes, without terraces, covered by mesophylls broad – leaved forest or pinewood. Limiting parameters are, consequentially, the slope, the soil depth and the erosion rate. The capability classification for these lands suggests a conservation of natural vegetation to protect soil and reduce soil erosion rate.

Moreover, the protection of soil and the conservation of mixed wood in this area have two important implications: (i) from a hydrogeological point of view, natural vegetation reduce impact of rain drops on soils, intercept hidden precipitations (mist and fog), allowing the conservation of water in soils; (ii) from an ecological point of view, soils are one of the most significant reservoirs of soil organic carbon and have the capacity to store carbon over very long periods of time (Saint-Laurent et al., 2017), in particular soil organic carbon increases under conifer and broad-leaved woodlands (Rodríguez-Murillo, 2011).

4. Conclusions

The objectives of this study were to develop a pedo-landscape map and a land capability classification of Vernazza catchment, in the Cinque Terre National Park (Main Map). Land capability map of the study area is dominated by class VII, these are lands with severe limitation due namely to stoniness, presence of rock fragments, useful depth and slope that make them generally unsuited to cultivation; only the 30% of the area may be used for crops but it requires very careful management and conservation practice. The map of the land capability classification will be a valid tool in helping Cinque Terre land managers and land use planners to manage land considering soil proprieties and potentialities, identifying areas with physical constraints for a range of land uses. In an historically terraced coastal agricultural landscape of a National Park recognized as a World Heritage site by UNESCO, a sustainable and correct territorial planning is pivotal.

Software

ESRI ArcGIS 9.2 is used to create the attribute database and compilation of the suitability map for this area and to produce the DEM. Saga GIS 6.3 is used to preprocess

and correct the DEM while ADOBE InDesign CS2 is used to create figures and the Map Design.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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LAND CAPABILITY CLASSIFICATION OF VERNAZZA CATCHMENT

Cinque Terre National Park, Italy

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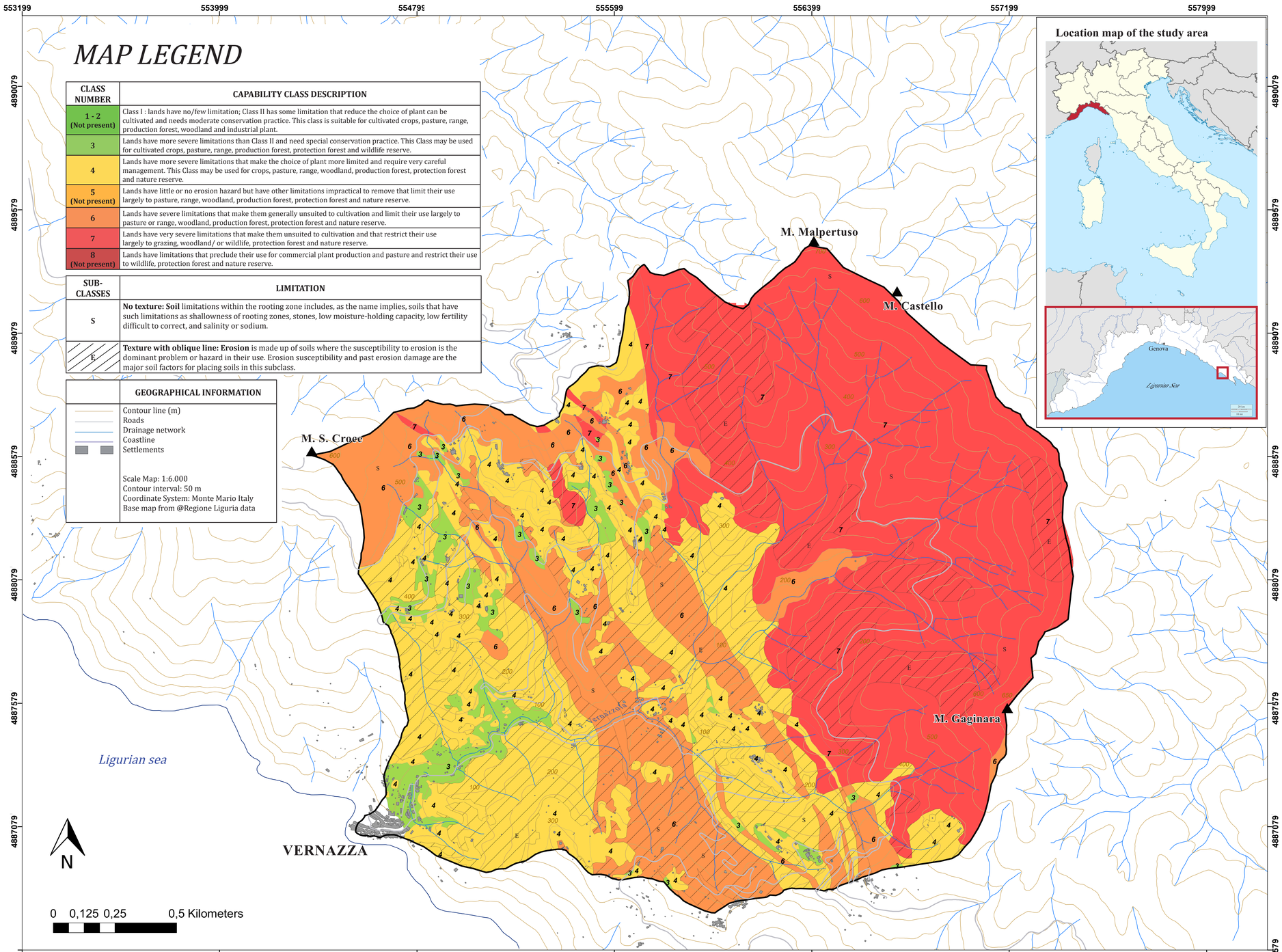
MAP LEGEND

CLASS NUMBER	CAPABILITY CLASS DESCRIPTION
1 - 2 (Not present)	Class I : lands have no/few limitation; Class II has some limitation that reduce the choice of plant can be cultivated and needs moderate conservation practice. This class is suitable for cultivated crops, pasture, range, production forest, woodland and industrial plant.
3	Lands have more severe limitations than Class II and need special conservation practice. This Class may be used for cultivated crops, pasture, range, production forest, protection forest and wildlife reserve.
4	Lands have more severe limitations that make the choice of plant more limited and require very careful management. This Class may be used for crops, pasture, range, woodland, production forest, protection forest and nature reserve.
5 (Not present)	Lands have little or no erosion hazard but have other limitations impractical to remove that limit their use largely to pasture, range, woodland, production forest, protection forest and nature reserve.
6	Lands have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, production forest, protection forest and nature reserve.
7	Lands have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland/ or wildlife, protection forest and nature reserve.
8 (Not present)	Lands have limitations that preclude their use for commercial plant production and pasture and restrict their use to wildlife, protection forest and nature reserve.

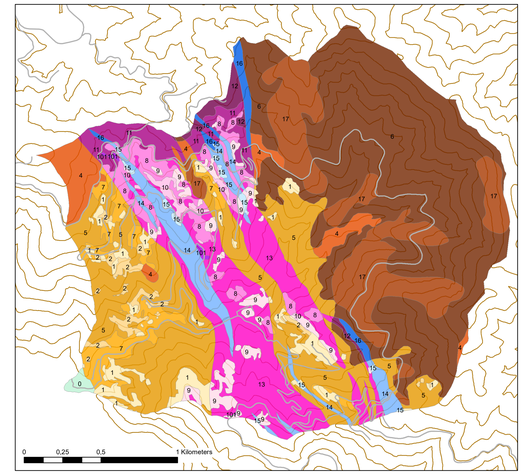
SUB-CLASSES	LIMITATION
S	**No texture: Soil** limitations within the rooting zone includes, as the name implies, soils that have such limitations as shallowness of rooting zones, stones, low moisture-holding capacity, low fertility difficult to correct, and salinity or sodium.
E	**Texture with oblique line: Erosion** is made up of soils where the susceptibility to erosion is the dominant problem or hazard in their use. Erosion susceptibility and past erosion damage are the major soil factors for placing soils in this subclass.

GEOGRAPHICAL INFORMATION
Contour line (m)
Roads
Drainage network
Coastline
Settlements

Scale Map: 1:6.000
Contour interval: 50 m
Coordinate System: Monte Mario Italy
Base map from @Regione Liguria data



PEDO-LANDSCAPE MAP



Pedo-landscape map legend with Land Capabiity Classification (LCC)

PEDO-LANDSCAPE UNIT			SOIL DESCRIPTION			
GEOLOGY	LAND USE	MAP UNIT	PHYSICAL PROPRIETIES OF SOIL	CHEMICAL PROPRIETIES OF SOIL	CLASSIFICATION WRB, 2015	LCC
Ponte Rotticci and Macigno Sandstones	Vineyard on terraced slope	1	Low to moderately developped soil on terraced slopes, with a superficial Ap horizon, loamy texture and more than 30% coarse fragment content in all the profile. Moderately well drained and high useful depth.	Acid reaction, non calcareous, moderately supplied with organic matter. Moderately high cation exchange capacity and low base saturation rate.	Association of Skeletic, Dystrict CAMBISOL (Escalic) and Skeletic, Brunic, Dystrict REGOSOL (Escalic)	4 S
	Olive crops on terraced slope	2	Soil on terraced slopes, loamy-sand texture and low than 30% coarse fragment content in all the profile. Moderately well drained and high useful depth.	Moderatly to strongly acid reaction, non calcareous, moderately supplied with organic matter. Moderately low cation exchange capacity.	Leptic, Brunic, Eutire REGOSOL (Escalic)	4 S
	Degraded terrace with grassland and pioneer formation of mediterranean maquis	3	Soil with A-C profile, loamy-sand texture and more than 50% coarse fragment content in all the profile. Moderately well drained and moderately high useful depth.	Moderatly acid reaction, non calcareous, moderately supplied with organic matter in the upper part. Moderately low cation exchange capacity.	Leptic, Skeletic, Endodystric REGOSOL (Escalic)	3 S
	Degraded terrace with mediterranean maquis and wood	4	Soil on abandoned terraced slope with a buried horizon, loamy-sand texture and more than 50% coarse fragment content at the bottom. High runoff and moderately low useful depth.	Moderatly acid reaction, non calcareous, moderately supplied with organic matter. Moderately high cation exchange capacity.	Hyperskeletic Eutric LEPTOSOL (Colluvic Novic)	4 S E
	Mediterranean maquis and ilex wood on steep slope	5	Very shallow soils, loamy-sand texture and more than 30% coarse fragment content in all the profile. High runoff and very low useful depth.	Acid reaction, non calcareous, well supplied with organic matter. Moderately high cation exchange capacity and low base saturation rate.	Association of Leptic Dystric CAMBISOL (Humic) and Leptic Dystric REGOSOL (Arenic)	6 S
	Pinewood on steep slope	6	Very shallow soils, loamy-sand texture and more than 30% coarse fragment content in all the profile. High runoff and very low useful depth.	Acid reaction, non calcareous, well supplied with organic matter, but with slow humification. High cation exchange capacity and low base saturation rate.	Leptic, Skeletic, Dystric REGOSOL (Ochric)	7 S E
	Mesophilous broad - leaved forest on steep slope	7	Shallow soils with a A-Bw-C profile, loamy texture and low than 30% coarse fragment content in all the profile. Moderaltly high runoff and low useful depth.	Acid reaction, non calcareous, moderately supplied with organic matter. Moderately high cation exchange capacity and very low base saturation rate.	Leptic, HyperDystric CAMBISOL (Humic)	7 S
Canetolo Shales and Limestones	Vineyard on terraced slope	8	Soil on terraced slopes, often with a with a buried horizon because of the terrace re-arrangement; loamy texture and more than 30% coarse fragment content in all the profile. Moderately well drained and High useful depth.	Neutral reaction, non calcareous, moderately supplied with organic matter. Moderately high cation exchange capacity.	Skeletic, Eutric CAMBISOL (Novic, Transportic, Escalic)	4 S
	Olive and other arboreus crops on terraced slope	9	Low to moderatly developped soil on terraced slopes, loamy texture and more than 30% coarse fragment content at the bottom. Moderately well drained and moderately useful depth.	Neutral reaction, slightly calcareous, well supplied with organic matter. Moderately high cation exchange capacity and high base saturation rate.	Association of Skeletic, Eutric REGOSOL (Escalic) and Skeletic, Eutric CAMBISOL (Escalic, Humic)	3 S
	Degraded terrace with grassland and pioneer formation of mediterranean maquis	10	Soil on recent abandoned terraced slopes, loamy to loamy clayic texture and more than 50% coarse fragment. Moderately well drained and moderately useful depth.	Alkaline reaction, higly calcareous, well supplied with organic matter. High cation exchange capacity and high base saturation rate.	Skeletic, Calcaric REGOSOL (Clayic, Escalic, Humic)	4 S
	Degraded terrace with mediterranean maquis and wood	11	Soil on abandoned terraced slopes, loamy texture and more than 30% coarse fragment content at the bottom. Moderately well drained and moderately useful depth.	Acid to Neutral reaction depending to litology, not calcareous, moderatly supplied with organic matter. High cation exchange capacity.	Association of Leptic, Skeletic, Dystric REGOSOL (Escalic) and Skeletic, Eutric REGOSOL (Escalic)	6 S E
	Grassland on simple slope	12	Soil with a A-C profile, loamy texture and more than 50% coarse fragment content in all the profile. Moderately well drained and high useful depth.	Neutral reaction, not calcareous, moderately well supplied with organic matter. High cation exchange capacity and high base saturation rate.	Leptic, Eutric REGOSOL (Humic)	3 S
	Mediterranean maquis and ilex wood on steep slope	13	Shallow soil with a A-B-C profile, loamy texture and more than 50% coarse fragment at the bottom. Moderately well drained, superficial runoff and low useful depth.	Acid reaction, not calcareous, moderately well supplied with organic matter. High cation exchange capacity and very low base saturation rate.	Leptic, Skeletic, HyperDystric CAMBISOL	6 S
	Mesophilous broad - leaved forest on steep slope	14	Shallow soil with a A-C profile and more than 50% coarse fragment at the bottom. Moderately well drained , superficial runoff and low useful depth.	Neutral reaction, not calcareous, well supplied with organic matter. High cation exchange capacity and high base saturation rate.	HyperSkeletic, Eutric LEPTOSOL (Ochric)	4 S
Gruppo del Vescovo Limestone and T. Pignone Marls	Olive and Vineyard crops on terraced slope	15	Shallow soil on terraced slopes, loamy texture and more than 20% coarse fragment. Moderately well drained and low useful depth.	Alkaline reaction, calcareous, well supplied with organic matter. High cation exchange capacity and very high base saturation rate.	Leptic, Calcaric REGOSOL (Escalic)	3 S
	Degraded terraces with mediterranean maquis	16	Shallow soil on terraced slopes, loamy texture and more than 50% coarse fragment. Moderately well drained and low useful depth.	Alkaline reaction, higly calcareous, well supplied with organic matter. High cation exchange capacity and high base saturation rate.	Skeletic, Calcaric REGOSOL (Escalic, Humic)	6 S
	Mediterranean maquis and mixed wood on steep slope	17	Soil on terraced slopes, clay-loamy texture and more than 50% coarse fragment. Moderately well drained and medium useful depth.	Acid reaction, not calcareous, well supplied with organic matter. High cation exchange capacity and low base saturation rate at the bottom.	Leptic, Skeletic, OrthoDystric CAMBISOL (Humic)	7 S