Tools for Risk Management

Risk Assessment of the Garfagnana Valley

GROUP 8

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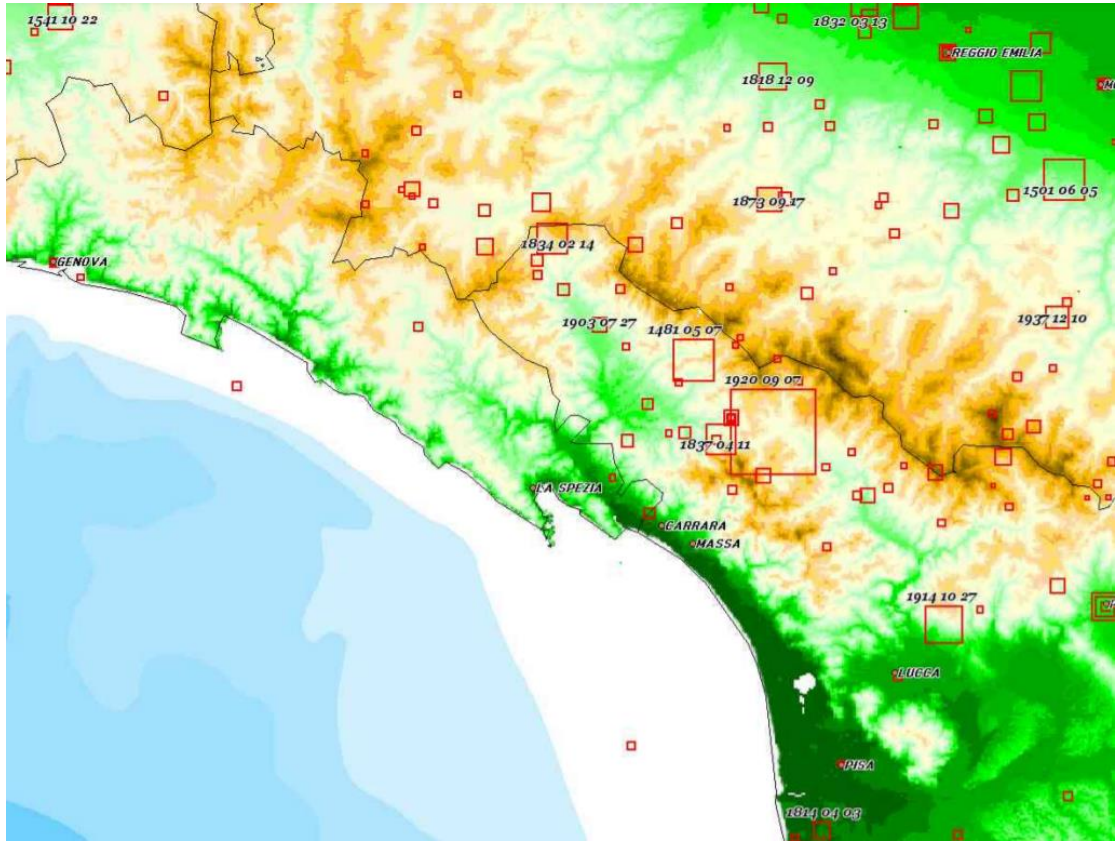
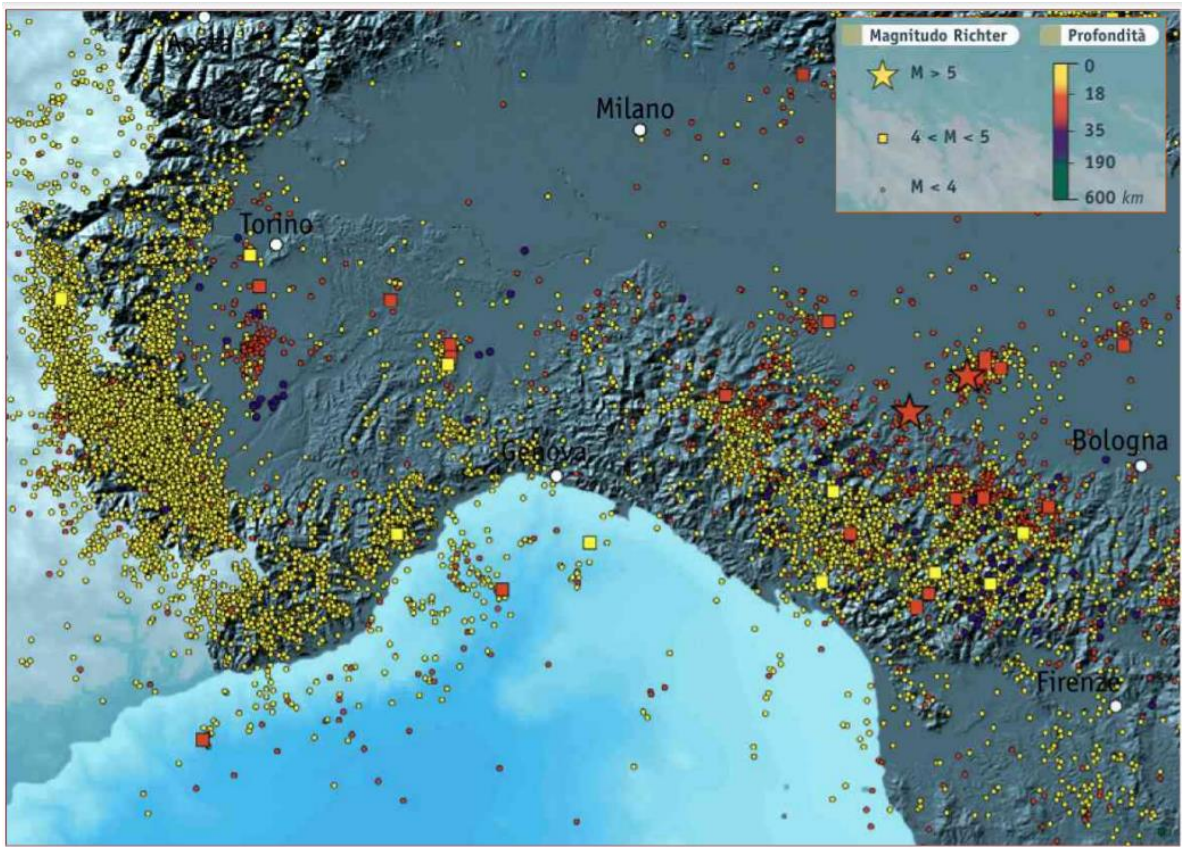
OUTLINE

1. PROJECT BACKGROUND
2. OBJECTIVES
3. RISK ASSESSMENT
    - 3a. Hazard Assessment
    - 3b. Exposure Analysis
    - 3c. Vulnerability Assessment
        - 3c.i. Physical Vulnerability Assessment
        - 3c.ii Systemic Vulnerability Assessment
    - 3d. Damage Scenario
        - 3d.i. Physical Damage Scenario
        - 3c.ii Systemic Damage Scenario
4. MITIGATION MEASURES

1. BACKGROUND

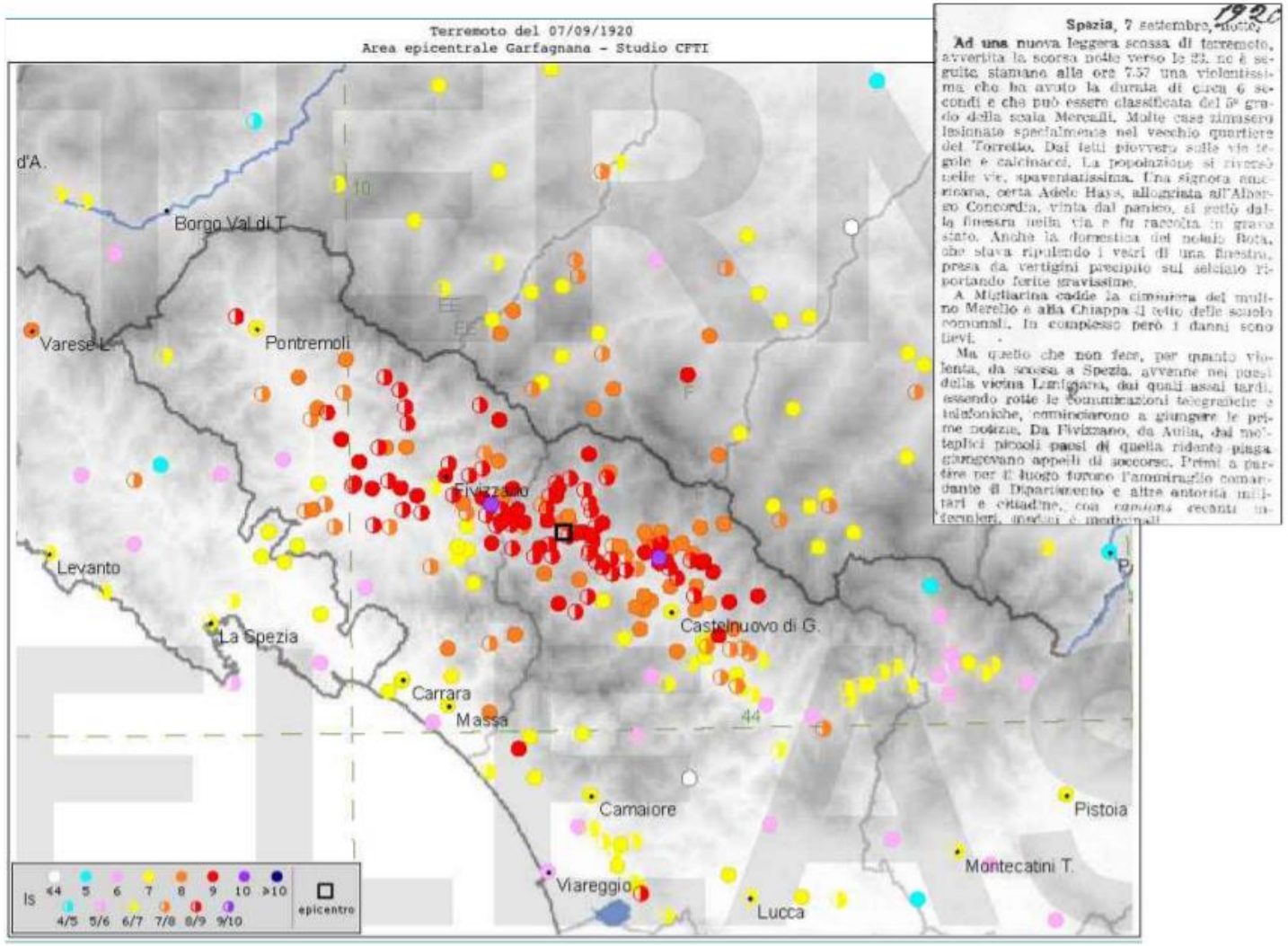


Seismic History in Tuscany



Recent Seismic Activity
(1981 – 2002)

BACKGROUND



Spazia, 7 settembre, notte.

Ad una nuova leggera scossa di terremoto, avvertita la scorsa notte verso le 23. ne è seguita stamane alle ore 7.57 una violentissima che ha avuto la durata di circa 6 secondi e che può essere classificata del 5° grado della scala Mercalli. Molte case rimasero lesionate specialmente nel vecchio quartiere del Torretto. Dai tetti piovvero sulle vie tegole e calcinacci. La popolazione si riversò nelle vie, spaventatissima. Una signora americana, certa Adele Hays, alloggiata all'Albergo Concordia, vinta dal panico, si gettò dalla finestra nella via e fu raccolta in grave stato. Anche la domestica del notaio Bota, che stava ripulendo i vetri di una finestra, presa da vertigini precipitò sul selciato riportando ferite gravissime.

A Migliarina cadde la cimasetta del mulino Merello e alla Chiappa il tetto delle scuole comunali. In complesso però i danni sono lievi.

Ma quello che non fece, per quanto violenta, da scossa a Spezia, avvenne nei paesi della vicina Lunigiana, dai quali assai tardi, essendo rotte le comunicazioni telegrafiche e telefoniche, cominciarono a giungere le prime notizie. Da Fivizzano, da Aulla, dai molteplici piccoli paesi di quella ridente plaga giungevano appelli di soccorso. Primi a partire per il luogo furono l'ammiraglio comandante il Dipartimento e altre autorità militari e cittadine, con camions recanti in-fermieri, medici e medicinali.

Garfagnana valley is prone to seismic activities. As shown in the previous maps, it's located in an area of active faults.

In 1920, an earthquake event occurred with an intensity rated 6.6 on the Richter magnitude scale.

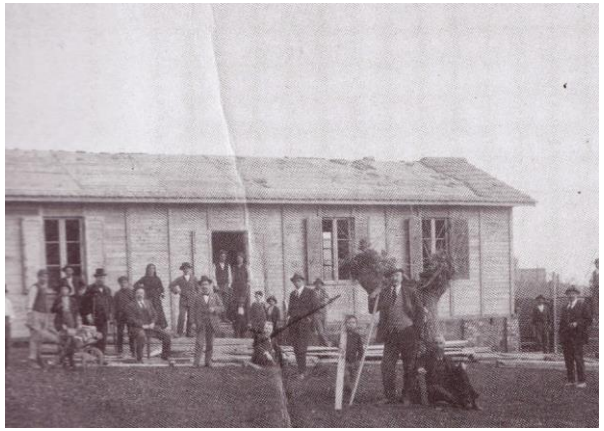
It was one of the most destructive seismic events recorded in the Apenninic region in the twentieth century.

The focus of this study is mainly about the risk assessment and mitigation measures aiming to reduce the physical and economical losses in the future.

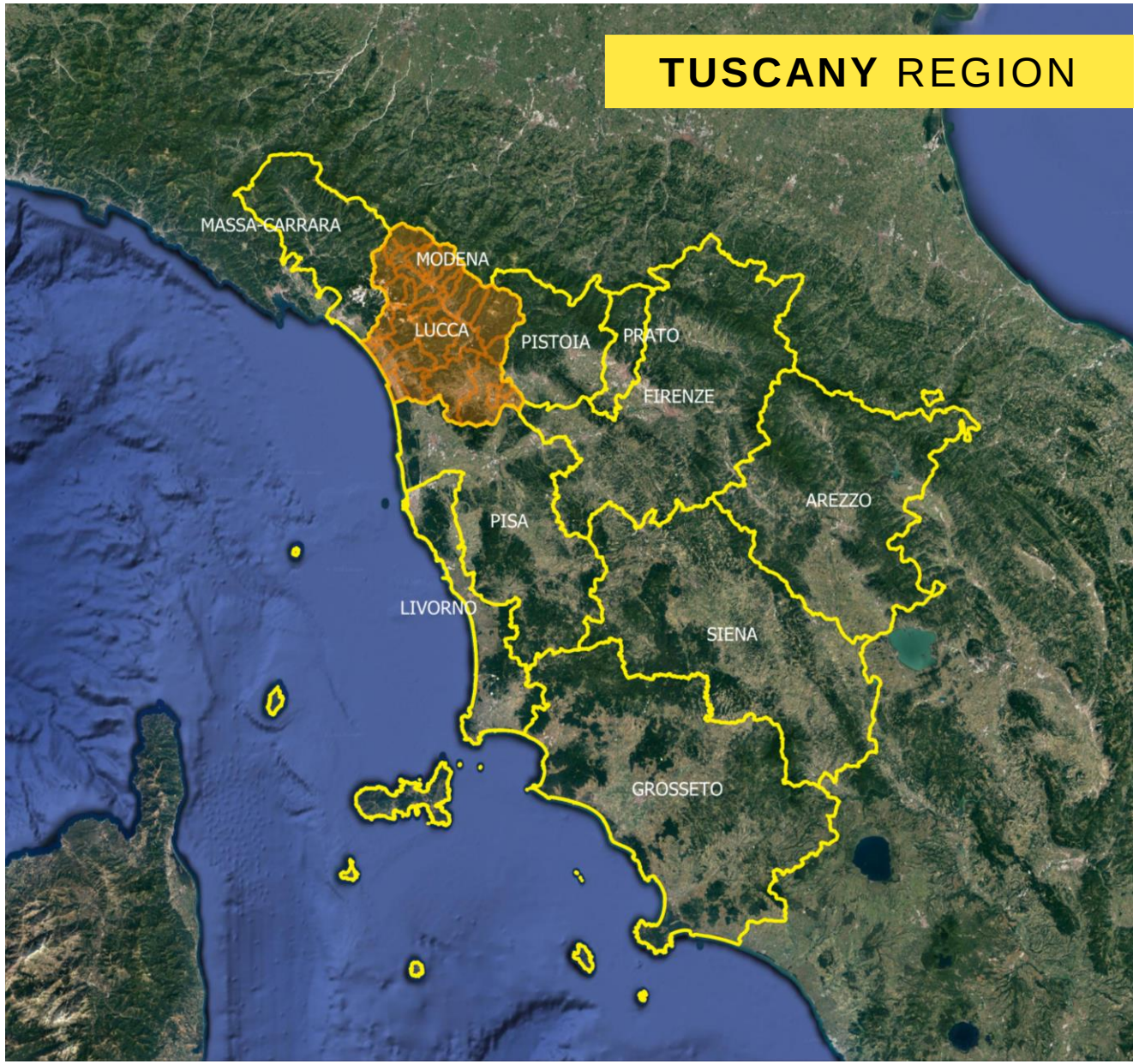
2. OBJECTIVES

1. Assessing the physical damage scenario
2. Assessing the systemic damage scenario
3. Proposing a plan to reduce the risk of Garfagnana

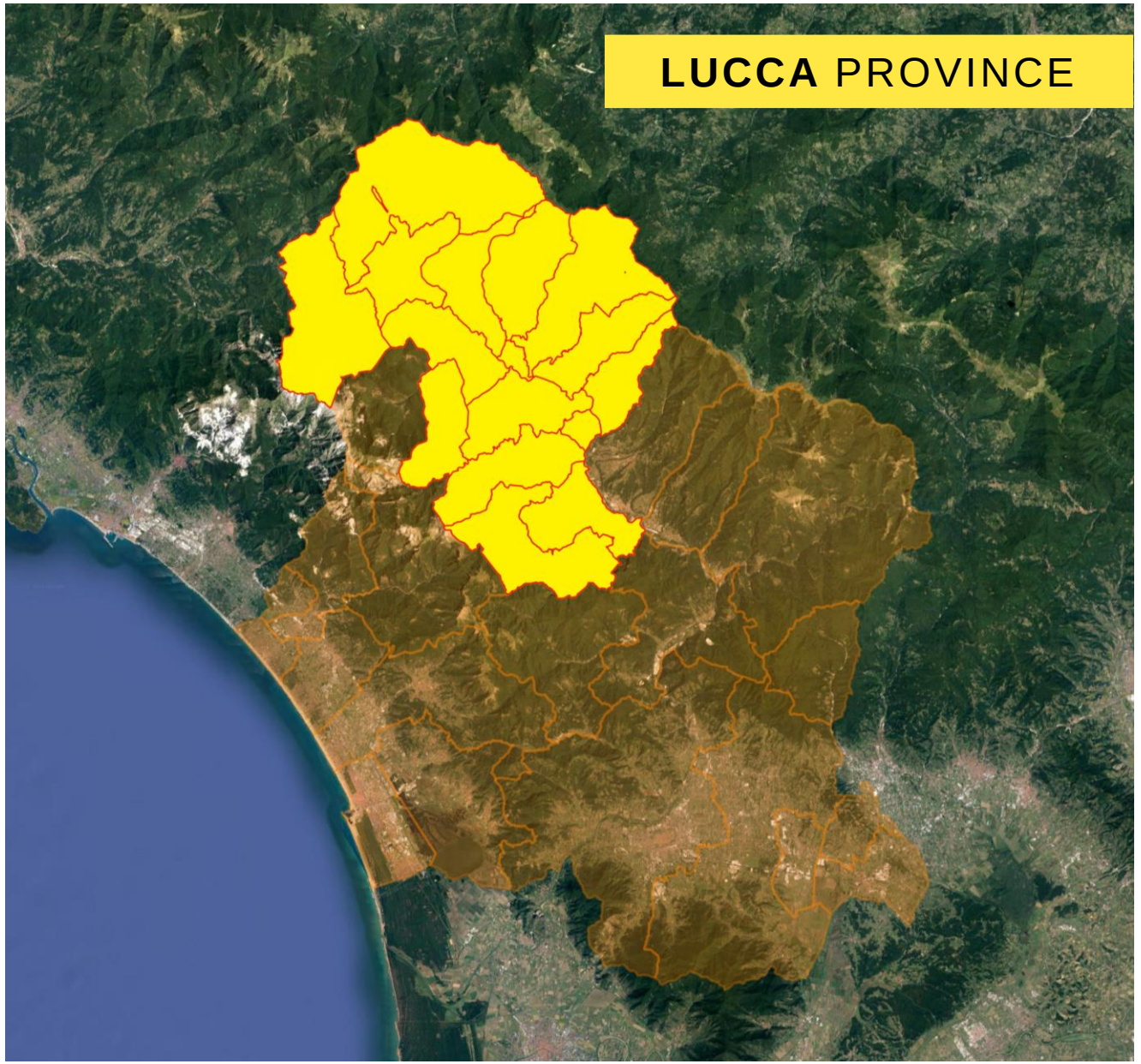
La chiesa di Villa Colemandina.



WHERE IS GARFAGNANA ?



WHERE IS GARFAGNANA ?

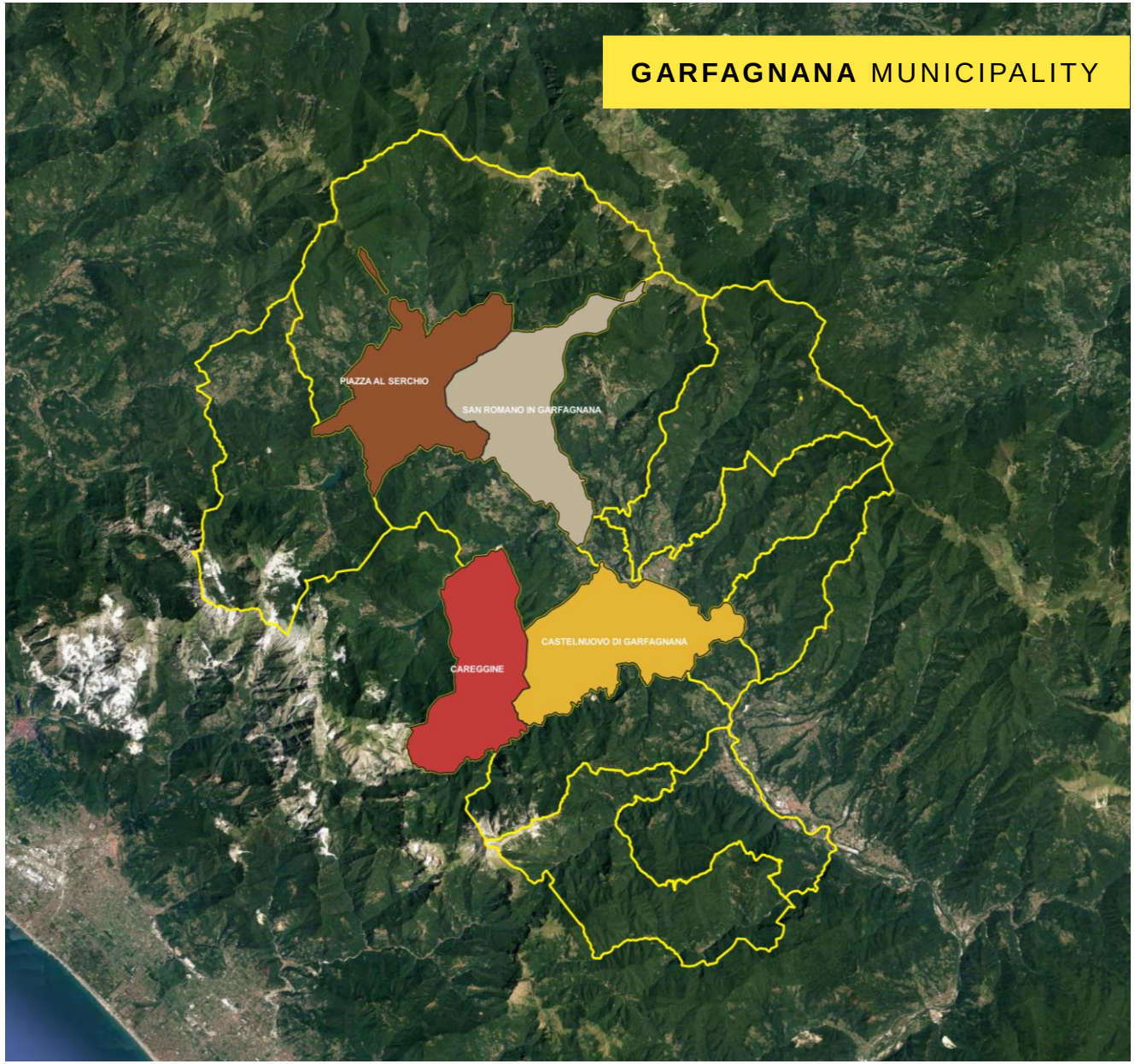


OUR AREA OF INTEREST

I. Valley scale

II. Municipality scale (4/14);

- Careggine
- San Romano in Garfagnana
- Castelnuovo di Garfagnana
- Piazza Al Serchio



RISK ASSESSMENT

02

Exposure Analysis

- Population
- Assets

04

Damage Scenario

- Physical Damage Scenario
- Systemic Damage Scenario

01

Hazard Assessment

03

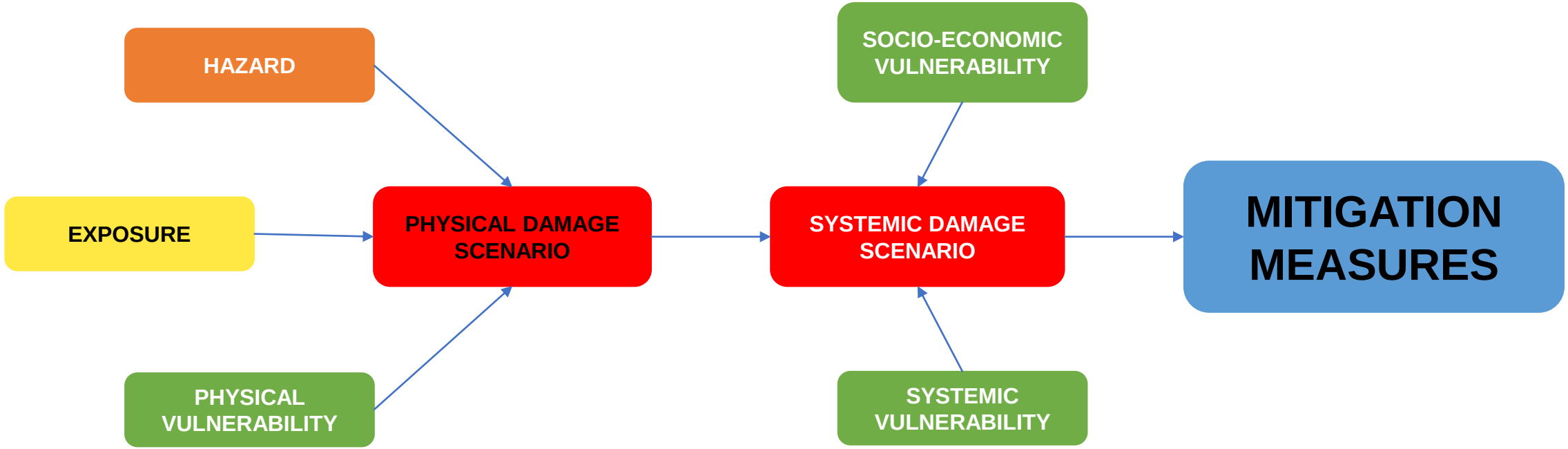
Vulnerability Assessment

- Physical Vulnerability
- Systemic Vulnerability
- Socio-economic Vulnerability

05

Mitigation Measures

METHODOLOGY

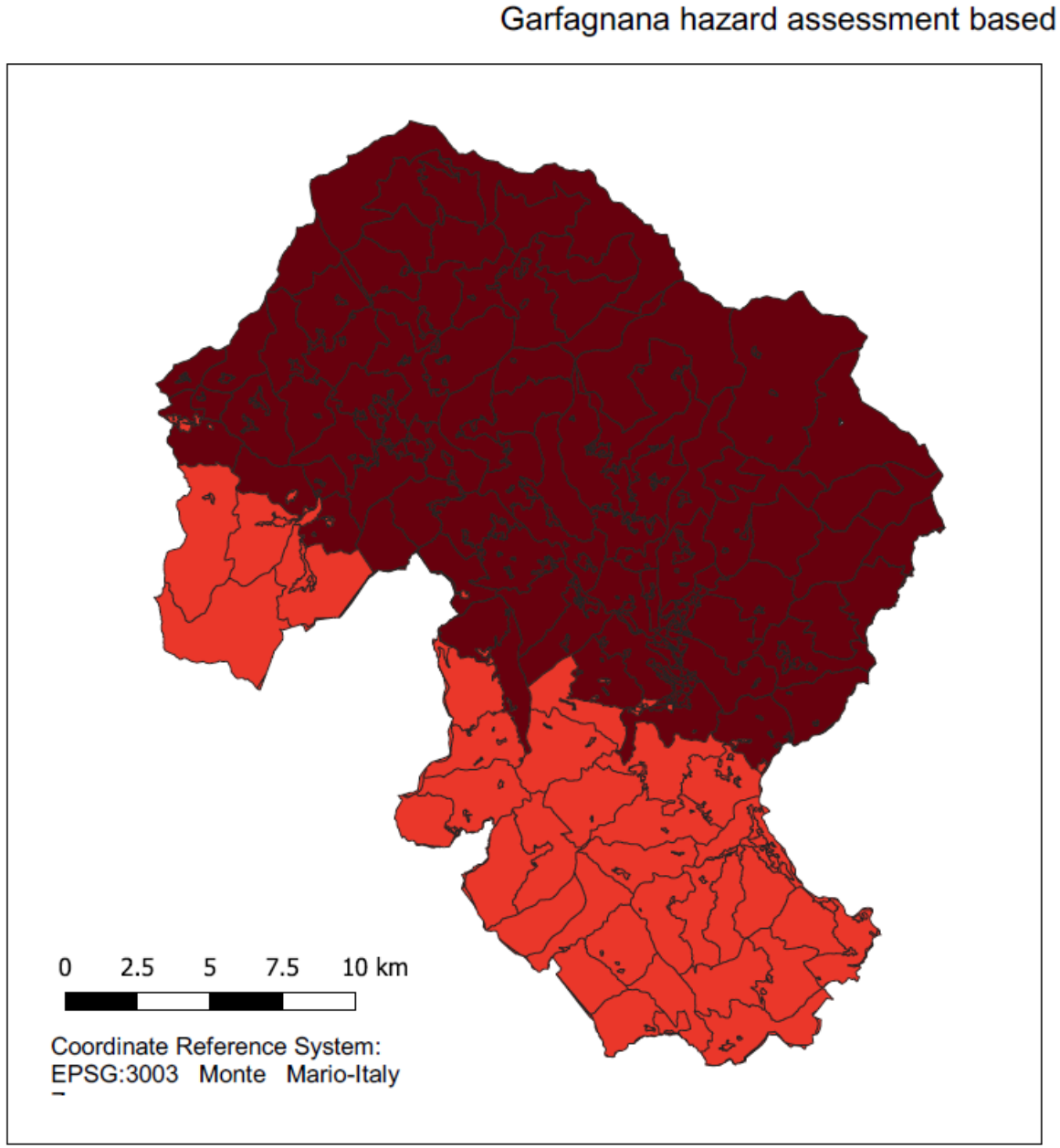


HAZARD

Generate hazard maps considering several types of hazard such as seismic, landslides, and microzonation

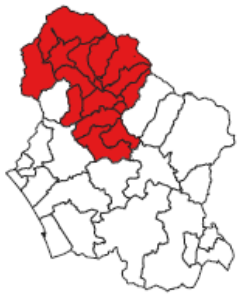
SEISMIC HAZARD MAP

Score	Classification
1	Low Seismic Hazard
2	Medium Low Seismic Hazard
3	Medium High Seismic Hazard
4	High Seismic Hazard



LANDSLIDES HAZARD MAP

Garfagnana hazard assessment based on Landslides

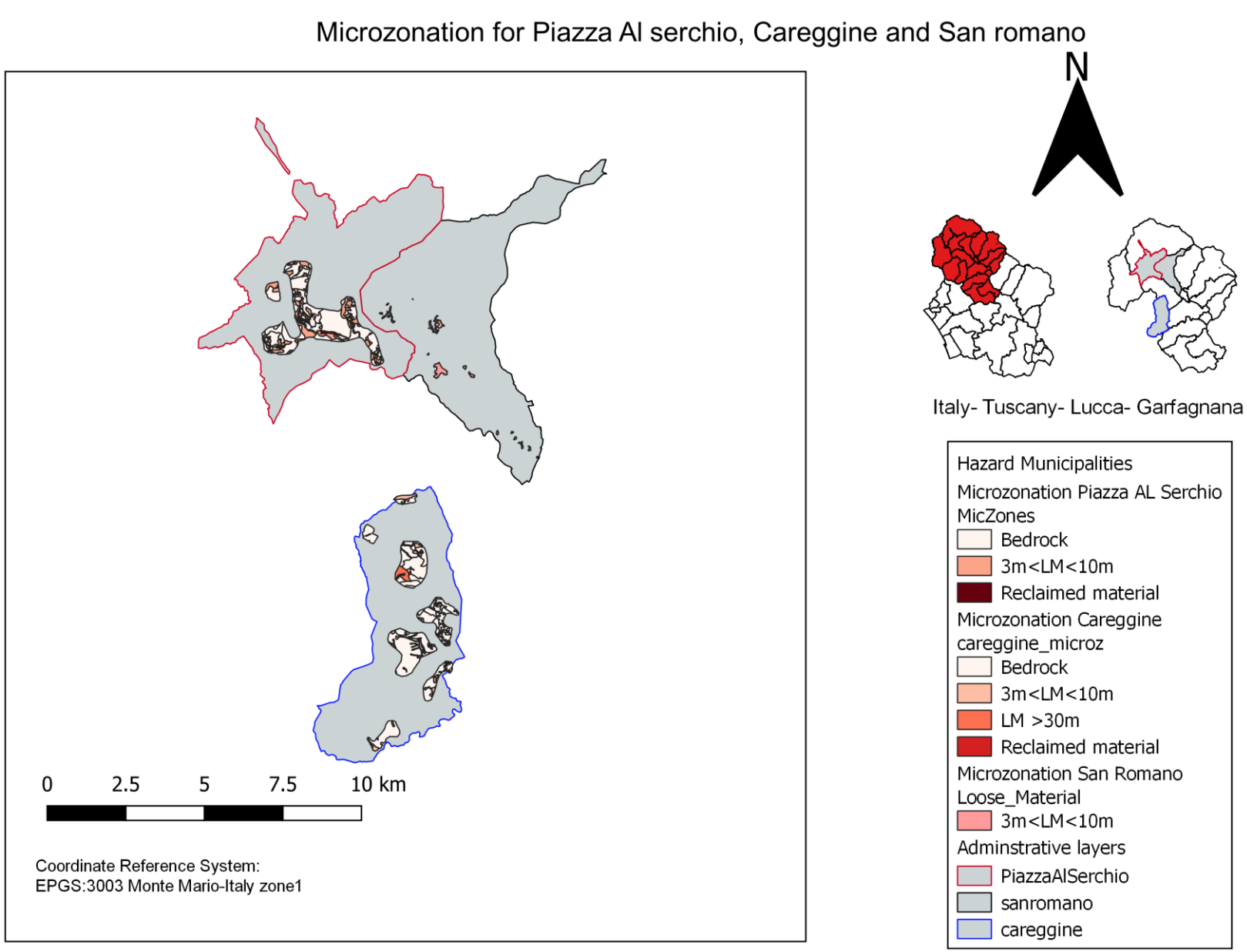


Italy,Tuscany, Lucca, Garfagnana

HAZARD
Hazard Garfagnana Valley
Landslide Garfagnana Valley
Low Landslides Hazard
High Landslide Hazard

	Score	Classification
Quiescent	1	Low Landslide hazard
Active	4	High Landslide hazard

MICRO-ZONATION MAP



Italy- Tuscany- Lucca- Garfagnana

Hazard Municipalities
Microzonation Piazza AL Serchio
MicZones
Bedrock
3m<LM<10m
Reclaimed material
Microzonation Careggine
careggine_microz
Bedrock
3m<LM<10m
LM >30m
Reclaimed material
Microzonation San Romano
Loose_Material
3m<LM<10m
Adminstrative layers
PiazzaAlSerchio
sanromano
careggine

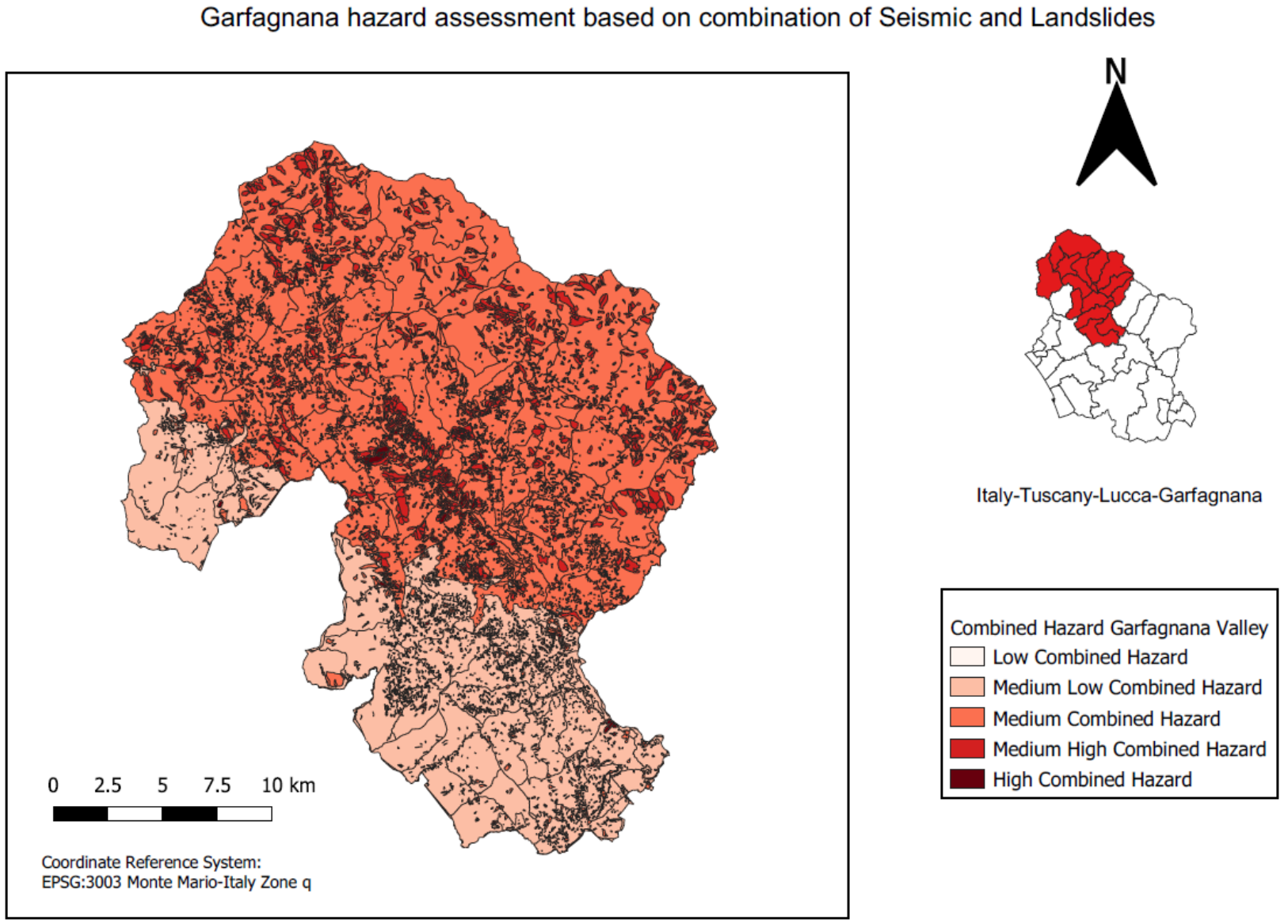
Given the microzonation for three municipalities (Careggine, Sanromano, and Piazza Al Serchio)

GARFAGNANA **COMBINED HAZARD MAP**

Valley scale

Methodology:

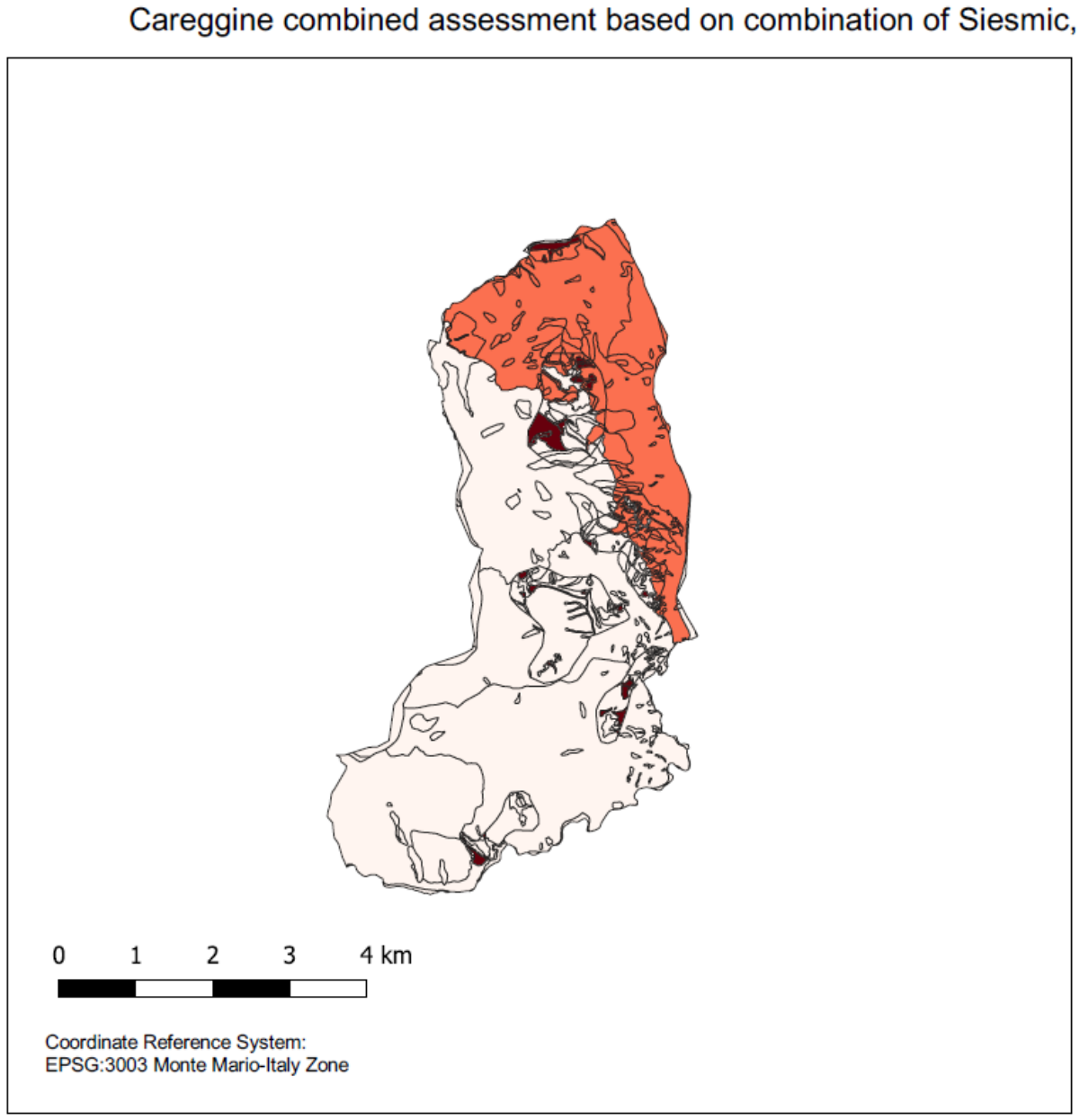
Hazard = Seismic + Landslides

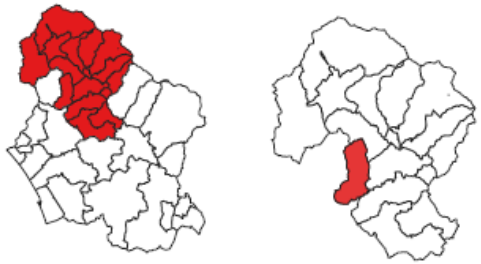


COMBINED HAZARD MAP

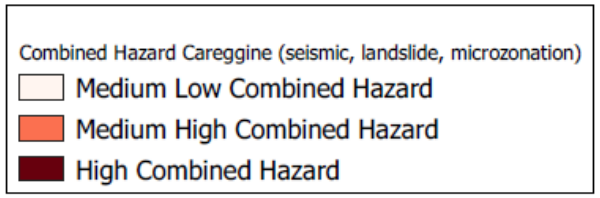
Municipality scale

(Careggine)





Italy- Tuscany- Lucca- Garfagnana- Careggine



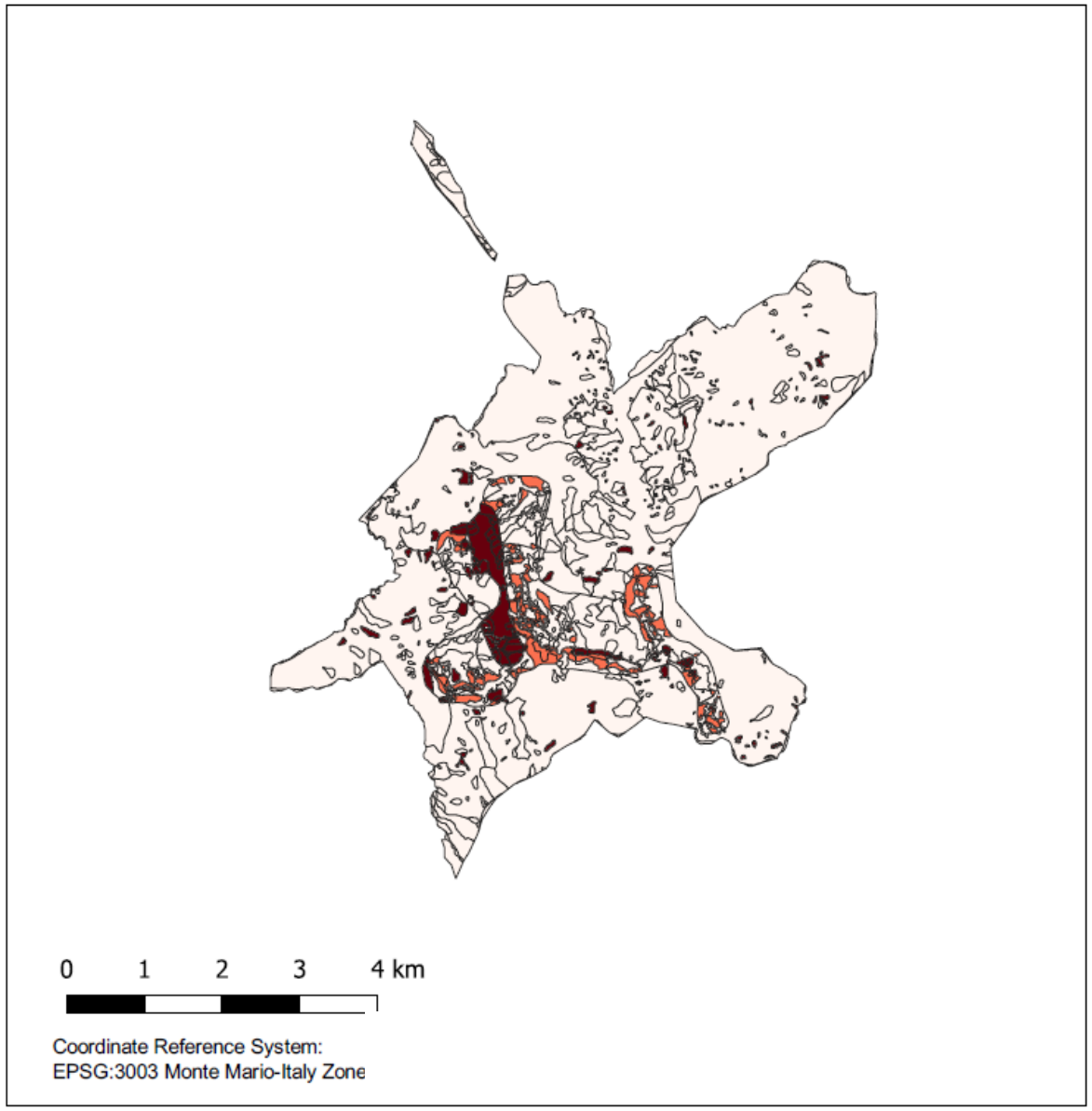
Methodology:

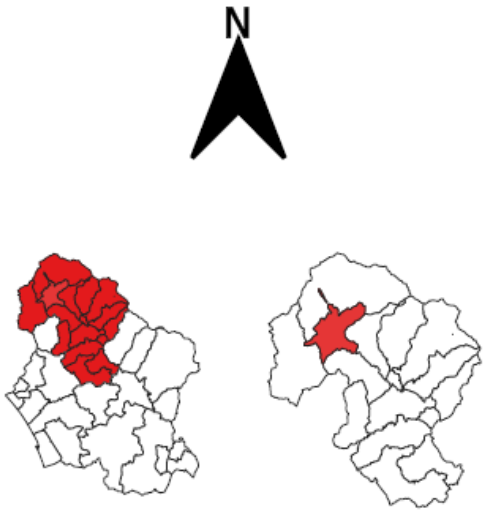
*Hazard = Seismic * Microzonation + Landslides*

COMBINED HAZARD MAP

Municipality scale

(Piazza Al Serchio)





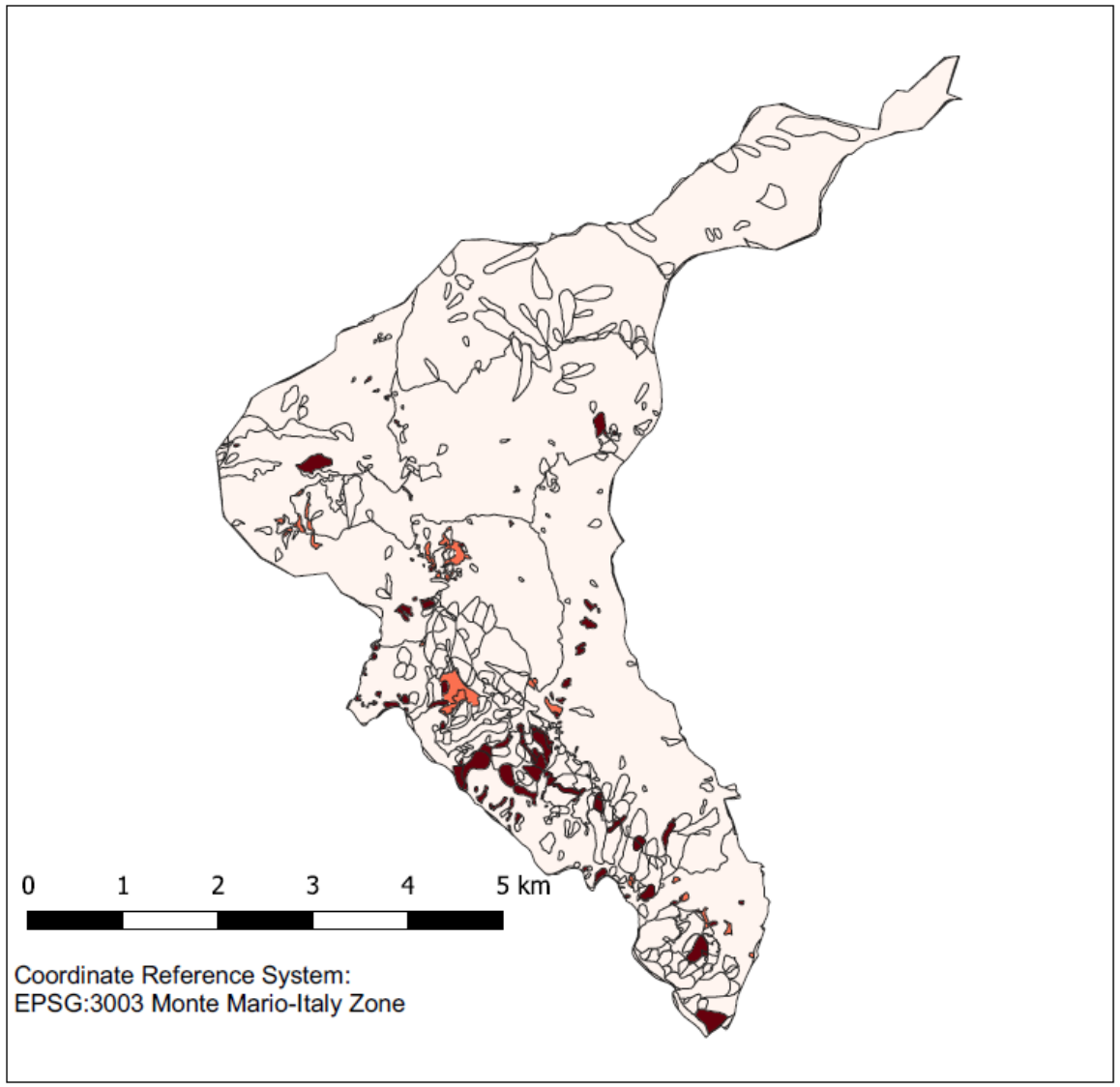
Italy- Tuscany- Lucca- Garfagnana- Piazza Al Serchio

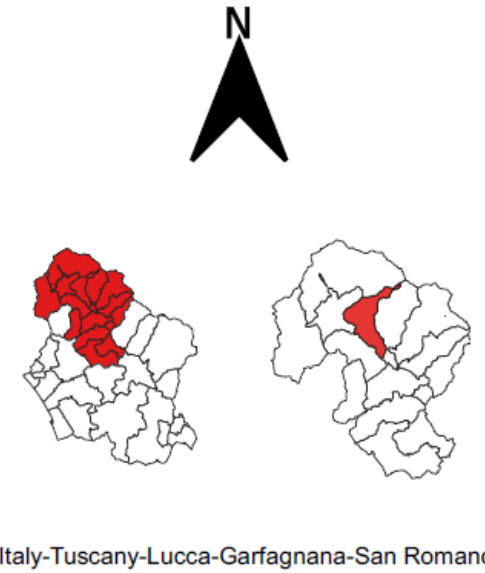
Methodology:

*Hazard = Seismic * Microzonation + Landslides*

COMBINED HAZARD MAP

San Romano combined hazard assessment based on combination of Siesmic, Landslides and Microzonation





Italy-Tuscany-Lucca-Garfagnana-San Romano

HAZARD
Hazard Municipalities
Combined Hazard Municipalities Scale (seismic, landslide, microzonation)
Combined Hazard San Romano (seismic, landslide, microzonation)
Medium High Combined Hazard
High Combined Hazard
Extremely High Combined Hazard

Municipality scale

(Sanromano)

Methodology:

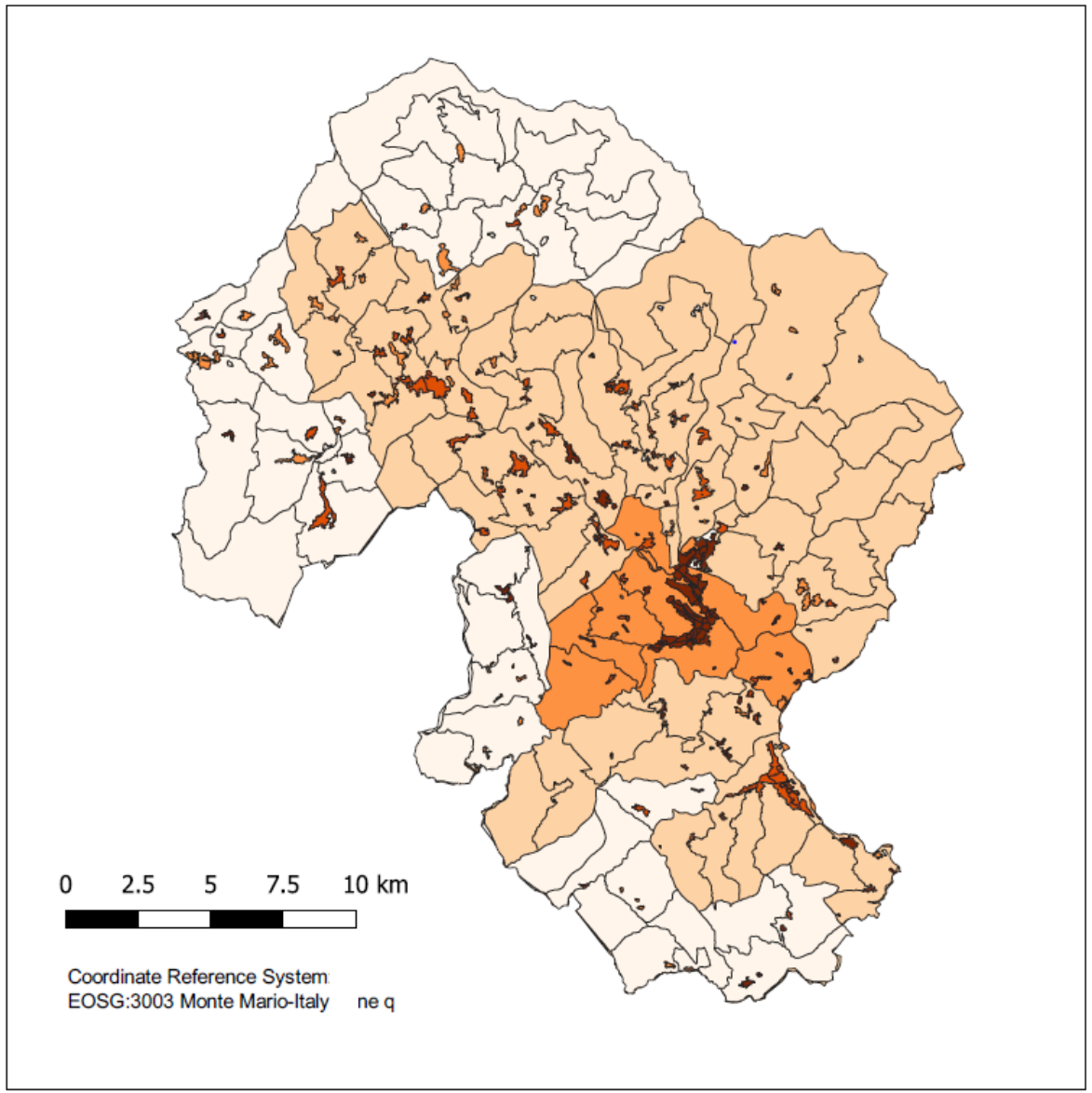
*Hazard = Seismic * Microzonation + Landslides*

EXPOSURE

Assessing the **number of people** and **number of objects**, **assets**, **infrastructures** in an area exposed to a threat to a natural hazard.

EXPOSURE: POPULATION

Valley scale



Italy- Tuscany- Lucca- Garfagnana

EXPOSURE

Exposure Garfagnana

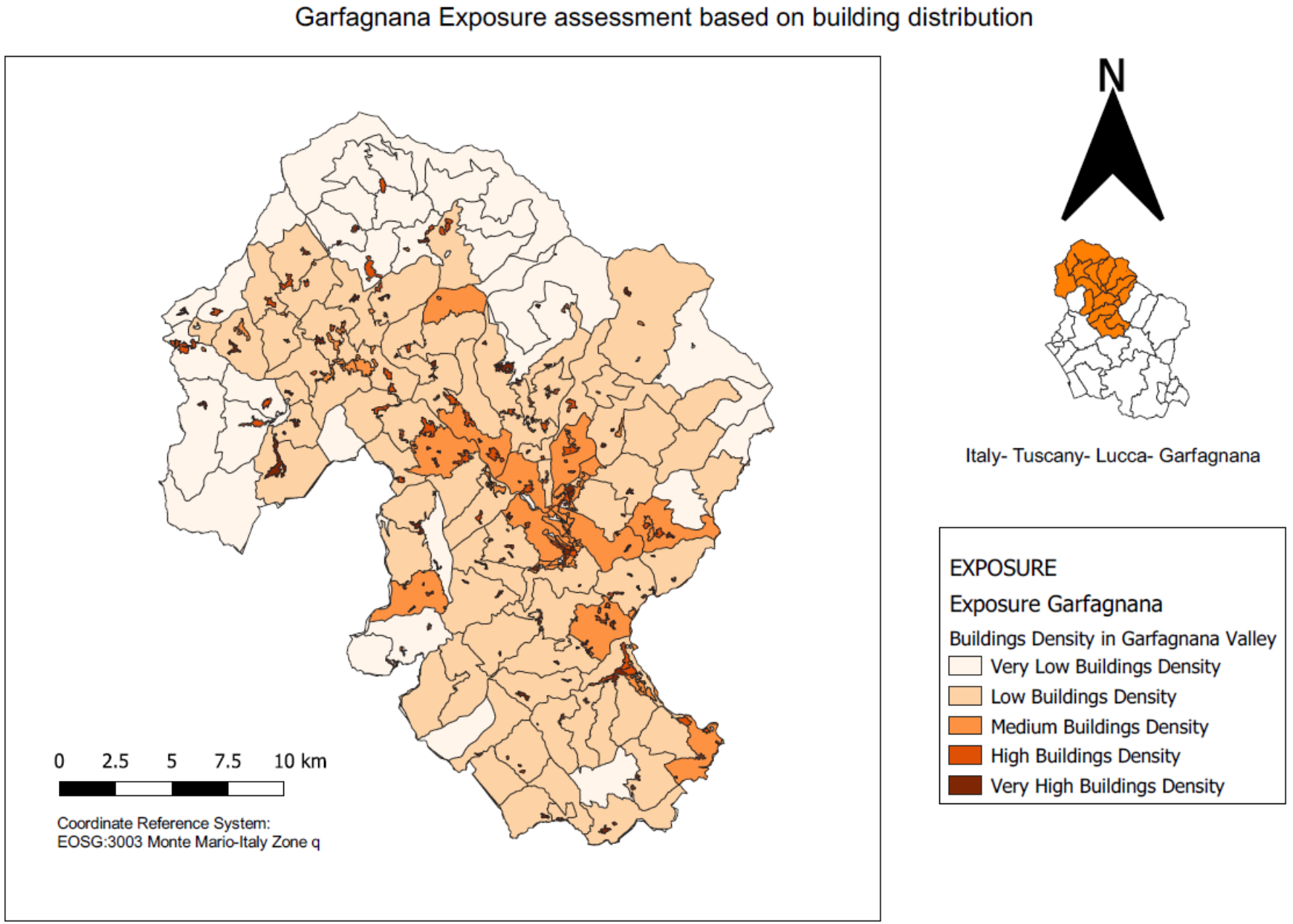
Population Density in Garfagnana Valley

- Very Low Population Density
- Low Population Density
- Medium Population Density
- High Population Density
- Very High Population Density

Analysis based on total population density

EXPOSURE: BUILDING

Valley scale

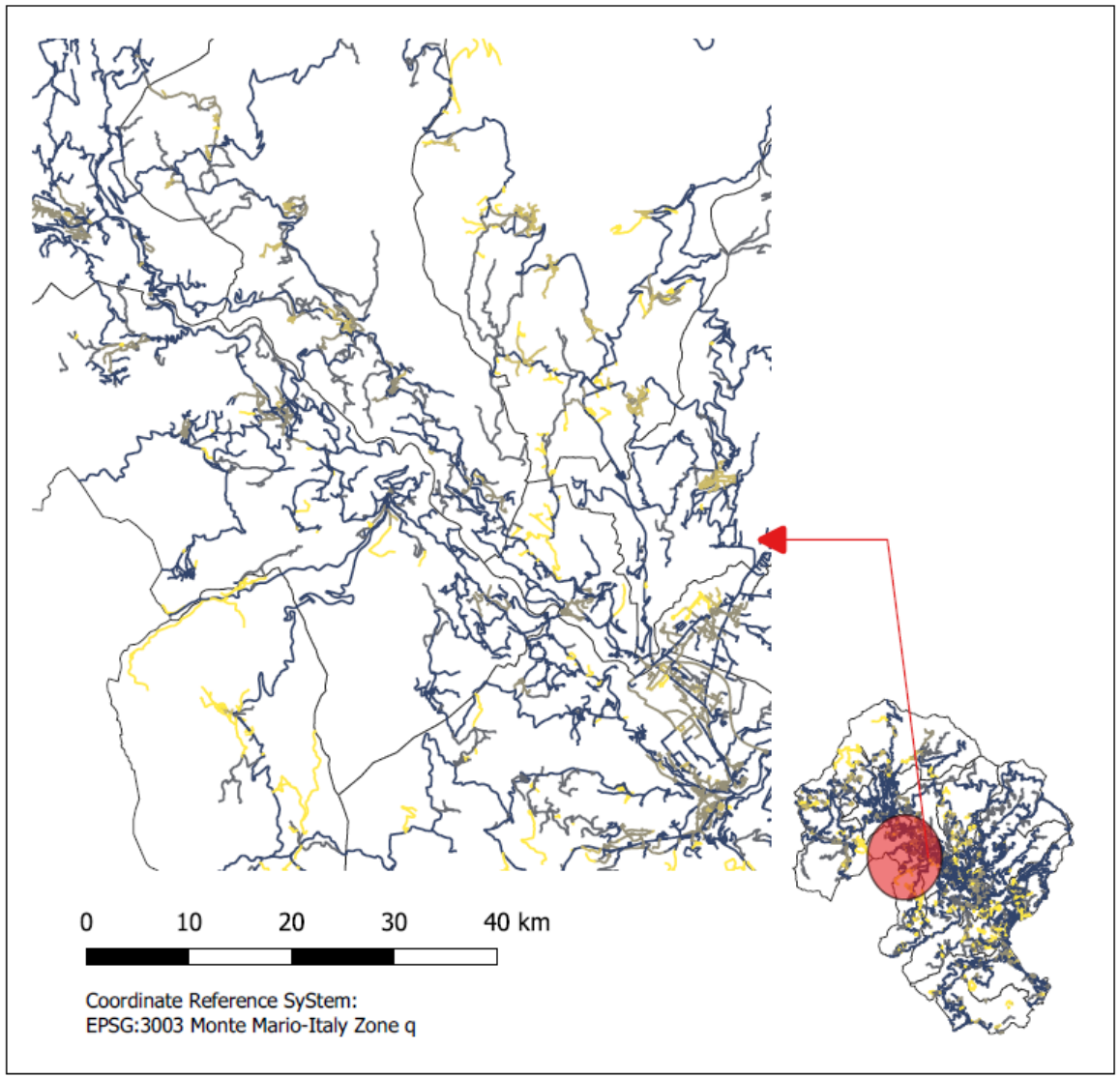


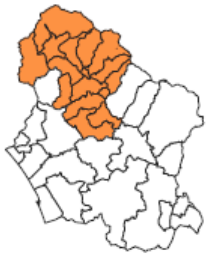
Analysis based on total building density

EXPOSURE: INFRASTRUCTURE

Valley scale

Garfagnana Road's exposure assessment based on the type of the roads





Italy- Tuscany- Lucca- Garfagnana

EXPOSURE

Exposure Garfagnana

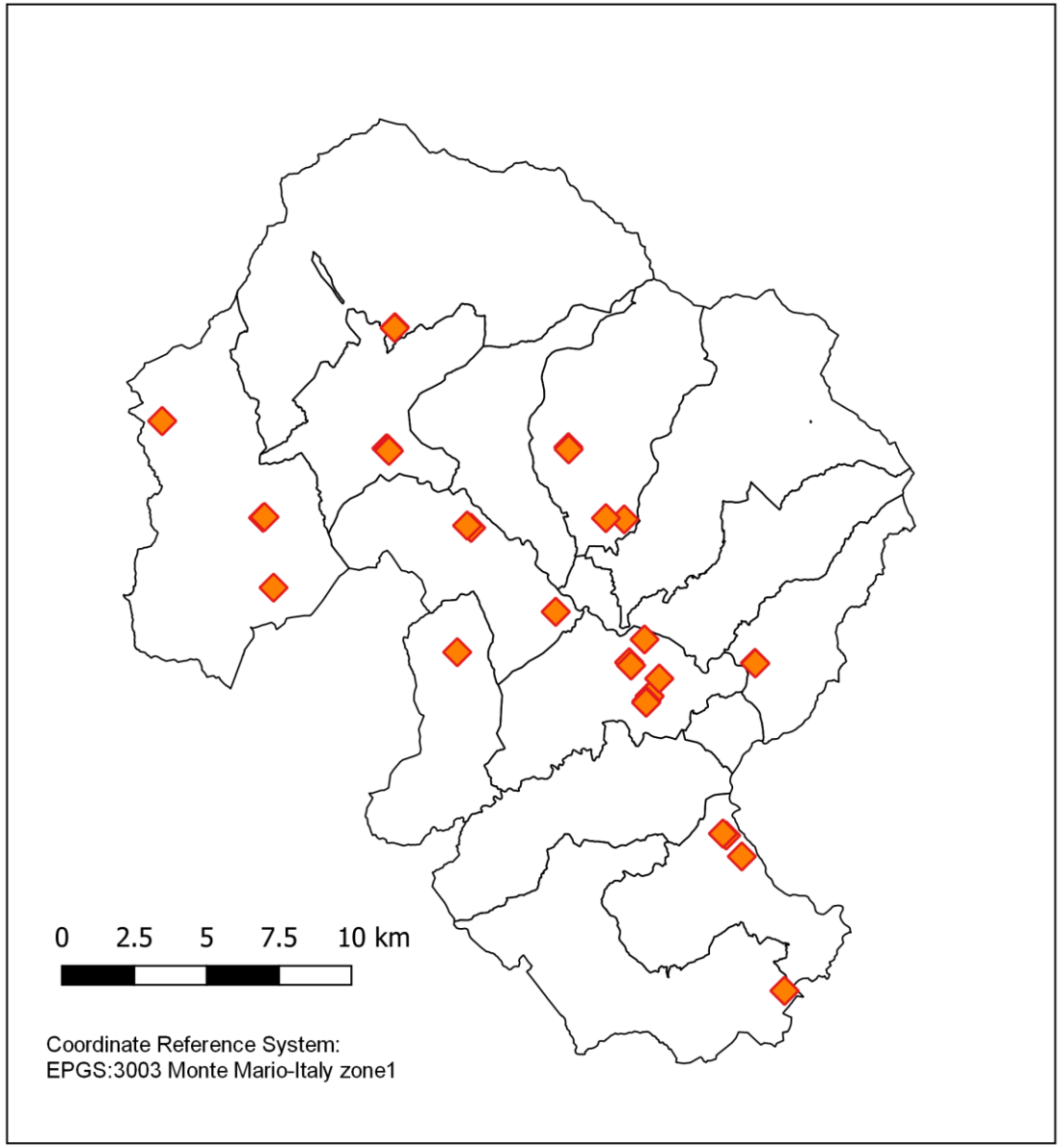
Road Classification Garfagnana Valley

- Highways
- Main Extra Urban Roads
- Secondary Extra Urban Roads
- Urban Roads
- Neighborhood Streets
- Local Roads

Analysis based on type of roads (width)

EXPOSURE: SCHOOLS

Valley scale



Italy- Tuscany- Lucca- Garfagnana

EXPOSURE
Exposure Garfagnana
Schools in Garfagnana Valley
Adminstrative layers
Garfanana valley municipalities

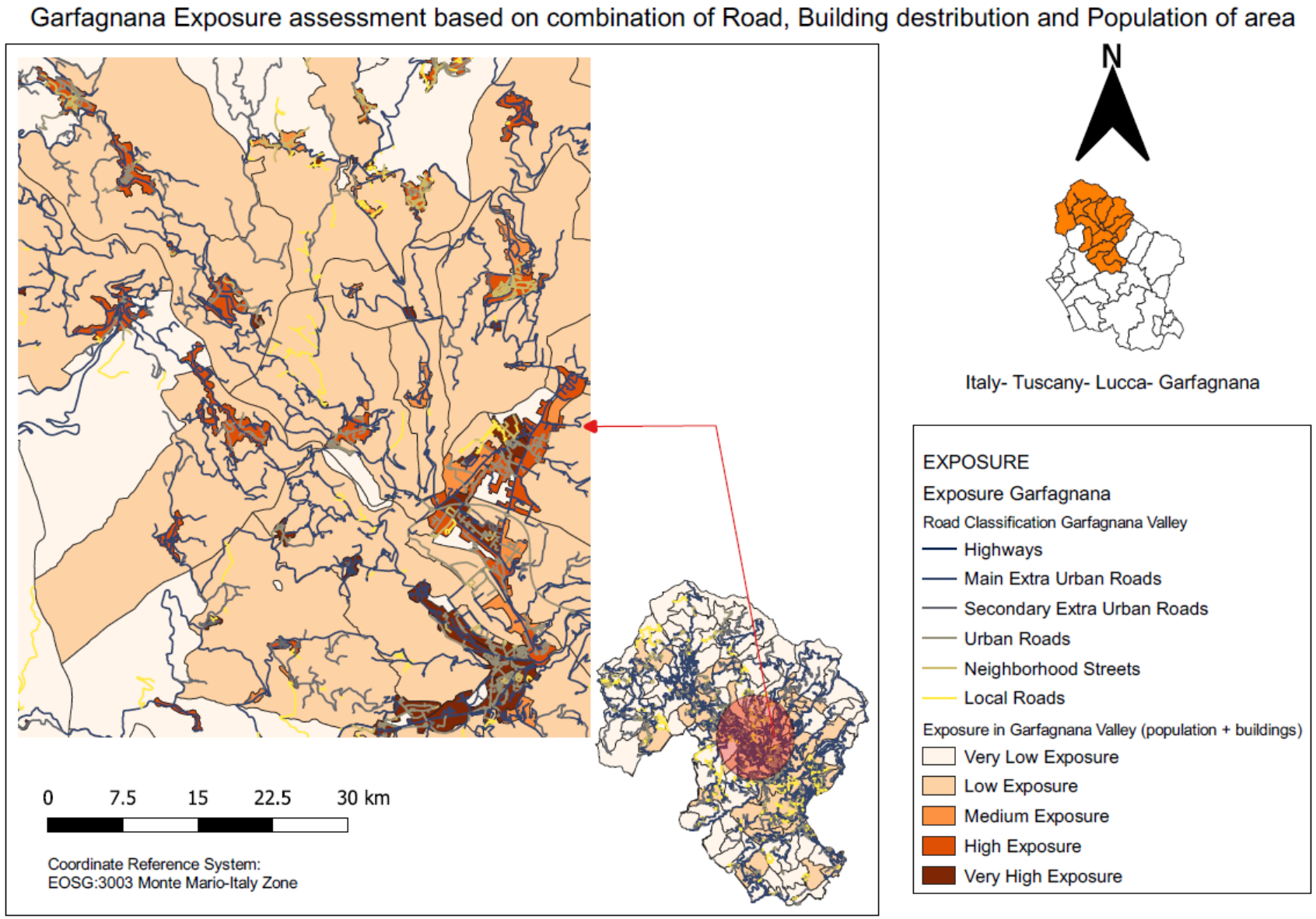
Analysis based on schools' location

COMBINED EXPOSURE ANALYSIS

Valley scale

Analysis based on:

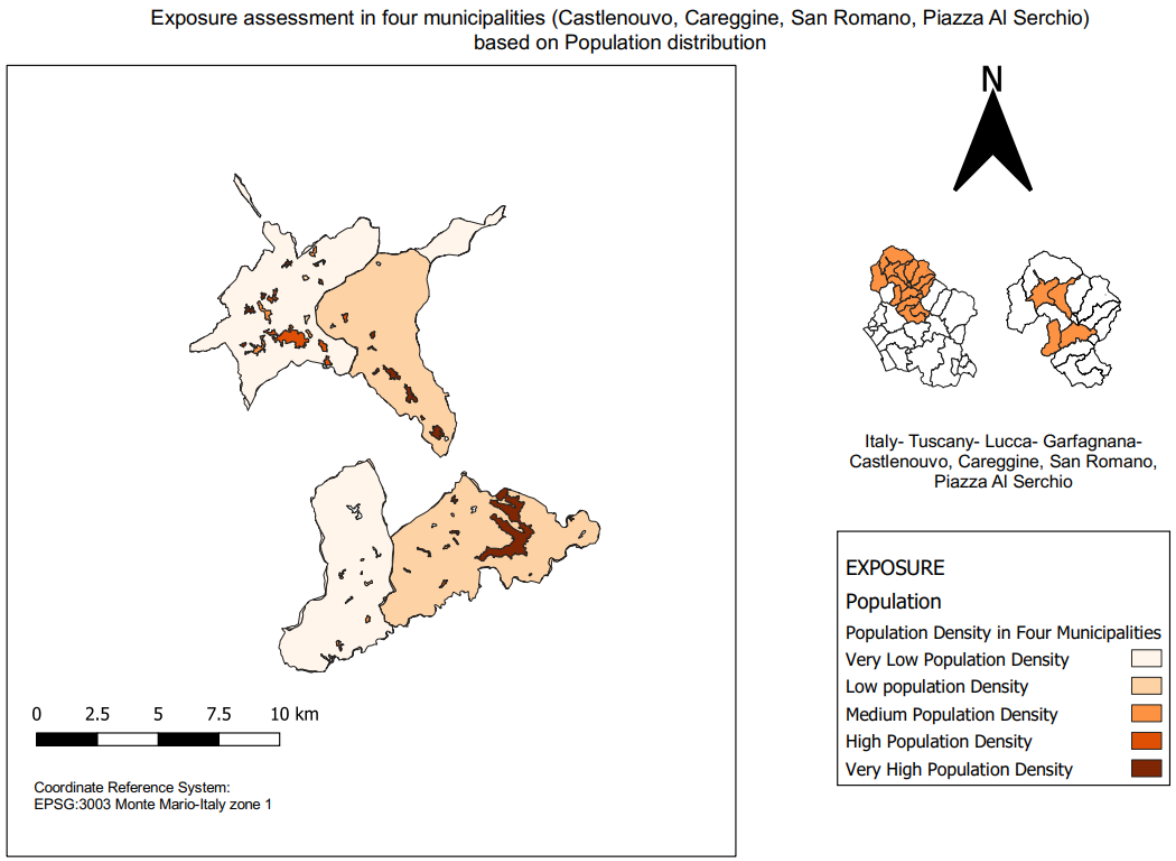
- Population Density
- Building Density
- Road



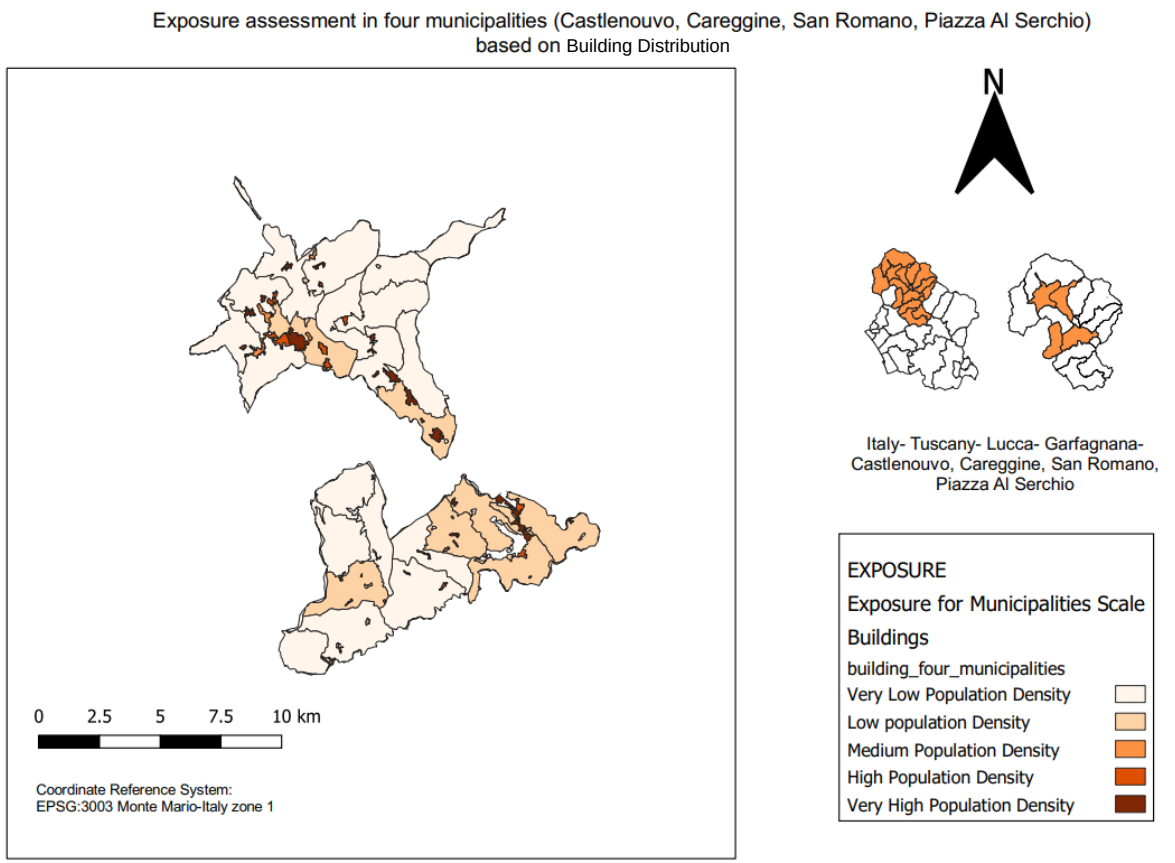
EXPOSURE ANALYSIS

Municipalities scale

Population Exposure



Building Exposure



VULNERABILITY

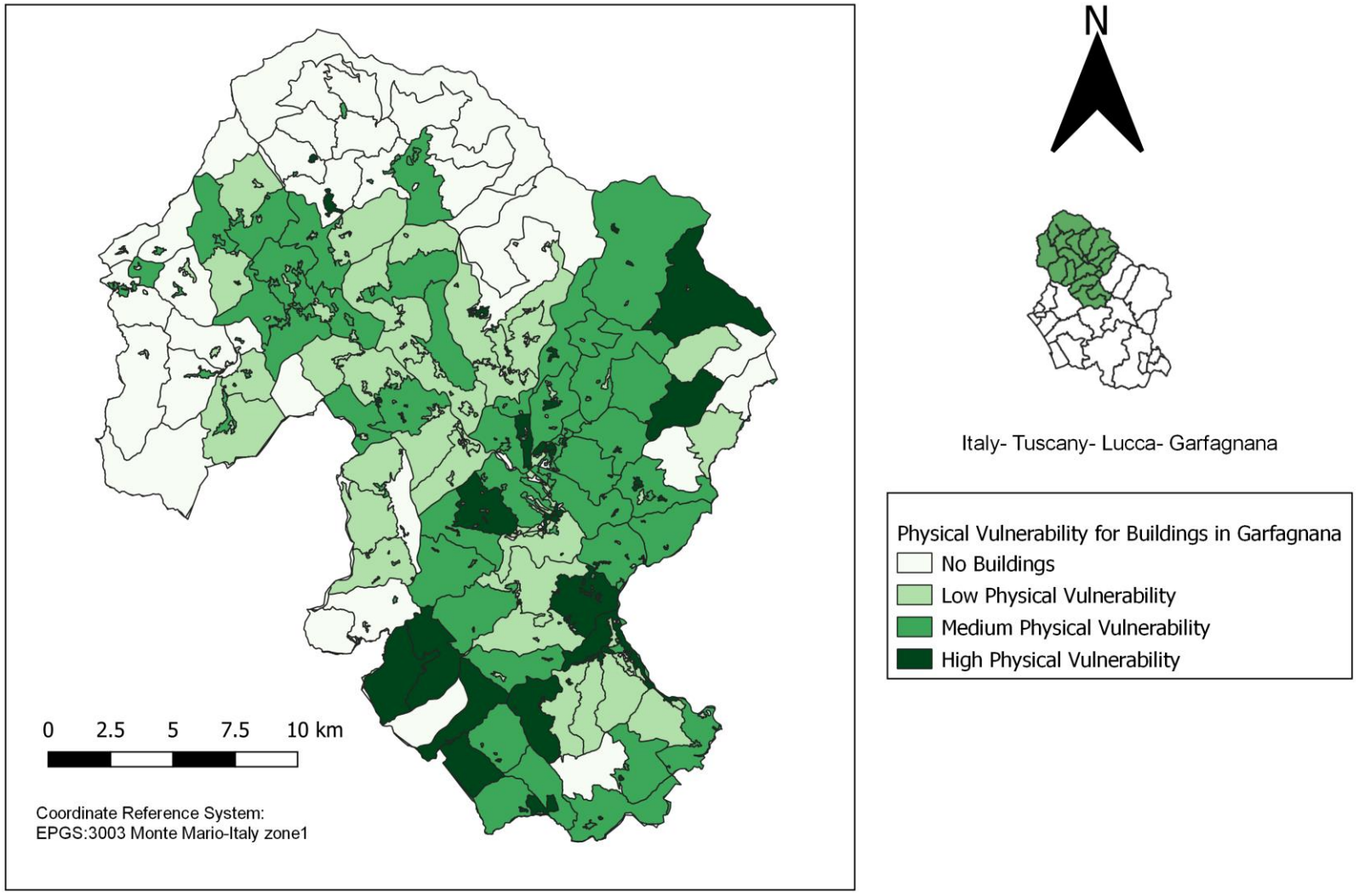
The propensity of an **asset** or a **system** to be damaged in case of a hazardous event.

PHYSICAL VULNERABILITY : BUILDINGS

Valley scale

Assessment based on the combination of buildings' age, construction type, and number of floor (height)

Factor	Criteria	Value
Age	Before 1919	1.25
	1919 to 1945	0.5
Construction Type	Weighted Bearing Structures	1.7
	RC Structures	1
Height	1 floor	0.25
	2 floor	0.5
	3 floor	0.75
	4 floor	1

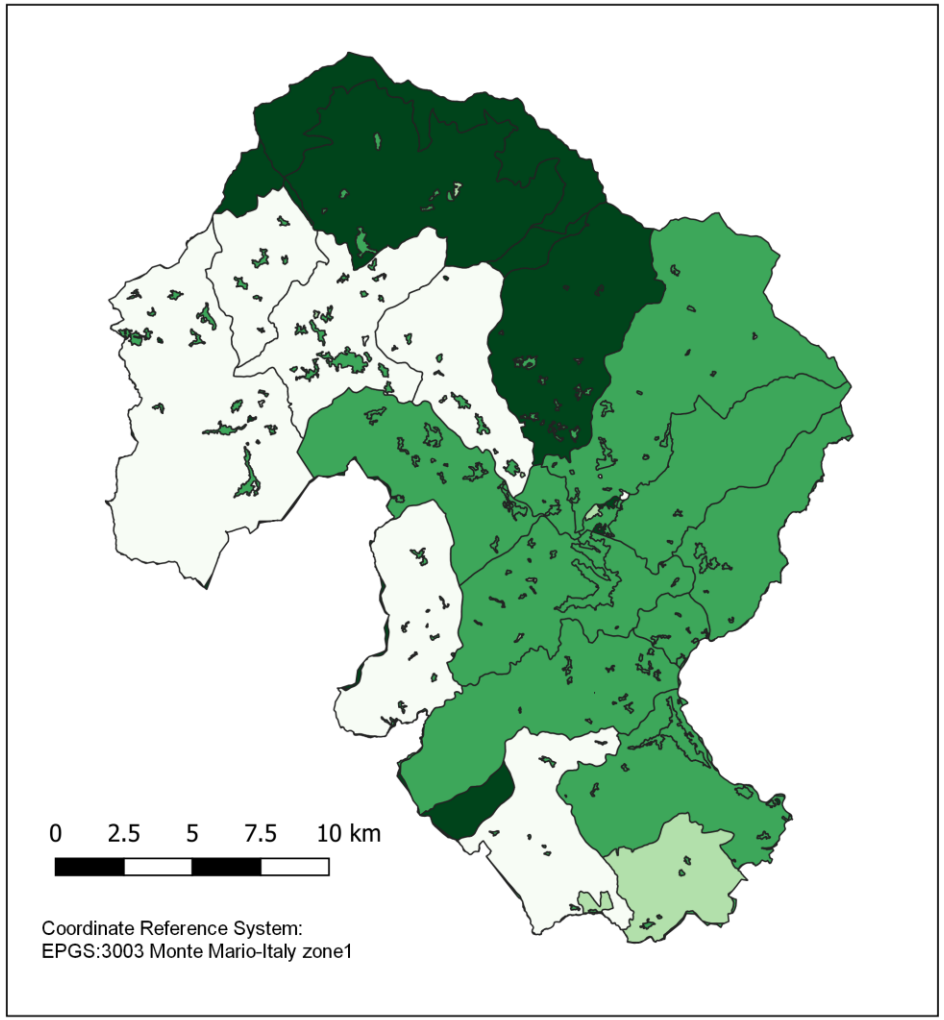


PHYSICAL VULNERABILITY : POPULATION

Valley scale

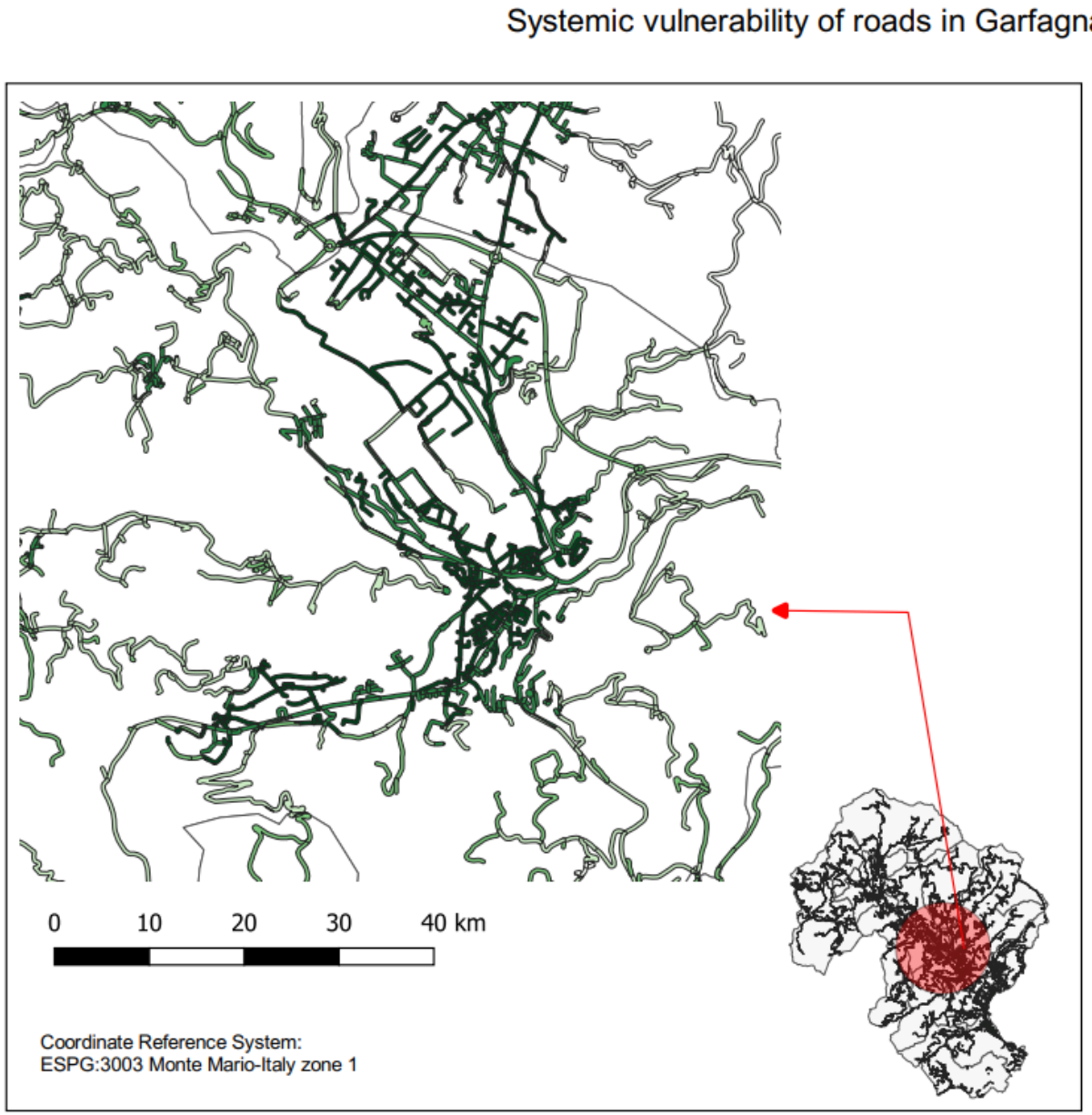
Assessment based on the populations' age as below:

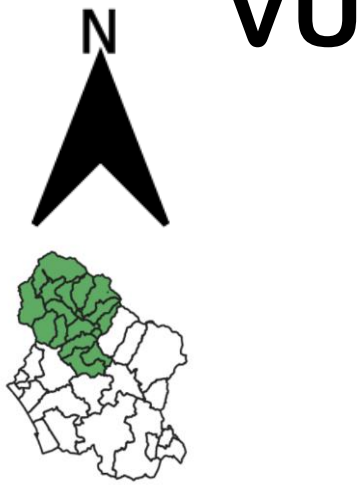
Factor	Criteria	Value
Age	15 to 39	0.5
	40 to 54	0.625
	55 to more than 74	1
	less than 5 to 14	1.125



SYSTEMIC VULNERABILITY

Valley scale





Italy-Tuscany- Lucca- Garfagnana

Physical Vulnerability

Systemic vulnerability for roads

- Very low systemic vulnerability
- Low systemic vulnerability
- Medium systemic vulnerability
- High systemic vulnerability
- Very igh systemic vulnerability

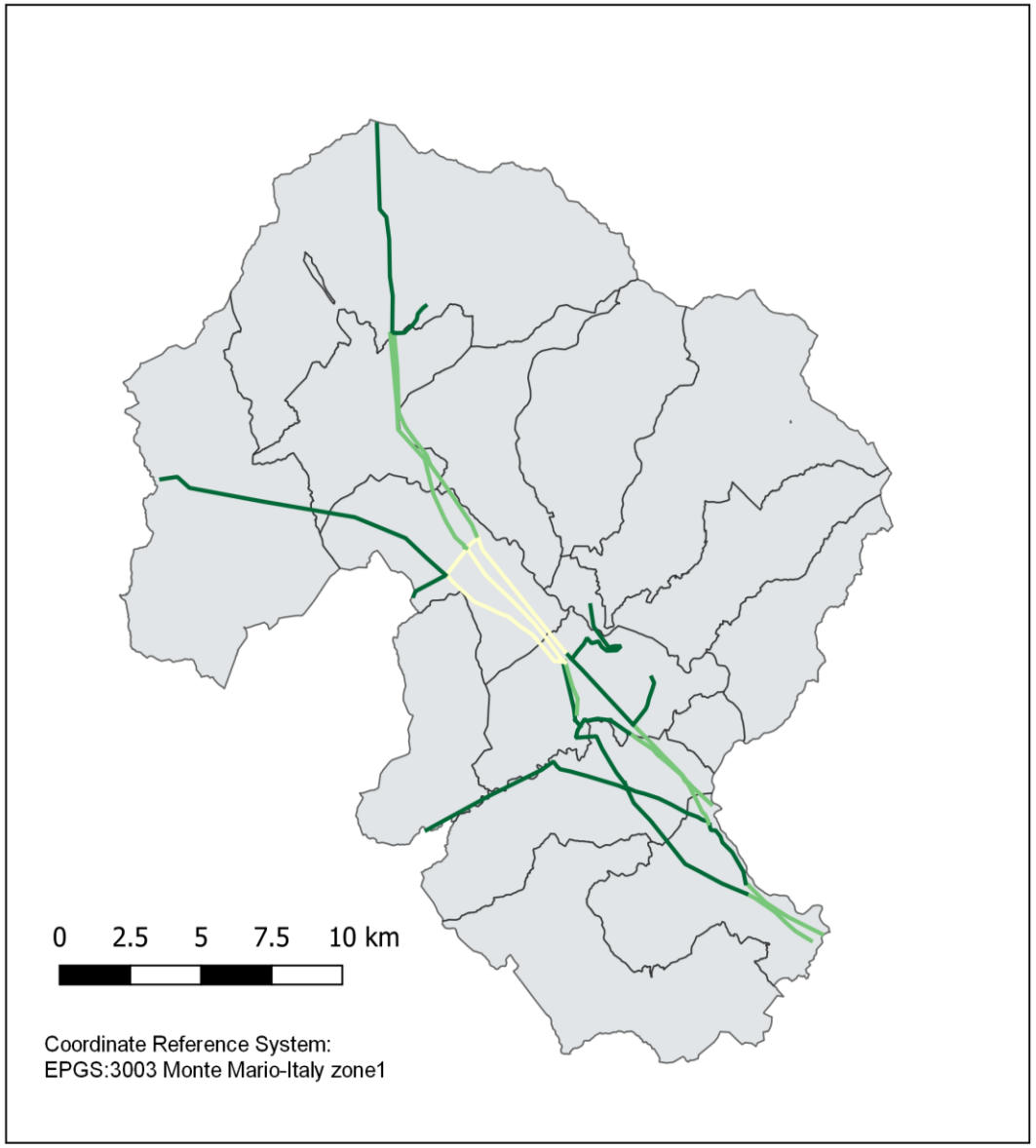
Adminstrative layers

- Garfanana valley municipalities

Analysis based on the combination of roads width and the number of population moving inside and outside

SYSTEMIC VULNERABILITY

Valley scale



Systemic Vulnerability Garfagnana Valley
Powerlines
- High Vulnerability
- Medium Vulnerability
- Low Vulnerability

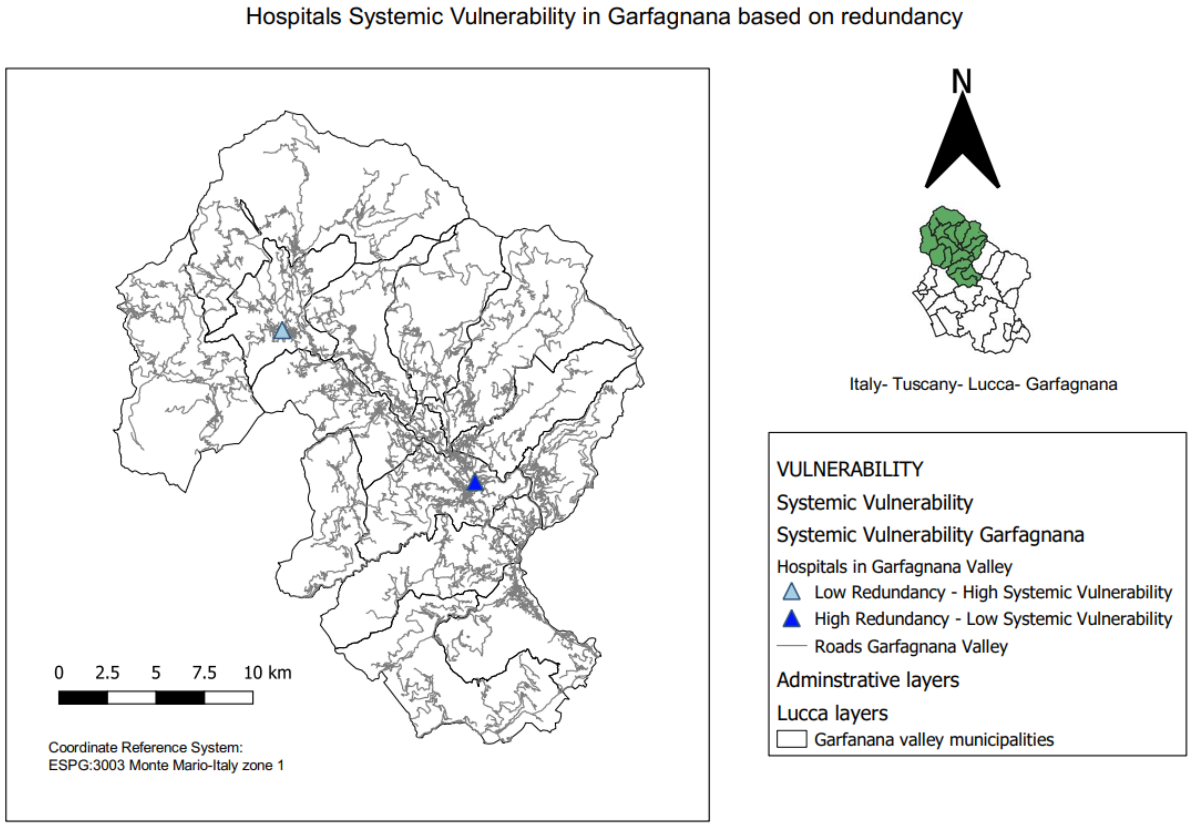
Adminstrative layers
- Garfanana valley municipalities

The classification is based on redundancy (alternatives)

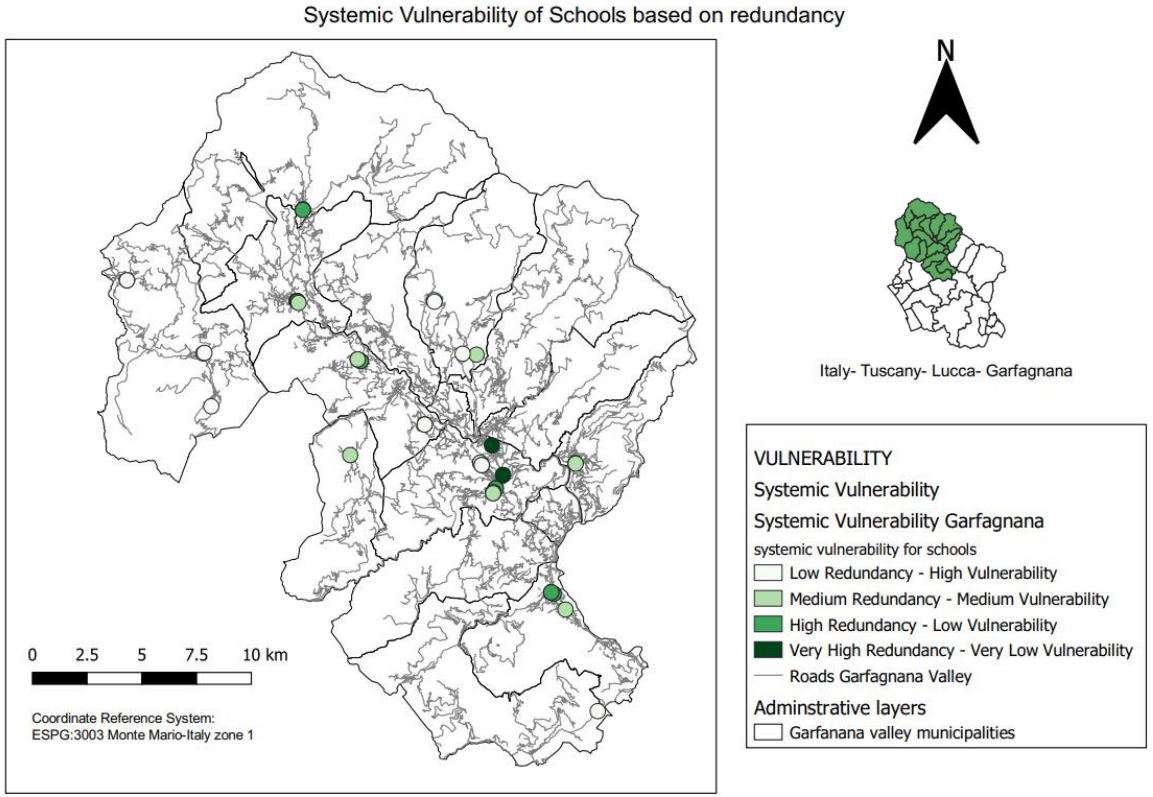
SYSTEMIC VULNERABILITY

Valley scale

Hospital Systemic Vulnerability

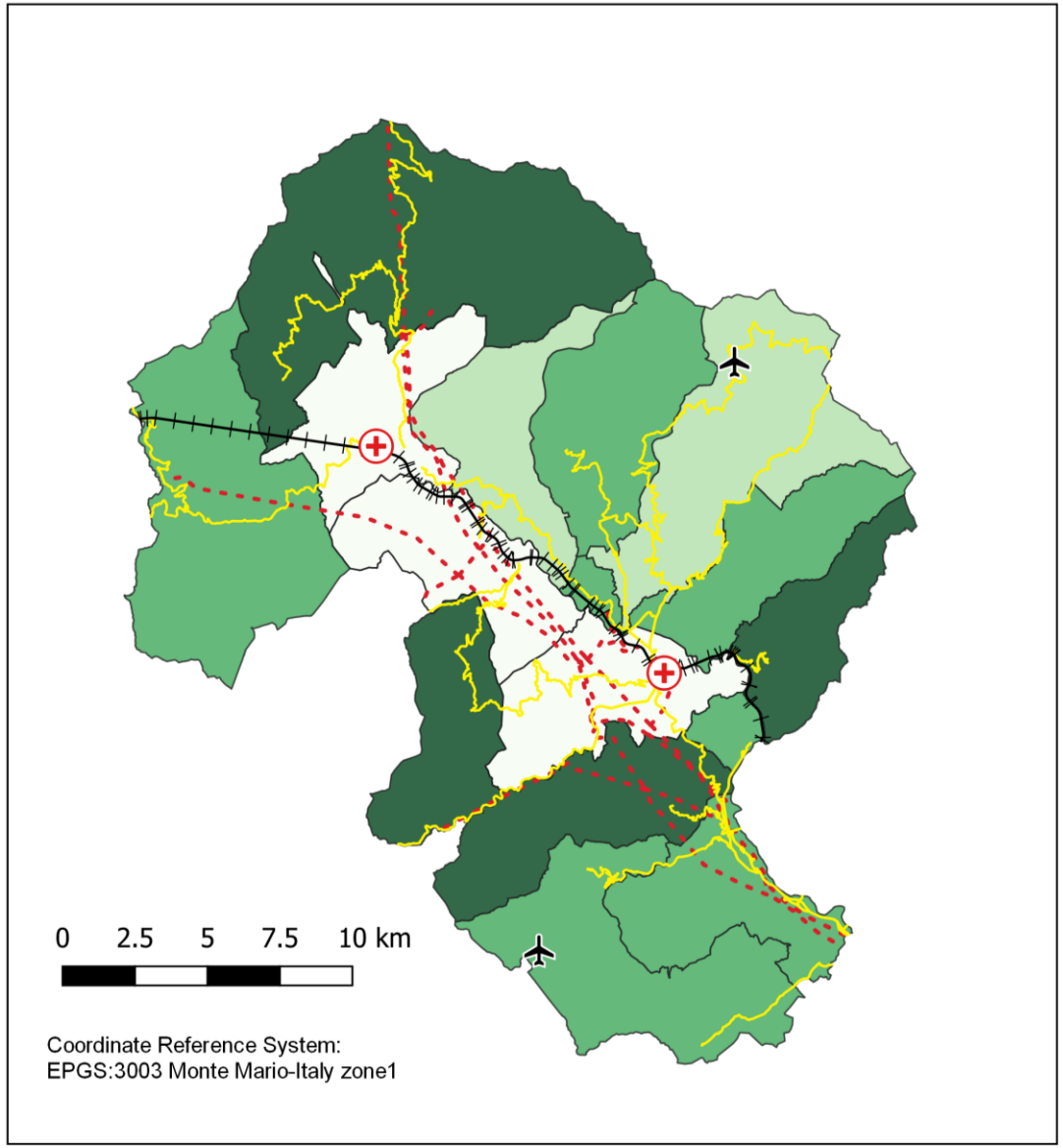


Schools' Systemic Vulnerability

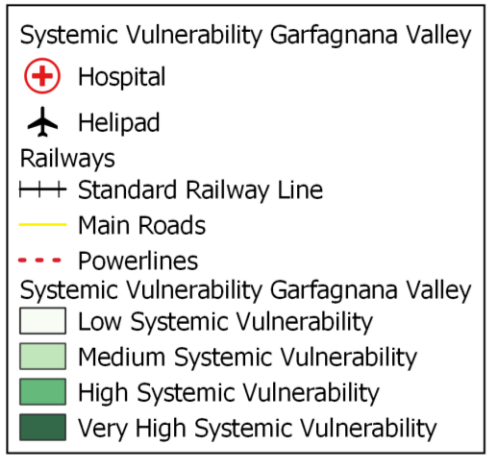


SYSTEMIC VULNERABILITY

Built Environment and Critical Infrastructure



Italy- Tuscany- Lucca- Garfagnana

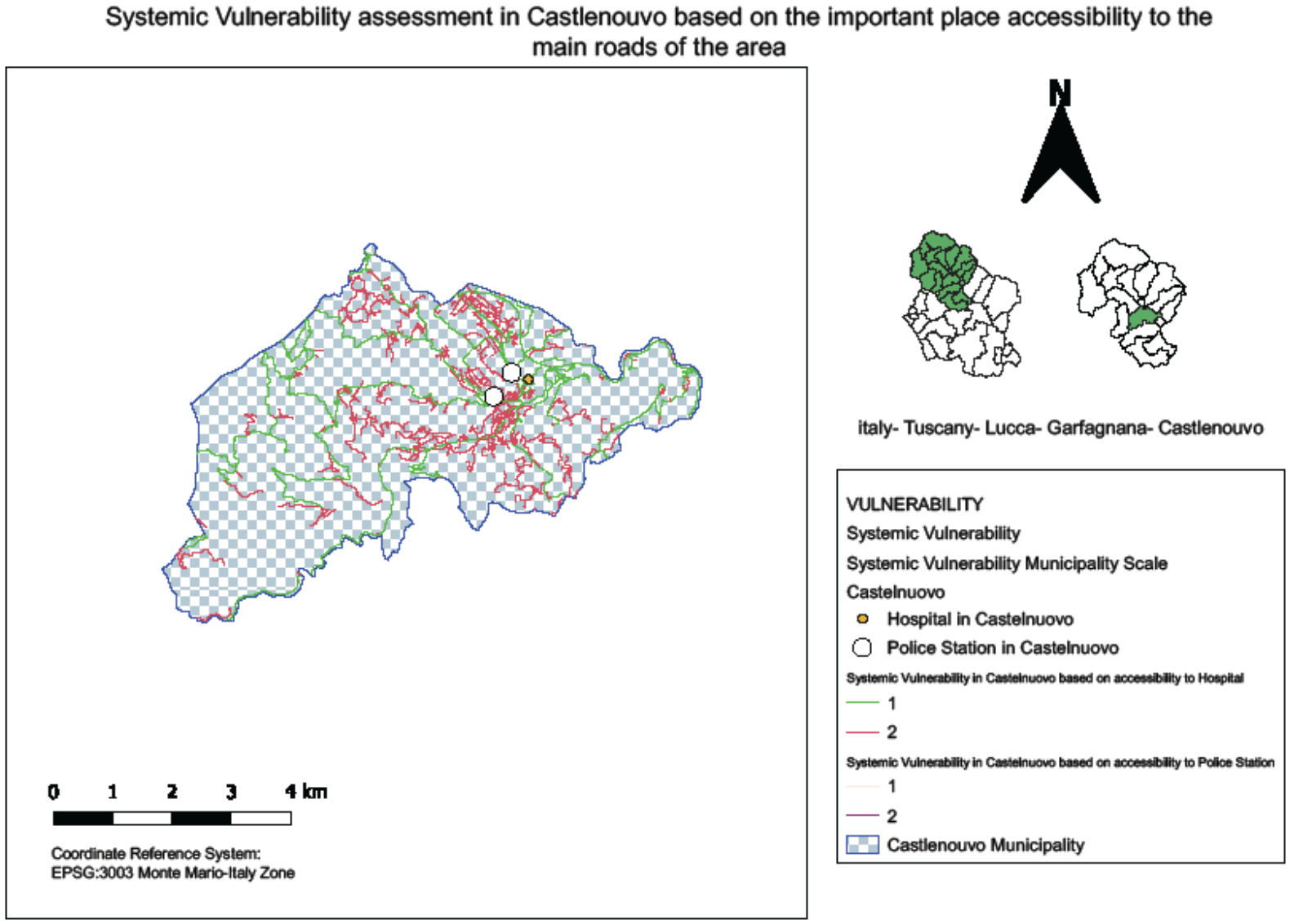


Analysis based on distance to public facilities and lifelines

SYSTEMIC VULNERABILITY

Municipality scale

Castlenuovo

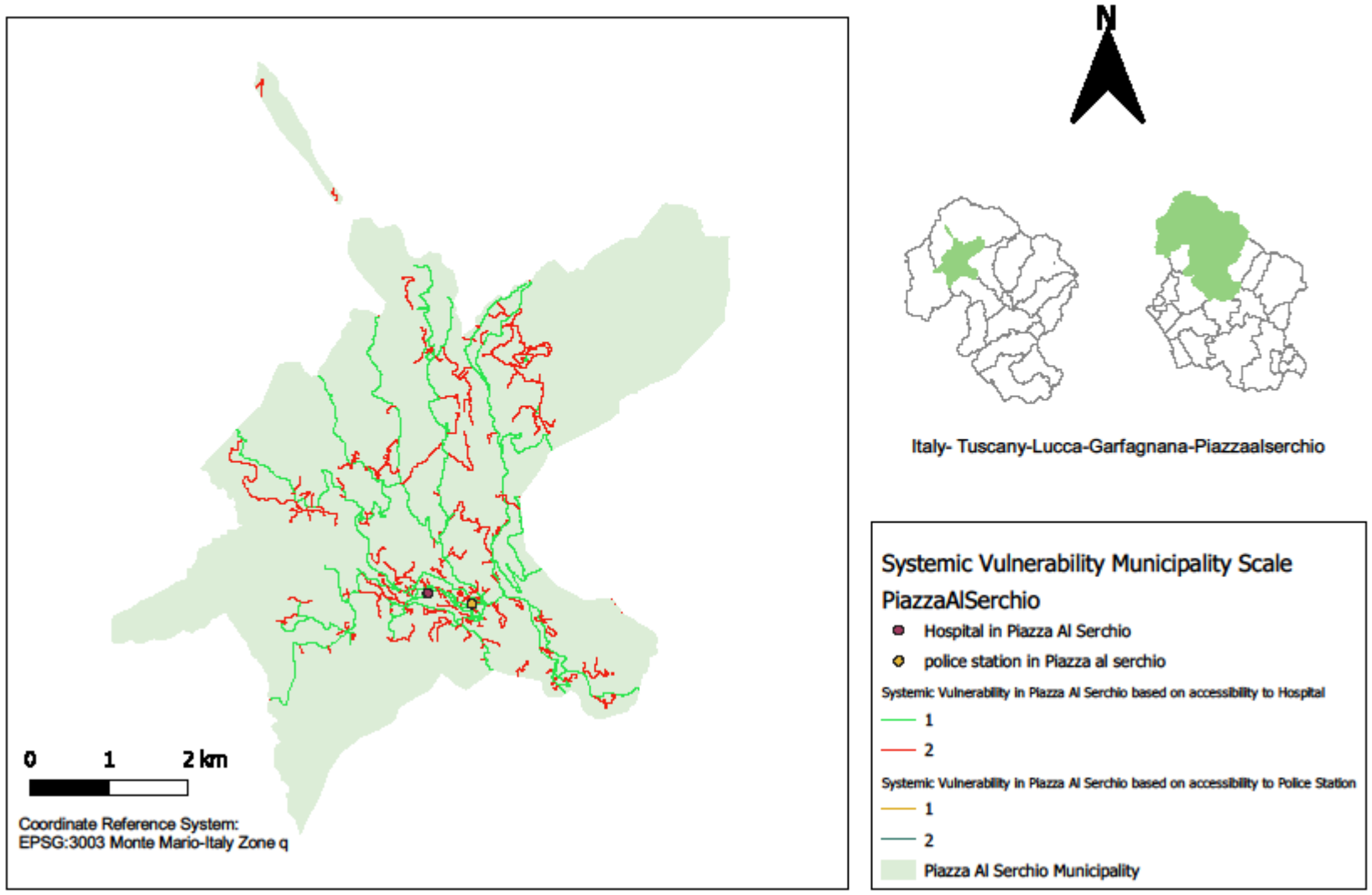


Analysis of roads based on hospital and police station accessibility to whole zone of the municipality

SYSTEMIC VULNERABILITY

Municipality scale

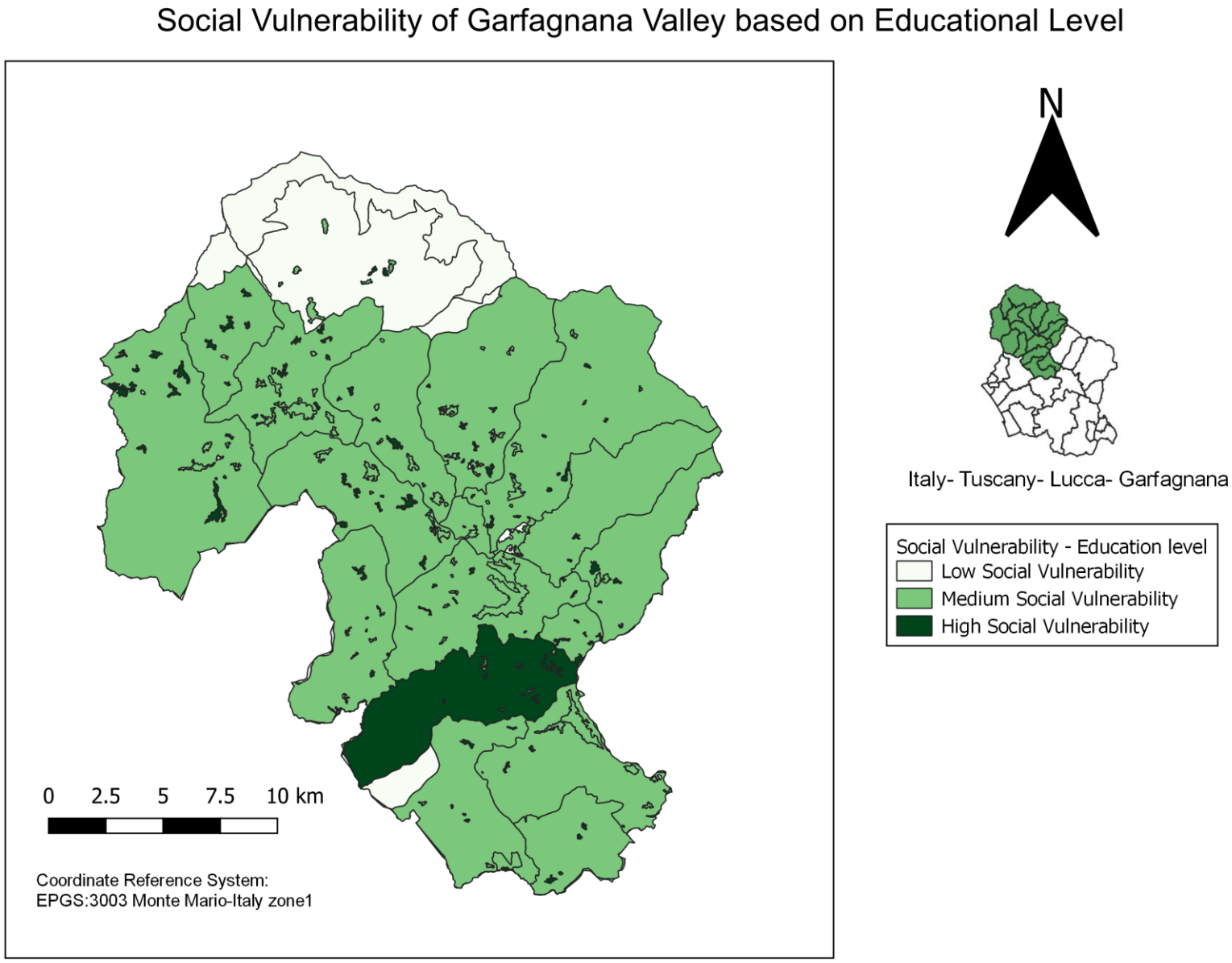
Piazza Al Serchio



Analysis of roads based on hospital and police station accessibility to whole zone of the municipality

SOCIAL VULNERABILITY

Valley scale

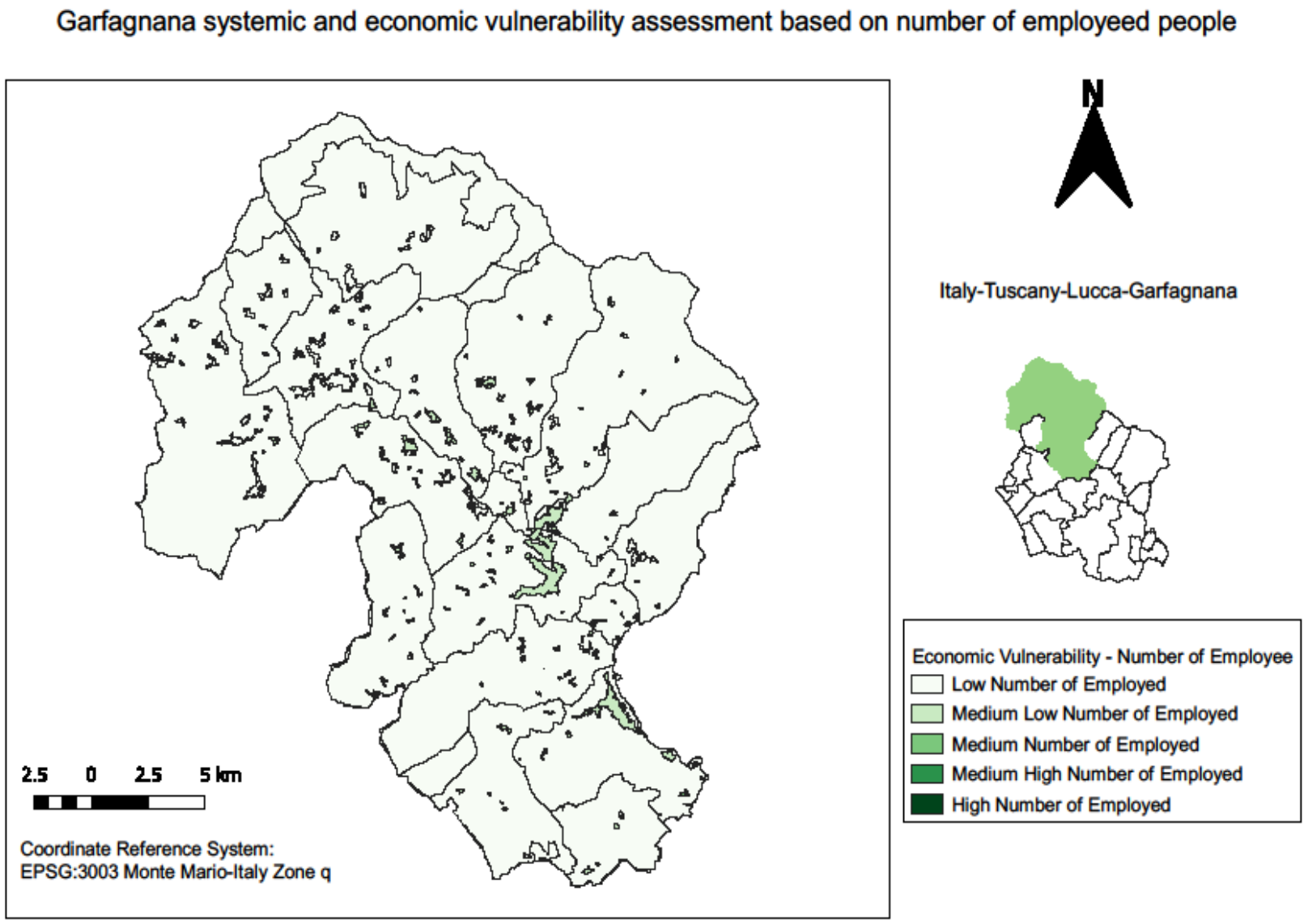


Assessment based on the educational level

Factor	Criteria	Value
Education Level	Highly educated - Low social vulnerability	**1**
	Intermediate education - Medium social vulnerability	**1.5**
	Lower degree education - High vulnerability	**2.5**

ECONOMIC VULNERABILITY

Valley scale



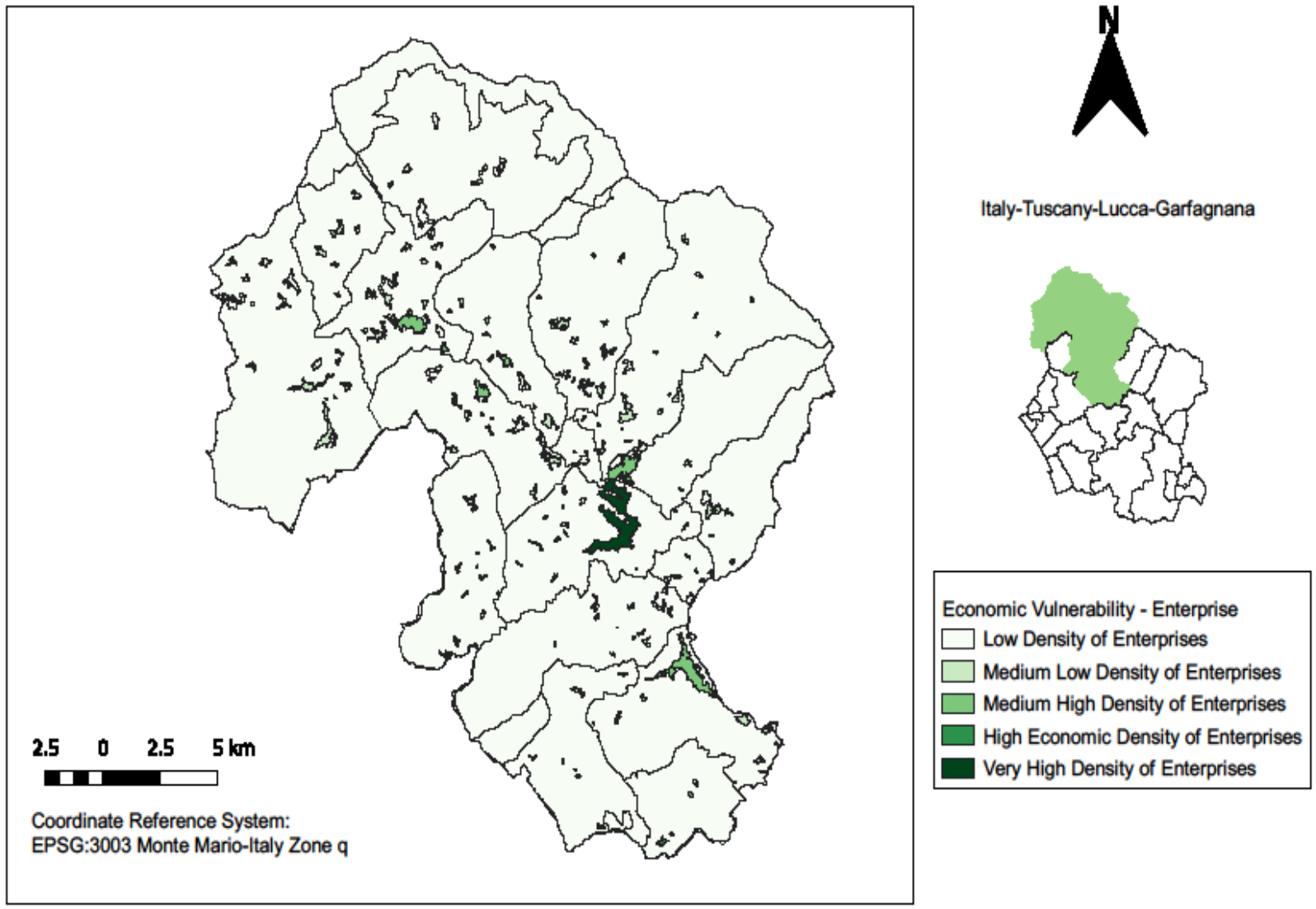
Analysis considering the number of people employed and unemployed as representation for economic assets

Methodology:

*2*employeed x 0.5*unemployeed*

ECONOMIC VULNERABILITY

Valley scale

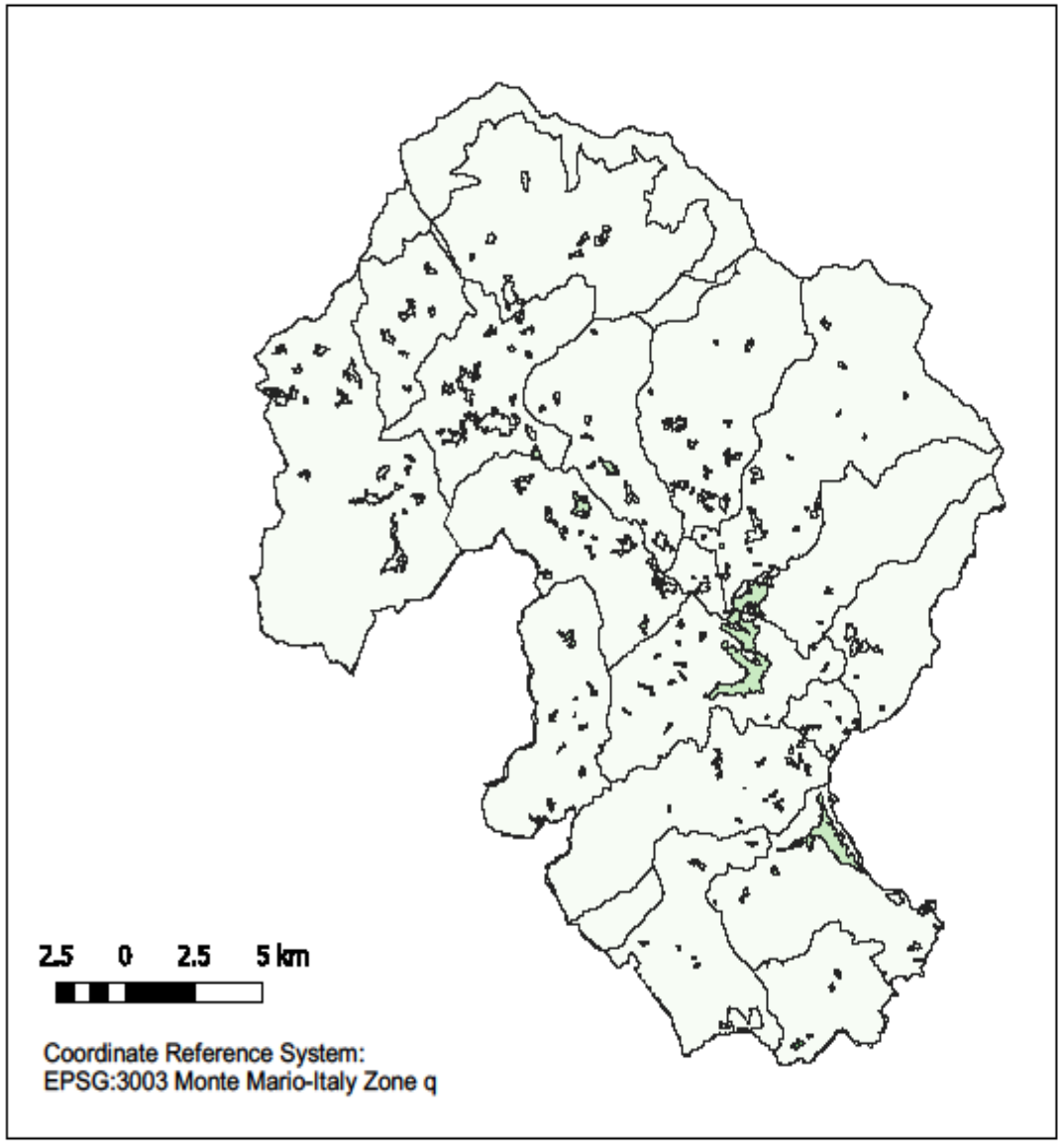


Analysis based on the density of unit local enterprises as representation for economic assets

SOCIO-ECONOMIC VULNERABILITY

Valley scale

Garfagnana systemic vulnerability assessment based on social economic vulnerability

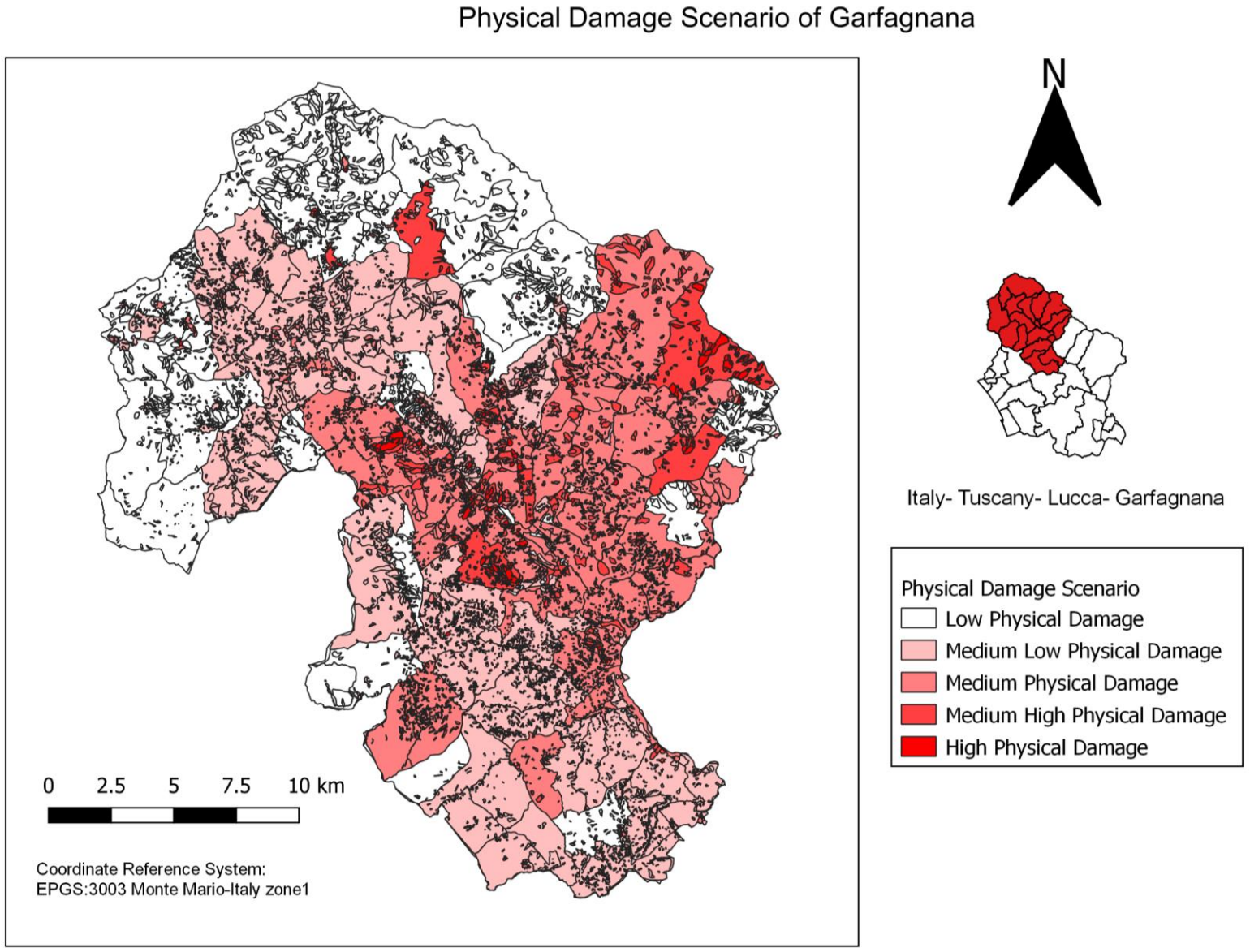


Italy-Tuscany-Lucca-Garfagnana

Social-Economic Vulnerability in Garfagnana Valley
- Low Social Economic Vulnerability
- Medium Low Social Economic Vulnerability
- Medium Social Economic Vulnerability
- Medium High Social Economic Vulnerability
- High Social Economic Vulnerability

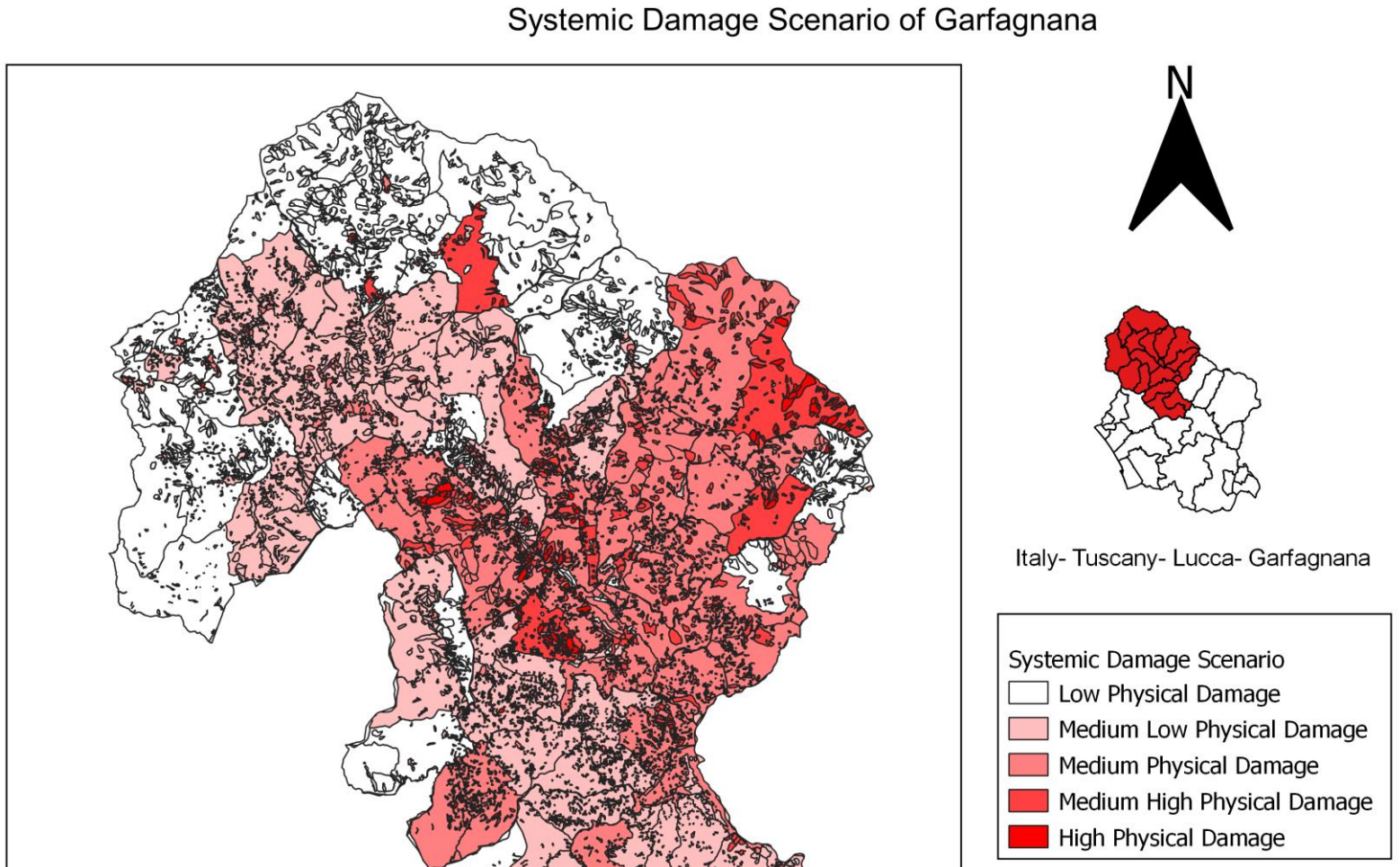
DAMAGE SCENARIO

PHYSICAL DAMAGE SCENARIO



For physical damage scenario we considered a combination of **Physical Vulnerability** and **Hazard**

SYSTEMIC DAMAGE SCENARIO



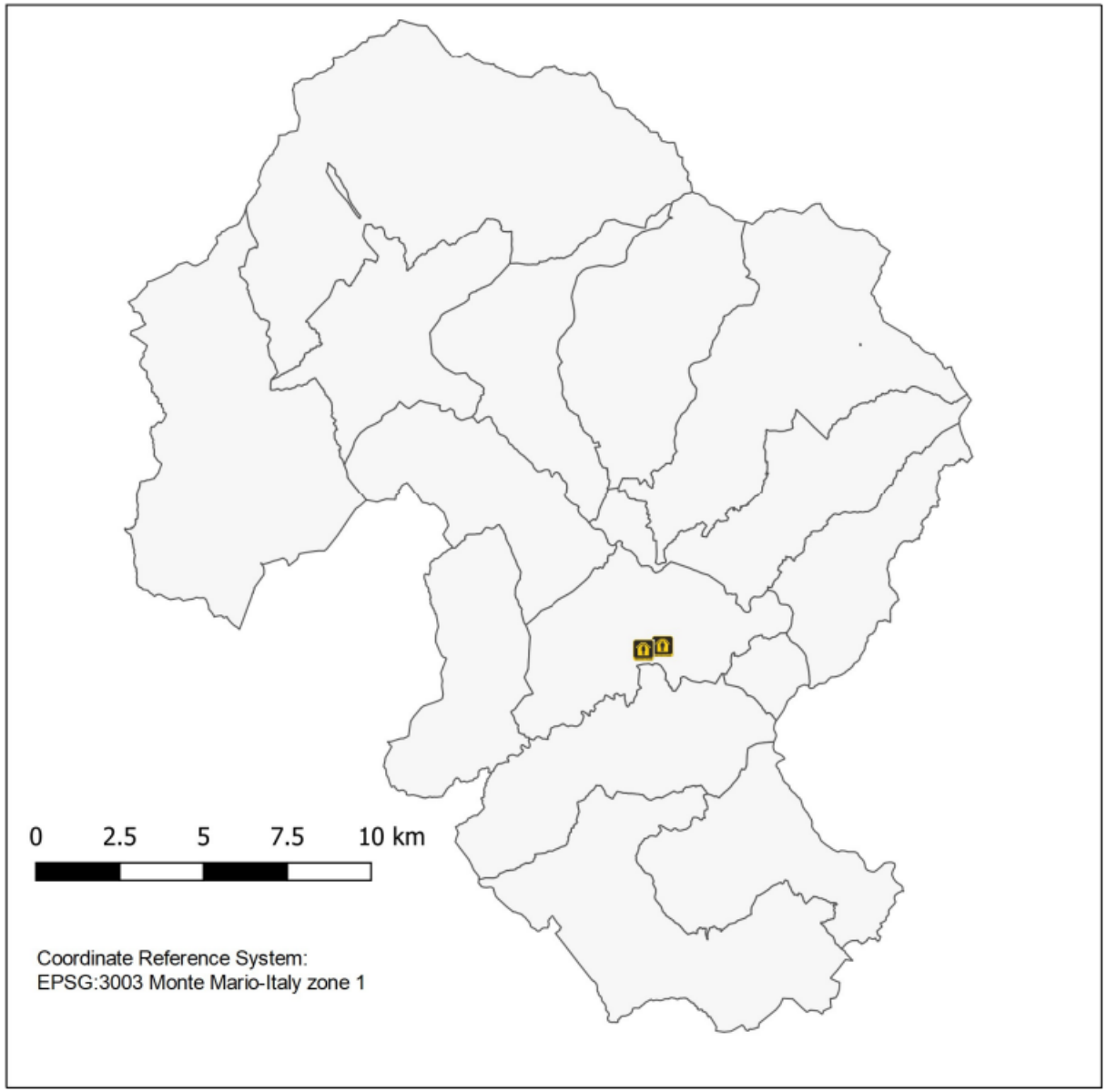
From the **Physical Damage Scenario**, we can obtain systemic damage scenario by combining it with the **Systemic Vulnerability**

MITIGATION

Proposed an action in order to prevent further losses

MITIGATION MEASURES

Garfagnana Shelters



Italy- Tuscany- Lucca- Garfagnana- Castlenouvo, Careggine, San Romano, Piazza Al Serchio

Adminstrative layers

Lucca layers

shelter

Garfanana valley municipalities

THANK YOU!