The Application of the Geodesign Approach to an Italian Post-Earthquake Context

Submitted by

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STUDENT REPORT

Abstract

The society is experiencing the increasing awareness of the complexity of urban systems and their vulnerability. Although community engagement is increasingly supported by the evolution of technologies which are becoming more accessible for a larger number of people, democratization of post-earthquake planning practices in the Italian context is still struggling to emerge and be included in the common practices. Given the fact that along with climate change challenges earthquakes are becoming more frequent and more impacting on territorial systems, traditional approaches urgently need innovative and more comprehensive perspectives suitable for being translated into action-oriented processes. It is assumed that the methodological geodesign approach could bring to the post-earthquake planning process some of the innovations acclaimed by researchers and practitioners, worldwide. Therefore, through a geodesign workshop conducted on the Norcia municipality case recently hit by a strong seismic event, it has been possible to test the approach's potentials and to investigate whether it could answer to the scientific call or not.

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1. Introduction

Global population is experiencing a fast growing rate which directly affects the way we live and how we adapt to the ever changing conditions of the planet. By an urban planning perspective this challenging issue can be mostly seen by looking at the evolution of the urban structures of human settlements and the related territorial systems, which make society to be operative, are getting more complex.
Indeed, the society is experiencing the increasing awareness of the complexity of urban systems and their vulnerability. In order to be able to deal with and to manage the operational complexity of systems, become fundamental the building of a strong knowledge concerning the study area, its geography and the urban systems which shape the territory.
For this purpose, communities are increasingly supported by a technological evolution and technologies are becoming more accessible for a larger number of people throughout the globe. Positive repercussions of this recent phenomenon is the spreading and sharing of knowledge and, consequently, the activation of more democratized processes. In particular, citizens, being increasingly recognized as important stakeholders within the decision-making process and relying on more inclusiveness, obtain more knowledge and therefore they likely become more sensitive to delicate issues.
As the climate change issue is recently showing, national and local authorities are enlarging the table of discussion with their communities through the use of social media tools.
People, thanks to the improved awareness, are increasingly recognizing the effects of such climate alteration and are showing to be more will to participate at the decision-making process aiming at reducing their individual and collective vulnerability.
Among others effects, natural disasters are getting more strong and more frequent, worldwide. Even earthquakes, as confirmed by the Fig.1 (Annex), are amplifying their impact effects along with climate change and, more specifically with global warming.
According to Crespellani (2012), earthquakes and their short and long-term impacts, can be observed and studied through two lens: the technical-scientific perspective which tells that seismic events can be dominated by humans, exploiting the most ongoing advanced technologies available and the socio-political perspective which shows that communities are not yet sufficiently able to defend themselves from earthquakes. In fact, strong earthquakes along with decontextualized interventions can destroy economic and social systems, triggering negative consequences as emigration towards safer places originating depopulation of impacted areas, destruction of manufacturing activities and reduction of cultural and landscape heritage values. In the worst case, urban textures are destructed, affecting then the relationship both among people and between inhabitants and their places, undermining the local identity.
In the specific of the Italian context, even the most recent seismic events have shown that traditional approaches are not able to address long-term challenges and involuntarily have induced local communities to economic stagnation and social fragmentation. By analysing several data, Crespellani (2012) have concluded that as shown by the emblematic cases of Irpinia and L'Aquila, respectively hit by seismic events in 1980 and 2009, in Italy prevention policies are totally insufficient and inadequate, concluding that without a drastic change in direction, in few decades Italy could be subjected to an epochal and in depth societal change.

As a matter of fact, the most fascinating Italian landscapes are even the most vulnerable and exposed to seismic events. As happened in the case of L'Aquila, historic city centres, old villages dominating Apennines hills, castles, Roman and medieval monuments, are destined to become aggregations of ruins surrounded by anonymous outskirts mainly characterized by stretched concrete surfaces. This occurs because of post-earthquake planning approaches mainly focused on the management of the emergency phase which led to the reconstruction of a detached new village, losing the relation with ancient cultural and culinary traditions, as in the case of Teora and Conca della Campania (Irpinia), (Fig.2, 3 Annex).
These are often results obtained through decontextualized interventions, where the geographical understanding of the study area is not pursuit (DesignGeo). Rather, it has been encountered an innovative and methodological approach which embraces a comprehensive awareness of the local geography as a fundamental starting point in every planning process (GeoDesign).
Therefore, some gaps within the traditional approaches that are likely behind some of the reasons of such irrational interventions have been identified. In an attempt to investigate improvements of current practices, it has been tested the application of an innovative approach to post-earthquake planning processes, aiming to find out whether it could bring enhancements to traditional approaches by trying to cover such gaps.
By testing the abilities of the innovative approach through its application to the most recent seismic event that has impacted the Norcia municipality and several other settlements in central Italy, it is the intended purpose of the authors to answer to the main research question:

"Which innovations enable the Geodesign approach to repair some of the gaps of post-earthquake planning practices within the Italian context"?

And furtherly to understand: "*Under which conditions the post-earthquake process can be better democratized"?*

Hence, the scope of the thesis is not to solve the current complex issues originated by the seismic events in the Norcia municipality, but rather investigating and testing a more comprehensive approach considering the post-natural disaster planning practices in the Italian context.

2. Conceptual Framework

2.1. Planning Practices shaped by the evolution of technologies

In the last 50 years, planning practices have radically evolved in terms of approaches, methods, techniques and tools.

According with Batty (2008), the planning process has rapidly shifted from rigid professionalism to collective negotiation. This change in paradigm required the development of a completely new fleet of tools aimed to enable the communication and dissemination of the multitude of information and ideas embedded in the planning process. As the urban and regional planning changed nature shifting from be traditional and exclusive for professionals towards a more inclusive and collaborative process, so the tools supporting it should.

Hence, computer-based tools are becoming crucial in order to assist and facilitate knowledge building, collaboration among all the actors involved and guide the decision-making process towards the final consensus.

In order to understand how the use of computers is affecting spatial planning and design, it may be useful to consider the influence of technology in contemporary cartography.

Looking back at the 1970s, cartography, a discipline which represent the media for analysis and design in planning, and in turns cartographers, have been directly influenced by other forms of expression of geographic information. As Goodchild (2000) pointed out, cartographers were terrified by the digital "virus" because they envisaged possible rebound effects of the coming cartographic practices able to spread skills in the society that, until that moment, were solely assigned to them.

The digital transition of cartography led to geographic information technology, geomatics, geoinformatics and geographic information science.

The main purposes that pushed towards the new trend implementation were related to more appropriate and all-embracing spatial analysis, data exchange, creating precise calculations, simplifying map creation, reducing production cost of paper maps.

The key software that activates and drastically speed up this transition is related to Geographic Information Systems (GIS). *"Geographic Information Systems - georelational databases - is the tabular data set related to geometric object representing real world objects. Systems are used to gather, store, analyse and represent data"* (Hanzl, 2007, p. 290).

It is not the goal of this chapter to extensively cover all the aspects regarding GIS. A thorough explanation and contextualization of GIS software and its functionalities will be given further in the report in the methodology chapter.

However, the GIS systems require high level of proficiency of users and thus, they are not the most suitable form for planning with public participation (Hanzl, 2007).

Hence, new experiments more group-oriented within the local scale, have been started in the 1980s. Despite the fact that planning practices were slightly opening up to citizens engagement, those methods of involvement were highly criticised, merely offering to the public the right to know, to be informed and to object (Kingston, 2002).

Meanwhile, the Internet penetrated the market in the 1990s, launching electronic information and communication services available to citizens, business and local governments. Considering that the Internet has become a part of the society quicker than any other new technologies such as television, telephone or automobile, the influence of the first-generation Internet has been playing a central role in individual and community development (Kingston, 2002). As stated by Pratchett:

"New technologies, in whatever form, are socially and politically neutral devices and have no inevitable consequences for democracy, participation or political engagement. However, the way in which such technologies are used and the purposes to which they are put can have radical consequences for the practice of democracy. The design of particular tools and their association with existing democratic practices (and other aspects of governance) shapes their value and impact, as does the way in which citizens and intermediary bodies (such as the news media, political parties and so on) adopt and use the technologies."(Pratchett, 2006, p. 3).

As a response to this, a vast development of various technological implementations within the field of spatial planning have interested both academic researches and "real-world" projects. As Hanzl (2007) mentioned, those implementations are of a various nature: from interactive 2D maps and visualization tools to 3D models and simulation games.

Nevertheless, even though these new IT systems facilitated citizen involvement, they were built on some limitations for instance, accessibility, representativeness, transparency of data, adoption of complex language of communication and so on (Healy, 1998)(Kingston, 2002).

Due to the necessity of overcoming certain public participation weaknesses, new innovative technologies in favour of planning were pushed again towards more advanced solutions.

Therefore, massive variety of software and tools based on second-generation Internet came in quick succession. A widespread literature regarding these second-generation Internet tools have categorized and nominated the new technology systems in different ways, as shown in Fig. 2.1 and listed in the Fig.25 (Annex).

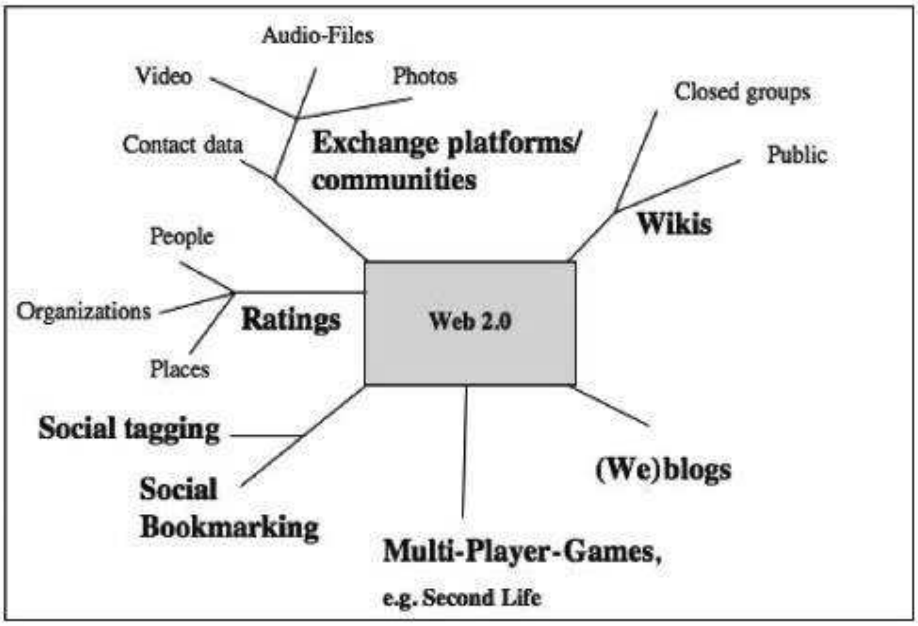


Fig.2.1: Web 2.0 composition. Source: Kubicek, H.

Digital Democracy, eDemocracy, eParticipation, Participatory Planning Geographic Information Systems (PPGIS), Information and Communication Technologies (ICT), Wikies, eVoting, blogs are just few examples of a vast classification of different tools and relevant concepts that often are grouped as Planning Support Systems (PSS) or Web 2.0.

In brief, PPGIS tools which are GIS-oriented software (as suggested by the name), denote the inclusion of marginalized population in planning by employing spatial and visual tools, using them without any specific license or through simple installation of plug-in (Kubicek, 2010) (Hanzl, 2007)

By definition as explained by Hanzl (2007) and Kubicek (2010), PSS is a general notion describing software that supports urban planning, while Web 2.0 refers to all the technological developments, which enable users to create, publish, and shearing new contents within the World Wide Web.

It has been pointed out that the general main goal of all the Web 2.0 software *"is shifting the Web to turn into a participatory platform, in which people not only consume content (via downloading) but also contribute and produce new content (via uploading) [...] breaking the barriers between users and data-providers"* (Bugs et al., 2010, p. 173).

Considering their functionalities, all the Web 2.0 and surrogate second-generation technologic systems come into place in order to be more inclusive and reach a wider audience, taking advantages of open source platforms, facilitating even further participatory practices in planning processes (Hanzl, 2007). As Hanzl (2007) pointed out, Web 2.0 and PSS enables displaying data in forms that are easy to understand by layperson, overcoming the initial issues and technicalities, which by Pickles (1995), previously categorized GIS-based software as elitist tools. *"By informing the public and allowing more in depth feedback it can aid the decision making process and helps to inform decision makers of the communities view"* (Kingston, 2002, p. 10). Certainly, a common point of all the software is the visualization of data.

Lynch has initially remarked the direct relation between visualization and individual action, where he stated:

"Visual education impelling the citizen to act upon his visual world and, this action causing him to see even more acutely. A highly developed art of urban design is linked to the creation of a critical and attentive audience (Lynch, 1960, p. 120). "

McCormick (1987) defined the science of visualization as a relationship of images and signals, which are initially captured, consequently transformed and finally represented. *"Abstraction of these visual representation can be transformed by computer vision to create symbolic representations in the form of symbols and structures"* (McCormick et al., 1987, p. 15)

Recently, the debate around existing valuable strengths and synergies between the power of visual computational techniques and the human capacity to reason and address complex space-related issues is becoming more and more animated.

One of the really first example of space-related analysis aided by visualization support has been carried in Paris, using a cartographic map where all the cases of malaria occurred within a defined urban area. Through the visualization of data, the researcher found out that all the cases where in proximity of water streams, so that he was capable of understanding the relation between the disease and the spatial context. Although, due to a vast complexity of territorial dynamics, heterogeneity of physical space, uncertainties, spatial and temporal scales, it is intricate for human analyst to reason and select the most appropriate scenario in an almost unlimited variety of options. As Andrienko et al., pointed out:

"Since it is physically impossible for an analyst to review all possible scenarios, computational support is absolutely necessary [...]an isomorphic visual representation, such as a map or an orthophoto, allows a human analyst or decision-maker to perceive spatial relationship and patterns directly" (Andrienko et al., 2007, p. 842, p. 844).

Nowadays, all the theories and methods regarding visual representation revolve around the concept of geovisualization in general and specifically, the emerging discipline of Visual Analytics, which led to define a sub-discipline known as Geovisual Analytics for Spatial Decision Support. The academic researchers and experts begun to pose some questions concerning Geovisual Analytics for Spatial Decision Support from the GIScience conference in Münster in Germany in 2006, also supported by the Canadian International Cartographic Association (Andrienko et al., 2007)(MacEachren, et al., 2004). In brief, *"Geovisual Analytics for Spatial Decision Support is a research area that looks for ways to provide computer support to solving space-related decision problems through enhancing human capabilities to analyse, envision, reason and deliberate"* (Andrienko et al., 2007, p. 847).

However, the domains of geovisualization are not only related to planning aspects but also broadened out in a variety of research areas. Public health, environmental science, molecular modelling and mathematics are just few examples (MacEachren, et al., 2004)(McCormick et al, .1987). In this case, crisis management is one of the most relevant domain. In emergency situations, key parameters change quicker than in common situations and due to time pressure, analysts and decision-makers do not have time to take into account all the variables, in depth (Andrienko et al., 2007).

"The cost of an error, however, may be very high. [...] Therefore, decision-support systems must provide support for distributed, shared memory along with efficient and intelligent computational and knowledge management tools that alert participants to key decision points, provide reminders about access to relevant prior information, and present and rate available options" (Andrienko et al., 2007, p. 843).

Besides, geovisualization tools have the potential to maintain the focus of who is observing a tangible object such as a map, avoiding different individuals to concentrate a debate on subjective or abstract matters. Nowadays, it is embedded that models, which address the future, include elements of visions (Hanzl, 2007).

At this point, the shift from technocratic paradigm to participative one was clear and marked, opening up to innovative collaborative software. New paradigm of social participation in planning assumes collaboration of all interested parties (Sanoff, 2000). As Hanzl observed:

"Both citizens and planners become providers and recipients of information. Such collaboration takes place in design groups and in internet systems where users are actively engaged in design process [...]. A term groupware - software for group work had been introduced for 'computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment" (Hanzl, 2007, p. 297).

Therefore, groupware underlines the necessity to be used by a certain group work.

Nowadays, a highly debated argument among professionals and researchers revolves around the Web 2.0, ICTs and PSS within the field of the e-Planning and e-Government. Wang et al., referring to the UK Planning-Service, pointed out that: "*e-Planning, as a section of e-Government, can enable easy access to information, guidance and services that support and assist planning applicants, and streamlined means of sharing and exchanging information among key players*" (Wang et al, 2007, p. 737).

However, it is not the focus of this thesis to analyse or examine any aspects of the e-Planning but rather trying to narrow down to the most updated and comprehensive planning approaches in relation to participatory practices after having contextualized the evolution of planning practices along with the technological evolution and consequent development of outgoing planning paradigm.

After having highlighted the evolution of technologies enhancing collaborative tools for supporting public participation, how has simultaneously evolved the theoretical frame around the concept?

2.2. Progress in Planning Theories: from the theory of Public Participation to the Concept of e-Participatory planning

The core of the concept of Public Participation puts the focus on democratizing the human beings beyond the society. The roots of the concept can be traced back to the Participatory Democracy Theory of Jean Jack Rousseau, through which he idealised the community participation and about which Foucault argued that:

"It was the dream that each individual, whatever position he occupies, might be able to see the whole of the society, that men's hearts should communicate, their vision be unobstructed by obstacles, and that the opinion of all reign over each" (Foucault, 1980).

As Sameh (2011) underlines, Rousseau based his theory above the argument that:

"the involvement of citizens in the decision-making process fosters human development, enhances the sense of political efficacy, reduces the sense of estrangement from power centers, nurtures a concern for collective problems and contributes to the formation of an active and knowledgeable citizenry capable of taking an active interest in governmental and managerial affairs" (Sameh, 2011).

Moreover, Pateman (1970) has indicated that the Participatory Democracy theory tries to solve an old antithesis, between individuality and sociality, introducing the notion that public participation has a main educational purpose.

"The theory of participatory democracy is built round the central assertion that individuals and their institutions cannot be considered in isolation from one another.

The existence of representative institutions at national level is not sufficient for democracy; for maximum participation by all the people at that level socialization, or "social training", for democracy must take place in other spheres in order that the necessary individual attitude and psychological qualities can be developed. This development takes place through the process of participation itself." (Pateman, 1970, p. 41)

Arnstein has conducted one of the first attempts to criticize the participation process and its inefficiency in providing citizens with real power. In the 1969, she published an article titled "A ladder of Citizen Participation" in which she organized the eight steps of the ladder into three levels: nonparticipation, tokenism and citizen power.

Aside the fact that it was of great importance to trigger the debate, nowadays it is considered quite worthless because the concept has been built around the assumption that citizen control is the only and proper goal of public participation and due to the fact that it focused merely on criticizing the conventional methods rather than enlightening planners on how processes can be improved.

Community participation is a widely known and accepted concept. Yet, it is a complicated notion as there is not specific and homogeneous definition. According with Moser (1989), the abundant range of definitions reflects the several different ways adopted to interpret the practical approach. Indeed the interpretations are based on specific fields of interest and the amount of stakeholders involved in a planning process are quite often considerable. Agencies, non-governmental organizations, governments and citizens always have conflicting objectives related to the own interests and it is possible to notice this conflict when it comes to the practice.

Moser (1989) stated that contradictions between intentions on paper and the real agenda can become apparent in the practice of community participation.

As the Director of UNCHS (UN-Habitat, 1986) stated in his report, it is not a direct interest of governments to involve citizens.

"In practical terms, community participation directly benefits agencies such as social welfare departments, planning offices and local housing authorities, because it broadens their resource base in physical, financial and most important human terms...It distributes or shares responsibility for the design, management, and executions of programs and projects. Through community participation, government, despite limited outlays in per capita support, can assist a far greater number of needy than can be reached by current conventional programs" (UNCHS, 1986).

In fact, according with Martin, Tarr and Lockie (1992), citizen involvement can occur for the only purpose that it provides a vehicle for diverting blame for governance failure from politicians and administrators.

Another reason is that politicians and government administrators consider community empowerment as directly proportional to their own loss of control (Sharp, 1992).

Kweit and Kweit (1986) have observed that democratic decision-making, in contrast to bureaucratic or technocratic decision making, is based on the assumption that all who are affected by a given decision have the right to participate in the making of that decision.

Furthermore, they have pointed out that policies can be evaluated through two criteria:

"the accessibility of the process and the responsiveness of the policy (contextualized policies built in favour of the entire community) to those who are affected by it, rather than the efficiency and rationality of the decision" (Sameh, 2011).

"In a democracy, it is the public that determines where it wants to go, and the role of its representatives and bureaucratic staff is to get them there. In other words, ends should be chosen democratically even though the means are chosen technocratically" (Kweit and Kweit, 1986, p. 25).

According to Innes and Booher (2004), the conventional practices related to public participation do not reflect the theoretical inputs and do not achieve the targeted outcomes.

For instance in public hearings, one of the most conventional methods used, citizens are put against each other and therefore forced to think in individual terms without have real power to influence the decision-making process.

As Craig (1998) has pointed out, a public participation program should have the following objectives:

- Expands the public's role in defining questions and making decisions
- Increase public involvement in generate and employ data and information
- Create a wider public involvement of stakeholders by using computer-based approaches

and, for the program in order to be efficient, Schuler (1996) argues that it should have the following characteristics:

- Unrestricted and Community-based: anyone in the community should offer his participation
- Reciprocal: data users should even be data providers
- Contribution-based: all the participants should contribute
- Accessible and inexpensive: the involvement process must be free to everyone
- Modifiable: the public participation process itself must be flexible in order to take into consideration the evolution of planning systems and software (groupware).

According to Sameh (2011), an active community engagement could enhance the sense of civic commitment among citizens, increase the final user satisfaction, create outcomes that are more realistic and be a catalyst for building trust within the governance.

Since the eight steps of Arnstein (1969) were too abstract and her ladder was not answering to how to improve the participatory planning process, Kingston (1998), basing on a previous work conducted by Weidemann-Femers, proposed a new ladder composed by six steps more related to the planning process issue.

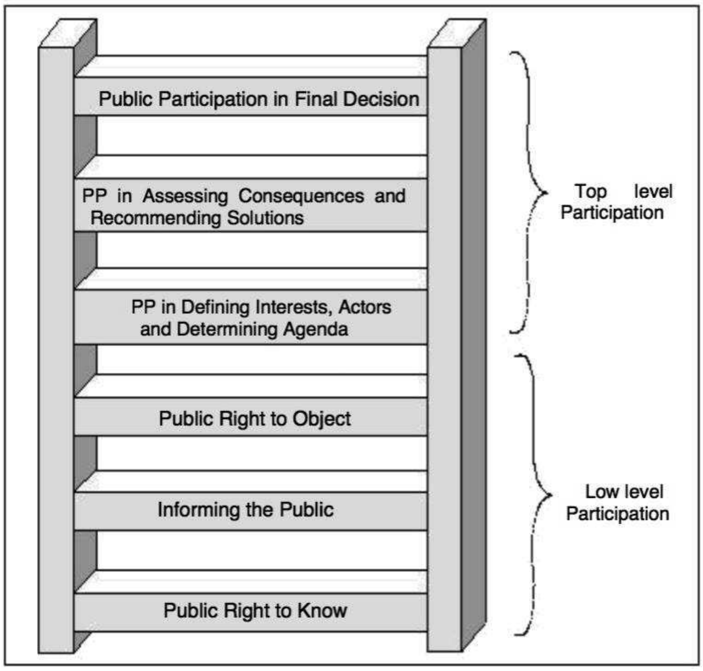


Fig.2.2: The public participation ladder according to Kingston 1998 with modifications. Source: Kingston, 1998.

The lower three steps represent no real public participation while the top three define a more interactive process. In particular, only the fifth and sixth levels democratically enable the decision-making process to create responsive policies.

According with Wates' report on Urban Design Group, the quality of development of the built environment is strictly related to quality of citizen involvement.

"*Improving the quantity and quality of public involvement in urban design is one of the keys to improving the quality of the built environment*." (Wates, 1998).

Even though in the current practice exist several methods to involve and engage citizens and new ones continue to emerge, there is a little knowledge about all the practices and this makes planners and practitioners to often adopt inappropriate approaches. Therefore, planners must define tailored programs able to meet specific and contextualized goals and objectives.

As Cogan et al. (1986) stated:

"A successful citizen participation program must be: integral to the planning process and focused on its unique needs; designed to function within available resources of time, personnel, and money; and responsive to the citizen participants" (Cogan, et al., 1986, p. 298).

PUBLICITY	PUBLIC EDUCATION	PUBLIC INPUT	PUBLIC INTERACTION	PUBLIC PARTNERSHIP
Building public support	Disseminating information	Collecting information	Two-way communication	Securing advice and consent
<---------------- PASSIVE			ACTIVE---------------->	

Fig.2.3: Criteria for an Effective Citizen Participation Program. Source: Cogan, et al., 1986.

The "horizontal" ladder of Cogan divides the steps into two categories, a passive contribution to the process by the citizens opposed to an active one, which represents the highest level of citizen involvement achieved through a public partnership approach. This proposal from Cogan opened the rising path to the interactive approach (inter-active), which assumes an active participation between the diverse groups of stakeholders involved.

Moreover, it is possible to trace the foundations of the six steps ladder proposed by Kingston in the studies conducted with respect to Forest Service decisions and resource management planning by Lang. He suggested:

"An integrated approach to resource planning must provide for interaction with the stakeholders in the search for relevant information, shared values, consensus, and ultimately, proposed action that is both feasible and acceptable" (Lang, 1986 p. 35).

Lang calls for a more interactive approach to planning because he considers the traditional comprehensive and strategic planning processes not sufficient for resource management planning. His suggestion is based on the assumption that interactive planning, which is made of open and participative processes, leads to better and more responsive decisions.

Interactive Planning	Conventional Planning
Includes information/feedback, consultation and negotiation	Limited information/feedback; maybe some consultation
Interaction occurs early on and throughout the planning process, with full range of stakeholders	Early interaction with implementers; affected interests not involved until late in process
Assumes that open participation leads to better decisions	Assumes that better information leads to better decisions
Planner as value-committed advocate	Planner as value-neutral expert
Focuses on mobilization of support	Focuses on manipulation of data
Plan = what we agree to do	Plan = what we should do
Success measured by achievement of agreement on action	Success measured by achievement of plan's objectives

Fig.2.4: Interactive Planning vs Conventional Planning. Source: Lang, 1986 p. 39.

Following the call for interactive approach, a further step has been taken by Kingston (2002) where he integrated in the ladder different forms of interactive technological systems as shown in the below Fig. 2.5:

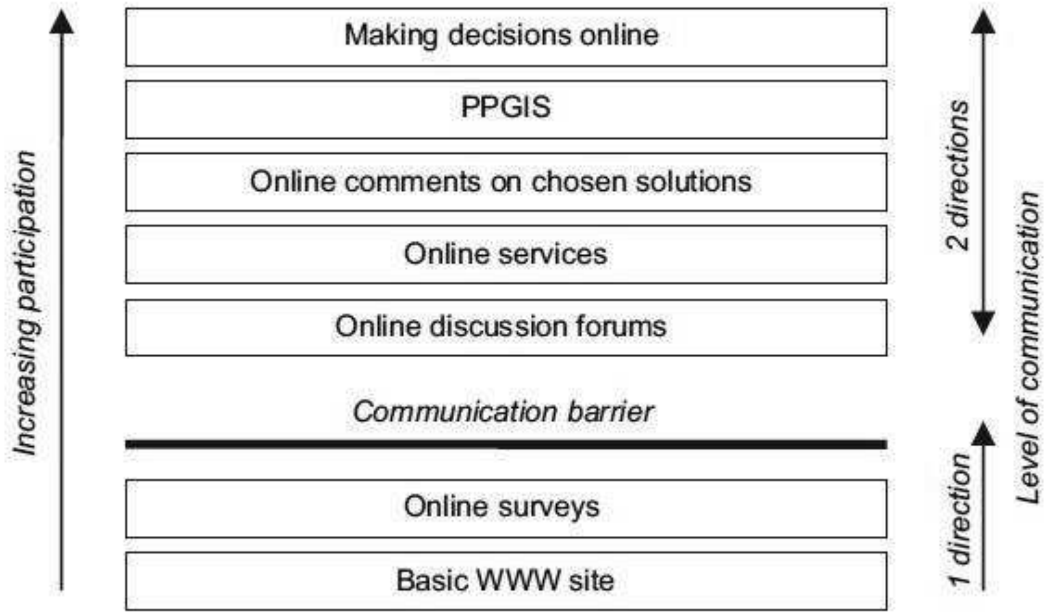


Fig.2.5: The Kingston e-Participatory ladder. Source: Hanzl, 2007.

The Kingston (2002) e-Participation ladder, initially rooted in the aforementioned Arnstein (1969) ladder of citizen participation and secondly, in the six-step public participation ladder (Kingston, 1998), sheds light on the possible public participation involvement according to various types of Web 2.0 and PSS. In this ladder, there are seven types of receivers and supporters of information among IT experts, professionals of planning responsible for communication of information, group of professionals with knowledge on the subject, politicians, group of citizens and stakeholders (Hanzl, 2007). An interesting point that diversifies the e-participatory ladder from the previous ones is the crucial aspect of the level of communication, which led to reconsider the role of data providers and data users. Hypothetically, through interactive technologic systems, users become data providers. In reality, due to various limitations also strongly related to the kind of realised prototype of systems, technical functions still maintain a division for data providers and data users (Hanzl, 2007)._However, as mentioned before also by Cogan et al. (1986), technologic support to public participation has the capability of generating either passive (one-direction) or active (two-direction) level of communication. This two-direction of communication means that users have the opportunity to directly influence preliminary processing of data together with providers for the sake of more robust background knowledge. In other terms, *"new information technology offers citizens new possibility of participation in the planning process even though most of the PSS mentioned are still experimental"* (Hanzl, 2007, p. 303)._Certainly, as Hanzl (2007) pointed out, the coming Web 2.0 and PSS have to deal with three main goals:

1. Provide communication platform suppressing a barrier of non-professionalism;
2. Allow for distant contacts
3. Manage a participatory planning process

The first point regards the ability of the coming PSS to be as much simplified and understandable as possible for layperson. This is a communicative improvement that reduces manipulative actions, enhancing a bottom-up approach to the expenses of a top-down one. The second aspect aims to eliminate or at least, limit the representativeness issue. While the third point it is an obvious call for an integration of the so called metaplanning methods in the future PSS. As Campagna pointed out, *"metaplanning can be defined as the design of the planning process"*(Campagna, 2016, p. 60). A list or a linear (chronologic) drawing of activities that a certain planning process will follow is a practical example of what a metaplanning method could be. It is actually the organization and representation of all the steps composing a complete planning or design process in order to reduce confusion and give a clear picture to all the actors involved. It is important to notice that the technological implementation together with the new planning paradigm, add greater complexity to planning practices, which demand more rigid, simplified and understandable metaplanning methods. For this reason, the development of the future PSS should take into account also the inclusion of metaplanning methods for the sake of the entire planning process. Since the six steps ladder of Kingston, the development of efficient and comprehensive public participation programs and the support of digital technologies are not anymore easily divisible. This relationship led from a simplistic passive public participation based on a one-direction communication level to an active collaborative process organized on a two-direction level of influence.

Summarizing, it is possible to clarify that although the project refers to the Public Participation Theory of Arnstein of 1969, better known as the ladder of public participation, it adopts its most updated conceptual version defined by Kingston (2002) as the e-participatory ladder.

As already largely stressed, the modern concept has been developed, among others, by Kingston (2002), which has considered the evolution of inclusive practices together with the evolution of technologies aimed at supporting participatory planning processes. The purpose of using the participatory planning perspective lays under the nature of the geodesign approach itself, technically translated into one of the most advanced planning support informatics tools, requiring all the interested stakeholders to comprehensively collaborate. Looking at the five top levels of the e-participatory ladder in Fig.2.5 above, the theoretical perspective conceptually supports the practical application of the geodesign approach to the case study, which in turn will generate some results furtherly analysed in a broader and contextualized perspective related to the post-earthquake awkward and complex conditions.

3. Methodologies

Besides, to help the authors in organizing their writing tasks, having a clear methodological structure can help the reader to holistically understand what are the objects and the purposes of a certain project, how it is intended to be developed and how to evaluate the quality of the findings. By clarifying the project type, it is more possible for the reader to adopt a similar perspective with the authors and therefore have a better understanding.

In this section, the research methodology explanation is provided, avoiding focusing either on the choices regarding the theoretical framework, which has been previously described, and on the data collection, to which it has been dedicated a separated chapter, precisely Chapter 6.

The purpose behind this study project was to test the ability of an innovative approach in dealing with the complex and delicate context of post-earthquake planning, investigating which positive enhancements it could bring to the Italian traditional planning practices. In order to shed light on possible approach improvements, a workshop has been organized. It is possible to say that the "action" of the workshop was fundamental to inform the broader research field of the post-natural disaster planning, aiming at finding improvements for some of the most relevant gaps within it. The reasons behind and the way this study has been carried out can categorize the project design as an Action-Research which comprises two main components such as action and research. Indeed, according to Kumar, *"Most action research is concerned with improving the quality of service. It is carried out to identify areas of concern, develop and test alternatives, and experiment with new approaches"* (Kumar, 2011 p.126).

Furtherly, action research relies upon a concept of community development that seeks the involvement of community members. Involvement and participation of a community in the total process from problem identification to implementation of solutions, are the two salient features of this type of project design (Kumar, 2011).

Narrowing down, based on the geodesign framework, the workshop adopts an abductive thinking approach that goes beyond what can be logically induced or deduced. It bases its process upon "*what might be hypothesized, guessed or imagined beyond what is logical"* (Miller, 2012 p.19). Moreover, according to Olsen and Pedersen (2008), the knowledge is created through and along the collaborative process and more likely leads participants' opinions to changes, rather than be used as external initial inputs for the research, aiming to be confirmed or denied.

Conversely, zooming out, the overall approach of this project can be defined as inductive. The knowledge generated through the abductive thinking approach is then generalised and contextualized to investigate a broader research field. In other words, the specificity of the innovative approach of the "action" is used to throw light on a more general field as the traditional post-natural disaster planning.

The choice to deal with natural disaster and to try to improve the current post-disaster planning practices arise from the consideration that, together with the worldwide recognized and accepted phenomenon of climate change, natural events will likely threat more frequently and more strongly urban and territorial systems and local communities around the globe. Besides, it has been considered the increasing complexity of our society and its operational systems. Therefore, more comprehensive post-natural disaster planning practices, aimed at reducing the vulnerability and increasing mitigation measures, have to be furtherly investigated.

Furthermore, the happening of a strong seismic event in 2016, focused the attention of the authors on the Italian peninsula, periodically impacted by earthquakes and the consequent well-known negative effects originated by not-tailored post-earthquake planning practices. Specifically, it has been chosen the municipality of Norcia as study area of the project due to some considerations. Initially, the rural town is currently risking losing its attractiveness as central pole both for international tourism related to religious and heritage aspects and for the famous high quality agricultural-products. Secondly, even though the municipality medium and small-sized urban areas had several significant damages, almost none of them recorded any casualties during the four quakes, making slightly easier to deal with collaborative processes comparing with other nearby towns almost totally destroyed, structurally and socially. Thirdly, also because some of the local institutions such as the Civil Protection of the Umbria Region and others, shown willingness in both providing data and collaborating for the success of the experimental test.

In order to have a better and a more complete understanding of the current situation concerning traditional post-earthquake planning approaches and practices, the conceptual support provided by the theoretical framework and the technological evolution of tools, documents, scientific papers and literature, have been deeply examined and used as sources.

In parallel, for what pertains the workshop phase, the authors have critically observed the process itself, the interactive dynamics among participants, their responsiveness to the new approach and to the new informatics tool. Participants as well were asked to provide feedback according with their observations generated while collaborating in the process. The two type of observations have allowed for reflecting upon the approach and the way that has been applied to the case.

Finally, it is also important to link to the concepts of validity and reliability, which are related to the quality of the research carried out. Validity expresses the quality of the investigation process and considers whether it was able to answer the research question. In order to obtain a valid project, the collection of data can be seen as a crucial phase, partially dependent on their availability. In this project, the data collection phase played an important role in the overall research in order to have a more complete initial representation of the geographical area and the damages caused by the earthquake. Therefore, the authors sought to obtain as much quality data as possible, according to their availability. For instance, since the workshop participants should represent local real-world stakeholders, they were thoroughly selected, although the academic purposes of the project.

Moreover, also reliability issues have to be addressed. Considering the complex conditions of the study area and the inexperience of the authors in conducting collaborative workshops based on the application of innovative approaches and software, it has been involved various experts familiar in dealing with geodesign studies in order to increase the professionalism and able to conduct the test. Therefore, the project have generated more reliable results and a more robust structure of the entire process, from pre-workshop to post-workshop phase.

4. Contextualization of the case study

4.1. Case Study

The Municipal territory of Norcia, which belongs to the province of Perugia, is placed in the south-eastern side of the Umbria region, bordering one another with Lazio and Marche regions. It is located in the central part of Italy and precisely its geographical coordinates are 42°47′36″N 13°5′38″E. The municipal boundaries cover an area of 273.71 sqm and being situated among some of the highest peaks of the Apennine range, its elevation is of 604 m. Therefore, it is placed in a mountainous landscape, where plains, mountains and valleys are continuously alternated.

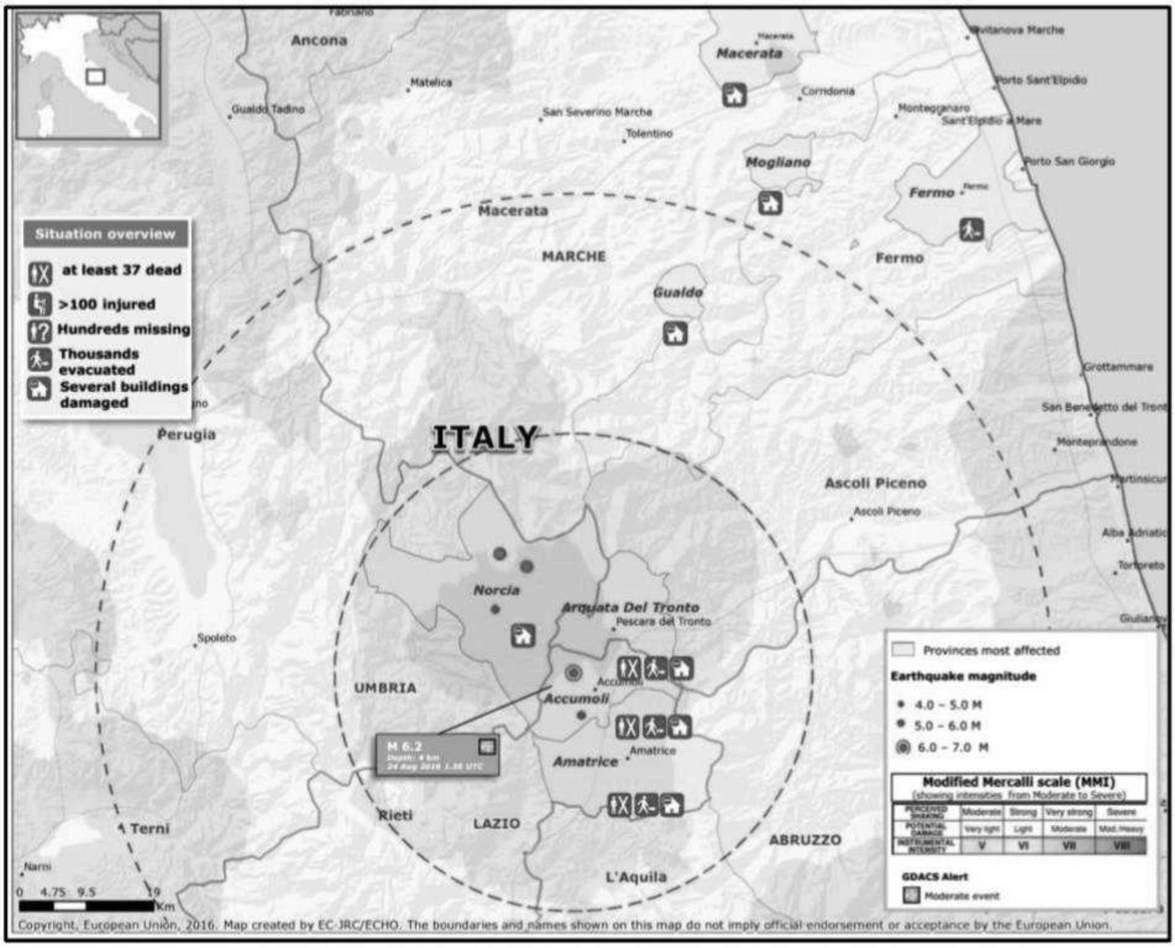
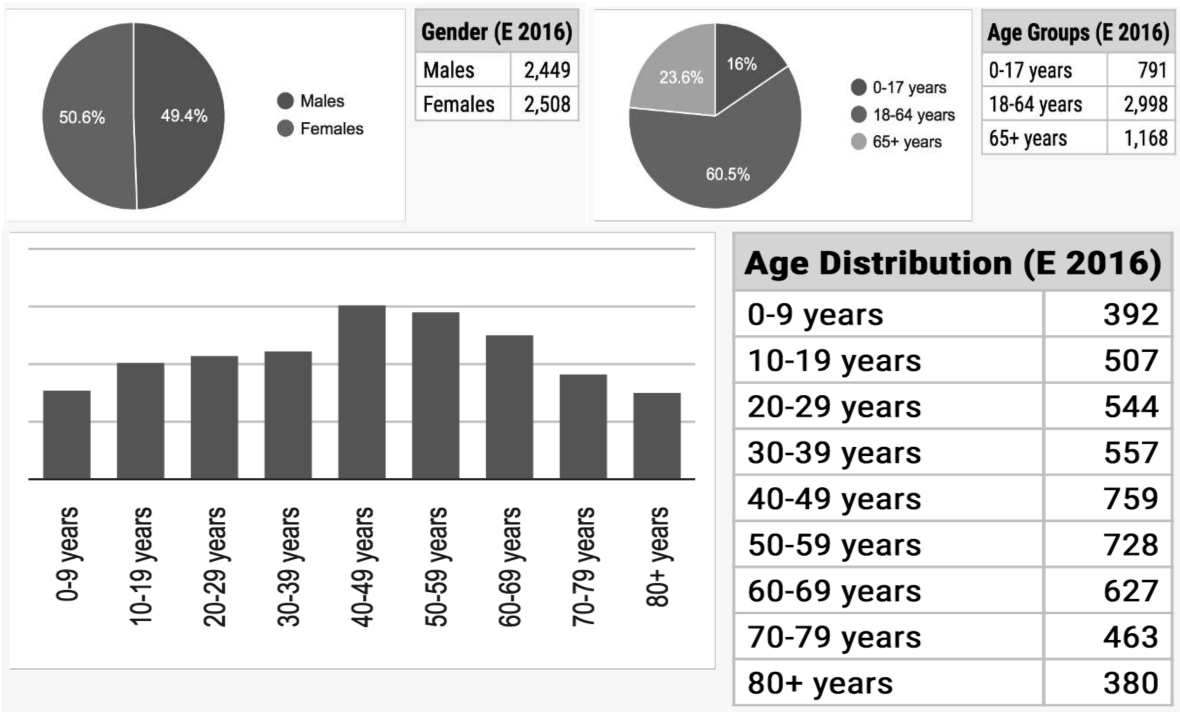


Fig.4.1: Earthquake map 24 August 2016. Source: INGV.

The total amount of people that inhabit the whole municipal territory, including Norcia town and the 27 minor hamlets is of 4957 with a slight annual increment of 0.2% and the population density of the town is of 18.1 inh/sqm. Citizens are equally divided by gender while the age distribution chart (Fig.4.2 below) shows that the over 65 years are more abundant than the under 18, according with the national tendency to be an aging country.



Gender (E 2016)	
Males	2,449
Females	2,508

Age Groups (E 2016)	
0-17 years	791
18-64 years	2,998
65+ years	1,168

Age Distribution (E 2016)	
0-9 years	392
10-19 years	507
20-29 years	544
30-39 years	557
40-49 years	759
50-59 years	728
60-69 years	627
70-79 years	463
80+ years	380

Fig.4.2: Population of Norcia, charts of gender and age distribution. Source https://www.citypopulation.de/php/italy-umbria.php?cityid=054035

As it is possible to notice by the population density, the extended municipal territory of Norcia is very little built and is mostly characterized by green landscapes covering plains, rolling hills and higher mountains. In general, the entire Norcia region can be described as a vast area where the ecologic value is dominant while the anthropic pressure is minimized. More in details, within the municipal boundaries, the protected reserve of Monte Sibillini national park spreads out for almost half of the whole area, from the eastern municipal border it reaches the town of Norcia as well. The town and its hamlets have been kept with their historical compact and dense form, and the old buildings, which have survived to previous earthquake events, are still predominantly marking the area. Rather, outside the walls is clearly visible where small-unplanned low-density suburbs are invading the agricultural land. Outside the built environment and except for the steep slopes of the mountains, agricultural and breeding farm fields occupy most of the land use availability since their final products are pillars for the local economy.

Within the settlements, streets are still narrow, built basing on pedestrian scale and for the purpose to connect both tiny and mayor squares while the connectivity between settlements and with the rest of the region relies mostly on the main road which comes from Foligno/Spoleto (North-west), runs along the western side of Norcia town and crosses the area going towards south. The road network is not highly developed and, except the main road, the minor ones have the only purpose to connect Norcia with the small detached hamlets. Public transport systems in the region are not very well developed and the way people move around strictly relies on private vehicles ownership. Going towards south, just outside the town, the main road coasts the industrial area, where most of the local industrial activities are based and upon which most of the local economy relies.

The economic systems of the area are still depending on products manually worked following traditional methods. Basically, the local economy counts on high quality agricultural products, as the lentils of Castelluccio and the black truffle which grows in the entire Norcia region, on the local pork meat transformed into multiple different products, as the worldwide famous Norcia ham and wild boar salami, and on the overall attractiveness of the area translated into both the ecological and cultural tourism. Tourists have being always attracted to this ancient village. This due to several reasons. Mainly because the town is a religious centre in Italy and it gave birth to St. Benedict. In fact, the whole region is characterised by the presence of several churches, abbeys and monasteries related to the Saint. Then cultural events related to tasting itineraries of the aforementioned high quality food products are very common and frequent so that it is an identity mark for the area and for its inhabitants. Meanwhile, the green landscapes attract huge flows of tourists that want to enjoy the local nature, by trekking and climbing up to the highest peaks or by simply cycling along scenic bike routes immersed into the green landscapes.

Finally, due to its location, the town is home of seasonal tourists which move here to escape the stress of big cities as Rome (160 km away) to their secondary (holiday) homes. It can be summarised that the region does not differ from the traditional Italian structure of old rural middle town settlements, where the term “old” does not only refer to the medieval nature of the built environment but especially it refers to the outdated infrastructure systems and, more in general, to the way all the urban systems are independently managed. This makes the seismic region even more vulnerable to the occurrence of seismic events and related effects.

Indeed, since the area has a long tradition in dealing with earthquake phenomena, the focus of the local government should be put towards the reduction of the vulnerability through a strategic and integrated approach to the post-earthquake recovery phase. Only in the last 40 years, since 1979, Norcia has been hit by quakes higher than 5 degrees seven times and both the frequency and the intensity are rapidly increasing. Recently, on the 24th of August 2016, a 6.2º earthquake impacted a vast area and the epicentre was only 10 km away from the town.

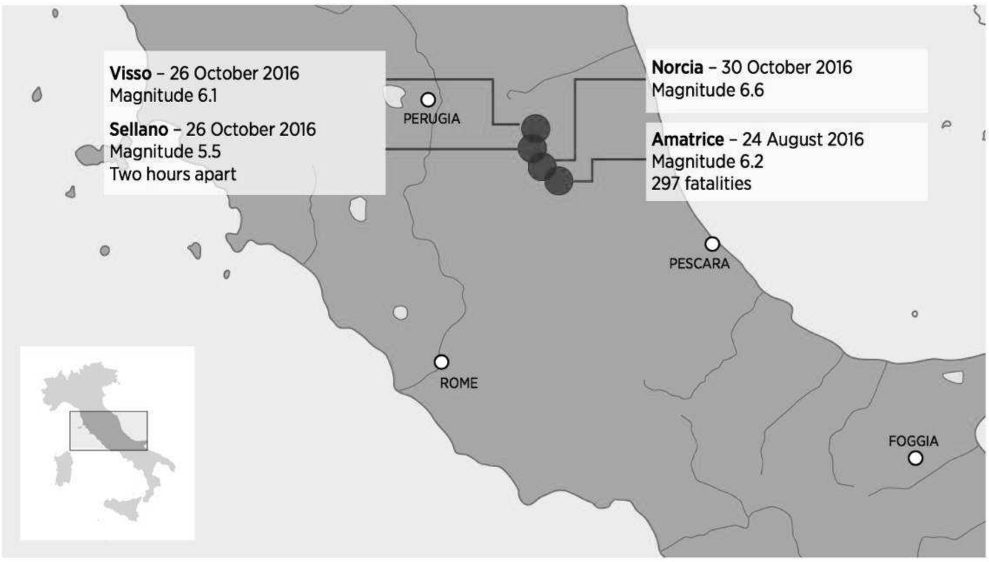


Fig.4.3: Geographical contextualization of the 2016 earthquakes. Source: Google.

The town of Norcia relatively suffered from this event, where most of the negative effects, as fatalities and destruction, have been experienced in the bordering regions of Lazio and Marche. The study area object of this project have reported no casualties at all and survived to the natural event accounting only for smaller damages to both public and private constructions. The most important information related to this first quake is that it has increased the vulnerability of buildings and infrastructures, increasing the overall exposure to hazards for the community. A second strong earthquake of 6.6º with epicentre closer to Norcia occurred on the 30th of October 2016, only three months later. Due to the increased exposure above mentioned, this second event has generated a bigger wave of negative effects. The town has lost big portions of its ancient city walls, private buildings have suffered huge damages rendering thousands of inhabitants homeless, activating a depopulation process for the whole municipality. Public historical and identifier cultural buildings have been completely destroyed, as the St. Benedict basilica and several abbeys and churches, while most of the businesses within the industrial area have shut down their activities due to the non-habitability of the buildings. Furthermore, damages at infrastructure systems have left some portions of the region unconnected from the rest of the network, as the only road connecting Castelluccio to Norcia main settlement. Moreover, the strong earthquake brought back to surface an ancient river named Torbidone, which has disappeared some decades ago, pushing the local community to re-adapt to its existence. All these negative effects have generated a vortex of inconveniences for all the other urban systems, from an economic, social and environmental perspective.

Fig.4.4: Pictures of Norcia damages. Source: The authors.

4.2. State-of-the-arts in traditional post-disaster planning and related gaps.

Earthquakes are strong natural events related to geomorphological issues. As most of natural disasters, their happening disrupt the functioning of all urban and territorial systems affecting the social system. In particular, the most impacted urban elements are the physical built environment of cities, infrastructure systems, socio-economic systems and the threaten lives of citizens (Olshansky and Chang, 2009), which can be suddenly compromised for decades by seismic events. It is matter of planners to manage the rebirth of affected systems in order to support the lives of communities. Moreover, agendas throughout the globe reflect the concerns built around the fact that along with climate change increasing effects, disasters will become more frequent and more economically challenging to face due to the increasing complexity of our urban systems. All of these are reasons why post-disaster recovery planning and management is an emerging and very important research field within urban and spatial planning (Olshansky and Chang, 2009).

Natural disasters threaten the ability of impacted cities to maintain their main functions but most of the damages appear during the recovery timeframe, when people suffer from stagnating economies, weakening of social networks and for the decline of provision of basic needs. According with Olshansky and Chang (2009), the challenges ahead for planners and local governments consists in understanding how to effectively manage post-disaster recovery while meeting the fundamental and time-sensitive needs regarding provision of housing, recover and revamp both economic and social systems without losing the opportunity for community and infrastructural betterments.

In the specific of post-earthquake planning, the event, which occurs periodically, is commonly tackled through a four-stage cycle, wherein recovery is one of the stages. The cycle starts with *Preparedness*, which refers to the capacity of a community to respond rapidly when a natural disaster is going to happen. *Response* is the set of actions taken in the immediate after the event occurred. The purpose at this stage is mostly to save lives and react to the emergency. *Recovery*, in the short term consists of the re-establishment of main systems necessary to maintain basic and standard needs (e.g. infrastructure systems) while in the long term the focus is put on the rebirth of urban systems necessary to restore the community functioning. *Mitigation* points at those activities aimed to reduce the vulnerability thus enhance the resiliency (Olshansky and Chang, 2009). In particular, recovery can provide the momentum for introducing mitigation measures and spread benefits to all four stages. Although, there is not an agreed definition on the concept of recovery and on how should be managed in practice. In some cases, it has been defined as the return to pre-disaster or without-disaster conditions while in other cases it has been argued that impacted communities very often have to face significant changes in their structures without being able to come back to either pre-disaster or without-disaster conditions (Olshansky and Chang, 2009).

Research in planning recovery always had a quantitative connotation and mostly focused on the immediate economic issues of a disaster. Conversely, new approaches more oriented towards the development of decision-support tools are recently begun to emerge. In particular, the systems approach to urban disaster recovery, which considers cities and regions as interconnected systems. This approach has some important strengths.

"First, it approaches cities as systems, identifying and focusing on key interrelationships that affect recovery. This allows for understanding how decisions in one sector may affect recovery in others, which means that better decisions (e.g., prioritisation of infrastructure restoration) can be made from the perspective of the entire community, city or region. Second, it is quantitative, allowing systematic and transparent verification with empirical observations and data [...]. Third, the approach is often visual and map-based, with associated benefits for analysis and communication; for example, being able to distinguish and relate recovery at the neighbourhood level to the urban scale" (Olshansky and Chang, 2009 p.206).

In a complementary manner, another approach seeks to investigate the role of both public and private actors in planning recovery processes. Within this latter approach, the collaborative and participatory planning plays a fundamental role. According to Olshansky and Chang (2009), the inclusion of citizens in recovery planning should be covered by transparent regulations made by local governments. As the World Bank (2008) pointed out, the effectiveness of post-disaster planning outcomes depends on how the planning process has been designed and on the content of the final plan, which in turn depends on the level of participation and commitment of all the key actors involved. Moreover, the collaborative process to post-disaster recovery can strongly unify the affected communities and thus gain more important contributions. Ying (2009) emphasized the importance of this aspect by quoting John McCarthy and Greg Lloyd (2007)' statement, which says that higher rates of community participation can help to increase social cohesion and then the overall quality of life. It has been furtherly reported:

"*In Kobe, government actively engaged affected communities and stakeholders through the formation of community development councils (Machizukuri) that had significant influence on outputs and outcomes of the urban and community planning process throughout the 10 years of reconstruction. Similar high levels of community engagement were also successfully structured in affected towns and cities of Gujarat"* (World Bank, 2008 p.6).

It is assumed that the two previous innovative approaches are needed in order to deal with an increasing complexity, regarding both urban systems and planning practices. By focusing on how the systems of the study area operate, it is possible to reach a better understanding of the geographical conditions and increase the overall knowledge of the place. Through the second approach, it is possible to create a more democratic process, which in turn will lead to have more consensus among public/private stakeholders and the local community impacted by the natural event. These two approaches face, respect and try to unfold the complexity of the post-disaster conditions instead to neglect it, as often happened in traditional approaches. In turn, it is fundamental to understand how to involve citizens to collaborate adopting a system thinking approach. The enlarged complexity has to be faced and understood so to facilitate more comprehensive and transparent processes.

Due to this complex conditions concerning the seismic effects and the need to integrate the new approaches, it becomes clearer the importance of having a robust strategy since the beginning of the process. It would allow for addressing short-term goals while avoiding to neglect long-term ones. Indeed, often the worst negative effects begin to appear after the emergency phase, in a longer time horizon, and if not solved could bring to the most catastrophic damages, as economic stagnation and inhabitants depopulation.

Moreover, considering that in a post-disaster environment more financial resources become available, the natural phenomenon can see as the momentum to accomplish improved conditions over the pre-disaster ones. Therefore, it is important to notice that nowadays, the world is experiencing a paradigm shift on how cities are seen, understood and thought and the transition is leading towards the conceptualization of a new model of city.

As De Vico et al. (2014) pointed out, city models represent the state-of-the-arts of cities and can be seen as reading guides to understand the conditions of cities and, more broadly, territories. Essentially a new city model arise when needs, habits and targets of the society are changing. In fact, climate change issues are emphasizing the increasing effects that natural disaster are having on complex urban systems. Therefore, regional and urban needs are changing, forcing the emergence of new representational models of cities. According to De Vico et al. (2014), the actual needs of the society are pushing towards the reconceptualization of the city model, which aims at new leading principles as reduction of soil consumption, urban regeneration, smart territory, sustainable mobility, care for environmental needs, new purposes for public spaces, inclusive planning and collaborative governance.

There is a worldwide attempt to address these goals through the model of the sustainable city. Hence, planners and local governments should also consider natural-disasters not only as an opportunity to improve comparing to the pre-disaster existing conditions but even as an opportunity for the transition in direction of the new city model. In other words, natural disasters offer to planners and local governments the occasion to foster the rebirth of the impacted urban systems towards the new globally accepted model of sustainable city leaving behind once and for all the post-industrial model. Yet, in the particular context of post-earthquake, the new model should be able to guide the communities involved towards a more resilient condition. Resiliency has been described by Olshansky and Chang (2009) as the capacity of a community to readily recover from the next event. Metaphorically, the ability of a community to *"bend in a disaster and then bounce back ready to face the next natural event"* (Olshansky and Chang, 2009 p.201). Therefore, the way the recovery occurs, and both its short term and long term goals, plays a crucial role for the future of the impacted community.

4.3. The Italian seismic context

The Italian peninsula is always being affected by high seismic hazards due to its geographical location. As it is possible to see by the Fig.4.6 below, particularly sensitive are the north-western part of the country in proximity of the Alpi range and along the Apennine range, running vertically from North to South.

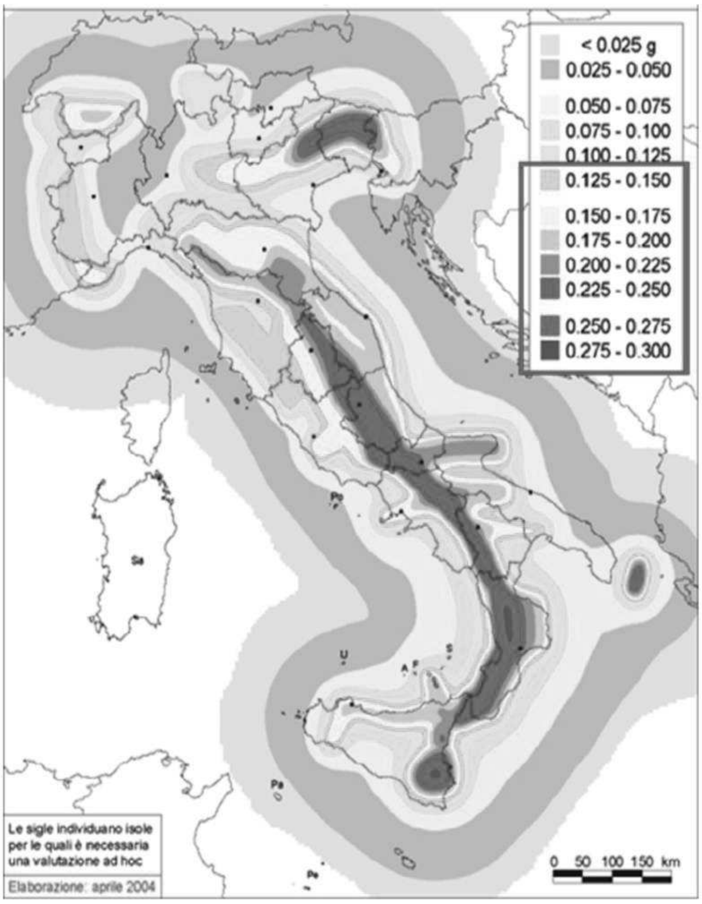


Fig.4.5: Official seismic hazard map of Italy. Source: INGV, 2004.

Therefore, Italy has a long negative tradition in dealing with earthquake events highlighting tremendous lives losses and huge social and economic costs (Dolce, 2012). Briefly, since 1000 A.D. 220 events occurred with epicentre Mercalli intensity scale ≥ 8 degrees. Moreover, in the past two centuries earthquakes with magnitude between 5.5 and 7.2 have caused about 150,000 casualties and have damaged and destroyed historical and cultural heritages, whose value is not quantifiable. More recently, in the last 50 years, earthquakes with magnitude between 5.5 and 6.9 had consequences for over € 150 billion in monetary losses. These consequences are attributable to several factors, as the *"obsolescence of many buildings, the late seismic classification of the territory, the high seismic vulnerability of the historical centres and of the huge Italian cultural heritage"* (Dolce, 2012 p.1).

A crucial role has been played by the political class. Very often, it neglected preventive approaches and it lacked on creating tailored policies aimed at reducing the vulnerability of all the seismic areas nationwide. Rather, the focus has always been put only on impacted areas and only by funding the reconstructions of the damaged built stock without having care for the recovery of the urban systems in a more long-term perspective. In fact, as Dolce (2012) pointed out, "*seismic prevention remains, however, a difficult objective to fully achieve, due to the high costs implied, the long time needed to achieve objectives, the little sensitivity of the public opinion and, consequently, the scarce interest of the political leadership"*. (Dolce, 2012 p.2). Only on the occasion of more recent earthquakes as Irpinia 1980, Sicily 1990, Umbria and Marche 1997, and above all, after the S.Giuliano Earthquake (Molise Region) in 2002, it has been tried to apply some risk mitigation measures through a more comprehensive and strategic approach to risk mitigation, in order to reduce vulnerability conditions.

Through the case of L'Aquila, heavily affected by a strong earthquake in 2009, it possible to show how a post-earthquake non-planning often occurs in the Italian context. In short, the quake mainly has destroyed the historic centre, cultural and architectural buildings and damaged primary infrastructure as road networks having strong negative repercussions on the economic and social systems. The "non-planning approach" can be attributed to the strong pressure put by the emergency situation which in turn often led to temporary and disconnected interventions. Indeed, a critical issue for the Mediterranean peninsula is that those temporary interventions are likely destined to become permanent in practice (De Vico et al., (2014).

Moreover, the consequences of this "irrational" approach to post-earthquake recovery is that the usual functions of the city centre have been displaced in peripheral areas, changing forever the original shape of the city and creating the need to re-think the entire infrastructure system according to the new city form. Hence, the non-planned interventions and the consequent unplanned transformation have created the condition for the city center to lose its centripetal force and its role as a landmark for the inhabitants' identity and for their daily life. As a result of focusing exclusively on the emergency phase, L'Aquila has been rebuilt in six months, creating a new city outside the city, disconnected from the existing historical fabric. Thus, it can be said that behind the "non-planning approach" there are principles that nurture fast interventions for the sake of urgency issues (short-term) over principles more devoted to the qualitative re-birth of the city structures (long-term).

For the purpose to overcome this irrational approach, De Vico et al., (2014), has suggested to adopt systematic perspective to local recovery. "Systematization" is seen as an approach able to overcome traditional non-planned urban developments by providing integrated solutions crucial to multiple systems and considering the infrastructure system as the linkage between all the urban systems.

Since the L'Aquila earthquake in 2009, it has been started a National Seismic Prevention Program running between 2010 and 2016. To briefly present it, the purpose of the program is to reduce the risk for human lives loss more than preventing economic losses. Since most of casualties occur for the collapse of private buildings, where citizens spend most of their time, the program aims to sensitize citizens and foster for spontaneous private actions. As other countries affected by recurrent earthquakes events and suffering from high vulnerability of its constructions, Italy has to undertake huge economic efforts in order to be able to mitigate the seismic risk. Therefore, since funding in Italy is a very delicate issue, the program tries to increase co-funding actions, requiring the support from both local governments and private owners. In particular, the adopted program had three main goals (Dolce, 2012):

1. Improvement of the knowledge,
2. Reduction of the vulnerability and exposure,
3. Mitigation of the effects.

According to Dolce (2012), the first point refers both to technical-scientific knowledge on the seismic risk and the geographical knowledge related to the territory as local hazards, population distribution, socio-economic-environmental activities and so on. This knowledge is becoming fundamental in order to prepare effective risk mitigation strategies, which afterwards need to be translated into practical action. The second point is about reducing the vulnerability of the most vulnerable constructions and, more broadly, of urban development areas affected by high risk. For this goal are required direct interventions, as limiting the land use and introduce seismic micro zonation, and indirect actions, as designing tools that enable the seismic assessment of the existing urban areas and built environments. The goal concerning the mitigation of the effects of the natural disaster is related to the adoption of a more comprehensive approach according to the increasing role of the civil protection in guiding and communicating with impacted communities before the event, within the emergency phase and during the post-earthquake recovery. Indeed, the level of preparedness and response of the population can be tested and improved by enhancing the informative and communicative relation between the civil protection system and citizens of high seismic risk locations.

It is possible to conclude that while the conceptual approach is evolving towards the acknowledgement of the importance in creating comprehensive strategies in the immediate after that a natural disaster occurs, and being able to include long-term goals since the beginning, the practical actions adopted are still far from leaving the traditional methods.

Summarizing, traditional approaches to post-disaster planning are focused on the mere reconstruction of what has been damaged or completely destroyed. Although, conceptually it has been recognized the need for new approaches, practical actions taken in the immediate very often do not reflect such needs. In fact, emerging research fields are calling for innovative approaches able to address some of these gaps, which is even the purpose of this action research project. In particular, a more comprehensive approach developed upon the integration of systems (1), a more inclusive collaborative approach between stakeholders and "the people of the place "(2) and the need for the creation of an early strategy able to guide short and long term action (3) are seen by the authors of this project as the most fundamental and urgent gaps which need to be covered.

Moreover, it has been furtherly noticed that the three main goals, previously mentioned, of the Italian Seismic Prevention Program could be seen as reachable by trying to address the three gaps of traditional planning. Hence, it can be said that this project and the national goals have similar purposes and this “test” is an attempt to address them in practical terms.

5. Technical Contextualization of tools

This chapter intends to highlight and explain the conceptual approaches and functionalities of the tools that have been chosen to apply in the thesis. Therefore, notions of Geographic Information System, Geodesign, Web 2.0 and Social media and their relative tools/software will be given in the following paragraphs.
It is important to mention that the methodological approach, which constitutes the core of the project, is based on geodesign, and on other required approaches and tools supported by its framework.

5.1. Geographic Information System and ArcGIS Desktop

It is an argued debate of current society to place themselves within the so called Age of the Information. Nowadays, the main trend of both the academic world and the public and private sectors are seeking and investing in new methods of data collection to gather as much information as possible. Nevertheless, it is a wrong belief to look at new information as an end point. In fact,

"information occupies a middle stage in a process modelled on the scientific method. The starting point involves data-raw observations, that have no particular value by themselves. Somehow, [...] these raw data acquire value when placed in a frame - a system of relationships among objects and assumption about those relationships" (Chrisman, 2002 ,p. 15).

This means that initial raw data have to be put in perspective to gather a certain value so that, knowledge can be developed further. In this context, human beings play a crucial role to activate and ensure the sequential flow from data, to information, to knowledge (Chrisman, 2002). In order to activate this process, in particular within the field of planning, a milestone passage from the analysis and elaboration of cartographic maps into advanced digitalised georeferenced information is attributed to Geographic Information System (GIS).
Explaining GIS with a clear and understandable explanation is really complex, due to its applications in numerous disciplines which adopted different perspectives. Although, a general definition of GIS could be:

"A Computer-based system that stores geographically referenced data, links it with non-graphic attributes (data in tables) allowing for wide range of information processing including manipulation, analysis and modelling. A GIS also provides for map display and production" (University of Maryland Library, 2012, p. 2).

Another way of describing GIS has been given by Chrisman (2002) where he saw GIS as "the organized activity by which people:

- Measure aspects of geographic phenomena and processes;
- Represent these measurements, usually in form of computer database, to emphasize spatial themes, entities and relationships;

- Operate upon these representations to produce more measurements and to discover new relationships by integrating disparate source; and
- Transform these representations to conform to other frameworks of entities and relationships" (Chrisman, 2002, p. 13)

In general, GIS differs from the other information systems because it handles geo-referenced data and attributes. Moreover, the major GIS studied aspects concern locations, conditions, trends, patterns and models (Liu et al., 2017).
However, GIS has always tried to grasp three basic components such as space, time and attribute. Initially, as mentioned previously in the text, space and in turn place, refer to objects shaped by length, width and height, which are in relation with each other according to distance and direction. Secondly, the element of time links the geographic information to temporal reference which *"works like a snapshot - valid for a specific moment in time"* (Chrisman, 2002, p. 17). Instead, attribute covers the storage of information which could be qualitative and quantitative, either based on physical properties or subjective observations.
GIS measures and associates the three components to spatial reference system established by the science of geodesy. The spatial reference system is

"a mechanism to situate measurements on a geometric body, such as the earth; establishes a point of origin, orientation of reference axes, and geometric meaning of measurement as well as units of measure. While, geodesy is the *"science of measuring the shape of the earth and establish positions on it. It involves study of geophysical properties such as variations in gravitational field"* (Chrisman, 2002, p. 20).

Having a common spatial reference system is a fundamental aspect because it creates the possibility to compare different information and maps. Besides, coordinates, which are a range of alternative spatial reference systems, can be always converted.
However, objects are obviously geographically represented and visualized by graphic symbols used on digital maps by data structure (Chrisman, 2002). Data structure is an *"arrangement of data entities that permits the construction of relationships through software operations; implements a data"* (Chrisman, 2002, p 71). The two dominant models of geometric representation in GIS are vector and raster.
On one hand, the vector model is based on analytical geometry and attribute control, building a complex spatial representation from primitive objects, such as points, lines and polygons (areas), located in a spatial reference system by coordinate measurements (Chrisman, 2002).

"*These primitives have a nested dependency: areas are described by boundary lines, and the location for a line can be approximated by string of line segments connecting a series of points. At the base, points are represented by coordinates*" (Chrisman, 2002, p. 76).

On the other hand, the logical structure of raster model is based on physical characteristics of computer graphic hardware, dividing the image into grid cells or pixels (rectangular building blocks) which are associated to attribute values. In addition, raster cells follow a spatial

reference system. To improve the quality of an image, raster model are supported by compression methods, procedures to storage attribute values in less space (Chrisman, 2002).
One of the main difference between the two representation methods is that by allowing creating new primitive elements, the vector model is attribute control-oriented, while the raster one adopts a framework that control space in order to measure attribute (Chrisman, 2002).
However, GIS concepts and methods related to software have generated a variety of applications which have been included in numerous software packages. ArcGIS Desktop is one of the most well-known and used geographical software, worldwide. It has been developed by the Environmental Systems Research Institute (ESRI) in 2001. Despite the prolonged permanence in the existing market, its potentialities and functionalities are still dramatically improving thanks to the advent of new technologies and more advanced applications.
ArcGIS Desktop is composed by complex elements, functions, options which are extensively described in a vast literature of handbooks, tutorials, *"Getting to know ArcGIS"* books and ESRI documents and therefore, they will not be deepened further in the text if not generally. Instead, it is the paragraph interest to briefly summarize the definition, all the major system components and basic functions that framed the ArcGIS Desktop software.
ArcGIS Desktop is a suite of programs with a long history behind it. Initially developed under the name of Arc/Info, it has been improved and changed, due to its usage complexity, by ESRI into ArcGis which, for the purpose of reducing its usage complexity and enhancing its potentialities, has successively been updated to the latter version of ArcGIS Desktop.
ArcGIS Desktop is based on three major components that are ArcMap, ArcCatalog and ArcToolbox. All this applications together cover extensively the possible GIS processes such as geographic analysis, data management, mapping as well as data editing, visualization and geoprocessing. ArcMap is the core of the software when it is used for map-based tasks. Through a page layout, its main function is to provide the means to display, analyse and edit spatial data and data tables. ArcCatalog is a tool for viewing and managing spatial data files. It helps users to always have the production of file, maps and date organized. Conversely, ArcToolbox, represented by an icon of a toolkit, is exactly a collection of tools and functions used to convert data formats, manage map projections, perform analysis and modify data (University of Maryland Libraries, 2012)
In addition, according to the user ability and needs, there are three levels of functionality of the software. ArcView is the simplest level, with basic mapping, editing and analysing functions. ArcEditor is slightly more advanced than the previous level due to increased editing functionalities such as topology and network editing. While, the most advanced level is provided by ArcInfo with the software fully functionality (University of Maryland Libraries, 2012).
Moreover, a particular credit of ArcGIS Desktop is its flexibility to be used and collaborate together with a variety of different software and open source tools in order to improve the overall geographical reliability and final quality of a project. Two classic examples of file format connectable to ArcGIS Desktop could be the DBdatabase and the XLS spreadsheet, respectively through Microsoft Access and Excel.

Trying to summarize, the purposes of using ArcGIS Desktop through its functions are various. From information storage and organization to visualization and mapping, from data editing to both basic and advanced spatial analysis of the geographic context for the sake of the creation of strong knowledge, realist maps and robust results. Specifically for this project, GIS and ArcGIS Desktop have been used to answer to some of the Geodesign models presented in the Geodesign Framework explained in the following paragraphs.

5.2. Geodesign: a term, a process and a framework

5.2.1. Background of the concept

The concepts behind geodesign are not new and actually, begun when old philosophers as Plato and Aristotle have introduced the significantly different concepts of space and place. More recently, as the Italian geographer Farinelli (2003) said regarding the different meaning of the two concepts that ancient Greeks gave:

"*Place ... is a part of the terrestrial surface that is not equivalent to any other, that cannot be exchanged with any other without everything changing. Instead with space [place as location] each part can be substituted for another without anything being altered, precisely how when two things that have the same weight are moved from one side of a scale to another without compromising the balance*" (Farinelli, 2003 p.11).

According to Miller (2012), the main idea beyond geodesign concept, is that a given geographic context (space), it affects and influences the way we are going to design it, how we adjust and adapt to our surroundings (creating places).
Geodesign seen as a term or a noun is quite new. It is not the case for geodesign seen as integrated process of activities (Miller, 2012).
For instance, it is considered that Frank Lloyd Wright, when he was creating the "Fallingwater" house he was doing geodesign (Miller, 2012). Wright had in mind the geographic context of the space (topography, streams and waterfalls, environmental issues related to the site, etc.), recognized by him as a fundamental requirement which leads to a design more integrated with the landscape of the site. He was able to do all these pre-design considerations in his mental space but this approach has a defined limit. It has been shown by George A. Miller (1956) that humans, in average, are able to mentally handle seven processing information (it ranges from 5 to 9 depending on the mental ability of people). The importance of knowing the geographic context for designing was at the core of Neutra's thinking as well. The architect, which has collaborated with Wright, called for a holistic approach of design, able to include in the premises of the project the importance of the geographic site, its natural characteristics and its surroundings (Miller, 2012).
The advent of electricity in 1910 triggered the creation of some basic technologies, as light tables equipped with translucent glass and illuminated from the bottom. Manning, a landscape architect, in 1912 has used this technology to make analysis of the geographic space by overlaying maps (Miller, 2012). Most likely based on Manning's method, McHarg is considered one of the principal pioneer of geodesign approach. In fact, in 1969, he assessed locations (best or worst) for land use by overlapping thematic layers of geographic information. While he was setting the bases for the conceptual development of GIS software, he was even promoting to abandon the narrow singular point of view, very common in those decades, in favour of a multidisciplinary approach. Meanwhile McHarg was formulating his graphical overlay method, Carl Steinitz (1995) was developing and formulating his complete framework for geodesign (landscape, regional and urban planning). Relying on his experience, he was able to create a conceptual framework, define design strategies and even shape procedural techniques. Furthermore, in the last couple of decades, both Dangermond

(2010) and Goodchild (2001) have contributed to make digital integrated spatial analysis happening (knowledge of the geographic space and of the existing places), the first one in terms of technologies (GIS software) and the latter more as a scientific development in GIS science. *"The disciplines of geography and design have been around for a long time, but in the last half of the twentieth century they began co-evolving with computing technology" (Dangermond, 2012).*

5.2.2. What is a Geodesign process?

Since the framing of the concept is quite new it is needed to provide a range of definitions, coming from several practitioners at the frontline of the approach, in order to be as much comprehensive and complete as possible.
Carl Steinitz, the formulator of the framework for geodesign as already mentioned, has broadly defined geodesign as "*a set of concepts and methods that are derived from both geography and other spatially oriented sciences, as well as from several of the design professions, including architecture, landscape architecture, urban and regional planning, and civil engineering, among others" (Steinitz 2012, p.1)*.
As Rivero (2015) has pointed out, "*Geodesign borrows from a number of different domains: architecture, engineering, landscape architecture, urban planning, traditional sciences etc. and takes a holistic and complementary view on the design process incorporating the different stakeholders"* (Rivero, 2015, p.42).
Indeed, it is widely recognized that Geodesign is "*a new approach to design and decision-making in urban and regional planning which is deeply rooted in the geographical sciences"* (Campagna et al., 2017, p. 3) and has the purpose to facilitate life in the geographic space (geo-scape) (Miller, 2012).
More into the specificity of the concept, Campagna (2014) has described the approach as:

"*an integrated process which includes project conceptualization, analysis, projection and forecasting, diagnosis, alternative design, impact simulation and assessment, and decision-support techniques.* The process integrates these activities by *"using enabling technologies for planning built and natural environments and it involves a number of technical, political and social actors in a collaborative decision-making"* (Campagna, 2014, p. 213).

As it is clearly possible to notice from the definitions, geodesign is an innovative approach to complex urban and regional planning problems (wicked) and for this reason its process should be carried out adopting a multidisciplinary approach. As a matter of fact, the approach stresses the importance of the collaboration between public authorities, specialists of the design field, professionals belonging to geographically oriented sciences, ICT experts (Information and Communication Technology) and laypersons coming from the local communities.
To prove the innovative nature of geodesign, it becomes relevant to highlight some of the most fundamental differences in respect of the traditional approach in spatial planning and design.
Firstly, *geodesign changes geography by design* (Steinitz, 2012, p. 1). It means that design projects and processes are going to affect and change the geographic space of the area

wherein they are intended for. In order to change for better the geography of a given area it is fundamental to have a complete geographic knowledge of that space and consequently the approach at the beginning of the process focuses "*on the extensive use of digital spatial data, processing, and communication resources"* (Campagna, 2014, p. 213). As opposed, in a traditional context the design principles fundamentally did not take into account the local geography and the knowledge related to it, rather they were often more dedicated to follow individual styles and oriented to the consideration of projects as aesthetic art works over their suitability and functionality in respect of the surrounding space.

Secondly, the designing process, which goes to change natural or artificial environments, or both, takes place within a certain geographic spatial context (Miller, 2012). In other words, it is now possible to design directly into a geographically referenced space. This means not only that new entities created are referenced to a geographic coordinate system, but even that they are, directly or indirectly, referenced to all the other information related (referenced) to that space (Miller, 2012). Conversely, following a traditional approach, entities would have been thought, designed and created in conceptual space (mental space), or using pencil and paper (paper space) or again even in a Cartesian coordinate system (CAD space) (Miller, 2012). All these approaches have in common that none of them have a geographic coordinate system to which refer. These kind of traditional approaches have some advantages as disadvantages. For instance, on the one hand, using pencil and paper have the advantage to be intuitive and users are very familiar with this sort of basic tools. On the other hand, it creates a sort of passive environment for the designer since performing analysis and accounting simultaneously for several factors is an action hindered by the method itself (mental and paper space). Indeed, the suitability of this approach decreases with the increasing of the complexity of the case, while GIS software allow the professionals to handle at the same time a wide range of complex spatial analysis. Given this, the challenge now is to develop valuable digital technologies, which are "*easy to use as using pencil and paper"* (Miller, 2012, p. 22).

Thirdly, the geodesign process is characterised by a workflow, which ends with the creation of a design. This innovative approach has the "*capacity to promote a unified, collaborative, and mutually agreed design, as a result of a multidisciplinary environment*" (Rivero, 2015, p. 44). The geodesign workflow differs from traditional ones even for its capability to allow the co-creation of a design project by supporting platforms which facilitate the collaboration and communication among actors, thanks to fast iteration processes, fast design cycles and for its ability to compare and account for the impacts as you proceed in the flow (Rivero, 2015).

5.2.3. The Geodesign Framework

For over thirty years working experience, Carl Steinitz (2012) has defined and redefined a framework for geodesign seen as a methodological process rather than as a theory nor as a discipline. The reason behind the formulation of a clear framework is that the current complexity of design projects forces them to deal with a vast range of sizes, scales, cultures, contents and time (Steinitz, 2012). Moreover, if the required collaboration among actors is taken into account as should be, it becomes clear that a *"certain level of organization is fundamental"* (Steinitz, 2012). Indeed, according to Moura (2015), the framework has been formulated in order to "*overcome the lack of clear methodological process that clarifies the roles of the different actors involved"* (Moura, 2015 p.2). Hence, here the scope of the framework for geodesign: since the process cannot rely only on a singular methodology, due to the reason that different approaches, principles and methods are needed depending on the specificity of the case, the framework becomes essential for the sake of the organization which eases the collaboration among actors within the geodesign process (Steinitz, 2012). Furthermore, the Steinitz' framework, by supporting visualization tools, allows for feedbacks along the entire process and promotes the understanding and assessment of both, existing situation and possible proposals. *"Visualization of simulated future landscapes can promote a common base to understand urban decisions, as a common language, to promote shared decision-making"* (Moura, 2015 p.2).

The framework for geodesign consists of three iterations and for each of them six questions have to be asked. The answers to these questions represent models. The framework has not been thought to be a singular linear process because for every geodesign study the process has to be shaped and modelled along with the case study's needs. Rather, it entails many iterative cycles as needed in order to reach the final agreed outcome. Indeed, the geodesign team has always to consider variations to the application of the framework which can appear linear but in practice often prompt responses to the flow's variations are required.
This structure is fundamental for any geodesign study.

As Steinitz (2012) has presented them, the six questions are the following:

1. *How should the study area be described in content, space and time?* The answers are **representation models** and they represent information and data on which the study has been built.
2. *How does the study area operate? What are the functional and structural relationships among its elements (systems)?* The answers to this question represent the **process models**, information for the analytical assessment of the study area.
3. *Is the current study area working well?* The answers to this question represent **evaluation models**. Here the cultural knowledge about the study area of the decision-makers makes the difference.
4. *How might the study area be altered? By what policies and actions, where and when?* The answers to this questions represent **change models**. They will be created and

compared within the geodesign study and they will be used as new generated data to project future conditions.

5. *What differences might the changes cause?* This question is answered by **impact models**. They represent assessments produced by the process models under changed conditions.
6. *How should the study area be changed?* This question is answered by **decision models**, which as the evaluation models, are highly influenced by the cultural knowledge of the decision makers.

The first three questions mainly investigate past and present conditions of the study area even though process models might also simulate future trends, while the last three are concerned about the future ones (Steinitz, 2012).

As aforementioned, all of these six questions have to be asked for each of the three iterations.

In the first iteration also seen as a pre-workshop phase, the answers to the questions are elaborated from one to six and it has the purpose to understand the study area and develop a general knowledge of how the area, and its systems, works. This facilitate the definition of the scope of the study. In this first iteration, the six questions are thus intended to answer *Why* the geodesign study has to happen.

The second iteration is about defining the methods to use for the study and the six questions, this time presented from 6 to 1, are to answer to *How* to carry out the study. The reverse order of the questions is crucial in creating decision-driven process rather than a data-driven one (Steinitz, 2012).

Possible questions that need to be answered can be (Steinitz, 2012):

6. How will the *decisions* be taken? What is important for the decision makers to know?
5. Which *impacts* are most important to take into account? How much detailed should the impact assessment be?
4. Which scenarios for *change* have been identified? Which time horizons to select? At which scale?
3. Which are the indicators to be used to *evaluate* whether the existing conditions are working well?
2. How complex should the *process* models be?
1. Where exactly the study area is? Which one are its boundaries? In which way is the study area *represented*?

Ultimately, the third iteration, which is generally mainly composed by a workshop phase, translates into practice what the geodesign team have defined during the second iteration. Here, once again, the six questions are proposed in their original order from one to six. In the proceeding with the performing of the study, the questions *What, Where* and *When* must find an answer. Hence, the iteration starts from the collection of the data, the ones identified throughout the first two iterations. Then data are analysed in order to understand how the processes and systems of the area operate. Then a range of evaluations is given in order to establish what is working well and what is not. Only now, it is possible to design some changes on the geographical space and subsequently analyse the impacts caused by the suggested changes. Likewise, for any design projects to become real, decisions must be made. At this stage decisions can fall towards a positive end, in this case a *yes* means present the results to the decision makers towards the implementation. A negative decision (*no*) implies that unsatisfactory results have been reached and through feedbacks, the cycle can restart from the second iteration or even from the beginning. At last, a *maybe* can be finally reached and some agreed smaller changes are proposed and considered, upon whose the study restarts and can be carried out faster since it can take advantage from the already built knowledge.

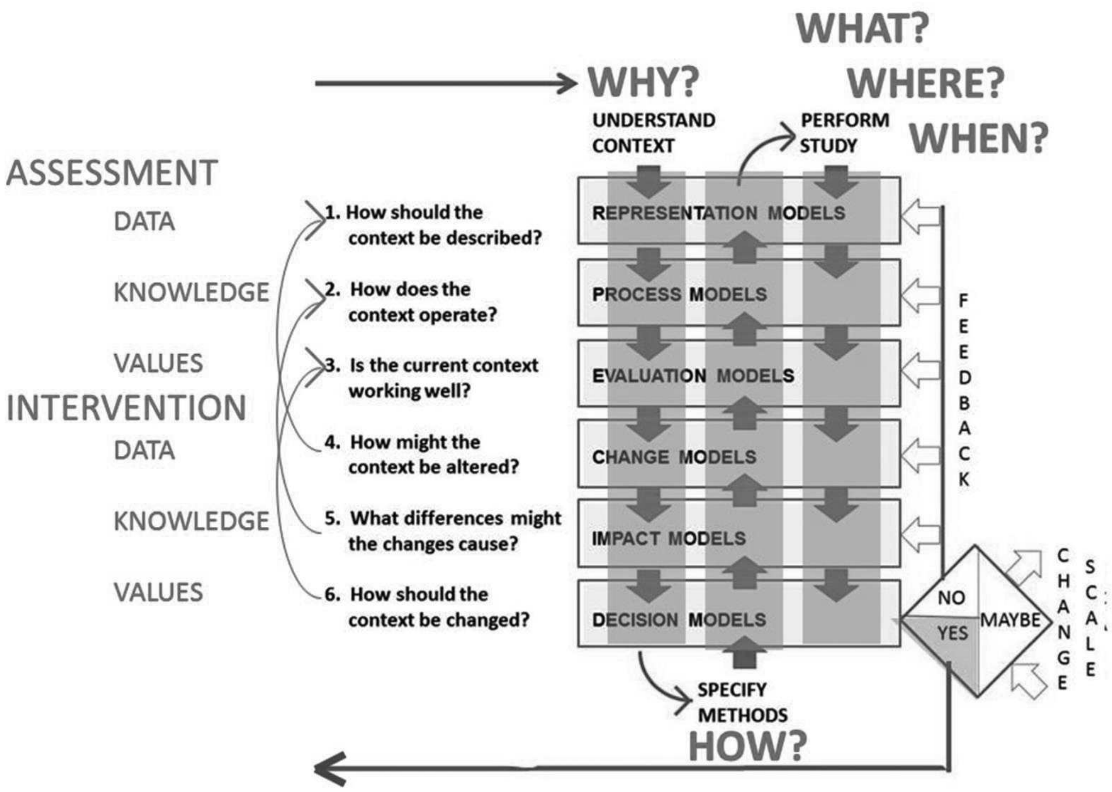


Fig.5.1: Geodesign Framework and iterations. Source: Nyerges, 2016.

It is important to emphasize that in order to achieve a final *Yes* which will lead decision-makers towards the implementation, the study project must go through the three iterations at least once. Conduct more than once the project using the built knowledge within the first round of the three iterations as input for the conduction of the second round can refine the overall quality of the final outcomes and foster the achievement of maximization of consensus.

5.2.4. Geodesign Hub tool

It has been possible to translate the Steinitz's framework into the Geodesign Hub software in 2015 by Hrishikesh Ballal, Ph.D. at the Centre for Advanced Spatial Analysis at University College London, under the direct supervision of Prof. Steinitz. The software, which is an open system, guides the users in a digital workflow wherein participants bring their ideas and opinions into the tool (Rivero, 2015; Nyerges, 2016). It can be seen as a part of the PSS previously described in Chapter 2 and it can be considered as a design aid able to support the most common geospatial data formats as Shapefile, KML, GeoJSON, etc., and the data created along the workflow can then be exported as Shapefiles (Rivero, 2015).

"In practice, the software is most useful when applied at the beginning of a study of considerable complexity, comprising multiple objectives and perspectives, several unknowns, and in need of an overarching strategy" (Nyerges, 2016).

One of the most important features characterising the software is its ability in creating rapid synthesis of the designs along the process and allows users to quickly edit the created designs (diagrams) until they can be satisfied. Such diagrams can be drawn using lines or polygons depending on the nature of the design (e.g. roads drawn as lines while buildings and areas drawn as polygons). Diagrams represent design interventions and they can be of two types: projects and policies. Projects are intended to represent physical changes to the territory and are visualized through plain colours sketches while policies are localized normative frameworks for action and are visualized as grid pattern shapes.

Additionally, the tool allows even to conduct near real-time analysis among designs, for now only concerning physical projects, and to address simultaneously multiple systems. The software accepts models from any discipline as long as it is possible to create a map out of that model and is possible to divide the map up to 5 different colours, which cannot be changed since they belong to a shared common language, crucial for a quality collaboration amongst several different domain expertise (Rivero, 2015).

However, the description of the tool and its application to the case study will be extensively developed in the chapter 6 and is possible to look at the software interface through the Fig.4 - 11 provided in the Annex.

5.3. Web 2.0 and Social Media: added values to participatory planning

With the advent of Internet, the accessibility to knowledge and to participate in sharing opinions and information has become an easy and common task, as far as the potential user can afford a device. It is important to differentiate the Internet, which is the system infrastructure of interconnected computer networks widely spread around the world and the many existing applications using such infrastructure. Lately, most of the new developed tools have the form of app(lication)s whose do not require the web to function (Carr & Hayes, 2015).

In short, internet brought the opportunity to create large and well-connected networks between individuals and between them and organizations. As a result of collaborative and communicative relationships between a vast number of individuals and organizations is the co-creation of social capital. "*The idea behind social capital is that networks of individuals share information and benefit from their relationships"* (Kent & Taylor, 2014). In other words, according with Kent & Taylor (2014), social capital is the benefit, under the form of added value from user-generated content, built through the interaction and shared opinions of citizens and organizations acting together in reaching collective goals.

Together with Web 2.0 technologies has risen even the concept of social media, which is still missing of a clear and mutually agreed definition. It seems that "*there is no commonly-accepted definition of what social media are, both functionally and theoretically. It is more that there is consensus of what can be considered social media but not on what defines a specific tool as social media" (Carr & Hayes, 2015 p. 2-3).* Social media are often explained providing examples of what they are but this does not push towards the development of a robust theoretical framework. For instance, as Carr & Hayes (2015) pointed out, if it is used Twitter as an example to define social media, the related theory cannot be extended to other media and such theory will be meaningful until Twitter will keep a meaning to exist without embedding its evolution.

Boyd and Ellison (2007) have defined social network sites as *"web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system"* (Boyd & Ellison, 2007 p. 211). Often social media have been wrongly described as social network sites. In reality, the latter belong to the broader set of tools of social media but it is not that all social media are social network sites.

In the last decade, a vast number of studies have tried to define what social media are. By most, they are often considered as channels that use digital technologies wherein interaction and user-generated content are the necessary core feature.

Michael Kent (2010) has defined social media as *"any interactive communication channel that allows for two-way interaction and feedback could be called a social medium"* (Kent, 2010). It has been further specified by him that social media, which allow the creation of social networks, are characterised by *"real time interaction, reduced anonymity, a sense of propinquity, short time response and the ability to engage the social network whenever suits each particular member"* (Kent, 2010 p. 645). Furthermore, Howard and Parks (2012) have seen social media as composed of three parts:

" (a) the information infrastructure and tools used to produce and distribute content; (b) the content that takes the digital form of personal messages, news, ideas, and cultural products; and (c) the people, organizations, and industries that produce and consume digital content" (Howard and Parks, 2012 p. 362).

Considering the above definitions to be only few among the multitude provided by authors, Carr and Hayes (2015) have noticed that some authors have tackled the issue mostly from a technical perspective while others from a more conceptual one, in term of principles. Carr and Hayes (2015) ended up with providing an own more comprehensive definition of social media, which has been put in simpler and more understandable form:

"*Social media are Internet-based channels that allow users to opportunistically interact and selectively self-present, either in real-time or asynchronously, with both broad and narrow audiences who derive value from user-generated content and the perception of interaction with others"* (Carr & Hayes, 2015 p.8).

Whatever it will be the most suitable definition for social media is not the core issue of this project. As opposed, the focus is more on the valuable user-generated content which social media and Web 2.0 bring to the participatory process within spatial planning.

As it has been aforementioned, social media and Web 2.0 are providing new channels not only for the dissemination of information but above all, for their mass production of content. This can be identified as a facilitating factor in term of paradigm shift regarding the relationship between citizens and decision-makers towards a more inclusive and democratically participated process. In this context citizens are shifting from being considered by governments as data consumers (clients) to being treated as data providers (partners), losing the passiveness which always has characterised public communities. As it is clearly shown by Linders (2012), citizens, generating information by evolving technologies, are gaining more control over the decision-making process while the responsibilities of decisions are spread and shared throughout the entire community. According with Linders (2012), it is possible to see a clear transition within the Digital Era Governance (DEG), in particular from e-Government (one way web communication as Web 1.0) which treats citizens as clients (or more appropriately as objects) towards We-Government (interactive and empowered citizens through Web 2.0 and social media tools) in which citizens are now treated as partners in manage the unknown future.

This sets the basis for a reconsideration of the role of Governments and of the responsibilities of the citizens. Citizens may now better collaborate with businesses and organisations in creating their own outputs and products while agencies and governments are left in charge to provide better tools and facilitate the processes through evolving frameworks for action to serve the at the best empowered citizens.

In planning as in others disciplines, within the framework that governments can provide to engage empowered citizens, stand out the approaches of Crowdsourcing and Volunteered Geographic Information (VGI).

Broadly, crowdsourcing is a specific sourcing model in which individuals or organizations use contributions from Internet users to obtain needed services or ideas (Wikipedia). Moreover, it can be even the collective development of a certain project made by a crowd of people external to the entity which has created the project itself (Wikipedia). More in detail, *"crowdsourcing is a set of techniques that allows the creation of datasets by collecting and joining contributions from citizens with no previous training or special expertise. Usually, citizens contribute voluntarily, and the Web is used as a platform for receiving contributions"* (Borges et al., 2015 p.366).

Relating to urban (spatial) planning, as Borges et al., (2015) have underlined, crowdsourcing can contribute significantly and in more than one way to geodesign. Basically "*crowdsourcing can be used along several steps of a geodesign process, when information from the crowd are needed"* (Borges et al., 2015 p.364).

Firstly, crowdsourcing can help in defining citizens' needs and opinions and so helping in narrowing down the identification of a certain problematic issue to solve (identify problems). It can even be a tool for collecting stakeholders' point of views helping to understand how they see the problem and how they assess the existing conditions. Crowdsourcing plays an important role in the collaborative process of geodesign. The grouping into mixed teams basing on different backgrounds of participants and fostering their collaboration in order to reach a commonly-agreed strategy it is crowdsourcing.

Lately, among a non-defined amount of possible crowdsourcing activities within spatial planning, it is possible to use for gaining feedbacks from citizens and let them assess and vote if a certain design solution (proposed change) can be able to meet their needs or not (Borges et al., 2015).

Since *"citizenship is related to the understanding of the spatial context"*, at the light of the changes in citizens' role, *"geodesign through crowdsourcing can help the community to fulfill their citizenship role"* (Borges et al., 2015 p.371). Hence, geodesign can educate citizens to become *"spatially-enabled citizens"* (Borges et al., 2015 p.372), enhancing then their citizenship, and can foster the creation of a shared code and a mutual understanding of urban systems and values fruitful for a better collaboration among diversified actors.

Very similar concepts are related to VGI (Volunteered Geographic Information), which, together with crowdsourcing, is based on two meaningful assumption:

a) a group can better solve a problem than an expert and b) observations gathered from a crowd (more observers) are more likely to be true than information obtained from a single observer (Goodchild & Glennon, 2010). Providing georeferenced platform as OpenStreetMap or Wikimapia allows the co-creation of maps by the users. Photos, videos and comments once uploaded on the web-based platform can be seen as georeferenced information about a precise geographical space. Moreover, *"it is becoming increasingly common for content of Twitter, Facebook, Flickr and many other social network sites to be georeferenced"* (Goodchild & Glennon, 2010 p.233).

In a post-disaster context, it has been shown by Goodchild & Glennon (2010) that VGI, which considers peoples and users as "sensors", is a much faster and responsive approach in generating valuable geographic information. When an emergency occurs, agencies are under pressure and highest are damages (natural, artificial and in term of life loss) slowest is their ability to release information.

Rather than waiting for common browsers as Google or the agencies' staff in collecting all the information, organise, synthesize and release them to the public (by the time the natural disaster could be already controlled), people with their local information contribute in creating quick responsive maps useful for the immediate after the disaster. This is happening simultaneously, while agencies are losing their resources (decreasing staff) and the consequent limited ability to provide fast geographic information which is vital to effective response, *"citizens have been empowered with tools and the ability to georegister observations bounded within the impacted area, share them through the internet and synthesize those observations into intuitive maps"* (Goodchild & Glennon, 2010 p.240).

To conclude, within this societal transition where the changing in citizenship role is driven by the technological evolution, geographic information will not only be used by all but they can be created by all. This can provide effective assistance to responders and emergency managers in dealing with planning post-natural disasters as well as in more general planning and design settings.

6. Data Description

The data description chapter stresses its focus on all the data and tools utilized and their procedural application throughout the project. The below data have been selected by considering the theoretical concepts and the methodological approaches. A simplified structure of the chapter is provided in the Fig.6.1 below.

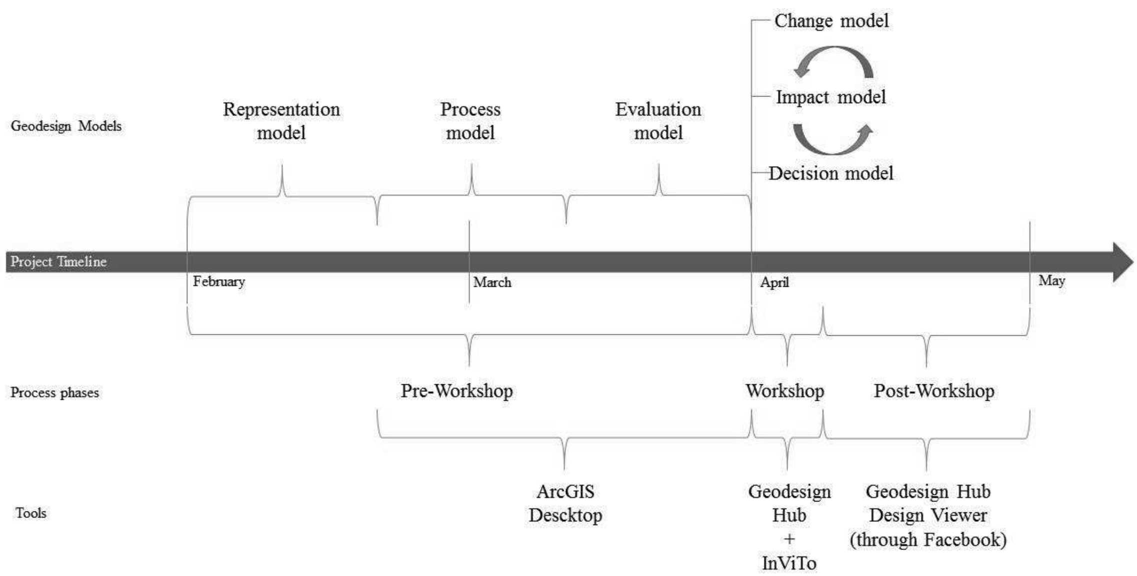


Fig.6.1: The method chapter structure simplified (timeline). Source: The authors.

As it can be noticed, the data have been described and divided in three main groups including Pre-workshop phase, Workshop phase and Post-Workshop phase, by following the chronological flow, seeking to answer at the geodesign model questions explained in Chapter 5. The Pre-workshop phase aims at constructing the Representation Model, the Process Model and the Evaluation Model. Whereas, the Workshop and the Post-workshop phases have the goals of addressing Change Model, Impact Model and Decision Model.

It is important to specify that the first three GD models are clearly mentioned and described model by model, in a linear way. While, Change Model, Impact Model and Decision Model cannot be individually stated because they are not occurring and examined in once, but rather periodically presented in an interchanged way throughout the workshop and the post-workshop phases.

6.1. Pre-Workshop

Representation model

The goal of the representation model is to collect, organize and produce data about the characteristics of the examined territory for the purpose of understanding the main spatial elements considering its specificities, vulnerabilities and attractiveness, deciding through which systems the area will be represented. Due to the impossibility to be in loco during the comprehension of how the study area operates, the cognitive frame of the Norcia municipality has been based on a web research for both general information and data collection. General information have been obtained through websites, local broadcasts, newspapers and articles. Besides, data gaining has been supported by consultation of national, regional, provincial and municipal websites where development plans and interactive WebGIS provided knowledge through either thematic maps and file. Those data available on the GIS environment (shapefile and raster), were recognized as important variables to include in the analysis. A general lists of most of the examined websites is provided in the Annex (Fig. 26 and Fig.27).

Moreover, a series of public and private authorities have been directly contacted in order to obtain specific files.

Through information and data, it has been defined the short and long-term project objectives.

Purpose of the geodesign study on the short term has been set as to develop planned and coordinated measures to reduce the possibility that citizens will leave the region choosing a safer place. If that would be the case, Norcia then will likely follow other Italian cities that after the quake have become ghost cities. This goal has been set basing on the assumption that it is much more easier to empty a place than to repopulate it. On the other hand, the focus is even on avoiding that temporary measures, for instance emergency housing solutions such as containers and prefabricated houses, will become permanent. This is the case of non-planned recovery, where irrational measures are taken to solve urgent issues without considering that they can create even more complex and wicked conditions in the long term. Meanwhile, for the long-term, it has been identified the importance of creating a common guideline for the regional development oriented towards the reduction of the overall vulnerability and exposure of the main territorial systems while enhancing the resiliency of the local community, which means creating the conditions to face in a better way the preparedness, response, recovery and mitigation phases for the next natural event.

The overall understanding of the study area helped to identify the prevailing character and key spatial elements that constitute the Norcia's territory. So that, by taking into consideration its geographical and historical context, socio-economic dynamics, local characteristics, current and future challenges, the authors decided to represent the territory through taking into account the following ten systems and their variables:

System	Layer	Attribute	Source

1. Ecology ECO	Carta Natura; Land Use; Natura 2000.	Sibillini natural area (SIC); Ecologic Value (EV); Ecological Sensibility (ES); Anthropic Pressure (AP); Natural Vulnerability (NV); Riparian zone, urban areas and industrial areas.	ISPRA; Data Sistema Informativo di Carta della Natura, Umbria region; Copernicus; UmbriaGeo; Monti Sibillini.
2. Agriculture AG	Land Use; River; Road Network (primary and secondary); Slope.	Important agricultural zone; agricultural parcels with quality food products under the label of "Indicazione Geografica Protetta" (IGP); Water proximity; Roads proximity.	Copernicus.
3. Public Spaces to support Civil Protection SPPC	Land Use; Road Network.	Urban areas; Industrial areas; Landslide risk (mass gravity movement).	Copernicus.
4. Cultural Tourism C-TUR	Places of cultural interest; Touristic itineraries; Road Network.	Abbey; Archeological site; Militar building, Villa and buildings with important architectural features; Trekking itinerary; CAI itinerary; existing facilities	Copernicus; UmbriaGeo.
5. Residential Development RES	Slope; Carta Natura; Zoning; Geomorphological risk	Residential zoning.	ISPRA; Data Sistema Informativo di Carta della Natura, Umbria region.
6. Commerce and Industry COMIND	Land Use; Zoning; Slope; Geomorphological risk; Carta Natura;	Urban zoning; Industrial zoning; Product transformation areas; Ecologic value (EV).	Copernicus; ISPRA; Data Sistema Informativo di Carta della Natura,

			Umbria region.
7. Transport TRASP	Road Network; Land Use; Slope;	Primary and secondary roads; Urban areas; Industrial areas; Forestry areas.	Copernicus.
8. Energy EN	Thematic maps; Natura 2000; Carta Natura.	Non adequate areas for solar, wind and biomass energy; Sibillini natural area (SIC); Ecological value (EV) and Ecological sensibility (ES).	Piano Urbanistico Territoriale (PUT2000); Piano Peasaggistico Territoriale (PPT) (Umbria Region); ISPRA; Monti Sibillini.
9. Priority of Intervention PRI	River; Land Use; Road Network; Itinerary; Altitude; Services	Forestry areas; primary and secondary roads; CAI itinerary.	Copernicus; UmbriaGeo.
10. Ecologic Tourism E-TUR	Nature 2000, Land Use; Itinerary; Point of interest; River; Road Network.	Trekking itinerary; Cycling itinerary; CAI Panoramic views; Forestry areas; Facilities; Primary and secondary road; Tourism services.	Copernicus; UmbriaGeo.

Fig.6.2: System definition. Source: The authors.

It is important to specify that the PRI and the E-TUR systems have been differently though compared to the others.

On one hand, as a consequence of the outdated nature of some considered data that due to their ongoing elaboration, do not thoroughly take into consideration the provoked anthropic and natural damages, it has been decided to keep the PRI system open to any possible implementations to problems primarily known by the people of the place. Hence, the system objective is to give to the participants the possibility to identify, pinpoint and prioritize the interventions on certain areas or important elements, which have not been considered and addressed in other systems, according to their personal knowledge.

On the other hand, the E-TUR system have been built through the support of the Interactive Visualization Tool (InViTo) software, described in the next paragraph. Due to the available data, the system final spatial information construction can be highly affected by subjective judgments regarding the importance of each spatial layers applied. For this reason, it has been decided, through InViTo, to give the possibility to the participants of the workshop to individually assign values and weights to the system's layers according to their personal interpretation, successively comparing their results to a generalized map created by the authors. The process will be explain further in the text.

Although the two systems have been kept open, it has been provided some layers and base maps in order to give spatial and territorial contents to each of the two systems.

Process model

Once defined how to represent the area through data collection during the representation model, the process model had the goal to transform those data into information. In other words, the process model's overall scope is to change the initial raw data acquired during the representation model into spatial information of the area. Technically, this was possible carrying out a spatial analysis, constructing distribution surfaces that highlighted the characteristic of each spatial location according to a related system. Relating back to Chapter 5, the spatial analysis was carried out in GIS environment, specifically through the ArcGIS Desktop software. Abiding by the general study goal, it is important to mention that the paragraph does not aim to extensively explain the technicalities of each applied GIS function to the project, but rather to generally summarizing them, providing a broad overview of their application.

Since some of the data obtained during the representation model were solely available as image file such as thematic maps, it was necessary to initially digitalized them in order to be able to technically process them on ArcGIS Desktop. Meanwhile, some of the data had to be also converted into a unique coordinate system for having the data on a common georeferenced environment, allowing their spatial integration.

Considering the data availability, the main processed GIS functions were applied in a combined and iterative manner for the construction of the spatial information of the ten systems. The functions are listed below together with their purposes:

- Kernel Density defines the surface distribution;
- Delauney and Triangulated Surface followed by the calculation of slope;
- Multicriteria Analysis integrates overlying data by weighting their sum of variables;
- Combinatory Analysis establishes some compositions in the place;
- Buffer zone specifies the areas of influence of certain spatial elements.

According to the processes objectives, the vast majority of the applied GIS functions exploit an algorithm of distribution, concentration, combination of variables or neighborhood studies.

Applying the abovementioned functions implied to take decision about interpolation models. In practice, taking into consideration the multi-criteria analysis, the authors, supported by the help of a sketched matrix, mentally reflected upon the used variables by weighting them case by case, according to personal perspectives. An example can be given looking at the ECO system where different weights were assigned to each layer, emphasizing a dominance of some of them such as the Sibillini natural area (SIC) layer, at the expenses of the others, Anthropic Pressure (AP) and Natural Vulnerability (NV), for instance.

While the mentioned GIS processes were used to construct the majority of the systems' information in the pre-workshop phase, a different function was applied to a specific system by testing it during the workshop phase that will follow in the report. The Interactive Visualization Tool (InViTo) software developed by the Higher Institution on Territorial Systems for Innovation (SiTi) is an open collaborative web gis toolbox for building spatial knowledge. As specified in the InViTo website (http://www.urbantoolbox.it/about/), the tool aims to guide users in building their spatial knowledge and awareness by means of high interaction with dynamic maps, in order to allow decision-makers to be informed before making their choices. Operationally, the tool allows users to assign different weighting values to a preset number of variables that after being integrated, generate a result, which visually reflects the adopted logic behind it.

The tool was applied for the purpose of making the participants test and understand the construction of a system's information, based on data subjected to personal weighting interpretations. The E-TUR system was chosen due to its data grounded in touristic activities suitability, which are information highly susceptible to subjective preferences, a fact that radically changes the final system construction according to the person in charge of assessing it. The subjectivism shapes the importance of each variable that in turn, affects the final system result and visualization. From the test, the participants could observe that their results were all different, according to each opinion about the importance (weight) of the variables. Hence, they were able to comprehend the logic behind the construction of the E-TUR evaluation map and recognized that all their proposals were contemplated in the map previously set by the geodesign team.

Finally, as a supplement a 3D model (Fig. 6.3) was elaborated and used to provide a realistic representation of the territory in order to facilitate the understanding of the study area.

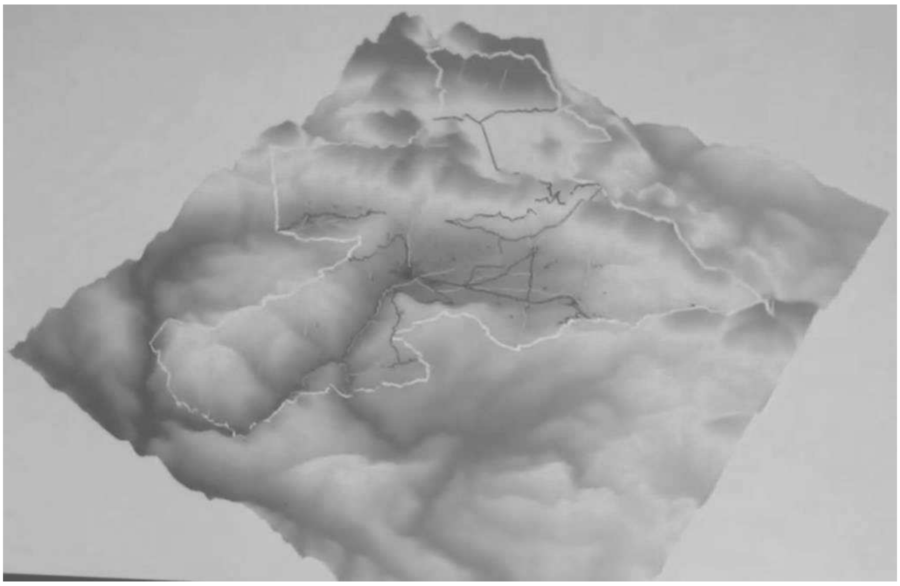


Fig.6.3: 3D models pictures. Source:

In conclusion, the information elaborated in this phase set the basis for the coming model.

Evaluation model

The evaluation model transforms information produced by process model into knowledge. This knowledge of the possibilities and limitations of a place constitutes the base to support the proposals of projects and policies concerning a specific field of interest, but also mapping the area where the resources already exists.

For the purpose of organizing both the steps in preparing the data and the creation of the evaluation model in a comprehensive but clear way, it has been used an excel spreadsheet which is also necessary to deal with the GDH software technical requirements. In this way, some of the information located in the excel file have been directly linked to the software.

The GDH spreadsheet is divided into six different sheets including Evaluation model, Evaluations Update model, Cross System Impact model, Cost Estimate model, Project participants and Working. In the Evaluation model spreadsheet the ten systems are set and listed along with a description of the adopted criteria and parameters for each system and their relative color-coded classes of evaluation.

Successively, the impacts are set in the excel Cross System Impact Model spreadsheet comparing the effects of one system on another, as shown in the Fig.6.4.

			SYSTEM EXISTING CONDITION									
		System #	1	2	3	4	5	6	7	8	9	10
			ECO	AG	SPPC	C-TUR	RES	E-TUR	COMIND	TRASP	PRI	EN
System #	SYSTEM CHANGE											
1	ECO		ND	-1	0	-1	-2	2	-1	-1		-1
2	AG		-1	ND	0	1	-1	1	1	0		0
3	SPPC		0	0	ND	0	-1	0	-1	0		1
4	C-TUR		0	0	0	ND	2	1	1	0		0
5	RES		-2	-1	0	0	ND	0	-1	0		1
6	E-TUR		2	2	0	0	0	ND	0	0		0
7	COMIND		-2	1	0	2	0	0	ND	0		2
8	TRASP		-1	1	2	1	1	1	2	ND		0
9	PRI										ND	
10	EN		-1	0	0	0	2	0	2	1		ND

Fig.6.4: Cross System Impact Model. Source: Project setup spreadsheet.

By considering a range of +2, most positive and -2, most negative, the Cross System Impact Model is based on an aggregation of systems that have similar impact generators and responses. Creating the matrix required to follow the rule in which it is necessary to consider how a system in the change group could impact, positively or negatively, another system condition in the existing context. For instance, taking the case of E-TUR from the vertical axis (rows) and ECO in the horizontal axis (columns), proposing new physical implementations or policies in support of E-TUR is positively synergizing with the existing ECO system. While, considering COMIND (rows) and ECO (columns) the situation is the opposite, where the COMIND strategies negatively affect the existing condition of the ECO system.

Together with the impacts, also costs have been estimated through the Cost Estimate Model.

In this case, the excel spreadsheet required to estimate the unit costs for physical implementations in each system by taking into account the local market prices.

Due to numerous uncertainties, it has been decided to consider as benchmark, the average costs of different Italian regions rather than the Umbria region. This model allowed to calculate the total estimate cost and therefore broadly suggest a general required budget for all the expected projects, physical constructions of the suggested plan in the case of full acceptance and real-life implementations.

Besides, the Project participants sheet has been used to names, contacts and details about participants. Finally, concerning the Evaluation Update model and the Working one, these spreadsheets had some technical information and working variables in order to run the project in the geodesign hub software.

In addition, the systems' targets were indicatively set according to the system objective, so that a certain area of intervention, generally expressed in measure units (square kilometre), has been assigned to each system.

system	mq		ha
res	2500000	total urban areas as we could move the intere city	250
eco	20000000	20% forest outside SIC	2000
comind	1000000	50% area res principal	100
agri	20000000	20% agricultural areas	2000
SPPC	50000	100 mc/per person * 3	5
Cultur	1000000	50% area res principal	100
ecotur	10000000	50% of agricultural/eco areas	1000
trasp	5000000	50% of buffer 50m roads	500
en	200000	[1.6 ha of solar energy panel/1Gwh]; a 4-person family uses 2700Kwh; 5000 Norcia population (5 ha); agriculture in proportion use 3 times more energy than housing (15 ha)	20

Fig.6.5: Targets. Source: Project setup spreadsheet.

Regarding the Evaluation model, this first spreadsheet is where the ten evaluation maps begun to be structured. Considering the systems, an initial descriptive evaluation is also made according to the G. Angus Hills methodology developed in the 1950s which is based on five steps, from dark green, green, light green, yellow to red.

Feasable	Suitable	Capable	Not Appropriate	Existing

Fig.6.6: Empty table with the classification. Source: Project setup spreadsheet.

Respectively, these colours stand for:

- Dark Green: it is the highest priority for change and is considered as “feasible”, meaning that it is suitable AND there is a demand or market to provide the new land use change;
- Green: it is higher priority, considered as ”suitable”, meaning that the area is capable of supporting the project and it already has the appropriate technologies to support the activity taking place BUT there may not yet be a market for the change.
- Light green: it is low but higher priority and is considered as ”capable”, meaning that at the moment of the evaluation it has to be provided both the technology and market to make it feasible, so that the market will come;
- Yellow: it is lowest priority for change and is considered as “not appropriate” or not capable of supporting the system, meaning that interventions in this area are very risky;
- Red: it is considered “existing” and is where the system is already well working and in a healthy state, meaning that it is feasible to maintain it as it is.

Initially, this type of classification identifies and ranks from dark green the most adequate parcels to be interested by a variation, to light green for less adequate areas, according to the system. Secondly, yellow colour represents the parcels with the lowest attractiveness to be modified, due to physical characteristics and costs. Instead, according to the system, a red colour emphasizes that the existing elements and conditions within an area do not require further implementations because well-functioning at the moment of the evaluation, so that the focus should be redirected and prioritized somewhere else.

However, the overall evaluation model scope is to transform the information elaborated in the process model into knowledge through the application of the Angus classification. Technically, an evaluation map is the result of a series of elaboration passages, in which the values of a file (in this case generated through the applied geoprocessing functions explained in the process model) are re-classified according to the values defined by the Angus color-coded classes.

Specifically, an evaluation map is not only a common “language” between technicians and laypeople but also an understandable common knowledge base that enables participants to work together. Therefore, the evaluation maps built the zero-layer in which participants started reflecting, discussing and drawing their strategies, informing the design throughout the workshop phase. Operationally, it has been possible to use the evaluation maps as knowledge base by uploading them on the Geodesign hub platform as base maps.

Therefore, putting in relation the color-coded classification to the geoprocessing functions accomplished in ArcGis environment and InViTo (where applied) with the logic mentioned in the process model, spatial criteria have been integrated with each other for the purpose of providing a final evaluation map for each system. Results are described and shown below:

1. ECO

System Objective: Preserving and increasing the natural areas and their biodiversity

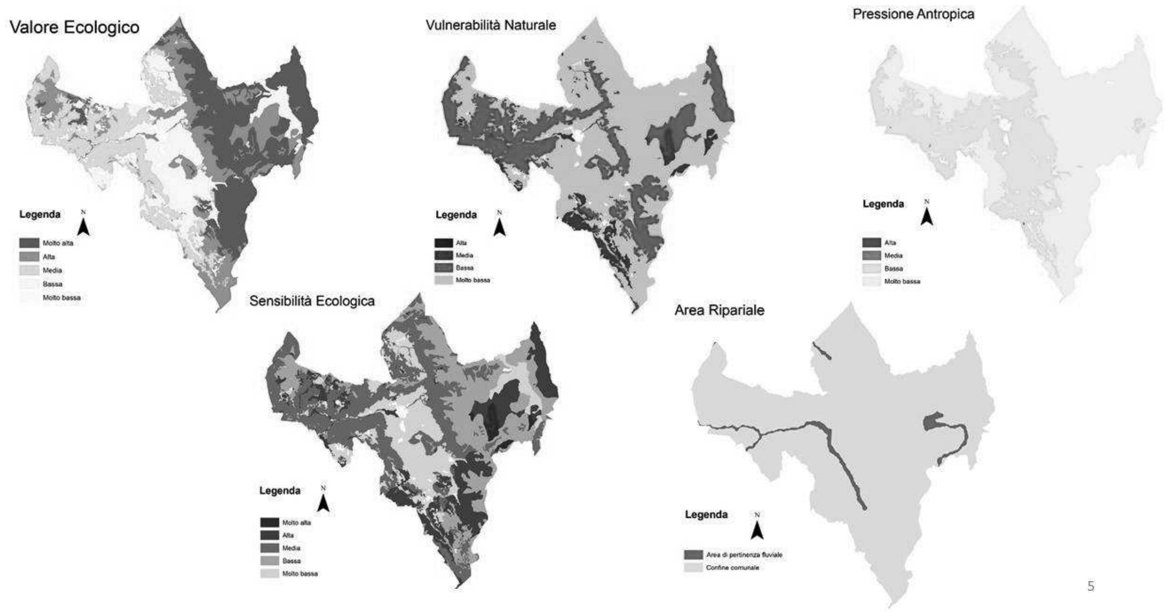


Fig.6.7: Layers composing the Ecology system. Source: The authors.

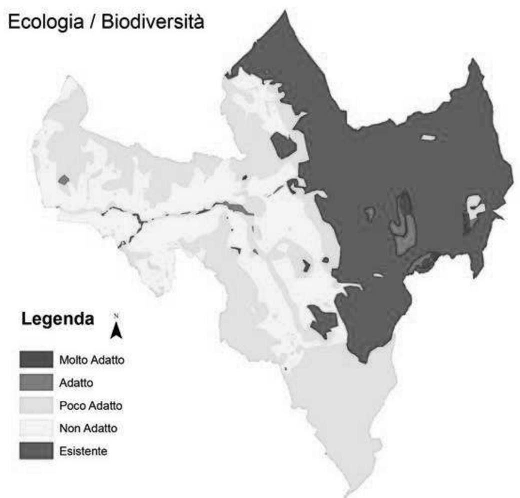


Fig.6.8: Ecology evaluation map. Source: The authors.

Feasable	Suitable	Capable	Not Appropriate	Existing
All the natural areas and parks of **high** faunal and vegetative interest (for EV & ES) and **high** risk grade (for AP & NV). All the riparian zone that could be extended.	All the natural areas and parks of high faunal and vegetative interest (for EV & ES) and high/medium risk grade (for AP & NV).	All the natural areas and parks of high/medium faunal and vegetative interest with high quality grade (for EV & ES) and high/medium risk grade (for AP & NV) outside the SIC boundary	Urban and Industrial areas; low ecological value areas	All the natural areas and parks of **high** faunal and vegetative interest with **high** quality grade (for EV & ES) and **low** risk grade (for AP & NV) within the SIC boundary (Sibillini natural area)

Fig.6.9: Spreadsheet evaluation description. Source: The authors.

2. AG

System Objective: Highlighting where agricultural parcels are planned to be developed and implemented.

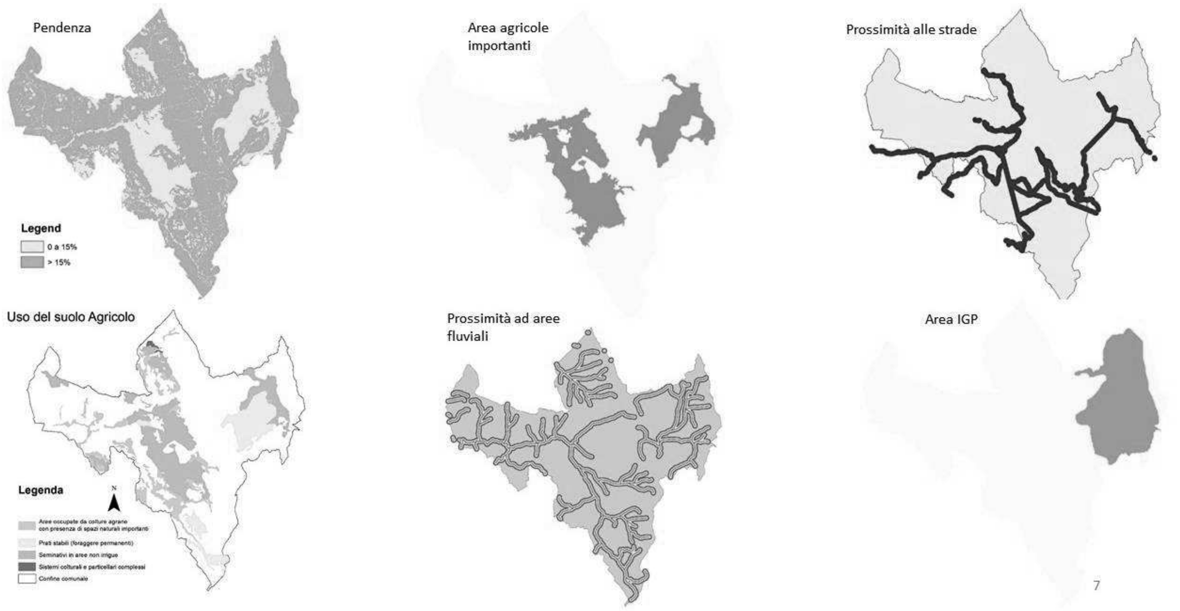


Fig.6.10: Layers composing the Agriculture system. Source: The authors.

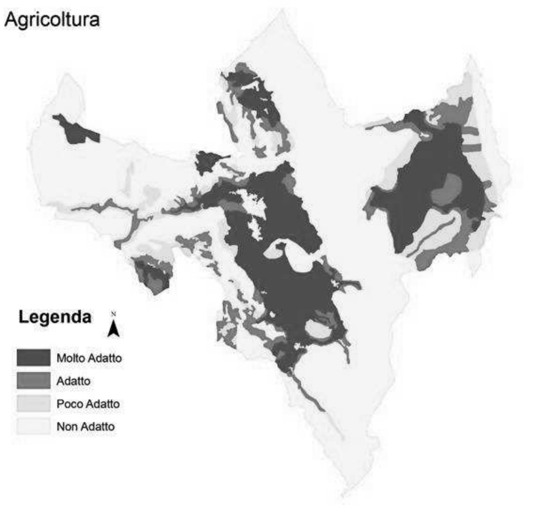


Fig.6.11: Agriculture evaluation map. Source: The authors.

Feasable	Suitable	Capable	Not Appropriate	Existing
Parcels of high agricultural potential with: slope <15%; inside the buffer of water and roads.	Parcels of agricultural potential with median conditions of infrastructure between: slope <15%; inside the buffer of water or roads.	Parcels of agricultural potential with few conditions of infrastructure between: slope <15%; inside the buffer of water or roads.	Parcels not appropriate for agricultural uses and/or without infrastructure.	

Fig.6.12: Spreadsheet evaluation description. Source: The authors.

3. SPPC

System Objective: Guiding the Civil Protection plan in case of emergency by locating the most suitable areas where to pinpoint possible "security measure”, identifying parcels useful for either the civil protection plan (urban evacuation and temporary solutions as tents), in case of emergency or citizens as public spaces, under normal conditions. The general idea is to emphasize synergies between public space and emergency needs, supporting a multifunctional approach.

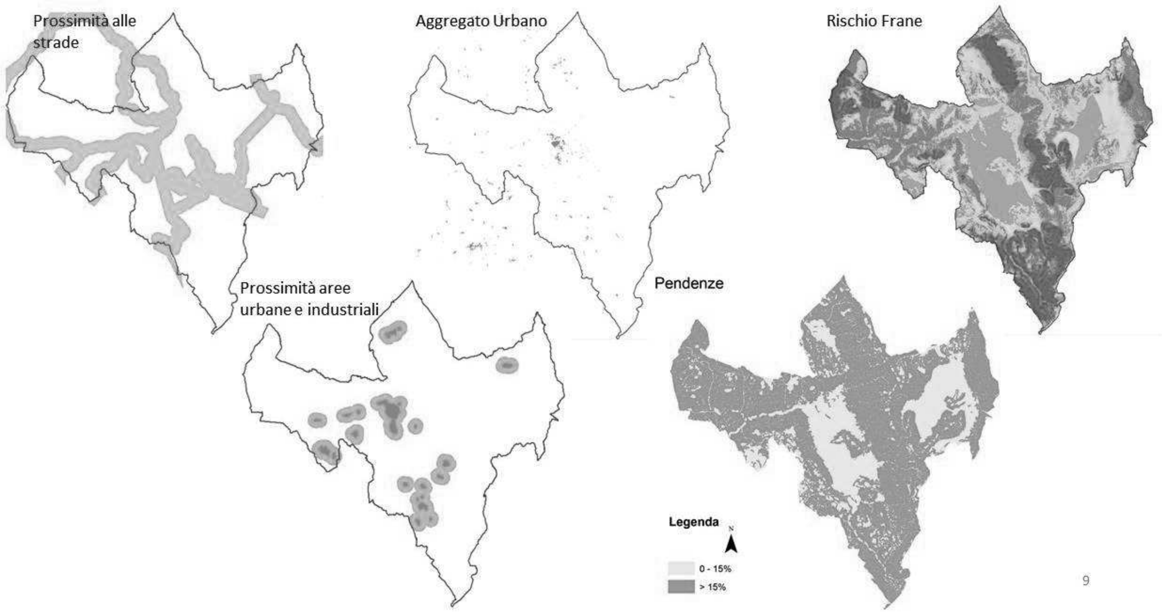


Fig.6.13: Layers composing the Public Spaces to support Civil Protection system. Source: The authors.

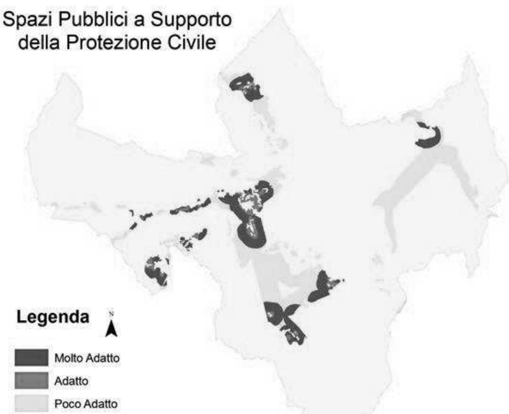


Fig.6.14: Public Spaces to support Civil Protection system evaluation map. Source: The authors.

Feasable	Suitable	Capable	Not Appropriate	Existing
When 1 km buffer of urban and industrial area intersects the 1 km buffer zone of the major arterial roads, slope less then 15% and no mass gravity risk.	Within the inner buffer of urban and industrial areas but excluding built blocks, slope less then 15% and no mass gravity risk.	Within one of the two extended buffers of urban areas or roads (1 km, respectively), slope less then 15% and low mass gravity risk.	Built blocks; slope > 15%; high mass gravity risk and everything far from urban ares and major roads (outside the buffer of both)	

Fig.6.15: Spreadsheet evaluation description. Source: The authors.

4. C-TUR

System Objective: Preserving the historical and cultural heritages that survived to the seismic event, enhancing the cultural touristic network, also assuming that collapsed sites will be rebuilt.

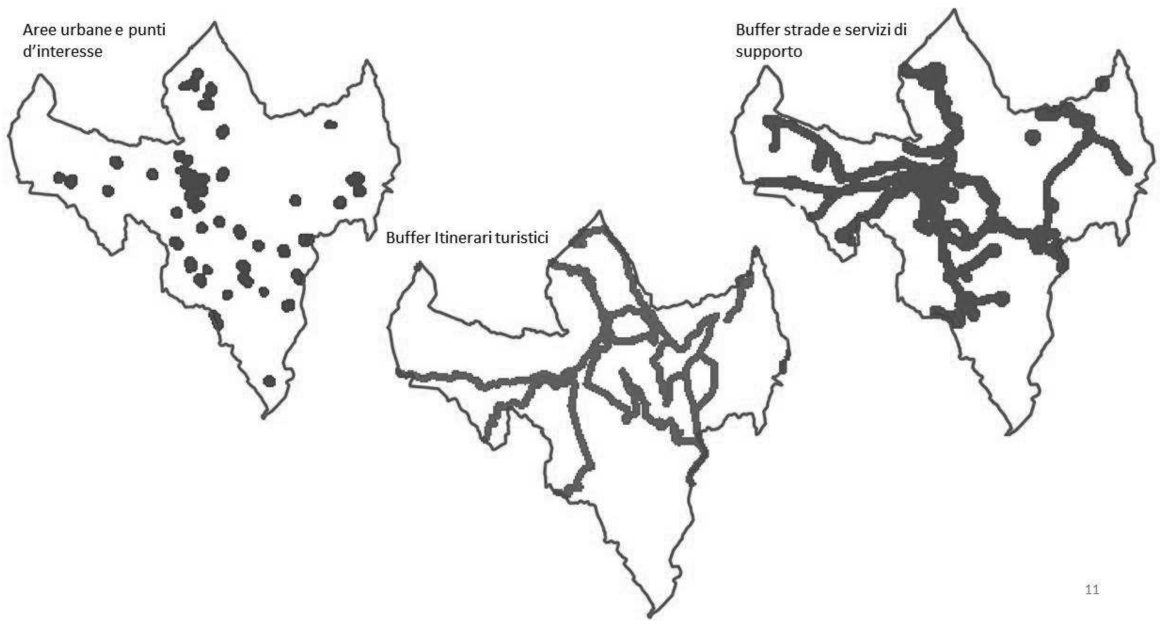


Fig.6.16: Layers composing the Cultural Tourism system. Source: The authors.

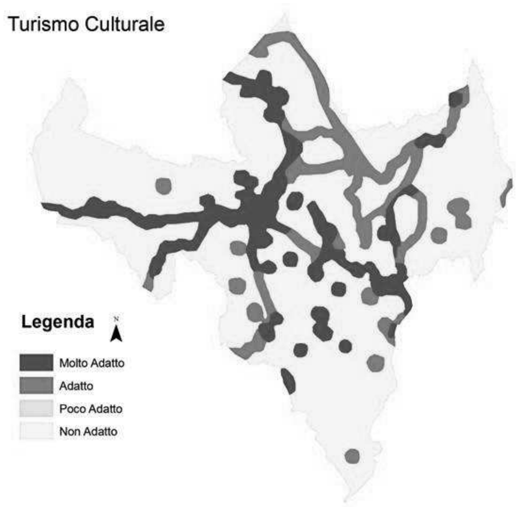


Fig.6.17: Cultural Tourism evaluation map. Source: The authors.

Feasable	Suitable	Capable	Not Appropriate	Existing
Urban areas and places of cultural intersts that coincide with tourist itinerary and that are well served by facilities and infrastructure.	Urban areas and places of cultural intersts or tourist itinerary but that are not well served by facilities and infrastructure.		Areas that are not attractive for a cultural pint of view.	

Fig.6.18: Spreadsheet evaluation description. Source: The authors.

5. RES

System Objective: Facilitating the residential development in proximity of the Norcia urban area beyond the more isolated hamlets, in order to avoid the sprawling in favour of principles of compactness.

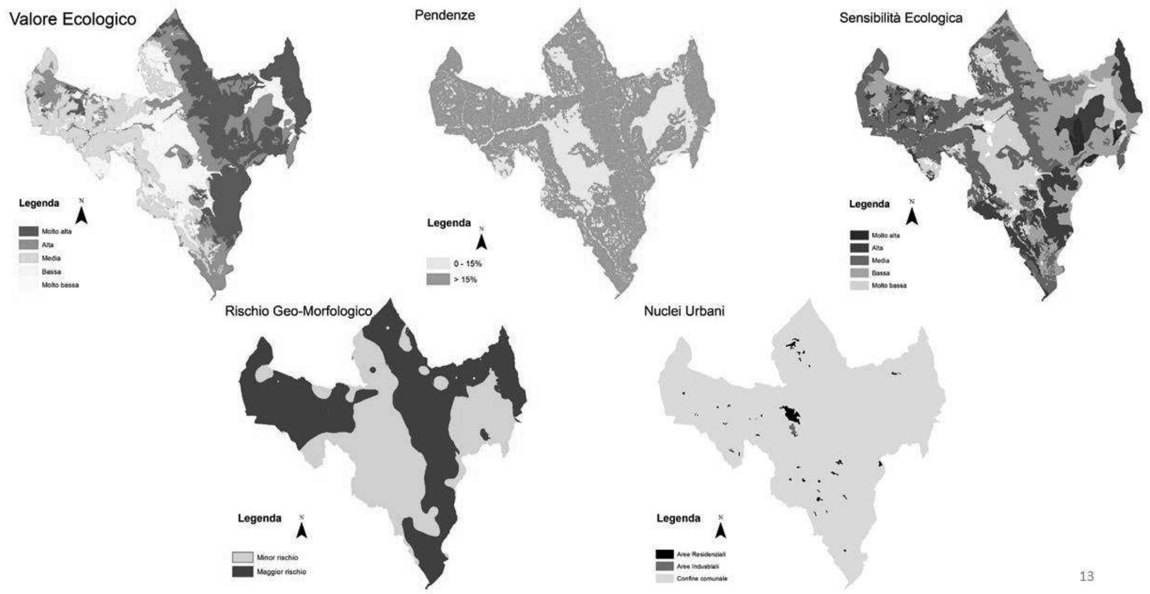


Fig.6.19: Layers composing the Residential Development system. Source: The authors.

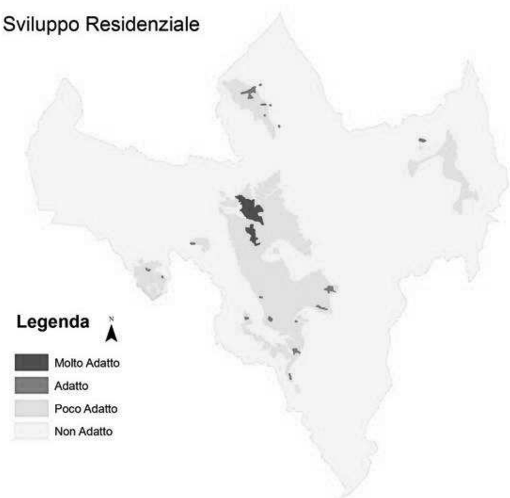


Fig.6.20: Residential Development evaluation map. Source: The authors.

Feasable	Suitable	Capable	Not Appropriate	Existing
Zoning only of Norcia	Zoning of minor hamlets and slope between 0 - 15%; very low EV and very low geo-morphological risk	All the other areas outside the zoning and in a flat landscape (0 - 15%); low EV and low geo-morphological risk	Areas where the slope is >15%; where the EV is high and the geo-morphological risk is medium / high	

Fig.6.21: Spreadsheet evaluation description. Source: The authors.

6. COMIND

System Objective: Infilling development potential for commercial and industrial parcels towards new types of economy, possibly linked with the seismic context. Another target here is to fill in the existing expansion areas in order to avoid the sprawl of industrial activities.

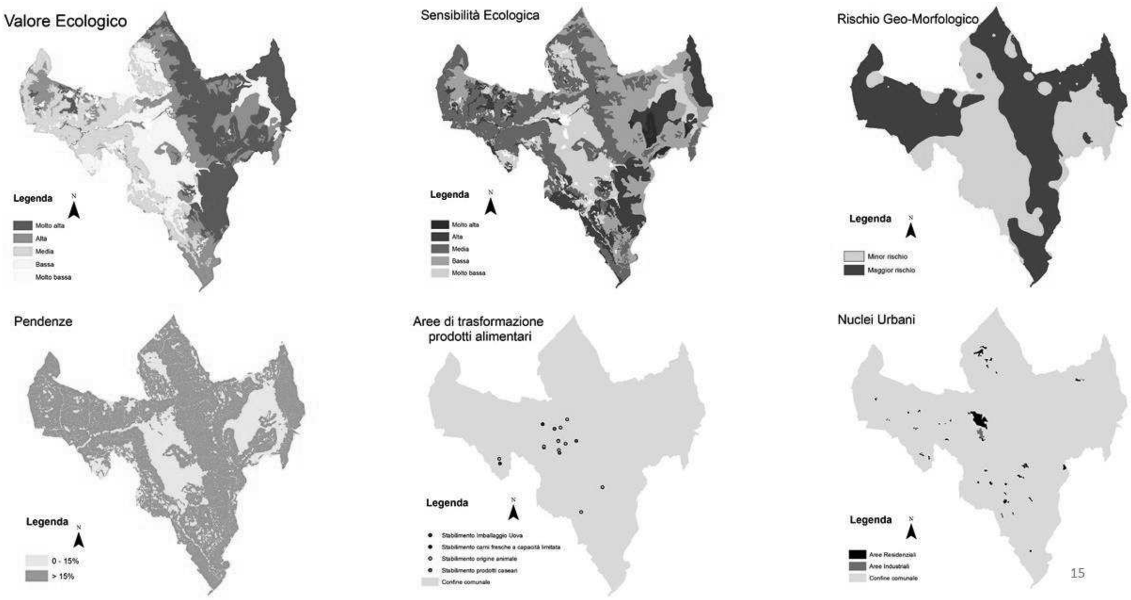


Fig.6.22: Layers composing the Commerce and Industry system. Source: The authors.

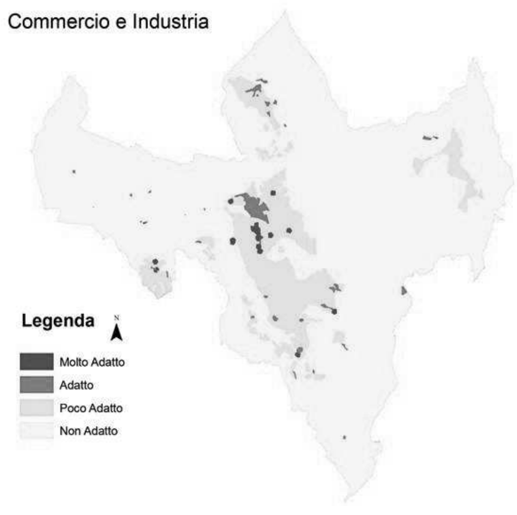


Fig.6.23: Commerce and Industry evaluation map. Source: The authors.

Feasable	Suitable	Capable	Not Appropriate	Existing
Zoning industrial areas and buffer of 150m from existing product transformation areas with a slope between 0 - 15%, low geo-morphological risk and very low EV	Outside the zoning and outside the buffer, slope between 0 - 15%; low geo-morphological risk and low EV	Outside the zoning and outside the buffer, slope between 0 - 15%; medium geo-morphological risk and medium EV	slope >15%; high EV and high geomorphological risk	

Fig.6.24: Spreadsheet evaluation description. Source: The authors.

7. TRASP

System Objective: Enhancing the connectivity between Norcia and both its inner hamlets and the surrounding outer major cities (through the existing major road network), possibly by strengthening the public and semi-private public means of transport; supporting the "modal shift" approach.

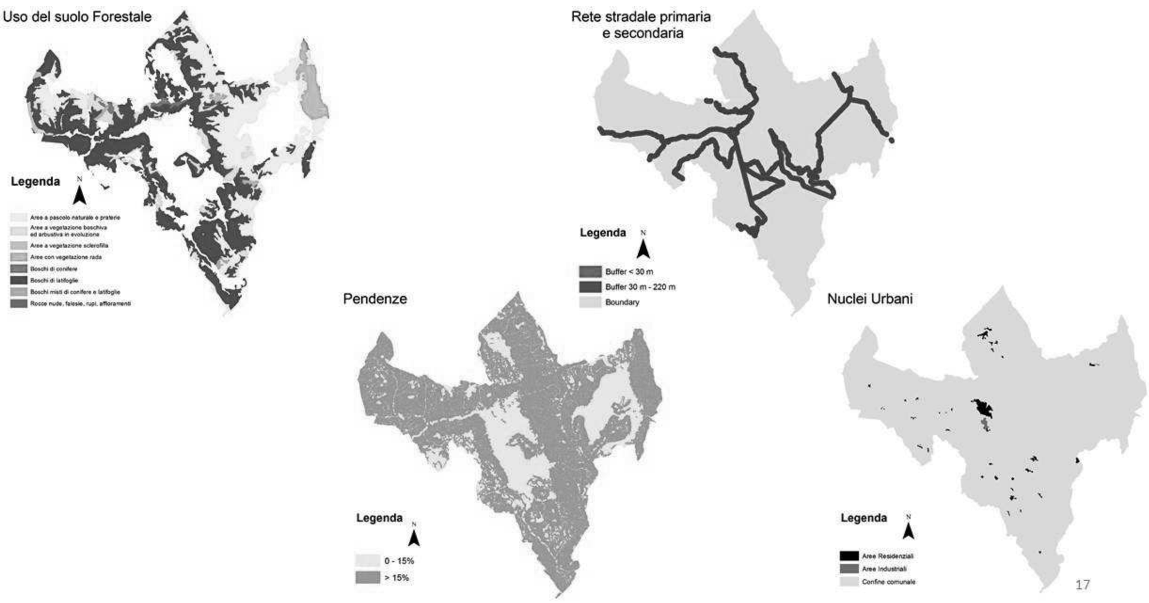


Fig.6.25: Layers composing the Transport system. Source: The authors.

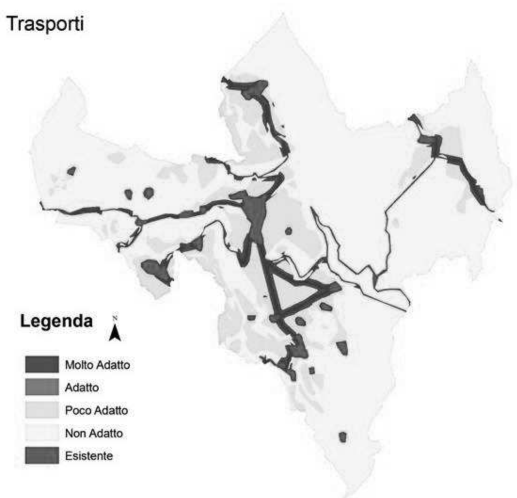


Fig.6.26: Transport evaluation map. Source: The authors.

Feasable	Suitable	Capable	Not Appropriate	Existing
Parcels within the road buffer of between 30m and 220m; with a slope between 0 and 15%		Parcels outside the 250m road buffer (30m + 220m); with a slope between 0 and 15%	areas cover by forest from land use; slope > 15%	The width of the roads (30m) and the built environment (urban and industrial areas)

Fig.6.27: Spreadsheet evaluation description. Source: The authors.

8. EN

System Objective: Identifying suitable area to development new form of energy production based on renewable sources.

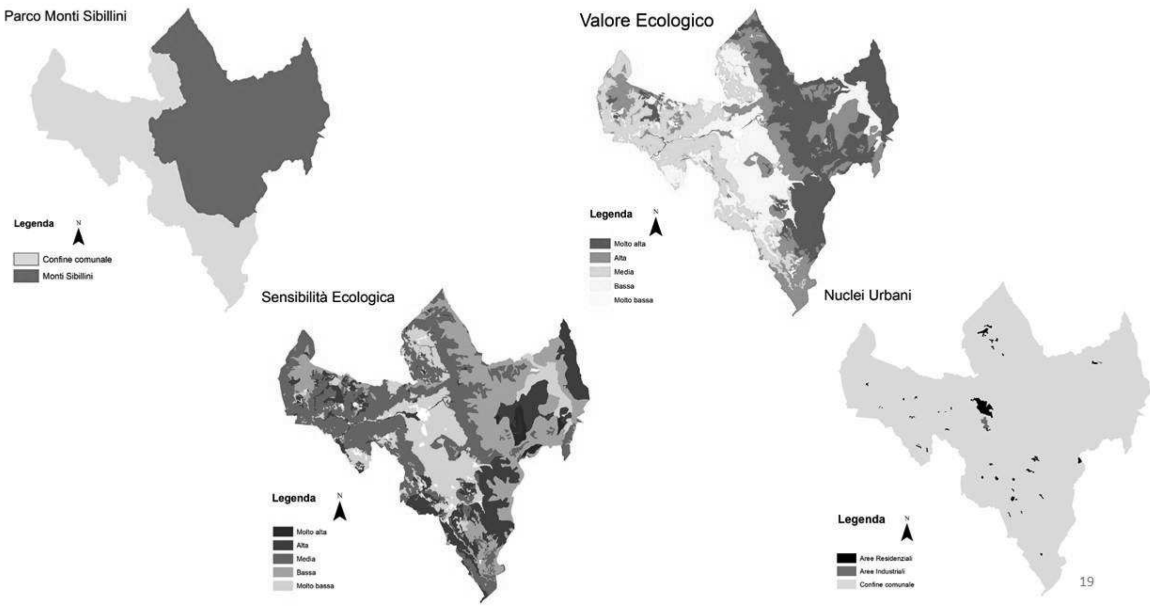


Fig.6.28: Layers composing the Energy system. Source: The authors.

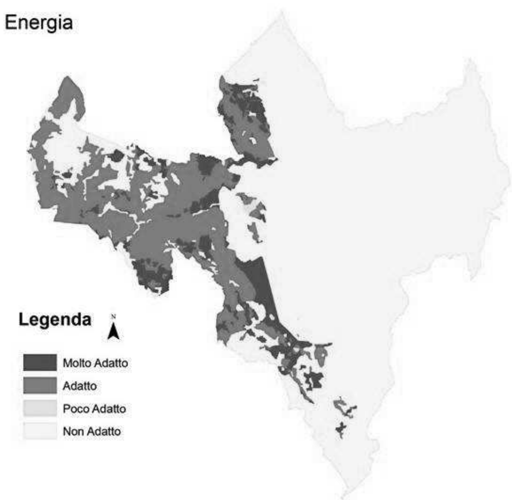


Fig.6.29: Energy evaluation map. Source: The authors.

Feasable	Suitable	Capable	Not Appropriate	Existing
Areas with very low EV and ES only outside the SIC	Areas with low EV and ES only outside the SIC	Areas with medium EV and ES only outside the SIC	Areas within SIC; with high EV and high ES outside the SIC	

Fig.6.30: Spreadsheet evaluation description. Source: The authors.

9. PRI

System Objective: Prioritizing the interventions on certain areas or important elements that have not been considered and addressed in other systems, according to the participants territorial knowledge. In this case, instead of layers, base maps have been considered.

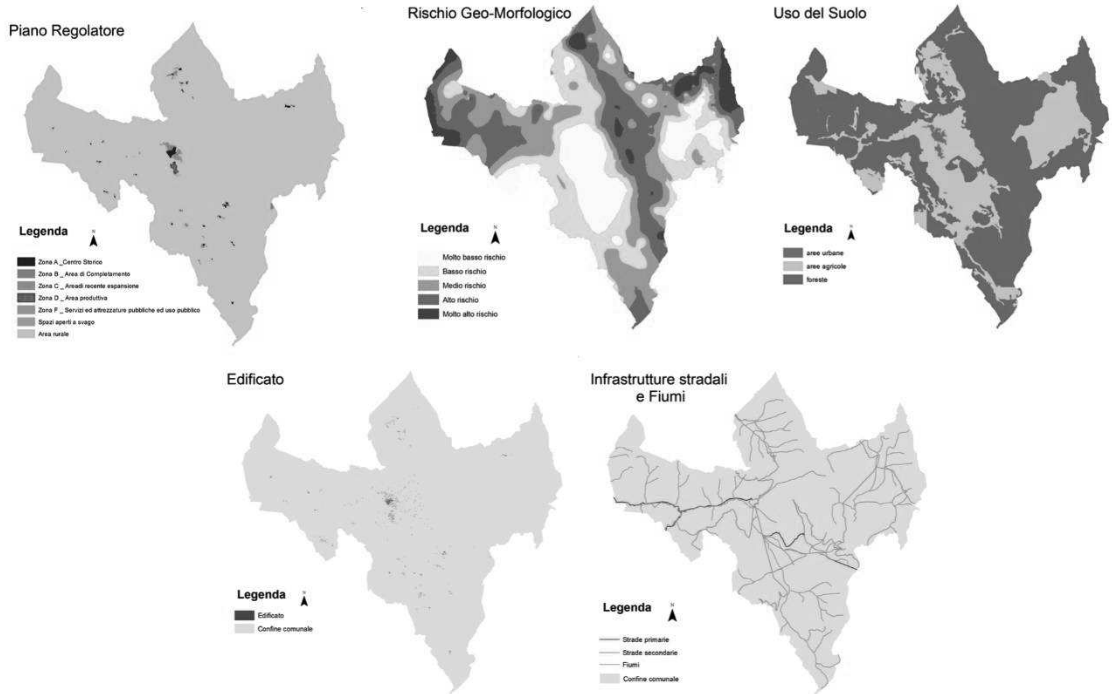


Fig.6.31: Base maps composing the Priority of Intervention. Source: The authors.

Fig.6.32: Priority of Intervention evaluation map. Source: The authors.

Feasable	Suitable	Capable	Not Appropriate	Existing

Fig.6.33: Spreadsheet evaluation description. Source: The authors.

10. E-TUR

System Objective: Preserving the existing touristic point of interests and enhancing the overall tourism industry revolving around natural elements. The creation of the E-TUR Evaluation maps was different compared to the others because it has been produced by the participants at the beginning of the workshop, through InViTo.

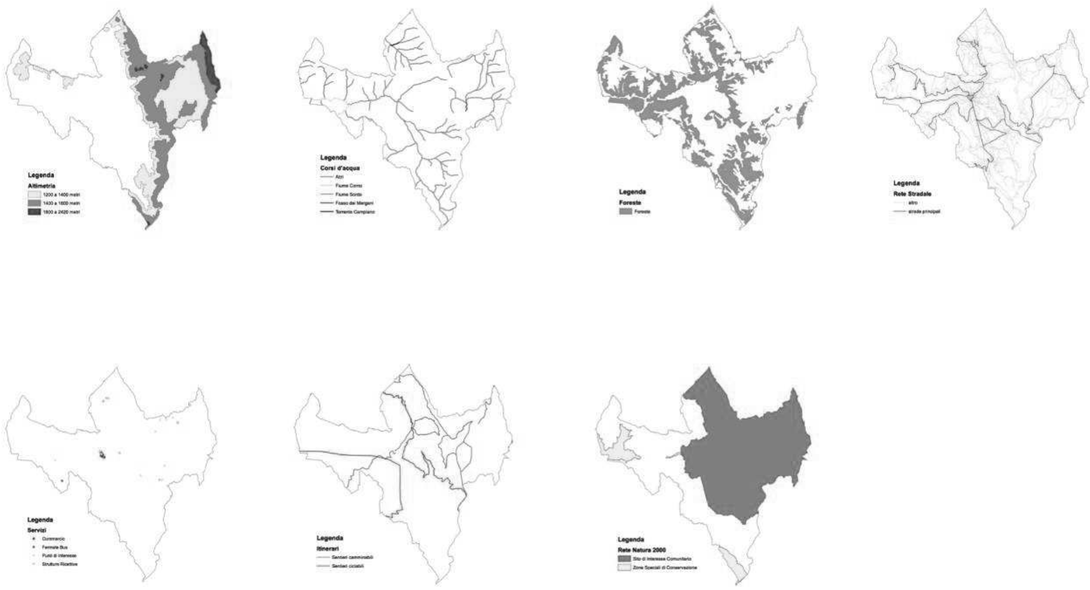


Fig.6.34: Layers composing the Ecologic Tourism system. Source: The authors.

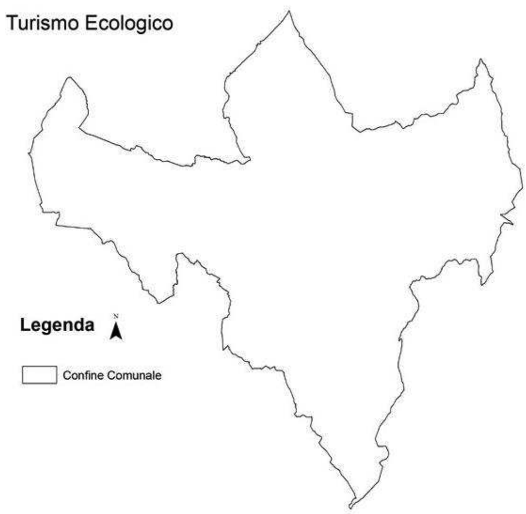


Fig.6.35: Ecologic Tourism evaluation map. Source: The authors.

Feasable	Suitable	Capable	Not Appropriate	Existing

Fig.6.36: Spreadsheet evaluation description. Source: The authors.

Workshop Organization

After having set the study area and the case study geographical boundary, the authors started to organize the workshop, choosing a location and contacting possible participants.

Due to the physical inadequate conditions of the built environment within the Norcia municipal area, the workshop have been set in Perugia at the Centro Linguistico di Ateneo, a department of the University of Perugia, on April the 6th and 7th 2017, lasting one day and a half in total. In order to properly run the workshop, the room was equipped with 25-30 laptops used by the participants, a video projector managed by the workshop conductor, a sheet blackboard with pencils and loudspeakers.

Concerning the participants, the authors decided to take advantages of the knowledge and experience of heterogeneous stakeholders with different background, expertise and interests, also from a representativeness perspective. Therefore, initially it was contacted a list of participants among:

- Five different departments of the University of Perugia including Dep. of Economics; Physics and Geology; Civil and Environmental Engineering; Agricultural, Food and Environmental Science; Political Science;
- Department of Civil Protection (governmental institution) of Foligno city which is the Umbria (regional) headquarters;
- Gran Sasso Science Institute, School of Advanced Studies, Aquila city;
- Municipality of Norcia (Mayor and technical officers);
- National Association of Building Constructors (Associazione Nazionale Costruttori Edili, ANCE);
- Centro Edile per la Sicurezza e la Formazione (CeSF);
- Fabricamus, an Architectural and Civil Engineering firm;
- The Monti Sibillini National Park Authority;
- Citizens of Norcia municipality;

- A vast number of local stakeholders, organizations, local cooperatives and onlus.

All of them have been contacted by phone call, video call, email and social media platforms including Facebook and Whatsapp. In order to facilitate the management of the workshop, mainly due to time constraints, the optimal number of participants was set between 20 - 30 people. Through a brief online registration form, they were asked few questions and to confirm their participation at the event.

Along with the organization of the workshop it was created a facebook page of the event where, exploiting the ability of the network, were invited people of the local community, participants and other people that somehow are in close contact with the territory or commute there for working reasons. The facebook page "Co-creare scenari futuri per il territorio comunale di Norcia" (Co-create future scenario for the municipal territory of Norcia, https://www.facebook.com/Co-creare-scenari-futuri-per-il-territorio-comunale-di-Norcia-385436458507889/?fref=ts), has been thought with the purpose to firstly create an open network revolving around the workshop event and secondly, to be used afterwards to spread some inputs in order to get critical feedbacks. The facebook page has been the platform where people could get access to the voting system generated by a geodesign hub plug-in. A more detailed explanation about how the plug-in has been used will furtherly come in the "Post-workshop" paragraph.

6.2. The Workshop

At the workshop day, eleven people showed up, actively participating throughout the one and a half day workshop. The compositions was:

- two persons from the Department of Political Science, University of Perugia;
- one person from the Department of Physic and Geology, University of Perugia;
- two persons from the Civil Protection;
- two persons from the Gran Sasso Science Institute;
- two persons from the Fabricamus firm;
- one citizen/student from architecture;
- one person from a local onlus.

Besides their interests and professions, most of participants listed above were either citizens or experts of the study area, defined by the Steinitz framework as ”the people of the place”.

However, in order to efficiently carry on a Geodesign workshop with the Geodesign hub software, a Geodesign team is required. The Geodesign team has the task to supervise both the overall workshop flow and the participants responsiveness, providing a tight hourly schedule and ensuring that it is strictly followed, explaining clearly every step to participants and being sure they understood, monitoring the development of diagrams, technical support and guiding participants as much neutrally as possible, only when required.

Therefore, the geodesign team offered coordination and technical support during the entire workshop, going group by group and supervising the overall process. The most important role within the geodesign team is played by the conductor who is in charge of leading the workshop. In this case, the geodesign team was made up by seven people including the GDH developer, one professor, two PhD students and three master students (the authors), with backgrounds in computer science, architecture, geography, urban planning, geoprocessing, geology and spatial analysis.

On the first, the workshop started with a presentation of the study area where objectives, results of spatial analysis and evaluation maps, already available on the platform, were presented.

SCHEDULE	
9.00: Workshop Presentation 9.30: InVito (Skype Polito) 10.30: Tutorial GDH_1 11.10: BREAK 11.30: Diagram Design. 10 groups	DAY 1

13.00: LUNCH 14.00: Tutorial GDH_2 14.45: Scenario 1_5 groups 15.30: Scenario 2_5 groups 16.30: Group presentations 17.00: Sociogram	
9.00: Tutorial GDH_3 9.40: Scenario 3_ 3 groups 10.40: BREAK 11.00: Presentations 11.30: Final Scenario_1 group / Discussion 13.00: Survey	DAY 2

Fig.6.37: Time schedule. Source: The geodesign team.

Afterwards, the coordinator provided an overview of the workshop schedule shown on the table (Fig.6.37), so that the participants got to know the workflow throughout the one day and a half. Moreover, according to the Steinitz scheme, the participants were abstractly positioned within the four circles, respectively representing design professions, geographical sciences, information technologies and the “people of the place”, in relation to their backgrounds and knowledge of the place.

According to the schedule, at 9:30 a.m. it was contacted via skype the InViTo developer, who explained to the participants what InViTo is and how to use the platform to build the evaluation map of the E-TOU system. Concluded the composition of the evaluation map and after a brief explanation of the conductor about the GDH functionalities, participants logged-in and got familiar with the GDH interface. Through the initial tutorial where only two systems were provided, it was required to them to use the main functions of the software. This step is actually the first one where participants started to use the software.

At 11:30 a.m., the first design cycle begun with ten groups which due to the scarce number of participants, have been mostly made up by one person. It was asked to the groups to create for each system, a number of geo-referenced diagrams which, through a specific and understandable title, provided base for the conceptual design proposals.

Fig.6.38: Participants pictures while drawing during the first design cycle. Source: The authors.

Practically, during this first design cycle, participants initially consulted both with each other and through the Internet to better define the territory, organizing their ideas. Then, taking into consideration the evaluation maps displayed on the GDH interface by activating or deactivating them, participants begun to draw their strategies and proposals into the GDH software which simultaneously shows the diagrams produced not only to the creator but also to the other participants. Concluded the first drawing session, all the diagrams have been automatically organized in a matrix by GDH, considering both the related system and the chronological order of creation and displayed by the software on the platform interface (Fig.5, 6 Annex). It is important to mention that all the design proposals drawn at this stage represent the first intermediate outcome which will be refined throughout the coming cycles of iterations.

For the second design cycle, participants were arranged in five groups, each one with different interests, affecting differently the decision-making process.

Group name	Acronym
Tourist sector entrepreneurs	IMP-TUR
Citizens	CIT
Civil Protection	PC
Agricultural entrepreneur association	AGRI
Public authority	AP

Fig.6.39: Five representative groups. Source: The authors.

The five groups included the Tourist sector entrepreneurs (IMP-TUR) group, the Citizens (CIT) group, the Civil Protection (PC); the Agricultural entrepreneur association (AGRI) and the Public authority (AP) group.

By 2:45 p.m, it was required to each group to set their decision model histogram.

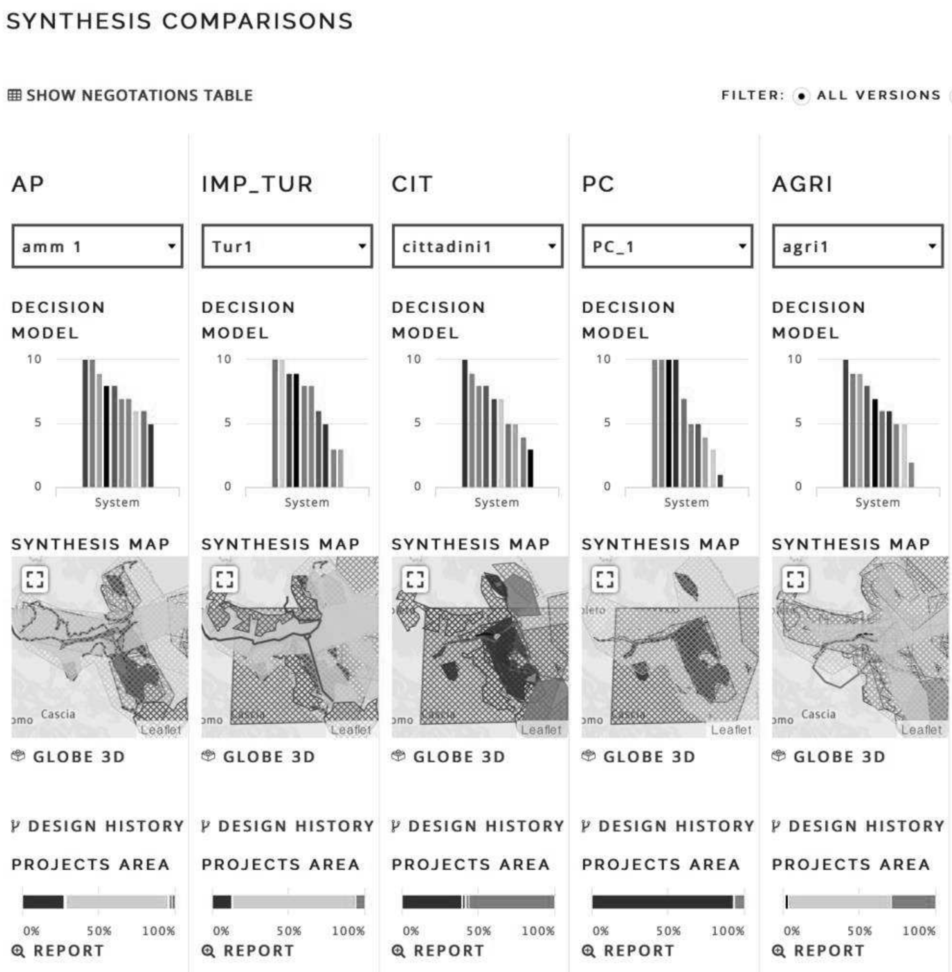


Fig.6.40: Software interface with the decision model histograms of the 5 groups. Source: Geodesign hub interface.

The decision model histogram (Fig.6.40) is basically an interactive bar chart that represents the group interests considering each system, prioritizing them by associating a value to each bar on a scale from 1 (almost negligible) to up to 10 (highest interest), according to the group perspective. For instance, since the AGRI group orientation revolved around agricultural aspects, they obviously focused their strategies towards, for example, AG, COMIND and TRASP systems, prioritizing more projects and policies within these systems rather than in other secondary ones such as RES or C-TUR.

After that, it has been mainly asked to the groups to select some of the existing diagrams, which could be also discarded, edited or created by scratch.

Fig.6.41: Participants collaborating when they were 5 groups. Source: The authors.

In this phase, participants constantly exchanged their personal knowledge of the territory with the group-team in order to mediate and choose on both strategies and their location within the study area. Since group teams were composed by two persons, these had to collaborate also in the drawing phase, where in the majority cases, one component was orally communicating the agreed strategies while the other was concretely drawing them into the GDH software. Changes were updated in the preset matrix and displayed real-time.

Then, at approximately 4:30 p.m., each of the group leaders presented the selected diagrams and explained the purposes behind the group synthesis map, seeking to convince the audience to embrace the idea.

Fig.6.42: Presentations from the group leaders. Source: The authors.

The day concluded at 5:00 p.m. by drawing the sociogram with the visual help of the blackboard. The sociogram is a matrix mutually assessed by the five groups where they expressed their agreement or disagreement to the other groups, considering possible synergies and conflicts between both the synthesis maps and the decision model histograms. In other words, by looking at the respected chosen strategies and prioritized histograms for each group, the groups stated whether they were open or not to collaborate with other groups, using a four-scale range from highly alike to highly unlike. Whether groups had selected similar diagrams or priority values in the same systems, they have been merged together as shown in Fig. 6.43, composing the new groups for the third cycle.

Fig.6.43: Final sociogram & People marking their preferences. Source: The authors.

The second day, after that participants were arranged in two groups so called AGRITURPA (AGRI; IMP-TUR; AP) and CITT_PC_1 (PC; CIT) according to the sociogram, the third design cycle started at approximately 9:00 a.m., with the negotiation phase where participants compared the similar diagrams from the selected synthesis maps. Later, the geodesign team asked to the two groups to select, create, edit or discard the diagrams from the synthesis maps. At this stage, the two groups defined and structured the new synthesis maps that became two in total. Thus, that, the fourth and last cycle started by merging all the two groups in just one. Hence, the last negotiation phase set the basis for the creation of the last synthesis map, that tangibly represent the suggested plan which maximize the consensus. During the fourth cycle started by 11:30 p.m., the role of the conductor from the geodesign team was crucial in order to coordinate the negotiation phase, which, at this stage, involves the totality of the workshop participants.

The conductor begun the final negotiation phase taking into consideration the diagrams from the two synthesis maps that have been selected by both groups, focusing the attention only on the common strategies. In this way, participants had to firstly go through an agreement process, building trust with each other and speeding up the negotiation phase, and then facing the conflicting diagrams. The overall fourth design cycle was composed by the conductor who acted as a neutral mediator of the negotiation phase in which contested debates took place. Besides, its role was also to coordinate the participants from an operational perspective, requiring them to edit or create new diagrams whether previously commonly agreed. An important aspect that differs this fourth phase from the previous ones is that before participants within their groups were asked to set the diagrams themselves, while in this final cycle, it was the coordinator responsibility to manually select the diagrams but only after the achievement of a common agreement. Once all the diagrams for all the systems have been examined, the negotiation phase was concluded and the final co-created plan presented. The completeness of the final scenario's projects and policies were visualized in both a 2D map and an online 3D model. Finally, the workshop has been concluded at approximately 1:00 p.m., after a discussion session about the final scenario and possible further reflections.

Moreover, at the very end of the one and half day workshop, the authors proposed an internal questionnaire to the participants. It was used Google Survey and reached the participants through their e-mail contact. Seven open questions were presented with the purpose of gaining feedbacks concerning both strengths and weaknesses of the geodesign flow and the software, the choices made by the authors along the pre-workshop phase in building the case study and even about the terminology used. Some of the answers have been analysed in the analysis chapter.

Summarizing the workshop phase, it is advantageous to simplify the workshop flow for the purpose of a better comprehension by representing it through the following scheme.

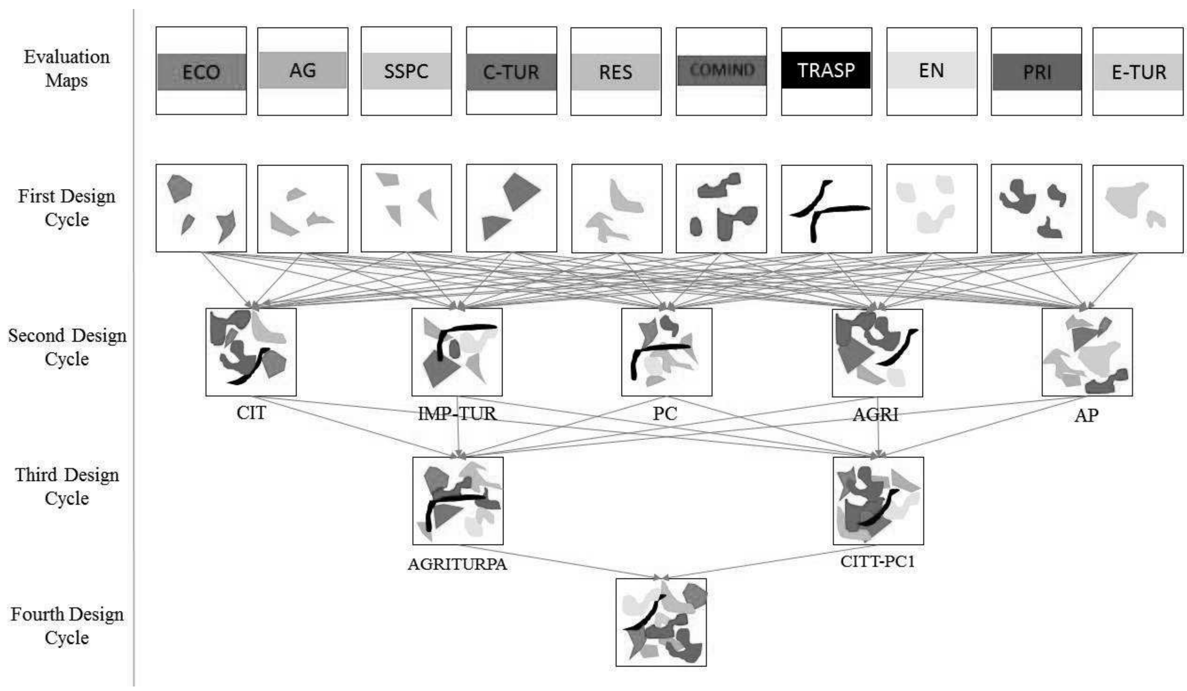


Fig.6.44: Scheme of the workshop's design cycles. Source: The authors.

As provided in the Fig.6.44, during the first design cycle, the participants individually planned a series of strategies by sketching diagrams for the ten systems, considering the respective evaluation maps. During the second design cycle, the participants were gathered together in five groups which created a synthesis map each by either selecting and editing the diagrams from the first cycle or creating new ones. Consequently, according to sociogram which took into consideration synergies among the diagrams, the five groups were merged in two groups, beginning the third design cycle which led to have this time, only two synthesis maps. The fourth and last design cycle begun with merging the two groups in only one where, through the negotiation phase, the co-created final map was achieved.

6.3. Post-Workshop

Completed the workshop and the survey, the post-workshop phase started from an elaboration of the final co-created plan generated from it. Before activating the GDH plug-in and sharing the voting system, the geodesign team decided to reduce the number of diagrams coming out from the final co-created plan. The adaptation was necessary due to an excessive number of diagrams which may lead to protract the voting time for the voters, meaning less votes for some of the proposed diagrams and in turn, leading to unsatisfying results. Hence, in order to decrease the voting time and enhance the amount of votes homogeneously for each diagrams, it was included in the voting systems only the limit number of diagrams, specifically only the agreed diagrams coming out from the two synthesis maps produced by the two groups during the third design cycle. So that, through the facebook page "Co-creare scenari futuri per il territorio comunale di Norcia", the geodesign team posted the link of the voting system which was active for a duration of two weeks, enlarging the process also to the local people that could not participate at the workshop. By giving them the possibility to vote each diagram, it has been possible to experience a more representative process.

Fig.6.45: Voting interface. Source: Geodesign Hub Design Viewer.

Operationally, people got the access to the voting system by clicking on a web link posted on the facebook page, the network had access to a GDH plug-in. The software extension allowed people to evaluate one by one all the diagrams, offering the options to accept a diagram (green button in the Fig.6.45), reject it (red button) or skip to the following one (black button). The GDH voting system was designed with an intuitive interface, enabling the voters to assess 27 diagrams in less than 3 minutes. Then their evaluations can be used by decision-makers to inform their final decision or to restart a new GD project which integrates the network's feedback.

Once the voting systems was closed, it was extrapolated a series of the raw data which were stored and further elaborated in an excel file.

7. Analysis

The analysis chapter has been structured in three different sections by following an inductive reasoning that goes from a narrow analysis of results to investigate broader characteristics.

Initially, the final results of the geodesign workshop are independently analysed system by system, in respect of the main objectives and the geographical assessments of each system, also to provide to the reader a better and more clear picture of the results. Then the overall results are presented and analysed in a combined way. This first part ends with the analysis of the social media voting system, which enabled the decision-making process to be opened to a larger portion of the local community.

In the second part, the focus has been broadened to the analysis of the collaborative process, relating the project back to the theoretical concept of the e-ladder, highlighting criticisms and benefits observed during the test and defining important conditions to fulfil, especially in post-disaster contexts.

Finally, in the third part the focus is put on demonstrating how the geodesign approach can cover some important gaps identified within the traditional post-earthquake planning approaches, seeking to answer at the main research question.

7.1. Analysis of the final results

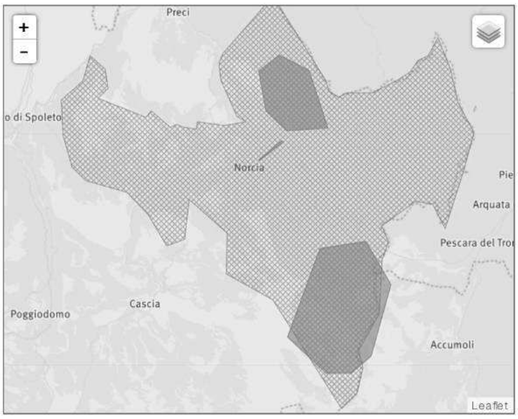
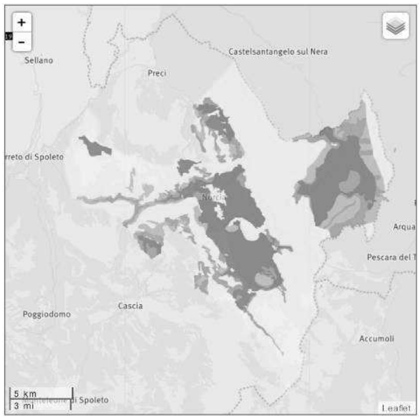
7.1.1. Diagrams analysis: system by system

As already stressed along the report, the choice of the systems intended to represent and analyse the study area plays a crucial role in defining the final outcome. In particular, systems have the purpose to represents both physical and more abstract main characteristics which shape the territory object of the case study.

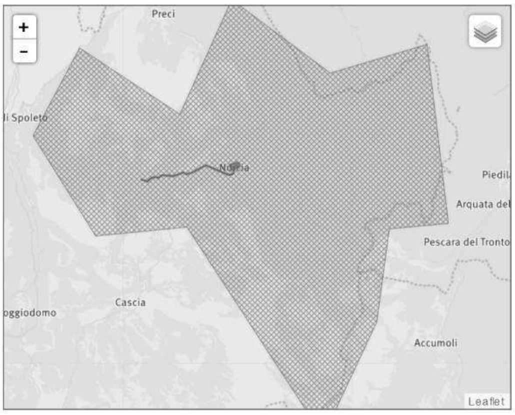
Concerning the choice of systems, it is common that some of them are repeated despite the study area due to their main role of summarizing territorial core elements which can be often the same independently from the study area. With regards to the Norcia project, the majority of the adopted systems such as ECO, AG, RES, COMIND, TRASP and EN represent, more or less, the basic elements on which basing the cognitive frame attributable also to other territorial contexts. Besides, it has been also decided to consider two systems such as C-TUR and E-TUR revolving around the tourism sector due to its importance as a major local economy booster. It is important to mention that objectives and processed data (layers) are the key aspects that shaped these eight systems from the mere representation of the areas to the seismic contextualization, diversifying the Norcia case from others.

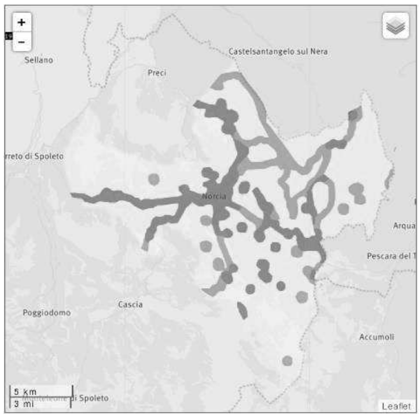
However, for SPPC and PRI circumstances are different because these two systems were not put in place merely to represent the area but rather to deal with and address the challenges during the emergency phase originated by the seismic event. In fact, they can be seen as innovative systems tailored according to the Norcia context and more specifically to its post-earthquake scene. The reasons behind the two strategic systems sought to include post-earthquake planning measures and strategies before and during the workshop phases. The decision of including these two systems is the overall composition that either directly or indirectly pushed all the involved actors to rethink and reflect upon the territory their perspective. For instance, in the systems identification during the pre-workshop phase, the authors investigated and identified clear objectives based on the post-disaster recovery and mitigation planning measures for the purpose of reducing future risks that are going to be originated by new earthquakes. While, during the decision-making process (workshop), participants were encouraged to think and practically include solutions attributable to post-disaster planning strategies through the creation of some diagrams.

Summarizing the final diagrams and analysing them system by system, it is possible to understand the dynamics which brought to the final agreed scenario and confirm whether the initial purposes and the geographical assessments (evaluation maps) have been pursued or not. Since the focus of this project is not to investigate the final systemic diagrams nor to define a final solution for the case study, the following tables are thus presented for enabling some specific reflections on the relation between geographical assessment, the main goals set at the very beginning of the study process and the final diagrams drawn by participants which have reached a compromise upon the relevance of their inclusion in the final strategy. In order to better read the visualizations of final diagrams maps below (Fig.7.1), plain colours represent projects while grid patterns are used to represent policies.

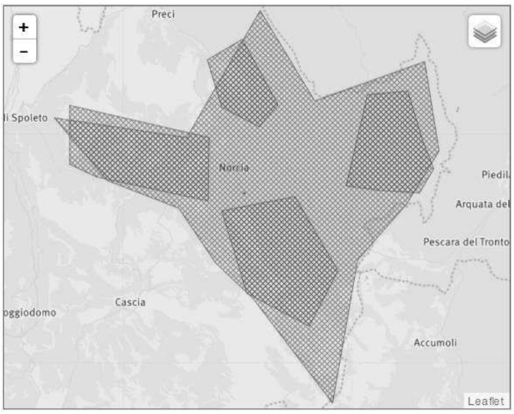
System	Visualization of Final Diagrams	Evaluation Map
A G		

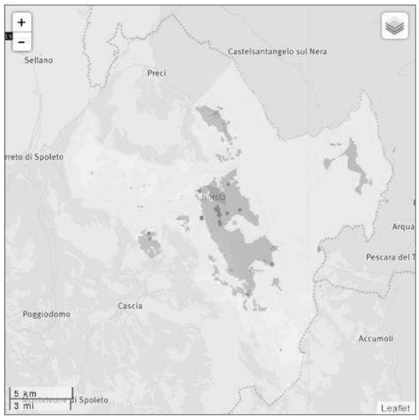
C. TUR



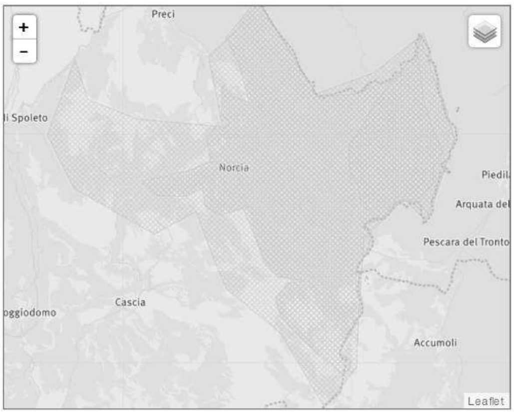


COMIND





E. TUR



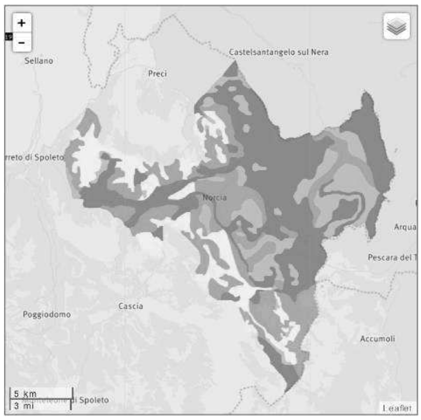


Fig. 7.1: System final diagrams map (left) and Evaluation Maps (right). Source: Geodesign hub.

In general, it can be said that for some systems the proposed interventions, referring to both physical projects and abstract policies, are more destined to specific geographical locations ascribable to an acupuncture approach while the proposals related to other systems cover the entire municipal boundary. With regards to this, it is possible to notice that for the systems related to the pillars of the local economy, as AGRI, COMIND, C-TUR and E-TUR (Fig.7.1 above), it has been suggested to introduce policies for the entire territory besides specific projects. This fact emphasizes the importance of strengthening such systems for the rebirth of the local economy which now is collapsed, while for other systems more related to the safety of the local community and to the vulnerability of the built environment more targeted and physical interventions have been proposed. Furtherly, it is notable through the overlay of the final diagrams visualization and the related evaluation map, which represent the geographical assessment for the system, that the suggestion obtained from participants mostly have reflected the pertaining geographical assessment, except for few cases. This is the case of the system “Agriculture”, where two extensive projects (plain colours) have been proposed for an area defined as “not appropriate” (marked in yellow) by the spatial analysis. This proposal is in line with the main goal set for the system and confirms that there is a need to enlarge the areas dedicated to activities related to the pillars of the local economy while working on the multi-functionality of the area. Indeed, the proposals concern the enlargement of grazing lands on the sides of the mountains while integrating more functionalities, as energy production and sport activities (Fig.32, 33 of the Annex).

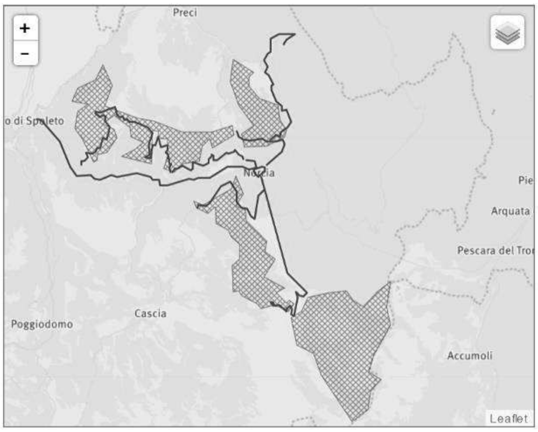
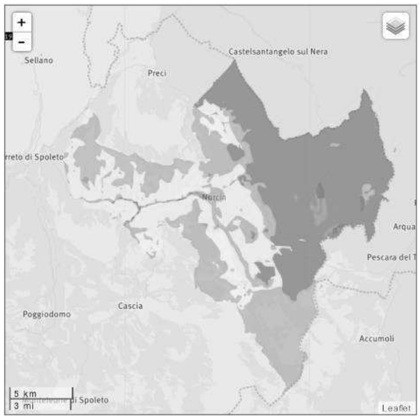
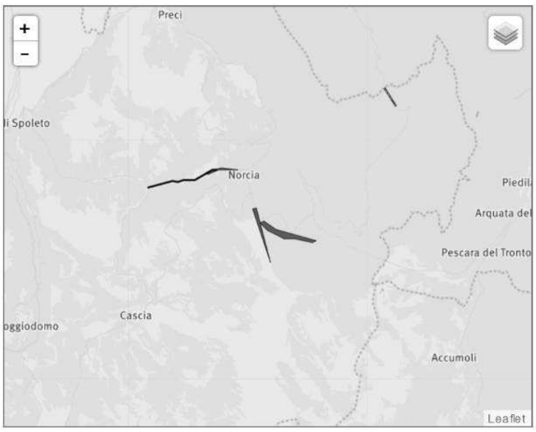
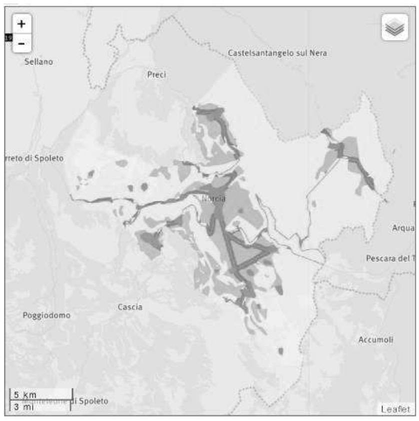
System	Visualization of Final Diagrams	Evaluation Map
E C O		
T R A S P		

Fig. 7.2: System final diagrams map (left) and Evaluation Maps (right). Source: Geodesign hub.

Yet, suggestive are the cases of ECO and TRASP systems (Fig.7.2), the only two systems where the presence of existing well functioning areas (marked in red) have been assumed. In both the cases participants agreed with the geographical assessment and did not proposed any intervention on the “red areas”. Rather proposals concern the expansion of these well functioning areas by creating a continuum with them. The diagrams suggested within the transport (Fig.58, 59, 60 Annex) system are clear examples of this approach. In fact, all the proposed interventions are road segments that serve to connect others well working segments of the network infrastructure, increasing the overall connectivity, which was the main goal for the system. By doing this, participants have agreed with the spatial analysis and made proposals according to the main goals for the related system. This trend is observable quite dominantly in the development of each system.

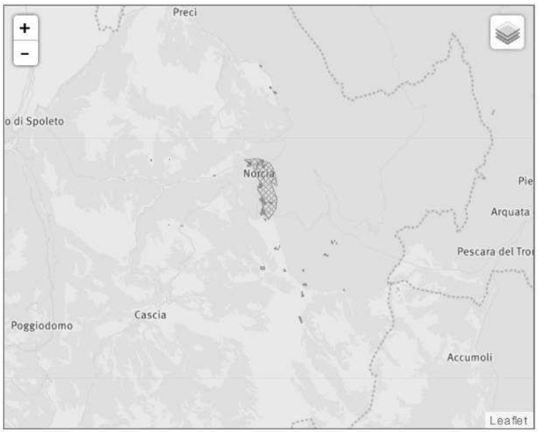
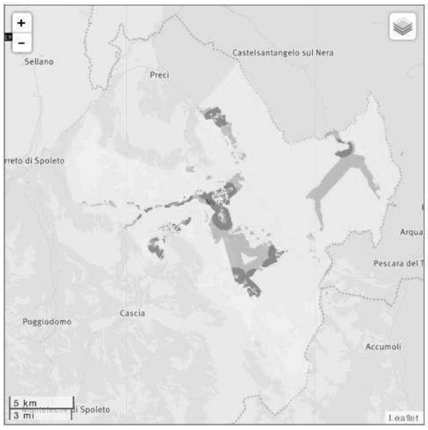
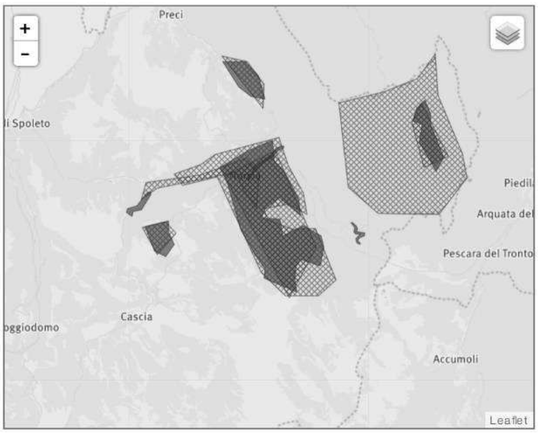
System	Visualization of Final Diagrams	Evaluation Map
S P P C		
P R I		

Fig.7.3: System final diagrams map (left) and Evaluation map / Municipal Boundary Map (right).

Source: Geodesign hub.

Looking at the two systems “Public Spaces for Civil Protection” and “Priority of Intervention” (Fig.7.3), and referring to the Fig.36-41 and to the Fig.64-69 Annex, it has been noticed that diagrams are mostly related to investigate the individuation of physical projects aimed to ease the Civil Protection management of the emergency phase and the implementation of the emergency plan. Thus, it can be said that the physical interventions within these systems are proposed for meeting the short term goals of the recovery stage. While the only policy suggested concerning anti-seismic measures for the built environment of the main settlement of Norcia town (Fig.41 Annex), has been shaped more as a mitigation measure in order to reduce the vulnerability and be more prepared for the next seismic event.

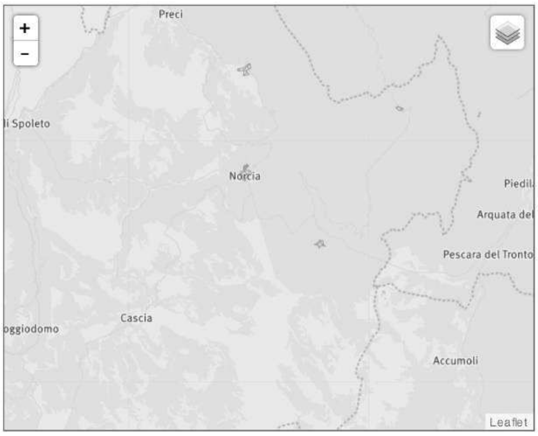
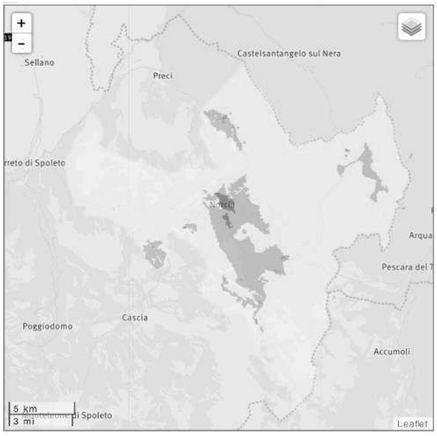
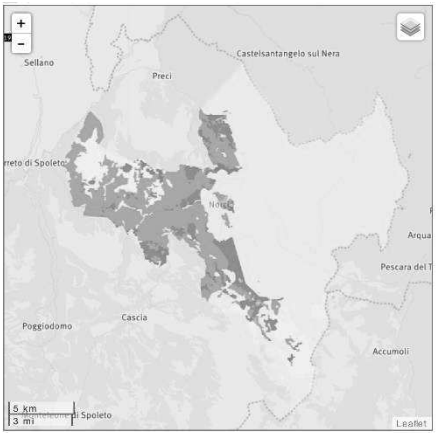
System	Visualization of Final Diagrams	Evaluation Map
R E S		
E N		

Fig. 7.4: System final diagrams map (left) and Evaluation Maps (right). Source: Geodesign hub.

For Residential and Energy systems (Fig.7.4), it has been proposed more localised smaller scale projects, concentrate in the flat plain surrounding Norcia town, where minor settlements are mostly placed. While the projects concerning residential development have to pursue reconstruction needs (Fig.48-52 Annex), the energy sector looks ahead at the future and try to exploit the increased financial conditions for accomplish betterments according with the urban paradigm transition. It is the case of agreement around the suggested implementations of a windmill park, a biomass plant and the solar panel policy (Fig.61-63 Annex).

7.1.2. Final scenario analysis: combined systems

The overlaying of the total chosen diagrams from all ten systems form the final outcome of the first workshop project. This outcome will not be necessarily enough to inform a strategic vision to adopt for the future development. Rather, it can be seen as a first product that needs to be modified and re-shaped through sharing it with the broader local community in order to gain precious feedbacks and by going through an entire or partial cycle of workshop, refining the quality of the inputs and enhancing the representativeness of the participants.

However, from an empirical perspective, along the stages of the whole process participants have drawn, edited and re-drawn 113 diagrams, of which 45 compose the final scenario. They are divided into 20 policies and 25 projects. Looking at the Fig.7.5 below, in the matrix on the left are collected all the final diagrams that compose the final scenario strategy map visualized on the right.

Matrix of final diagrams negotiated

	ECO	AGRI	SPPC	RES	C-TU	E-TU	COMI	TRAS	EN	PRI
1	1			1						1
2	1		1	1	1	1	1		1	1
3	1		1	1	1					1
4			1						1	1
5			1	1	1		1			1
6			1							1
7	1	1	1				1	1	1	
8								1		
9		1				1				
10					1			1		
11				1	1			1		
12					1			1		
13						1				
14		1								
15		1								

Final scenario map

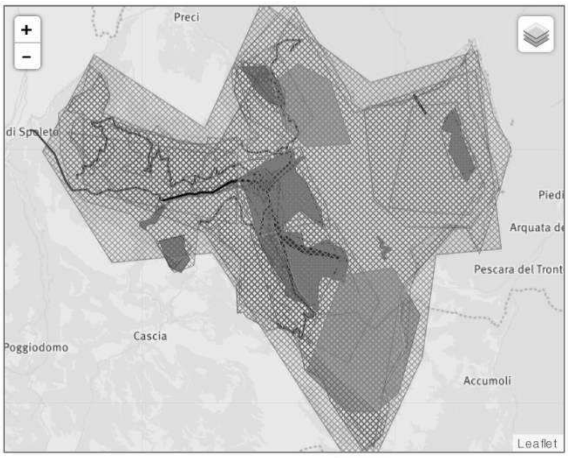


Fig.7.5: Matrix of final diagrams negotiated and Final scenario map. Source: geodesign hub interface.

Analysing the matrix above, it can be said that while participants have produced along the workflow a diverse total amount of diagrams for each systems. In the final negotiation, it has been decided to keep between three and six diagrams per system resulting in a balanced proposal, while the size of areas interested by changes differs quite considerably for each system. Indeed, as aforementioned, for some systems it has been proposed policies that cover the entire area while more located interventions for others, mostly projects, have been defined.

It is very important to underline that more proposals have been suggested regarding the same location. The overlay of diagrams can have a synergetic nature or a constraint one and which function has to be prioritized is something that is addressed during the final negotiation phase, where participants can opt in favour of multi-functional solutions, which sometimes requires the editing of already drawn diagrams, or more drastically discard the less meaningful.

Moreover, once the final scenario has been negotiated between the "stakeholders", the GDH software allows for some interesting further analysis. For instance, looking at the Fig.7.6 below, the cell on the left refers to the percentage that the total diagrams of each system covers in respect of the total area dedicated to projects. In the counting are included only projects and their size is immediately calculated in real time while drawing them. Hovering over the "project area" bars, it would be possible to see the total amount of land consumed. Projects related to "Priority of intervention" occupy 40% of the area dedicated to projects and are extended for 35 km^2 (brown) while physical interventions in the Agriculture system are intended for 57% and cover 50 km^2 (green). In between the two are Transport with 2% and Public Spaces for Civil Protection with 1%. The other systems expect less than 1% of land consume except for Eco-Tourism which informs the final outcome only by policies.

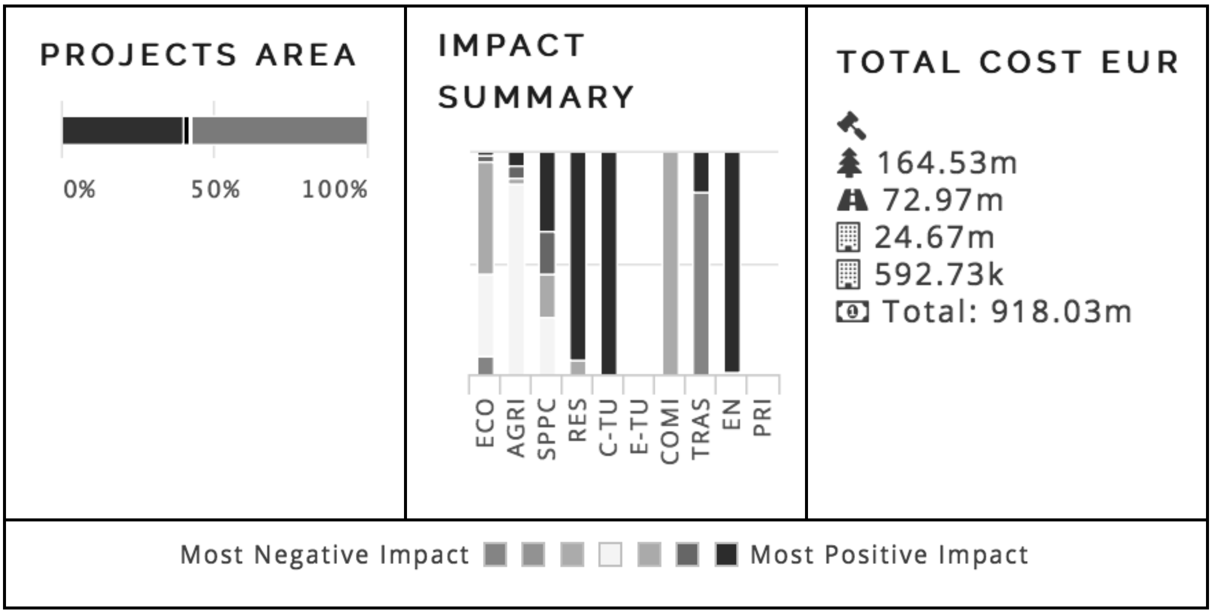


Fig.7.6: Real-time analysis of the final scenario. Source Geodesign Hub interface.

Then, considering the expected interventions, impacts for each system can be generated and considered to inform the final decision. Through the ease of the legend, it is clear how some projects within certain systems impact more than others. It is the case of Transport, Ecology, Agriculture and Public Spaces for Civil Protection, while Residential, Cultural Tourism and Energy are expected to impact less. From this considerations are excluded Eco-Tourism due to its focus on policies and Priority of Intervention which has not been assigned any impact since it was an open system of a mixed nature. Therefore, it was not possible to predict the related impacts on the other systems. On the right a list of the cost interventions and the total economic impacts of the project strategy.

7.1.3. Analysis of the voting system

Furtherly, in order to obtain feedbacks from local people which could not be able to participate at the workshop, it has been used a GDH plug-in which enables the sharing of the selected diagrams through social media platform. For this scope, it has been decided to use only the diagrams which both the two final groups during the third cycle agreed upon leaving out the other diagrams that have needed a final negotiation phase. Out of the 45 diagrams that compose the final scenario, the total of the diagrams characterized by maximus agreement is of 27 diagrams, where 17 are projects and 10 are policies.

Spatially, the projects areas are almost equally split accounting for 48% occupied by PRI projects while 50% within the AG system. The remaining 2% is occupied by projects concerning the TRASP system and the SPPC system. The total costs of the mostly agreed-diagrams accounted for 800 m Euro.

Final agreement scenario matrix

	ECO	AGRI	SPPC	RES	C-TU	E-TU	COMI	TRAS	EN	PRI
1	1			1						1
2			1	1	1		1			1
3			1	1	1					1
4			1						1	1
5			1	1	1					
6			1							1
7		1	1						1	
8										
9						1				
10					1			1		
11										
12										
13										
14		1								

Final agreement scenario map

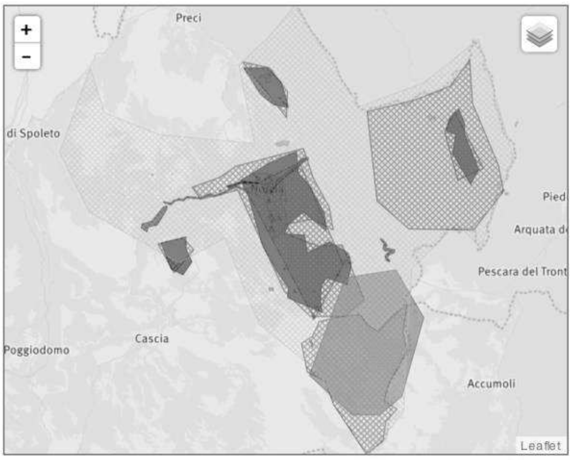


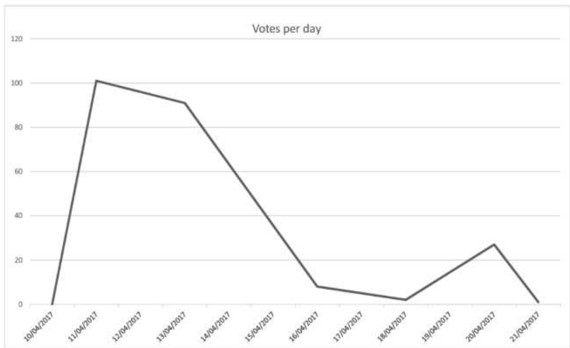
Fig.7.7: Final agreement scenario matrix and map. Source: Geodesign hub interface.

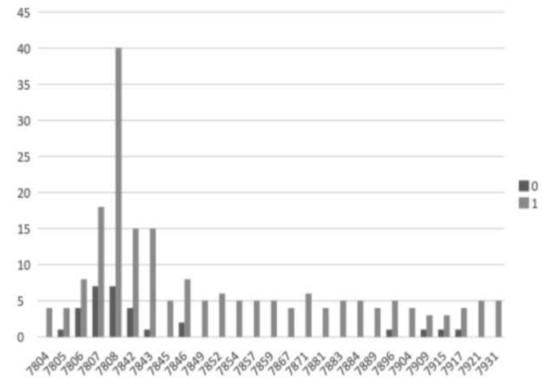
Since the focus of this projects is not to analyse the results in order to find a solution for the problematic case of Norcia but rather to understand the potential of the adopted approach and related tools in a post natural disaster context, it has been decided to use the Agreement diagrams because based on a lower amount of diagrams and therefore it took less time for people to vote. Scope of the trial was the enhancement of the inclusiveness of the decision-making process by using the feedback as new inputs to inform the final decision.

The voting link has been open the day after the end of the workshop and it lasted for almost a couple of weeks. As it is possible to see from the left chart below (Fig.7.8), people have voted more during the first four days and then it dropped down. It was needed a recall to vote by posting again the link in the facebook page in order to get another little "peak" of votes.

By keeping high the attention of the community it would have been possible to gain much more feedbacks and then have a much more inclusive and representative process. Rather, by looking at the right chart below (Fig.7.8) it is notable how people have voted irregularly for what concern the number of votes per diagram. On the X axes are the diagrams id while on the Y are the number of time that diagrams has been voted. Even if the total number of votes, which is 273, is not that high in order to be considered important, it is still possible to see some trends as the sort of consensus between voters on accepting (orange bars) or rejecting (blue bars) design proposals. Indeed, voters have decided to reject only some diagrams while others have received total acceptance. If the blue bars in the chart would have been spread along the entire chart it would have meant that opinions are still very heterogeneous regarding interventions and an overall consensus would have been far to the achievement.

In general, it can be said that the way the tool has been used is too simplistic and the total amount of feedbacks obtained too marginal, but for the academic purposes of this project, it has clearly showed its potentialities.

<table>
<tr><th>Frequency of voting (per day)</th><th>Results of voting (per diagram)</th></tr>
<tr><td>


</td><td>


</td></tr>
</table>

Fig.7.8: Charts voting frequency and results. Source: The authors.

To summarize, thanks to the methodological approach considered, it has been possible to reach the creation of a mutually-agreed outcome in only one and a half day of workshop, which successively, has been object of a voting system. By enlarging the possibility to influence the decision-making process, the geodesign team aimed to empower the inclusiveness of the process and the representativeness of the results, enlightening the potential of the tool.

However, considering the geodesign framework, the final decision model should be answered with a maybe, where both the voting feedbacks and the participants feedbacks will have to be integrated as new generated inputs to inform a new cycle of the geodesign study. Nevertheless, the project has been carried out not to find a solution for the Norcia case but rather to test whether the approach is profitable for post-natural disaster planning cases, for several reasons as low representativeness of participants and voters, the exclusion of some functionalities of the tool in order to simplify its application, the absence of the municipal representants as the mayor or other council members and last but not least the fact that it was an academic study project, the final outcome cannot be considered applicable nor deliverable.

7.2. Analysis of the collaborative process

Analysing the Norcia planning process and relating back to the conceptual framework described in Chapter 2, it is possible to reflect upon some characteristics generated by the adoption of certain planning practices based on public engagement as highlighted by Arnstein, Cogan and more recently, Kingston.

According to the upgraded e-Participation ladder_model, the Norcia project has been carried out by applying a series of technologies and methods ascribable to the three top ranked categories which are the most efficient and comprehensive participatory-oriented technologies of the Kingston's ladder. In practice, by adopting the GDH software it has been possible to touch upon two steps of the e-ladder, simultaneously. In fact, the tool is a "PPGIS" (second e-ladder rank) technology based on the creation of georeferenced strategies, which also requires "making decisions online" (first e-ladder rank), supporting the public audience to concurrently work together on the cloud during the information of the design. Moreover, in the post-workshop voting phase, it has been also possible to practically apply and test the category about "online comments on chosen solution" (third e-ladder rank), by asking to voters, whether they accept or reject solutions arose from the workshop phase.

The adoption of such technologies put the emphasis on the active participation that comes into place through the two-direction communication between data provider, in this case the authors and the geodesign team, and data users represented by participants and voters. Considering this, the two-direction communication has been widely applied during the workshop and partially adopted in the post-workshop voting phases. A practical example of its application could be the nature of the GD workshop itself, where, differently from other type of workshop, the participants had the power to directly create and inform the design of the area supported by the technical guidance of the geodesign team.

Nevertheless, it has been applied a one-direction communication during the collection and processing of data in the pre-workshop phase, remarking a separation of roles between data providers and users. Not considering a two-direction communication at the early stage of a GD project may generate a series of negative consequences such as increase of manipulative actions, wrong elaboration of geographical assessment and lack of inclusion of qualitative information provided by the local community.

Taking a different point of view of the overall process, it is worth to reflect upon the effects that an increase of new forms of technological tools usually bring into the planning scene. As in this case, following and putting into practice innovative planning approaches such as advanced collaborative processes in design and decision-making, often demands the integrated use of different technologic software. Generally, whether projects are not established and based on a robust, clear and simple framework (also called metaplanning) of applied tools and activities, it is likely to end up with a more complex planning process, either in terms of required technical skills or regarding the overall process understanding. The Norcia project has been a meaningful test where it has been possible to notice that through the adoption of the GD framework and the GDH tool, this complexity is respected and organized. It cannot be pointed out that complexity is reduced but al least, the methodological approach and its software coped with it. This is also reflected by the participants' comments from the survey where they emphasized that the technology applied in the Norcia project was "easy to use for all the social sectors but at the same time really well functioning, enhancing interoperability, simultaneity of analysis and comparison". Moreover, a participant also pointed out that the overall applied process was "easily understandable thanks to a clear synoptic outline".

After having analysed the final suggested plan through its diagrams and the results of the voting test, it is crucial to further investigate some dynamics that the geodesign approach and its tool brought into the overall Norcia planning process from a collaborative perspective. It will be done through zooming out to a broader picture the chronological phases explained in Chapter 6, seeking to shed light on benefits and criticisms observed throughout the project, addressing possible basic conditions and solutions to some important gaps of the traditional Italian post-disaster planning approach and consequent practices.

Pre-workshop

Considering the pre-workshop phase flow explained through the representation, process and evaluation models, it is possible to notice that the local community has not been included in none of the three models. The main reasons are attributable to both the project time constraints and external challenging factors.

Initially, time constraints linked to the fact that the project has academic purpose played an important role, disallowing the authors to be in Norcia during the data collection phase.

Consequently, the Norcia chaotic overall status of emergency highly limited the inclusion of the local community, especially the technical support from local experts in the pre-workshop phase. The non-existent support of the technical office of the Norcia municipality hindered the data collection and most of all, limited the project group to base some of the spatial analysis on partially outdated information. After the seismic event, the territory has been subjected to an immense number of physical disturbances that require long elaboration processes, which in turn demand a certain time frame to cope with. In fact, it has been used partially updated information also due to the challenging situation for local public authorities in elaborating the data and disclosing it to the public. For instance, in order to know which building blocks were damaged or destroyed, it has been requested to the Civil Protection department a series of data that were approximately updated only by the 20%, providing an incomplete representation of the reality.

This lack has been reflected through the answers that participants gave in the survey. In fact, it has been noticed that the geodesign team primarily reflected the participants ideas about variables and layers applied, even though it came out that some of them would have also included information about water pollution, air pollution, aspects linked to the local labour market and demographic distribution changes before and after the seismic event. Another example could be the participants knowledge regarding the Torbidone river which generated land use changes of some of the parcels interested by, activating a chain of cause-effect between agriculture reliefs and negative economic consequences.

Obtaining this kind of information within the pre-workshop phase leads to include these new variables in the geographical assessment of the territory, basing the evaluation maps on robust and coherent knowledge. Considering the project, the absence of a participatory phase during the pre-workshop passage led to elaborate semi-updated territorial variables and layers, providing not fully reliable information of the area which obviously, influenced the overall results.

It is important to stress out the fact that collaboration in the pre-workshop phase is crucial for the entire GD project, because it brings local data in the representation model that are elaborated into information in the process model, which in turn alter the evaluation model knowledge in a more trustful manner. In this way, systems are decided together with "the people of the place", as well as variables and layers. Moreover, idealistically, the citizens involvement at this stage facilitate to overcome some possible mistakes such as uncertainties and manipulations.

The latter is one of the main challenge to address especially during the creation of the process model because it is where people have no control on how information are elaborated, due to either technicalities or not access to data. It is the case of the Norcia project where the authors with the support of the geodesign team, created the evaluation maps for each system according to data availability and personal preferences which, despite being kept as much neutral as possible, were still subjective. Therefore, the planner can highly influence the creation of any results with non-existent control from third party. A way of overcoming this common issue is to take advantages of using PSS and Web 2.0 as platforms that facilitate "data collectors" through active collaboration, creating the opportunity to obtain better data with less efforts and in less time.

Workshop

Reflecting upon the workshop phase, it is possible to emphasize both criticisms and benefits to the collaborative process due to the post-seismic context of the case study.

On one hand, looking at the amount of the contacted participants and the ones that really took part at the workshop, it is possible to notice that the representativeness of local actors was not respected because just few of the expected local stakeholders participated at the event. This consequence is directly related to the negative effects originated by the seismic event in the study area. During the days of the workshop, the entire Norcia municipality was still under a state of emergency and therefore the majority of the people were obviously forced to prioritized other daily activities at the expenses of participating at the workshop. A practical example can be given considering that during the workshop days, the Norcia citizens, farmers, retailers and so on, were already occupied to physically reactivate the Castelluccio's crops, one of the main local economic booster both for agricultural and touristic incomes, which were delayed due to the seismic event that temporarily impeded the access to the main road, the only city connection. Clearly, the workshop has been negatively affected by it, ending up to have few of the contacted participants, thus a low representativeness of local actors. It is a relevant problem that significantly increased the challenges to attract "the people of the place", in this case citizens and the municipal technicians, to participate at the workshop, therefore researchers and academics interested in carrying out similar projects in comparable contexts should take it into account.

On the other hand, one of the most interesting benefits noticed along the workshop flow, is that due to the GD methodology predisposition to exploit a democratic process, participants are willing to be actively engaged, leading to an agreed selection of strategies (diagrams) which tangibly represent the maximization of consensus. The democratic process is technically put into place by the GDH software thanks to the iterative pattern and a cyclic scheme which once again, embrace a two-direction communication of information. In fact, the design back and forth pushed the actors involved to at least consider a variety of changes, editing, adjusting and eventually discarding diagrams by giving an equal chance to all of the participants' ideas until a final co-created plan is achieved. In other words, the democratic process clearly abolishes the initial participants societal roles gap, a factor that can be recognized with an idealistic image of a hierarchical flat linear layer of actors involved.

Also the participants pointed out in the survey that the software highly supported and facilitated consensus dynamics along the negotiation phases in between the four design cycles.

Consequently, another observed positive effect in the collaborative process regards knowledge exchange. It has been noticed throughout the entire workshop, that participants were naturally predisposed to exchange opinions, ideas and improve personal knowledge. Particularly during the third cycle of the workshop, participants were willing to share their knowledge of the area through discussion and reflection, even though always the same one or two persons were leading the group. Instead, another common practice during the first design cycle was to improve personal knowledge through Internet consultation of documents and general information of the area for getting a clear picture of the local existing trends from the system perspective and how they can be improved.

Therefore, there was not only a flow of information exchange between technicians and participants, but also among "the people of the place", expanding general territorial insights. The process also encouraged personal knowledge growth, stimulating the participants critical perspective on the territory.

In parallel, another important aspect on a broader scale that can be recognized by analysing the collaborative process during the workshop design cycles is the role of the conductor and the geodesign team. It is observable that their ways of acting and guiding the information of the design, requested to embrace a new role of the planner, which in this case, covered the position of the mediator, neutrally facilitating the interaction among participants, especially in the last negotiation phase (fourth design cycle). This change required urban planners and administrators to reconsider their professional role, which has shifted from a technical developer of master plans (putting into effect the decision-makers' ideas) to a mediator which enables the creation of consensus upon a spatial plan (activating the community and putting into effect its opinions and agreed proposals).

Indeed, according to Gibson (1979), in a citizen-participant dominated design, planners were afraid of losing their professional role. Conversely, it became more delicate requiring patience and listening skills, in order to drive the inclusive process towards the final agreed outcome.

Post-workshop

Regarding the post-workshop phase, it is initially relevant to specify that the voting system covered a secondary role in the overall project (a test in the test), even though it is an important action that should be included in every GD project in comparable contexts.

Analysing the collaborative process of the voting system results and considering that the Norcia's citizens are approximately 4900 in total, it is possible to notice that the local voters representativeness is considerably low. For obtaining considerable feedbacks in a way that can affect the final decision, it is necessary to significantly increase the total amount of votes. Therefore, as it came out from the voting system analysis, in order to repeat the test and reach more votes thus a higher representativeness, it is necessary to post and frequently advertise the voting system. This means that people need to be constantly remembered to vote and a possible strategy that the authors could have adopted in order to avoid falls of the voting frequency, could be to stay active on the social media page for the entire period. Moreover, it may be useful to spread the voting system link through several social-media platforms used by the local community.

The post-workshop phase should be seen as a fundamental passage to enlarge the representativeness of every GD project in post-disaster contexts because, whether collaborative-oriented technologies are applied, a vast amount of information can be obtained quickly, with minimum economic and time efforts. The rapidity of getting feedbacks on a co-created plan from the overall local community is of prime importance in post-disaster planning due to the pressing necessity to exceed the status of emergency. Although limited, an example of quickly collection of feedbacks can be given by the Norcia project where the total amount of votes have been collected in just two weeks only by sharing the voting system on the Internet and by posting its link twice on Facebook.

Analysing from a broader perspective all the benefits and criticisms highlighted through the investigation of the collaborative process in the three chronological phases, it is possible to observe that a collaborative process in a context of post-disaster planning is satisfactory whether is capable to cope with the three basic conditions listed below:

A - Planners should embrace the new role of being mediators

The first precondition which open up to the other two basic conditions and therefore significantly influence their achievements is the new role of the planner. The planner has to adopt a new, radical approach as a mediator that do not cover the role of the decision-maker but rather neutrally guides the construction of the knowledge, facilitates the design process informed by the local actors and discloses the final outcomes to the public by enabling them to easily obtain the community opinions.

The new orientation of the planner helps to avoid manipulative actions during the pre-workshop phase, especially during the construction of the process model where the data are highly alterable, according to subjective preferences and interests. A possible operation that may avoid this sort of top-down manipulations relies on providing transparent, consultable and understandable information to the audience, especially during the pre-workshop process model elaborations. In this scenario, applying forms of technology, which are ascribable to the top ranks of the e-participation ladder, may be the right solution to overcome the issue.

Concerning the workshop phase, the new planner approach demands to have skills such as patience, respect, listening and being able to guide only under request of the participants or whether strictly necessary in case of conflicts. Whereas, during the post-workshop phase its role is to include the most advanced collaborative-oriented technologies in order to get the community feedbacks that will be successively integrated into the final suggested plan in a neutral manner.

The new skills of the planner spread throughout the three chronological planning phases open up and support a more democratic process

B - Collaboration should be enlarged to the three process' phases

The Norcia project informed by the GD framework, embedded collaborative processes localized mainly in the workshop phase. The GD approach suggests to involve collaborative processes throughout the project but it does not compulsory obligate to apply them in either the pre-workshop and the post-workshop phases as it does for the workshop one, leaving the choice open to the individual planner intentions. Indeed, spreading participatory practices in each chronological phase is a fundamental requisite that should always be respected.

This aspect is even more important whether applied to post-disaster context because it may be beneficial not only to the collaborative process itself but also to positively influenced some negative effects originated by the seismic event. Implementing the inclusion of "the people of the place" in the early stage of a post-disaster project support to build trust between the local community and public authorities. Moreover, collaborating also provides to the people the idea of the city objectives its future pillars and main components, opening up the possibility to get back the citizens in the area after the emergency phase, overcoming the possible frequent negative effects of depopulation and economic stagnation.

C - Representativeness of local actors should to be satisfactory

The third basic conditions to robust collaborative processes in post-disaster planning is related to the degree of involvement of all the local actors, also known as representativeness. As previously analysed, due to the explained constraints, the representativeness of the Norcia project resulted to be low comparing the number of participants at the workshop and their backgrounds to the variety of local stakeholders that populate the municipality.

Usually the representativeness may refer to either results or participants. The first step towards the consideration of a highly representative process starts from the selection of the participants. In a seismic context, this decision is even more crucial and highly influences the entire project from data gaining to final results. By excluding a local actor, a societal role is taken out from the entire process, losing that sector-based knowledge and influence on the other actors and sectors.

Besides, changing the perspective, another manner of enhancing the representativeness of a collaborative process is to involve all the local stakeholders not solely during the workshop phase but throughout the entire process, including pre-workshop and post-workshop. Due to the workshop limitations such as constraints about timing, location and a close number of participants, the pre-workshop and post-workshop phases are two strategic steps where various type of collaborative processes can be tested. Indeed, in these two phases the collaboration can be done through the technological support of open-source platforms, without restricting the participation to a specific place, at a specific timing, perfectly supplementing and enhancing the type of collaboration generated by the workshop phase. Applying new technology in the pre-workshop and post-workshop phases can be very effective from a representative point of view, because technologies can be reached by a widespread and heterogeneous audience.

In a post-disaster planning context, high representativeness may bring territorial knowledge exchange between the involved actors. This knowledge exchange is obviously important in every GD pre-workshop phase but also even more important in a post natural disaster scenario. Particularly in emergency contexts, data collection is a key factor and an important first step that requires a certain amount of time. Obtaining local knowledge by "the people of the place" concerning the territory, the social and demographic structure, the local economy and identities, is a crucial passage to properly structure the pre-workshop phase. At this stage, spending the required time and technological collaborative-oriented tools may mean that truthful and reliable data are gained and integrated while top-down manipulative actions are limited. Although, a current common practice of data gathering is to take advantages of other forms of PSS and Web 2.0, which are able to obtain high qualitative data in a relatively limited time and with minimum efforts.

Taking a step back while trying to summing up all the aforementioned analysis, it is possible to highlight the fact that before, adopting traditional approaches to planning, a group with similar backgrounds was in charge of informing the post-earthquake plan. This often led to neglect relevant information regarding the manner which urban systems operate, considering only partial knowledge of the threaten area. In other words, non-comprehensive approaches rely on a set of uncertainties that remain unsolved. This increases the possibilities to generate interventions, which are not really effective and not contextualized for local needs.

Nowadays, although the existence of software that allow the creation of a more comprehensive and complete knowledge, in the Italian context, where the main focus is still almost put exclusively on the emergency phase, those tools are still struggling in being recognized and applied as innovative and improving approaches.

In this scenario, geodesign becomes fundamental because it is able to originate a different rationality behind by involving the community and by enlarging the decision-making group from an homogeneous project team to a much more heterogeneous one, both in terms of knowledge and representativeness of selected participants. Collaboration within a wider heterogeneous teamwork can bring more diversified knowledge, opinions and backgrounds useful to cope with uncertainties while enabling the accomplishment of a commonly agreed strategic direction in a lower amount of time.

Therefore, through the geodesign approach it becomes possible to address short-term goals in the early stage of a post-earthquake planning process while creating cohesive action-oriented plans towards the meeting of long-term goals. In other words, fast and irrational is seen by the authors as negative while fast and comprehensively organized is rather seen as an improved approach. This reflection has been also remarked in the answers of some of the participants at the workshop who pointed out high implementation potentiality of the GD approach and the GDH software for the decision-making process in the Italian post-disaster planning context. Analysing this information and considering the basic conditions, it is observable that through a single workshop, participants glimpsed the possible effects that a GD project final outcome might have on a territory hit by seismic events. The prime influence of such final outcome is emphasized by the fact that it strategically comes into place at the early stage of a post-disaster planning process. In fact, as mentioned, the final results are meant to constitute the suggested plan that defined the guidelines and coherently activates and coordinates all the chosen co-created strategies towards the city development.

Besides, summarizing the overall analysis of the collaborative participation process of the Norcia project, it can be stated that the three basic conditions were not entirely respected due to some constraints directly and indirectly linked to the seismic event that limited the collaboration only during the workshop phase and hindered the representativeness of the Norcia local actors.

However, according to the GD approach, the Norcia project is only the first round of workshop that should be improved by a second one in order to reach reliable results. Therefore, considering that in relation to the Norcia project, it can be argued that all the basic conditions have to be fulfilled by a further cycle of iterations.

7.3. Improvements in post-earthquake planning approaches

As previously stressed in the contextualization of the study case, it can be observed that traditional approaches in dealing with post-earthquake recovery in Italy are mostly focused on the emergency phase and on building back as it was before the natural event.

Consequently, other important challenges that could be addressed since the immediate post-event by taking advantage of the increased monetary resources, are left out. Especially, this is the case of the construction of a robust geographical knowledge of the area which aims to understand how the integrated systems operate respectively, the inclusion of the local community to collaborate at the decision-making process and the relevancy of creating a development strategy with a longer time horizon in the early stages of the recovery planning focused on the reduction of the overall exposure and vulnerability to seismic events.

As it has been possible to understand through the Aquila post-earthquake recovery planning case, the traditional approaches have led in the past to important negative consequences which will take decades to be solved, when possible. The irrational approach of focusing exclusively on reconstruction priorities have often generated decontextualized interventions which in turn make the urban systems conflicting each other instead of synergising, increasing the above mentioned exposure and vulnerability towards future seismic events. Moreover, a major negative consequence can be the negligence of recover the main local economies which will bring the community into a “wicked” economic stagnation, often reason of depopulation phenomena.

While the traditional approach analyses each system separately, pushing towards the physical and infrastructural reconstruction of the urban systems, the system thinking perspective deals with them in an integrated and synergic way. Indeed, the integrated systems approach has shown all its comprehensiveness in addressing the complexity of the case rather than avoiding it. The division by systems is a way to unfold the complexity avoiding to lose the opportunity of building the knowledge around the understanding of how systems affect each other and whether the project interventions are feasible and operational in the whole picture or not.

Furthermore, the innovative GD approach relies on a strong active engagement of the local community, where people are not simply informed of the decisions taken but rather contribute through a two-direction communication to inform the decision-making process.

Through the approach, people gain a better understanding of both their territory and the strategic directions that their city will adopts for its future development, possibly guiding them to make individual daily choices in line with the those directions and relying on stronger trust towards the public authorities which in turn, may lead to enhance the overall resiliency.

Indeed, it has been observed that although challenges are more likely to arise in complex post-earthquake conditions, the collaboration between authorities and inhabitants is manageable and it can foster the creation of a faster, more comprehensive and mutually-agreed strategy since the beginning of the recovery planning process. The importance of working on the creation of a co-created plan in the earlier phase of post-earthquake planning, is embedded in its nature to be a framework for guiding the actions along the entire development period, which in the Norcia case study has been set to a 20 years time horizon. Clearly, both municipal actions and individual inhabitants' behaviours will have to refer to the collaborated developed scenario in order to succeed in a long-term perspective, strengthening the community continuously under seismic threat.

It becomes more obvious that without such a guiding framework, irrational interventions along the recovery timeframe have more chances to arise, especially if it is considered that after every singular accomplished project, the geographical assessment of the area could have been drastically changed and this is something that traditional approaches, in practice, simply do not take into consideration.

Hence, it is possible to say that through the geodesign approach, it seems to be possible to address these gaps and deal with natural disaster recovery planning in a more comprehensive way, dealing simultaneously with short and long-term goals. However, qualitative and quantitative evidences collected in one single round of iterations is considered by the authors not sufficient to state that the tested geodesign approach is able to really bring betterments to the future post-earthquake practices. Even though the project validated possible benefits to post-disaster planning, originated by the GD approach application, in order to argue that the methodology is effectively able to overcome the integrated systemic thinking and the collaborative gaps, further investigations through other rounds of the same case and by applying the GD framework to other post-natural disasters projects in different contexts, become necessary.

8. Further Discussion

The benefits of applying geodesign approach to natural disaster recovery planning can be analysed even in a broader perspective.

Earthquakes, especially in Italy, are highly dramatic events due to the ancient nature of towns and their infrastructural systems. The geodesign approach, together with addressing some of the most important gaps of the traditional practices, can exploit the “momentum” offered by the natural disaster and turn it into an opportunity for change. Indeed, currently the society is witnessing a transition towards a new city model leaving behind the post-industrial idea of city in favour of more sustainable principles. Italian cities are struggling in investing their own funds towards the transition. Rather, cities heavily impacted by quakes are more likely to embrace urban innovative measures by taking advantage of the catastrophe due to the consequent European, national, regional, local, private and volunteer support funding.

Planning processes in sustainable development are often system-oriented and require a certain level of active community involvement. These two aspects, which are shared with the geodesign approach, occupy a central role in urban and regional planning and could be beneficial to integrate them at the local scale in post-disaster planning.

Indeed, in order to succeed in the transition it is fundamental to understand how the urban systems should be changed and the criteria to assess the interventions as well. In fact, as previously mentioned, it has been included the Energy system aiming to trigger some reflections upon the earthquake seen as an opportunity for change. Participants understood very well the opportunity and formulated transition-oriented proposals concerning renewable sources. As the Fig. 61, 63 and 62 in the Annex show, it have been proposed to implement Biomass plant and a wind farm, while introducing a policy able to ease the introduction of subsidies for solar panels.

Even in other systems, it has been proposed diagrams in favour of the transition. It is the case of the proposed diagrams: “Sustainable road pavement” (shown in the Fig. 30 in the Annex); “Regulation of urban traffic” (shown in the Fig. 46 in the Annex); two cycle path: “S. Pellegrino cycle path” and “Piediripa cycle path” (shown in the Fig. 56 and Fig. 57 in the Annex) and “Development and empowerment of public transport” (shown in the Fig. 68 in the Annex).

It can be concluded that the innovative geodesign approach it is not useful only to address gaps within the traditional Italian approaches to post-earthquake recovery planning, rather it can even be decisive in including design changes in favour of the transition according to the current sustainable city model. It would enable the creation of a strategy not solely reconstruction-oriented but more rebirth-oriented. As it happened in this action-research project, it has been clearly observed how participants immediately left behind opinions mostly focused on build back as it was before the seismic event for embracing ideas shaped by the new paradigm.

It would be interesting to analyse the issue more in depth and try to answer to a possible further research question as: How can be possible to influence people's opinions and consequently their behaviour by approaching them through a geodesign workshop?

9. Conclusion

Nowadays, it is widely recognized that some of the major urban and societal issues worldwide revolve around the fact that exponentially increasing natural disasters events have to be faced or at least mitigated. Indeed, a vast number of international research are seeking to define and transform advanced post-disaster planning approaches into practices.

In particular, system thinking and participatory approaches are seen as potential innovations that could bring enhancements to ordinary post-earthquake planning practices, thus increasing the chances to avoid the repetition of past catastrophic interventions, which negative effects will last for decades.

Accordingly, these two innovations are, by its nature, embedded into the methodological approach of geodesign, which is mainly focused on creating a robust geographical knowledge of a given territory by the integration of its operational systems and on the pursuit of the democratization of participatory design for decision-making processes. Therefore, aiming at investigating and testing the pertinence of applying these innovations to emergency conditions, the geodesign methodology has been applied to the Norcia post-seismic context.

From the study emerged that on one hand, a system thinking approach enhances the overall spatial knowledge of the area and likely, it will lead to more contextualized interventions. On the other hand, even though considering the augmented complexity of a seismic context, it is possible to enable the creation of a more democratized collaborative process, which will lead to have more agreement and consensus upon the contextualized interventions throughout the local community. In turn, the overall outcome of the applied GD framework is rapidly co-created in the early stages of the post-seism and it should be treated as a commonly agreed framework for action able to coherently address both short and long development challenges.

Therefore, answering to the initial research question, it can be said that the Geodesign methodology could be able to repair at some of the main gaps of traditional Italian approaches. But it is important to state that, through the test, it has been observed that a collaborative process can be recognized as effective and better democratized in a context of post-disaster planning whether respects the conditions under which [1] the collaboration is enlarged to the three process' phases (pre-workshop, workshop and post-workshop) and [2] the representativeness of all the local actors is respected. Indeed, these two conditions are directly linked to the precondition regarding [3] the new role of the planner who, by acting as a mediator, has the ability to create the circumstances for concretely achieving the previous conditions.

It is therefore advisable to insist in this direction and apply the methodological approach to several more cases of post-earthquake in different contexts in order to investigate whether it could be adopted by practitioners in real-world projects aiming, this time, at solving wicked development issues.

Bibliography

- Andrienko et al. (2007). *Geovisual analytics for spatial decision support: setting research agenda.* International Journal of Geographic Information Science, 21(8), pp. 839-857.
- Arnstein, S. R. (1969). *A Ladder of Citizen Participation*, JAIP, Vol. 35, No. 4, July 1969, pp. 216-2.
- Batty, M. (2008). *Planning support systems for cities and regions*. Lincoln Institute.
- Borges, J., Jankowski, P. and Davis, Jr., C.A. (2015). *Crowdsourcing for Geodesign: Opportunities and Challenges for Stakeholder Input in Urban Planning*. Springer International Publishing Switzerland.
- Boyd, D. M., & Ellison, N. B. (2007). *Social network sites: Definition, history, and scholarship*. Journal of Computer-Mediated Communication*, 13*, 210-230. doi: 10.1111/j.1083- 6101.2007.00393.x
- Bugs, G. et al. (2010). *An assessment of Public Participation GIS and Web 2.0. Technology planning practice in Canela, Brazil.* Cities, No. 27, pp. 172-181.
- Campagna, M. (2014). *Geodesign from Theory to Practice: From Metaplanning to 2nd Generation of Planning Support Systems.* Tema Journal of Land Use, Mobility and Environment.
- Campagna, M. (2016). *From Metaplanning to PSS 2.0: Exploring the architecture of Geodesign as a process*. Research In Urbanism Series, 4(1), 57-70.
- Campagna et al. (2017, forthcoming). *Collaboration in planning: the Geodesign approach.* Poznan Conference, June 2017.
- Carr, C. T., & Hayes, R. A. (2015). *Social media: Defining, developing, and divining*. Atlantic Journal of Communication*, 23*(1). doi: 10.1080/15456870.2015.972282.
- Chrisman N. R. (2002). *Exploring geographic information systems*. New York, John Wiley & Sons, Inc., 2nd Edition.
- Cogan, A., Sharpe, S., & Hertzeberg, J. (1986). *Citizen Participation in F.S.* So, I. Hand, & B.D. McDowell (Eds). *The Practice of State and Regional Planning*. (pp. 283- 305). American Planning Association.
- Craig, W.J. (1998). The Internet Aids Community Participation in the Planning Process. Proceedings of the COST-UCE C4 International Workshop on Groupware for Urban Planning, Lyon, February 4-6, 1998.
- Crespellani, T. (2012). *"Terremoto: evento naturale ed evento sociale"*. Conferenza tenuta al Festival Scienza- L'alfabeto della Scienza- V Edizione, Cagliari, 6-11 Novembre 2012.
- Dangermond, J. (2010). *GeoDesign and GIS – Designing our Futures*. In: BUHMANN, E., PIETSCH, M. & KRETZLER, E. (Eds.), Peer Reviewed Proceedings of Digital Landscape Architecture 2010 at Anhalt University of Applied Sciences. Wichmann, Berlin/Offenbach, 502-514.
- Dangermond, J. (2012). Foreword of Steinitz, C. (2012). A Framework for Geodesign. Changing Geography by Design, Esri Press, Redlands.

- De Vico, B., et al. (2014). *A new infrastructural-relation model for the post-earthquake city of L'Aquila.* WIT Transactions on Ecology and The Environment, Vol.191, WIT Press.
- Dolce, M. (2012). *The Italian National Seismic Prevention Program.* 15 WCEE, Lisbon.
- Farinelli, F. (2003). *Geografia. Un'introduzione ai modelli del mondo*. Turin: Einaudi.
- Foucault, M. (1980). *Power/Knowledge: selected interviews and other writings 1972-1977, p. 152.* (edited by C. Gordon). Brighton: Harvester Press.
- Gibson, T. (1979). *People Power*. Penguin. Harmondsworth.
- Goodchild, M. F. (2000). *Cartographic Futures On A Digital Earth,* Journal of the North American Cartographic Information Society, Cartographic Perspectives, No.36, Spring 2000, pp. 3-12.
- Goodchild, M.F. & Glennon, J. A. (2010). *Crowdsourcing geographic information for disaster response*: a research frontier, International Journal of Digital Earth, 3:3, 231-241, DOI: 10.1080/17538941003759255.
- Hanzl, M. (2007). *Information technology as a tool for public participation in urban planning: a review of experiments and potentials*, Design Studies, Vol. 28, Issue 3, May 2007, pp. 289-307.
- Healey, P. (1998). *Building institution capacity through collaborative approaches to urban planning*. Environment and Planning A, 30, 1531-1546.
- Howard, P. N., & Parks, M. R. (2012). *Social media and political change: Capacity, constraint, and consequence.* Journal of Communication*, 62*, 359-362.
- Innes, J.E., & Booher, D.E. (2004). Reframing Public Participation: Strategies for the 21st Century. *Planning Theory & Practices*, 5(4), 419-436. doi:10.1080/1464935042000293170.
- Kent, M.L. (2010). *Directions in Social Media for Professionals and Scholars*; SAGE Handbook of Public Relations. ResearchGate.
- Kent, M.L. & TAYLOR, M. (2014). *Social Media in Public Relations: Reflections on Extending and Narrowing Relationships*; 7th International Forum on Public Relations and Advertising (Bangkok, 2014).
- Kingston, R. (1998). *Web Based GIS for Public Participation Decision Making in the UK*. National Center for Geographic Information and Analysis, Proceedings of the Workshop on Empowerment, Marginalisation, and Public Participation GIS, Santa Barbara, Ca, October 14-17, 1998. http://www.ccg.leeds.ac.uk/vdmisp/publications/sb_paper.html
- Kingston, R. (2002). *The role of e-government and public participation in planning process,* XVI Aesop Congress Volos, July 10-14, http://www. ccg. leeds. ac. uk/democracy/presentations/AESOP_kingston. Pdf, verified 20/02/2017.
- Kubicek, H. (2010). The potential of E-Participation in Urban Planning: A European Perspective. In: Silva, C. N. *Handbook of Research on E-Planning: ICTs for Urban Development and Monitoring*. New York: IGI Global. 168-194.
- Kumar, R. (2011). *Research methodology, a step-by-step guide for beginners.* SAGE Publications.

- Kweit, M.G., Kweit. R.W. (1984). *The politics of policy analysis: The role of citizen participation in analytic decisionmaking*. Policy Studies Review 3,2: 234-245.
- Lang, R. (1986). *Planning Analysis: The theory of Citizen Participation*. University of Oregon.
- Linders, D., (2012). *From e-government to we-government: Defining a typology for citizen coproduction in the age of social media.* Government Information Quarterly 29 (2012) 446–454. Elsevier journal.
- Liu X. et al. (2017). *A State-of-the-Art Review on the Integration of Building Information Modeling (BIM) and Geographic Information System (GIS)*. ISPRS International Journal of Geo-Information. 6, 53.
- Lynch, K. (1960). *The image of the city*, MIT Press, Cambridge, MA.
- MacEachren A. M. et al. (2004). *Geovisualization for knowledge construction and decision support.* IEEE Computer Graphics & Applications, 24 (1), p.13-17.
- Martin, P., Tarr, S. and Lockie, S. (1992). *Participatory environmental management in New South Wales: policy and practice*. ed. G. Lawrence, F. Vanclay and B. Furze, Agriculture, Environment and Society: Contemporary Issues for Australia, Melbourne: MacMillan, pp. 184-207.
- McCormick B.H. et al. (1987). *Visualization in scientific computing*. Computer Graphics, ACM Siggraph, 21(6).
- Miller, G. (1956). *The Magic Number Seven, Plus or Minus Two.* The Psychological Review.
- Miller, W. R. (2012). *Introducing Geodesign: the concept*, Esri Press, Redlands.
- Moser, C.O. (1989). *Gender Planning and Development: Theory, Practice and Training*. London: Routledge.
- Moura, A.C. (2015). *Geodesign in Parametric Modelling of urban landscape.* Journal for Cartography and Geographic Information Science. Vol. 42, Iss.4.
- Nyerges, T. et al. (2016). *Geodesign dynamics for sustainable urban watershed development.* Journal for Sustainable Cities and Society Vol. 25. Elsevier.
- Olsen, P.B., Pedersen, K. (2008). *Problem-Oriented Project Work. A workbook*. Roskilde University Press.
- Olshansky, R. and Chang, S. (2009). *Planning for disaster recovery: emerging research needs and challenges.* Chapter 2 of Blanco, H. and Alberti, M. (2009), Shaken, shrinking, hot, impoverished and informal: Emerging research agendas in planning. Journal Progress in Planning. Vol.72. Elsevier.
- O'Reilly, T. (2005). *What is Web 2.0: Design Patterns and Business Models for the Next Generation of Software*, http://www.oreilly.com/pub/a/web2/archive/what-is-web-20.html, viewed 12/03/2017.
- Parker, B. (2002). *Planning Analysis: The Theory of Citizen Participation.*
- Pateman, C. (1970). *Participation and democratic theory*. Cambridge England: Cambridge University Press. ISBN 9780521290043.
- Pickles, J. (1995). *Ground Truth: the social implications of geographical information systems*. London: Guilford Press.

- Pratchett, L. (2006). *Understanding e-democracy developments in Europe*. Scoping Paper. In Ad hoc Committee one-democracy (CAHDE), Strasburg, 18-19 September 2006. Retrieved December 12, 2008.
- Rivero, R. et al. (2015). *Promoting Collaborative Geodesign in a Multidisciplinary and Multiscale Environment: Coastal Georgia 2050, USA*.
- Sameh, H. M. M. (2011). Ms. C. Thesis: *Public Participation in Urban Development Process through Information and Communication Technologies.* Ain Shams University.
- Sanoff, H. (2000). *Community participation methods in design and planning*, John Wiley and Sons, New York.
- Sharp, R. (1992). *Organizing for change: People-power and the role of institutions*. ed. J. Holmberg, Making Development Sustainable. Redefining Institutions, Policy, and Economics, Washington, D.C., USA: Island Press, pp. 39-64.
- Schuler, P. (1996). *New Community Networks: Wired for Change*. Addison-Wesley Longman.
- Steinitz, C. (1995). *A Framework for Landscape Planning Practice and Education*. Process Architecture, no. 127.
- Steinitz, C. (2012). *A Framework for Geodesign. Changing Geography by Design*, Esri Press, Redlands.
- UNCHS (UN-Habitat, 1986). *Community Participation in Urban Projects in the Third World*.
- University of Maryland Libraries (2012). *Introduction to GIS, Using ArcGis Desktop 10.* U.S. Government Information, Maps & GIS Services, Version January 2012, http://www.lib.umd.edu/gov-info-gis, viewed 15/04/2017.
- Viterito, A. (2016). *The Correlation of Seismic Activity and Recent Global Warming.* J Earth Sci Clim Change. 7: 345. doi:10.4172/2157- 7617.1000345.
- Wang et al. (2007). *Urban Information integration for advanced e-Planning in Europe,* Government Information Quarterly, No. 24, pp. 736-754.
- Wates, N. (1998). *Involving local communities in urban design: promoting good practice: A special report on the Urban Design Group's Public Participation Programme*, UDG, Urban Design Quarterly, issue 67
- World Bank, (July, 2008). *Planning for Urban and Township Settlements After the Earthquake.* World Bank Good Practices Notes.
- Ying, S. (2009). *Post-earthquake reconstruction: Towards a much more participatory planning.* Theoretical and Empirical Researches in Urban Management.
- https://www.citypopulation.de/php/italy-umbria.php?cityid=054035, viewed on 20th April 2017.
- https://en.wikipedia.org/wiki/Norcia, viewed on 20th April 2017.
- https://en.wikipedia.org/wiki/List_of_earthquakes_in_Italy, viewed on 20th April 2017.

Annex

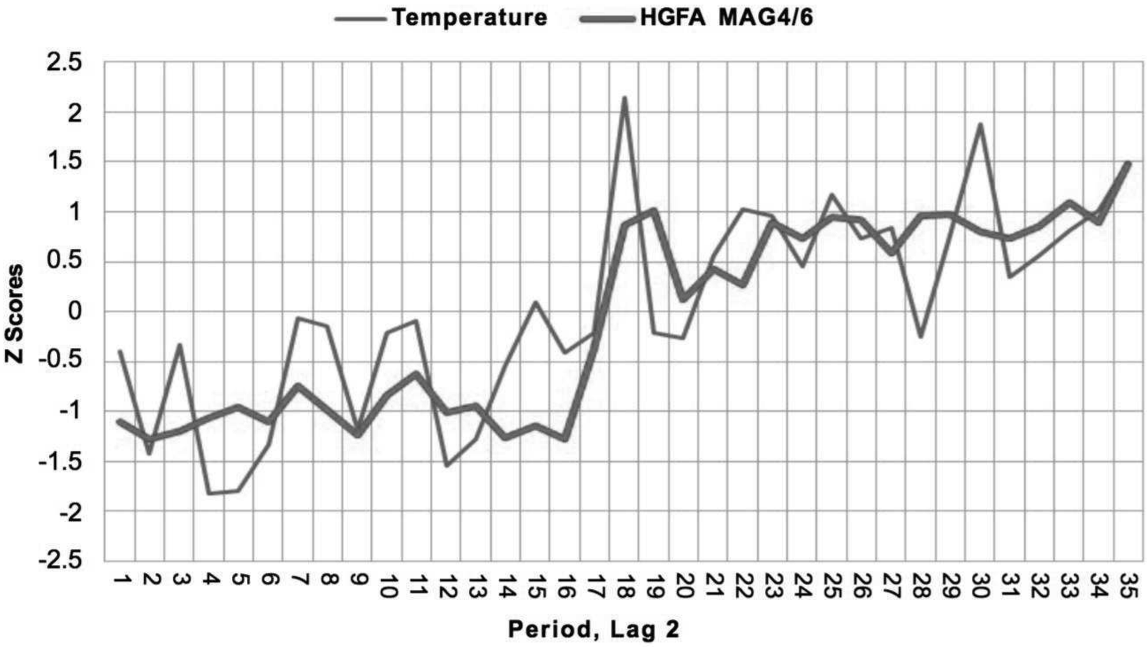


Fig.1: Global temperatures and HGFA MAG4/6 earthquake frequencies (z-scores), two-year lag adjusted yearly averages. Source: Viterito, 2016.

Fig.2: Conza della Campania after the reconstruction and today. Source: Crespellani, 2012.

Teora, oggi

Fig:3: Teora oggi. Source: Crespellani, 2012.

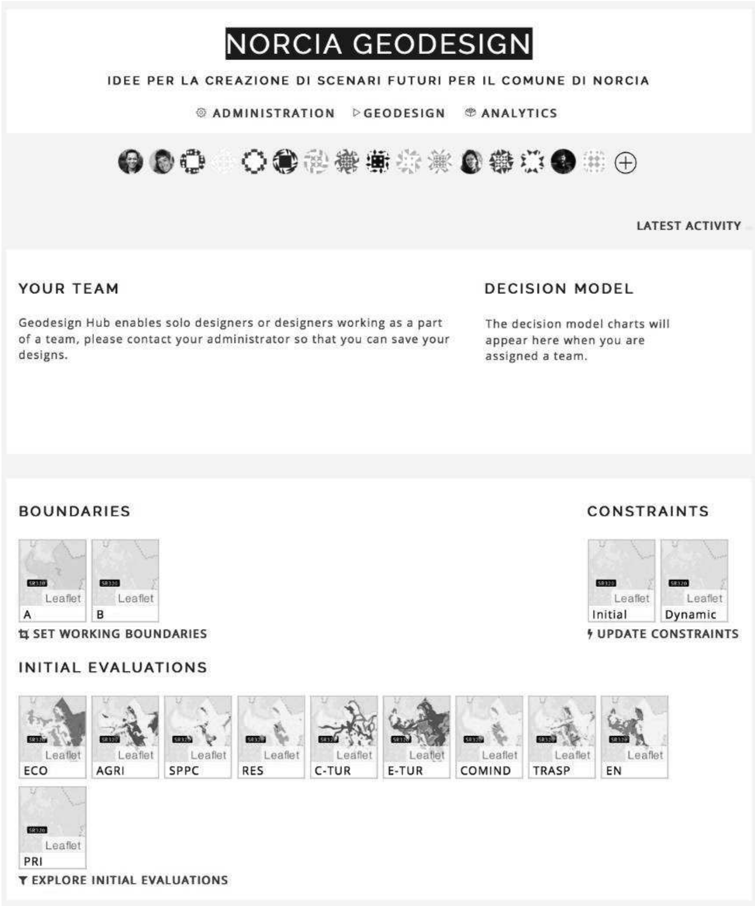


Fig.4: Geodesign Hub Interface. Source: www.geodesignhub.com

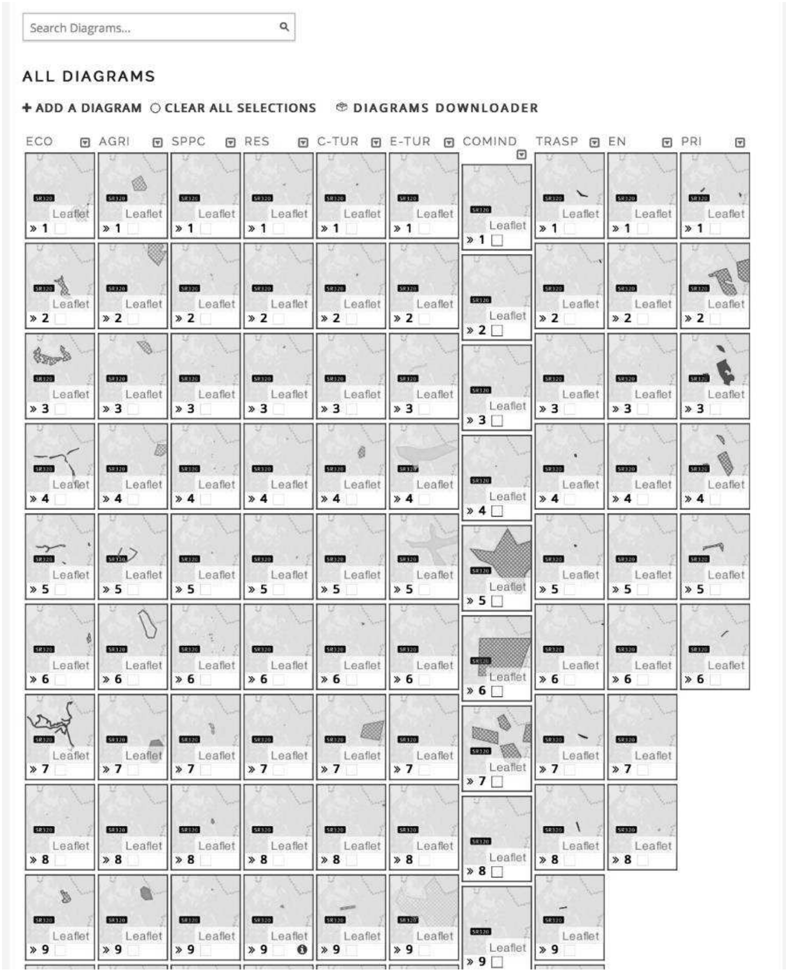


Fig.5: Geodesign Hub Interface. Source: www.geodesignhub.com

Fig.6: Geodesign Hub Interface. Source: www.geodesignhub.com

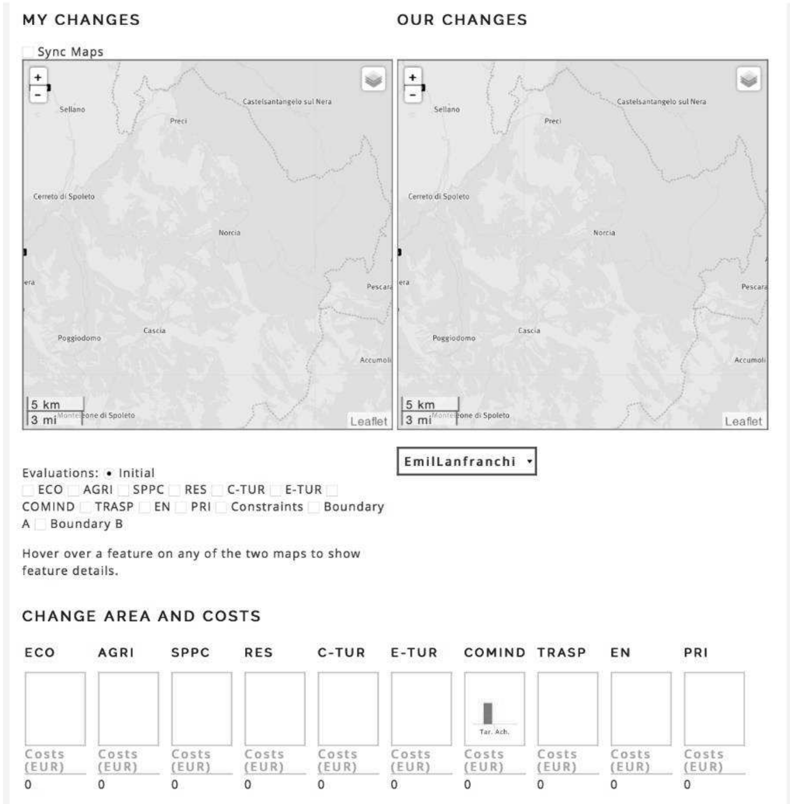


Fig.7: Geodesign Hub Interface. Source: www.geodesignhub.com

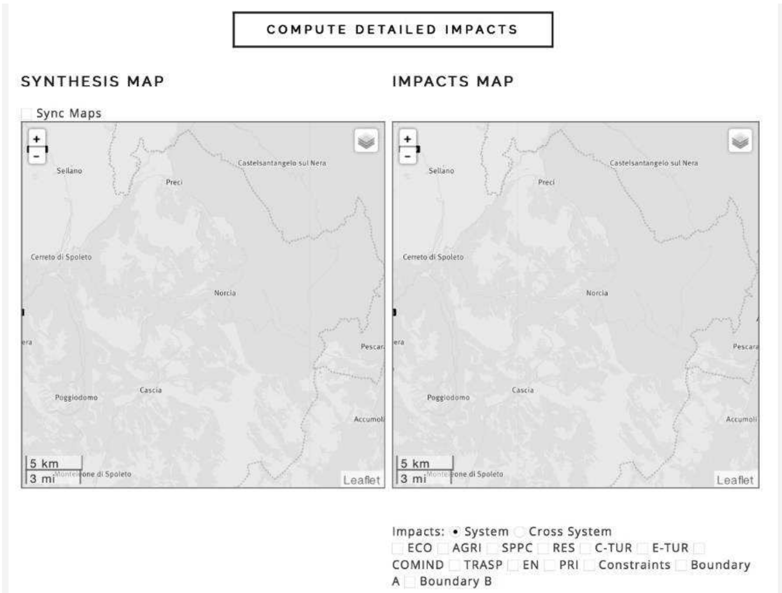


Fig.8: Geodesign Hub Interface. Source: www.geodesignhub.com

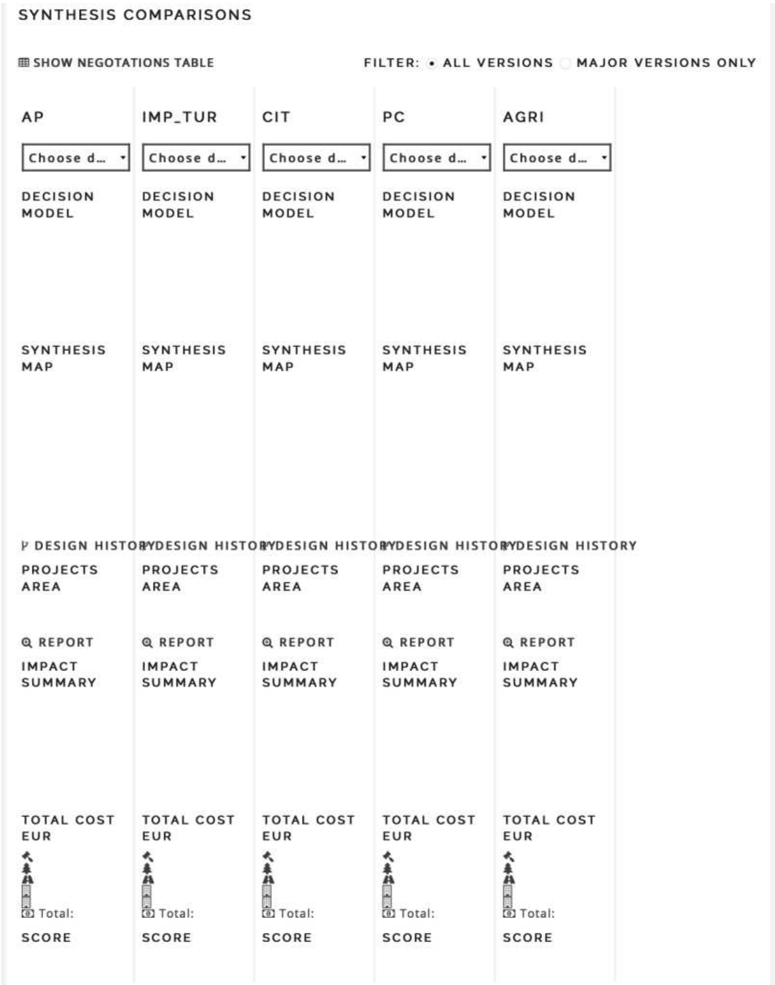


Fig.9: Geodesign Hub Interface. Source: www.geodesignhub.com

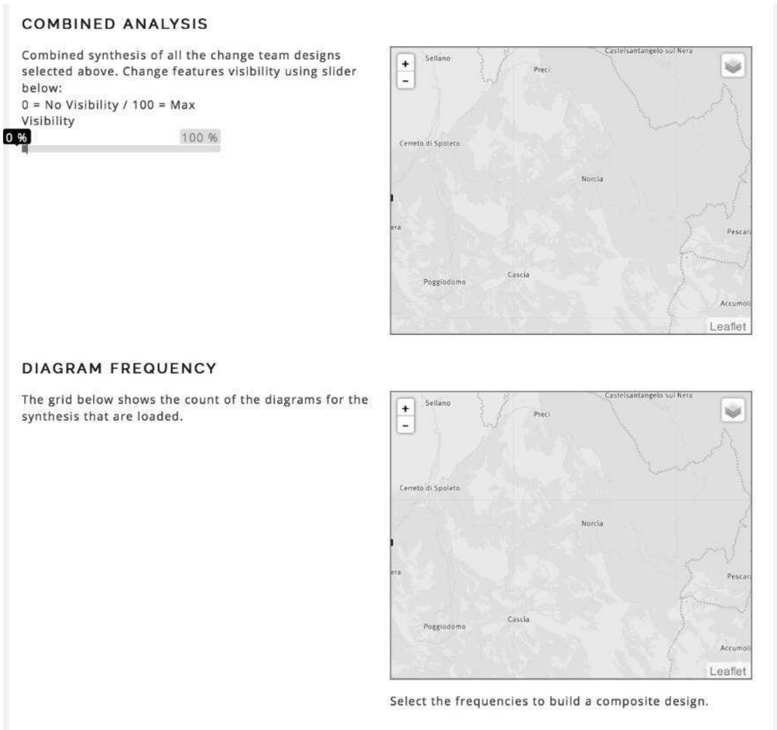


Fig.10: Geodesign Hub Interface. Source: www.geodesignhub.com

Fig:11: Geodesign Hub Interface. Source: www.geodesignhub.com

Fig.12: Collaboration at the workshop. Source: The authors.

Fig.13: Collaboration at the workshop. Source: The authors.

Fig.14: Collaboration at the workshop. Source: The authors.

Fig.15: Collaboration at the workshop. Source: The authors.

Fig.16: Collaboration at the workshop. Source: The authors.

Fig.17: Collaboration at the workshop. Source: The authors.

Fig.18: Damages in Norcia. Source: The authors.

Fig.19: Damages in Norcia. Source: The authors.

Fig.20: Damages in Norcia. Source: The authors.

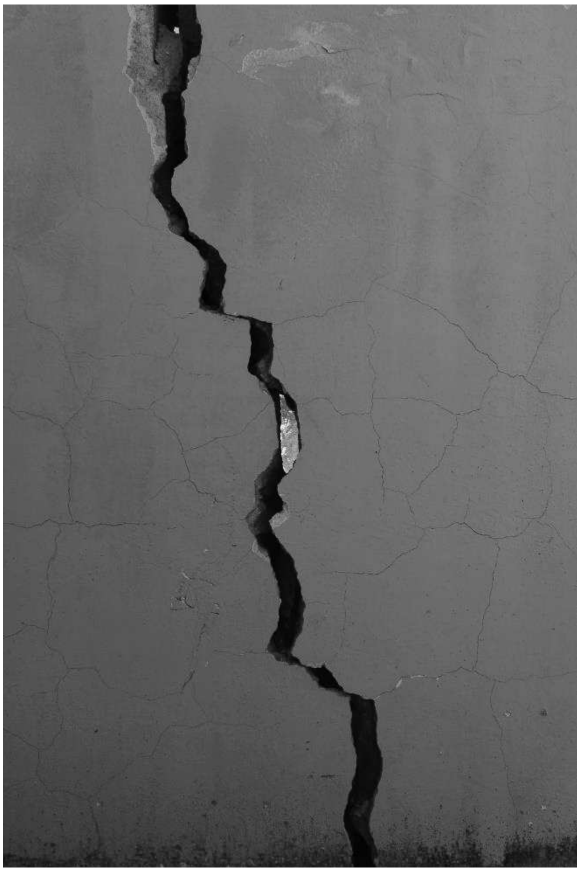


Fig.21: Damages in Norcia. Source: The authors.

Fig.22: Damages in Norcia. Source: The authors.

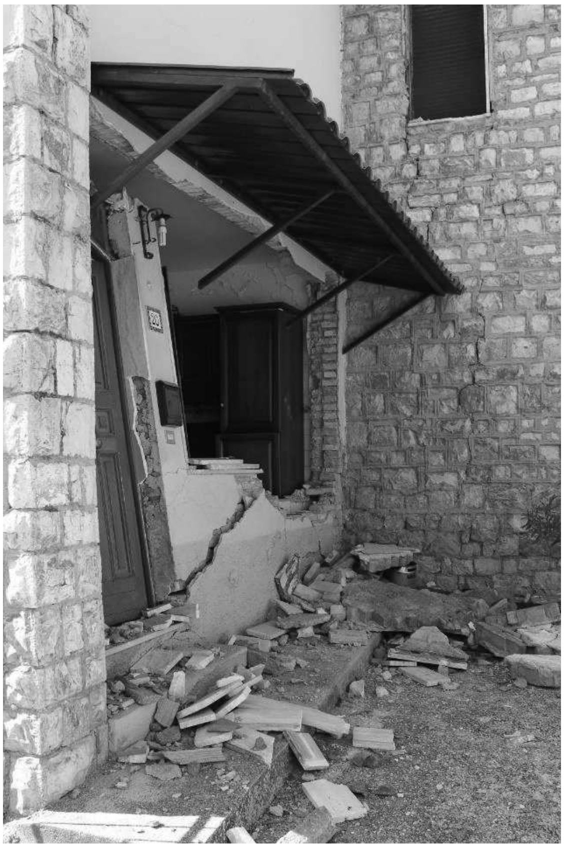


Fig.23: Damages in Norcia. Source: The authors.

Fig.24: New Torbidone river. Source: The authors.

eParticipation Chat Rooms	Web applications where a chat session takes place in real time especially launched for eParticipation purposes
eParticipation Discussion forum/board	Web applications for online discussion groups where users, usually with common interests, can exchange open messages on specific eParticipation issues. Users can pick a topic, see a "thread" of messages, reply and post their own message
Decision-making Games	These typically allow users to view and interact with animations that describe, illustrate or simulate relevant aspects of an issue; here with the specific scope of policy decision-making
Virtual Communities	Web applications in which users with a shared interest can meet in virtual space to communicate and build relationships; the shared interest being within eParticipation contexts
ePanels	Web applications where a 'recruited' set, as opposed to a self-selected set, of participants give their views on a variety of issues at specific intervals over a period of time
ePetitioning	Web applications that host online petitions and allow citizens to sign in for a petition by adding their name and address online
eDeliberative Polling	Web applications which combine deliberation in small group discussions with random sampling to facilitate public engagement on specific issues
eConsultation	Web applications designed for consultations which allow a stakeholder to provide information on an issue and others to answer specific questions and/or submit open comments
eVoting	Remote Internet enabled voting or voting via mobile phone, providing a secure environment for casting a vote and tallying of the votes
Suggestion Tools for (formal) Planning Procedures	Web applications supporting participation in formal planning procedures where citizens' comments are expected to official documents within a restricted period
Webcasts	Real time recordings of meetings transmitted over the Internet
Podcasts	Publishing multimedia files (audio and video) over the Internet where the content can be downloaded automatically using software capable of reading RSS feeds
Wikis	Web applications that allow users to add and edit content collectively
Blogs	Frequently modified web pages that look like a diary as dated entries are listed in reverse chronological order
Quick polls	Web-based instant survey
Surveys	Web-based, self-administered questionnaires, where the website shows a list of questions which users answer and submit their responses online
GIS-tools	Web applications that enable the users to have a look at maps underlying planning issues and to use them in various ways
Search Engines	Web applications to support users find and retrieve relevant information typically using keyword searching
Alert services	One-way communication alerts to inform people of a news item or an event, e.g. email Alerts and RSS Feeds
Online newsletters	One-way communication tools to inform a general audience or a pre-registered audience of specific news items and events
Frequently asked questions (FAQ)	A 'tree' of questions and answers that can be searched using keywords or by inputting a question or statement
Web Portals	Websites providing a gateway to a set of specific information and applications
Groupware tools	Tool environment to support computer-based group works
LIST SERVS	Tool for information provision and two-way interaction that can be used for Citizen2Citizen, Citizen2Administration, Citizen2Politicians etc

Fig.25: List of technologies in favor of public participation. Source: Kubicek, 2010.

1. Piano urbanistico territoriale (PUT), 1983

http://www.umbriageo.regione.umbria.it/pagine/piano-urbanistico-territoriale-1983

http://www.umbriageo.regione.umbria.it/pagine/piano-urbanistico-territoriale-2000

http://www.umbriageo.regione.umbria.it/pagine/l-r-n-272000-piano-urbanistico-territoriale

http://www.umbriageo.regione.umbria.it/pagine/cartografia-del-piano-download

http://www.umbriageo.regione.umbria.it/pagine/servizi

http://ecografico2.umbriaterritorio.it/Ecografico/gw/Home.do

3. Piano paesaggistico regionale (PPR)

http://www.umbriageo.regione.umbria.it/pagine/gli-elaborati-del-piano

http://www.umbriageo.regione.umbria.it/pagine/comprendere-il-piano-paesaggistico-regional
e

http://siat.regione.umbria.it/paesaggineltempo/

4. P.A.I.

http://www.abtevere.it/node/88

5. S.I.A

http://sia.umbriaterritorio.it/siaumbriaeiv/EsploraDati/EsploraMain.htm

http://sia.umbriaterritorio.it/portaleter/opencms/portale/menu/contenuti/raccoltaRifiuti/

http://sia.umbriaterritorio.it/portaleter/opencms/portale/index.html

6. Protected Natural areas

http://www.regione.umbria.it/ambiente/natura-e-biodiversita?idc=39&explicit=SI

7. WebGIS and Database

http://dati.umbria.it/group

http://webgis.agriforeste.regione.umbria.it/webgis/aree_protette/map.phtml

http://geo.umbriaterritorio.it/webgis/v3/viewer/index.html?config=config-BBPP.xml

http://land.copernicus.eu/local/natura/natura-2000-2012/view

Fig.26: Web consultation for data 1. Source: The authors.

- Municipality info and study area info

http://www.comuniverso.it/index.cfm?menu=687

http://www.tuttitalia.it/emilia-romagna/14-mirandola/

https://it.wikipedia.org/wiki/Terremoto_dell'Emilia_del_2012#Lista_dei_comuni_maggiormente_colpiti

http://protezionecivile.regione.emilia-romagna.it/

http://www.sibillini.net/il_parco/index.php

http://www.ing1.unipg.it/

http://dsa3.unipg.it/didattica/

- Earthquake info

http://esse1-gis.mi.ingv.it/s1_en.php?restart=0

http://zonesismiche.mi.ingv.it/

https://ingvcps.wordpress.com/la-pericolosita-sismica-2/

http://www.share-eu.org/node/90

http://www.ilcorrieredellacitta.com/primo-piano/rischio-terremoto-rischia-piu-regione-regione.html

http://www.thelocal.it/20161013/how-italy-plans-to-rebuild-its-earthquake-damaged-towns

- Norcia

http://www.regione.umbria.it/agricoltura/programma-di-sviluppo-rurale-2014-2020

http://ultimora.perugiaonline.com/news/ultim-ora/terremoto-norcia-dietro-le-quinte-un-prodotto-turistico-per-rilanciare-le-aree-colpite-dal-sisma-ricci-rp-annuncia-una-mozione.html

http://www.comune.norcia.pg.it/

http://www.umbria24.it/cronaca/terremoto-pronto-a-terni-il-prototipo-delle-casette-prefabbricate-per-gli-sfollati

http://www.umbria24.it/fotogallery/terremoto-realizzato-a-terni-il-primo-prototipo-delle-casette-per-gli-sfollati

Fig.27: Web consultation for data 2. Source: The authors.

List of agreed diagrams divided by system

1. ECO

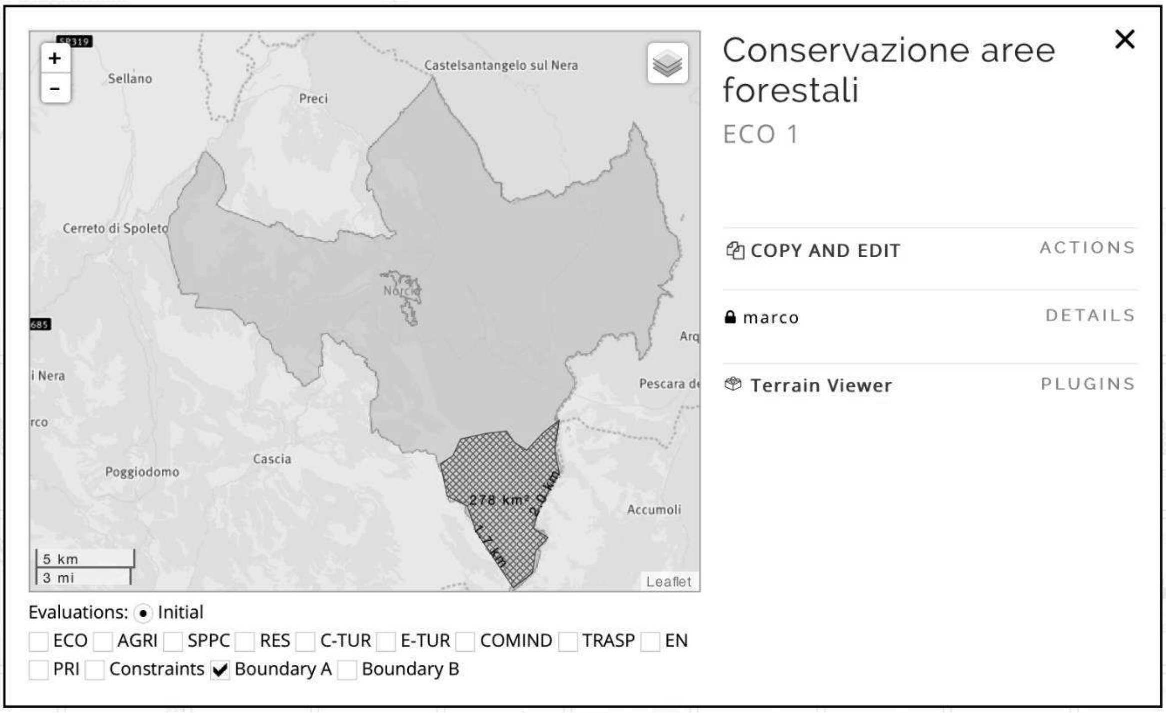
Forestry conservation


Fig.28: Forestry conservation. Source: Geodesign hub project interface.

Forestry conservation

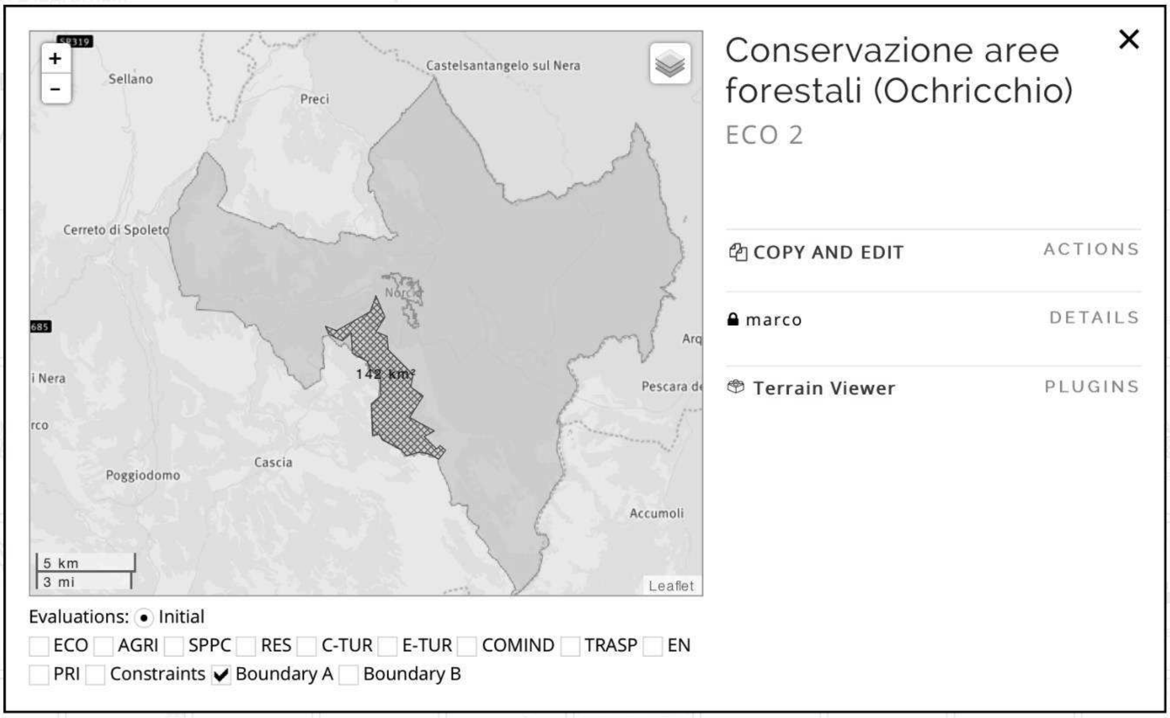


Fig.29: Forestry conservation. Source: Geodesign hub project interface.

Sustainable road pavement

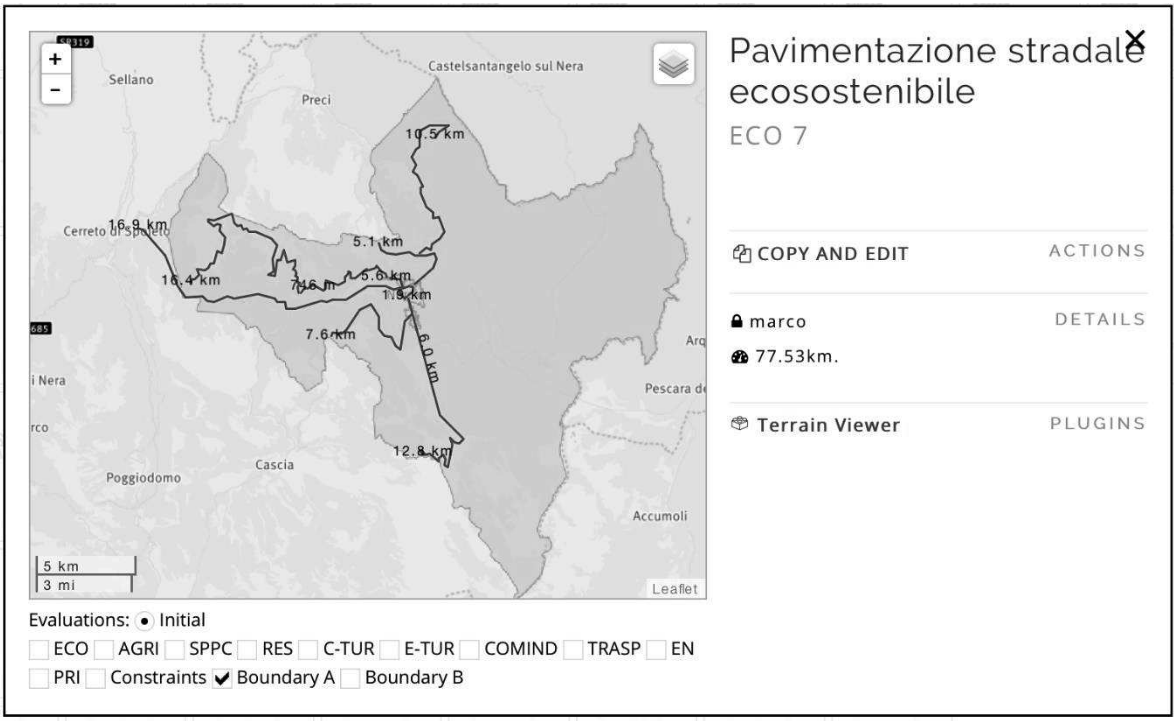


Fig.30: Sustainable road pavement. Source: Geodesign hub project interface.

Forestry conservation

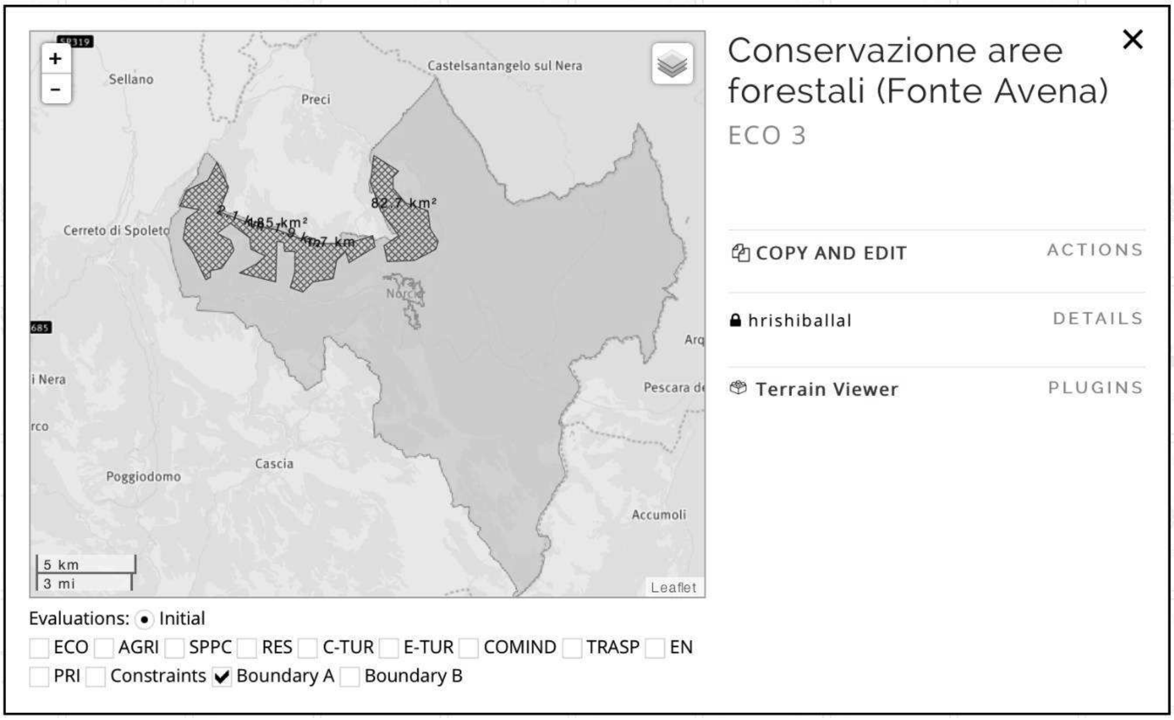


Fig.31: Forestry conservation. Source: Geodesign hub project interface.

2. AG

Multifunctionality with energy production

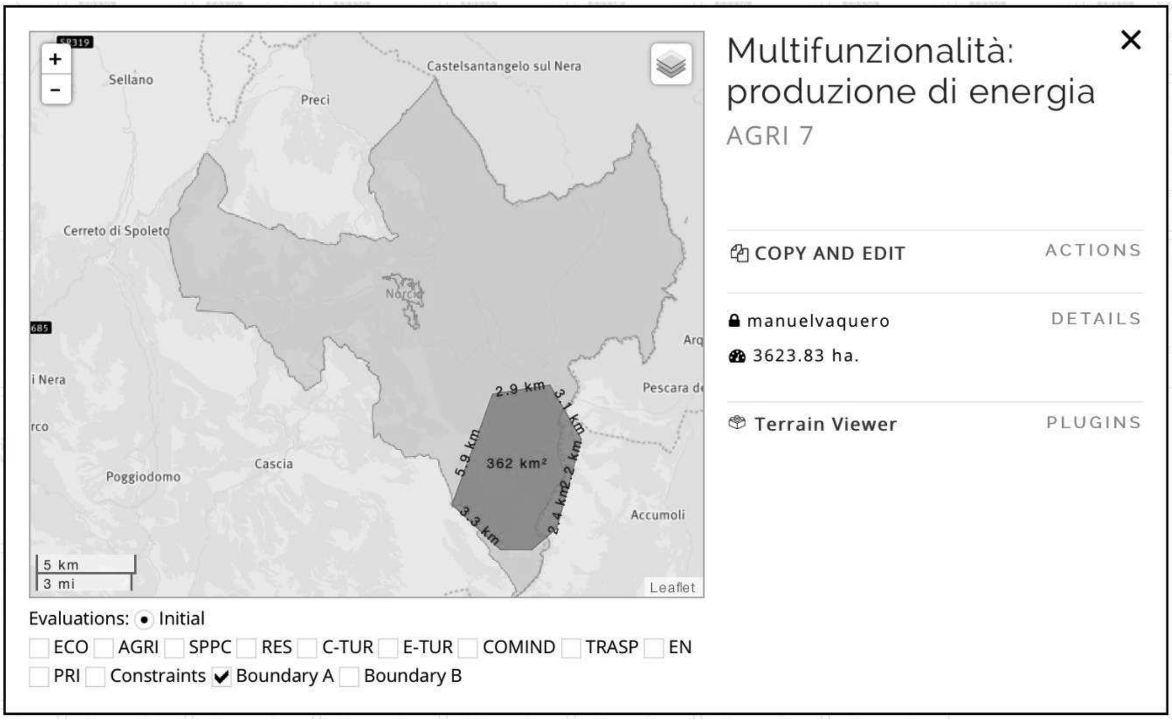


Fig.32: Multifunctionality with energy production. Source: Geodesign hub project interface.

Multifunctionality with mountain sports

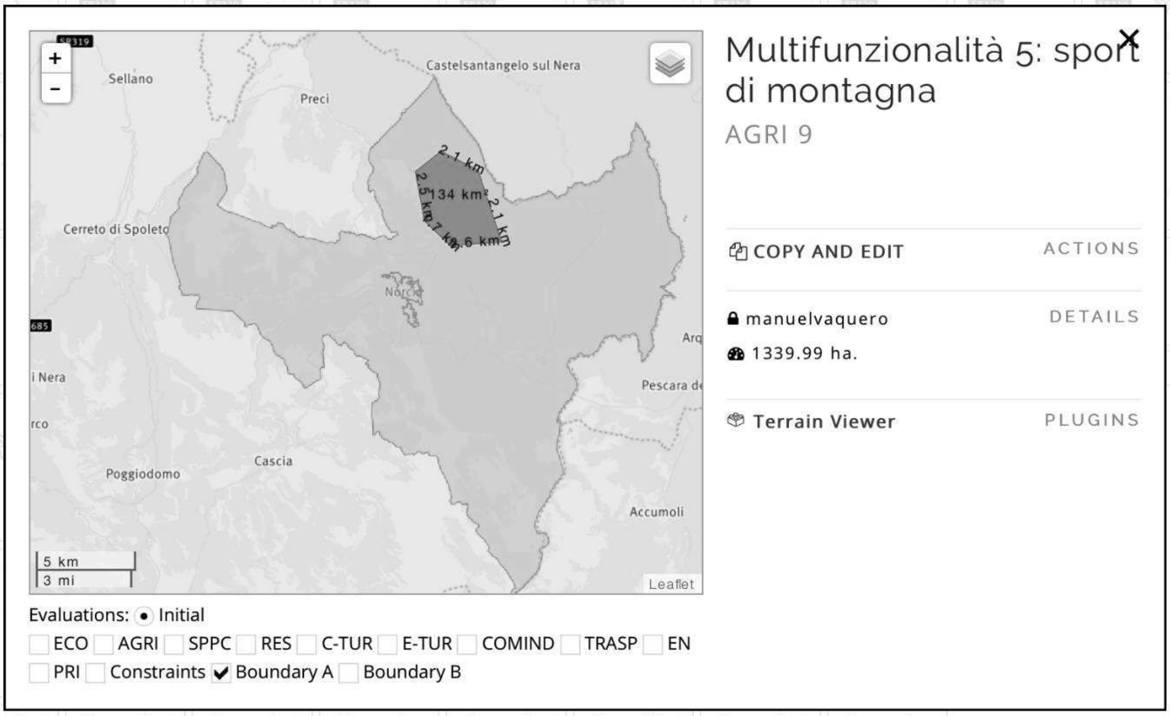


Fig.33: Multifunctionality with mountain sports. Source: Geodesign hub project interface.

Use of the new water resource Torbidone river

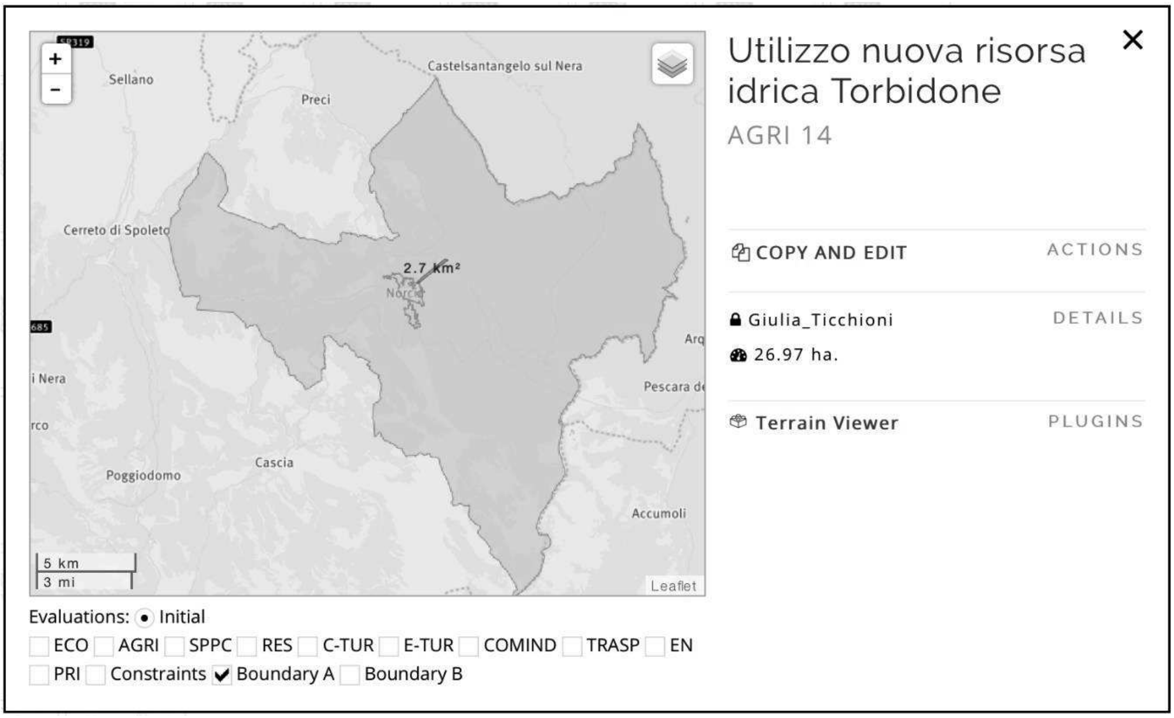


Fig.34: Use of the new water resource Torbidone river. Source: Geodesign hub project interface.

Multifunctional agri businesses

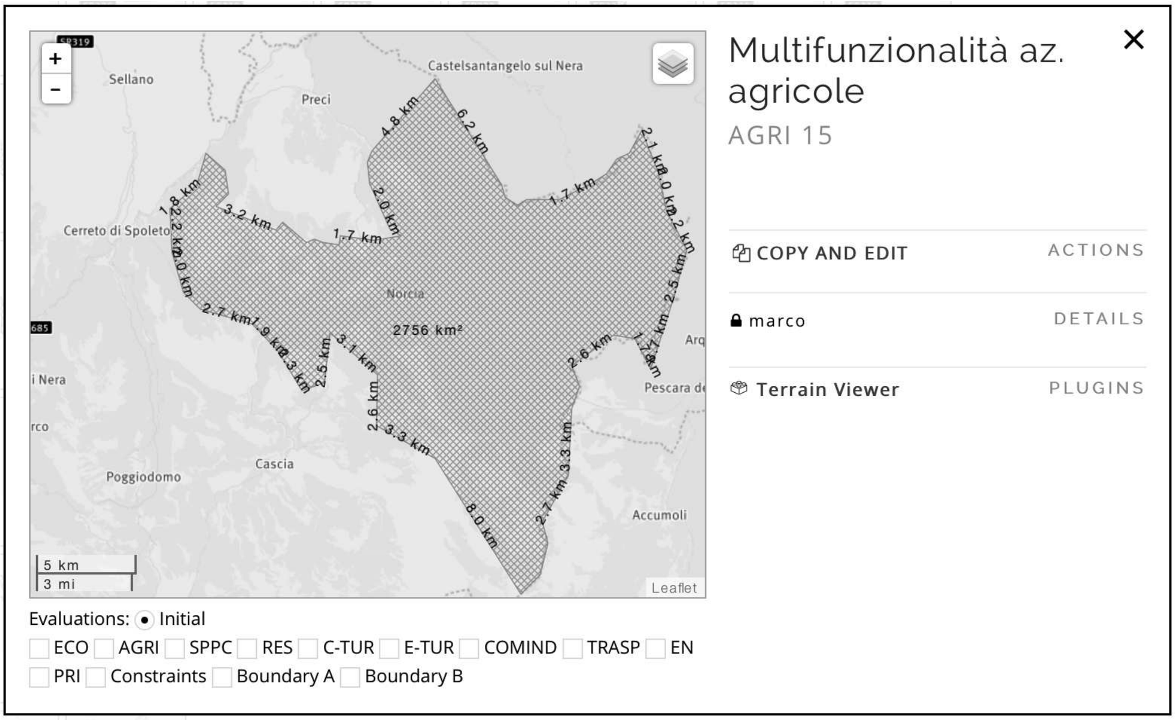


Fig.35: Multifunctional agri businesses. Source: Geodesign hub project interface.

3. SPPC

Buildings of strategic interest for Civil Protection

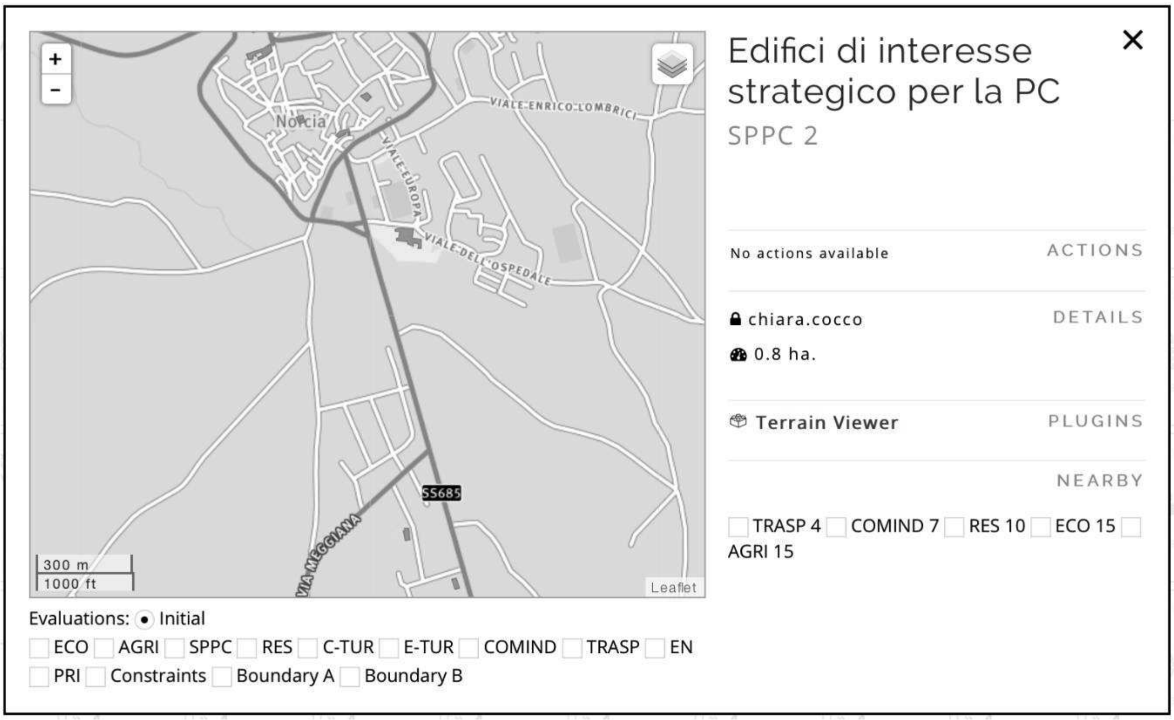


Fig.36: Buildings of strategic interest for Civil Protection. Source: Geodesign hub project interface.

Emergency areas in case of earthquake event

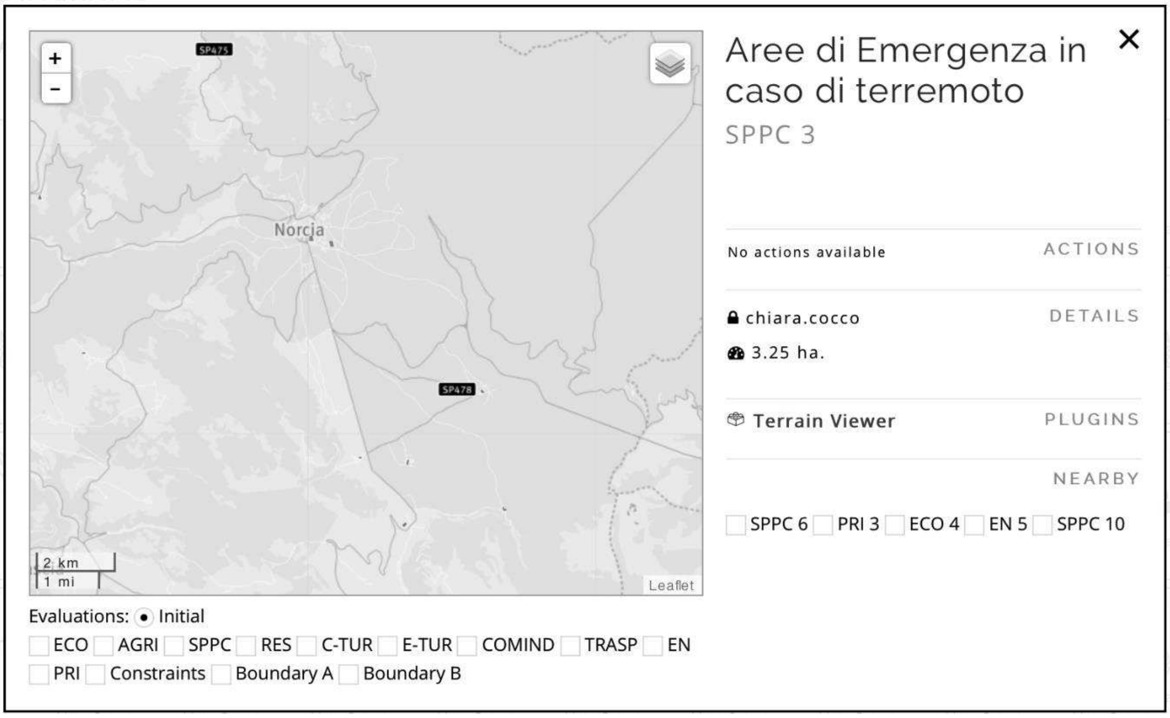


Fig.37: Emergency areas in case of earthquake event. Source: Geodesign hub project interface.

Designate areas for containers

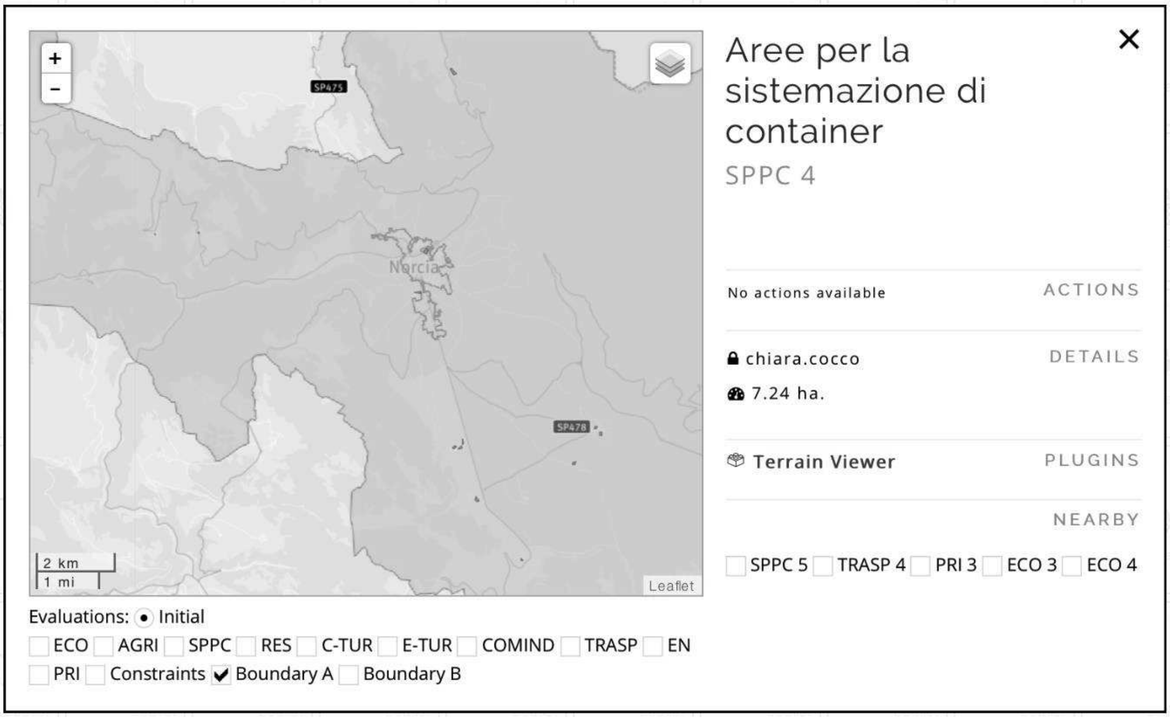


Fig.38: Designate areas for temporary. Source: Geodesign hub project interface.

Sites assigned for ruins deposit

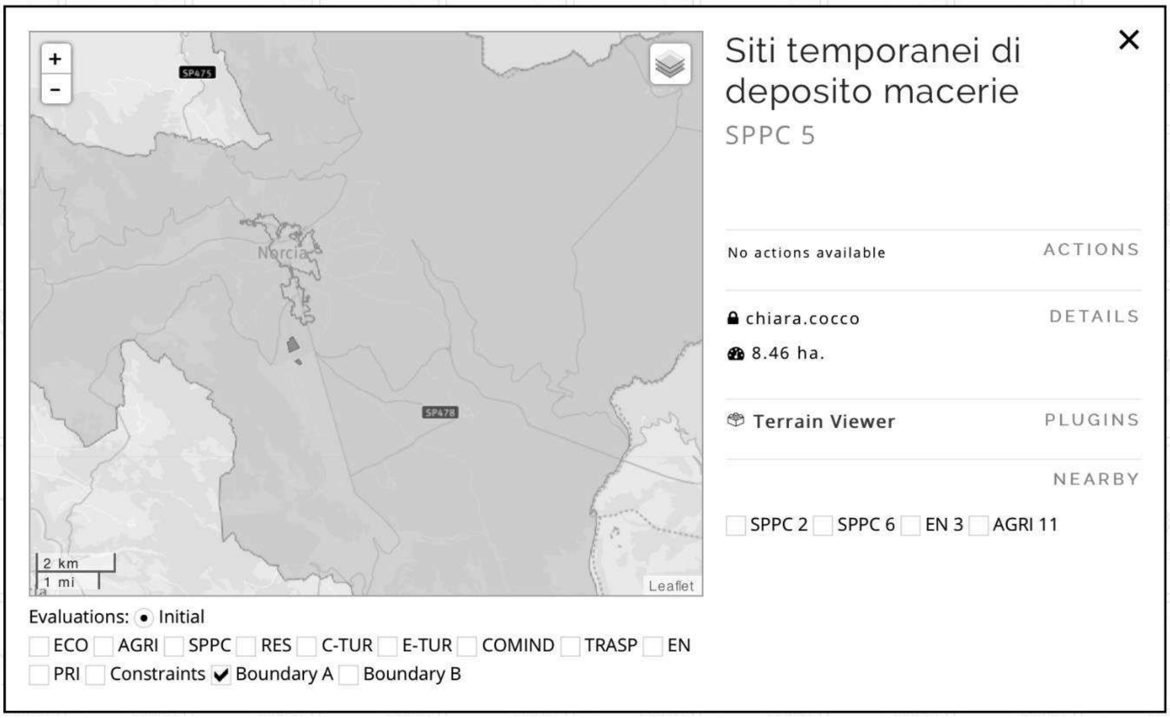


Fig.39: Sites assigned for ruins deposit. Source: Geodesign hub project interface.

Assigned areas for temporary houses (SAE)

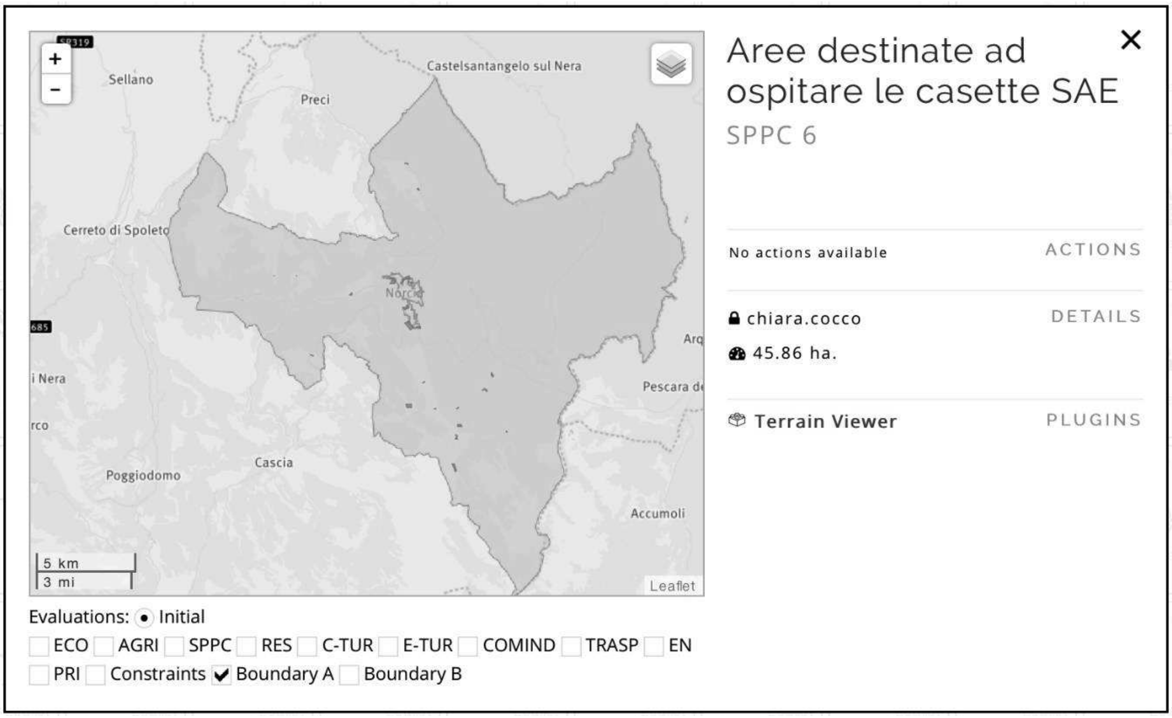


Fig.40: Assigned areas for temporary houses (SAE). Source: Geodesign hub project interface.

Anti-seismic arrangements

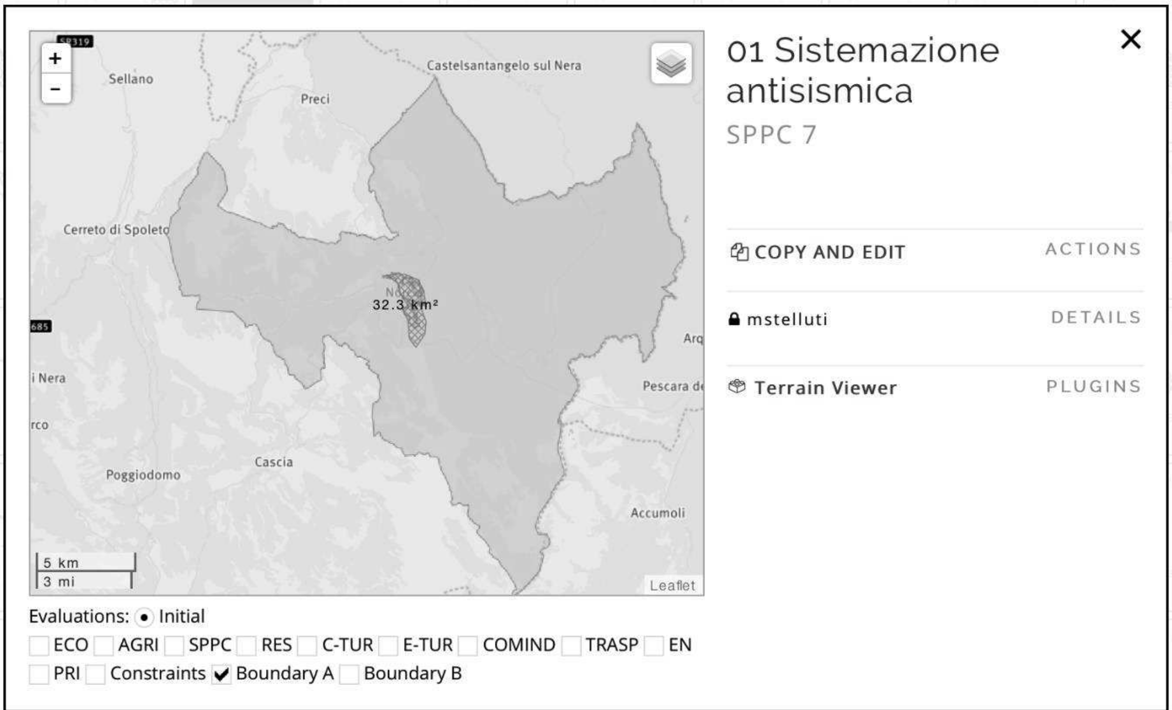


Fig.41: Anti-seismic arrangements. Source: Geodesign hub project interface.

4. C-TUR

Protection areas of historic and characteristic activities

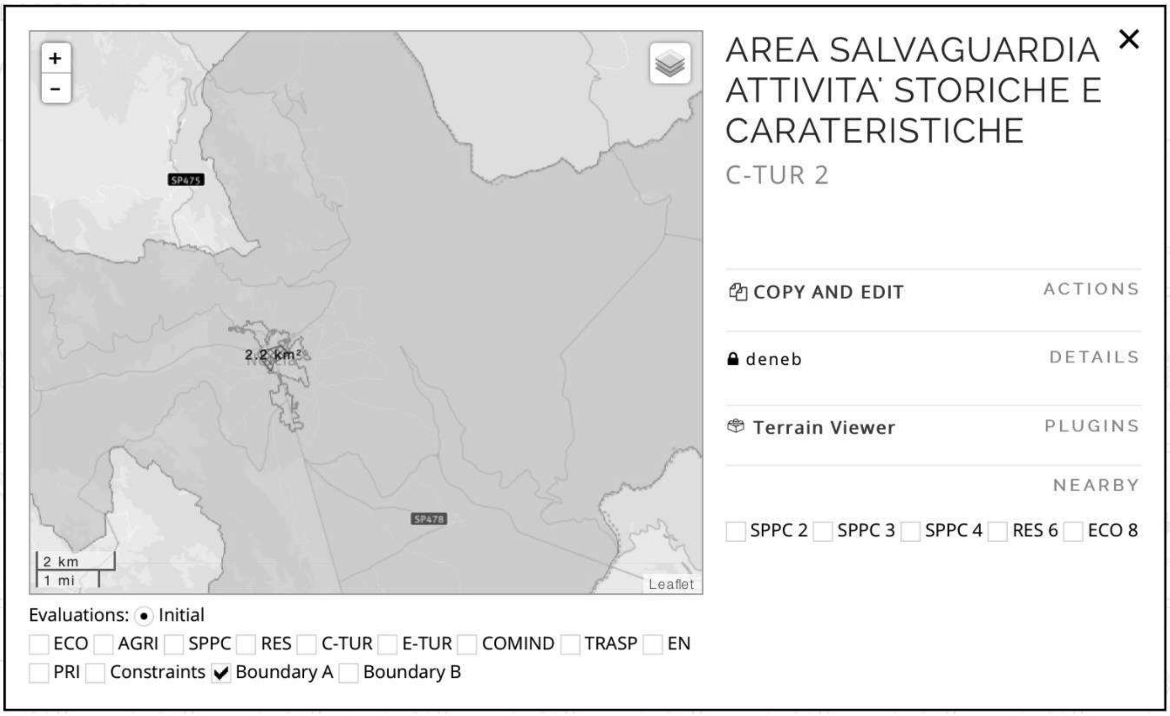


Fig.42: Protection areas of historic and characteristic activities. Source: Geodesign hub project interface.

Earthquake museum

Fig.43: Earthquake museum. Source: Geodesign hub project interface.

Reconstruction and requalification of the Cathedral

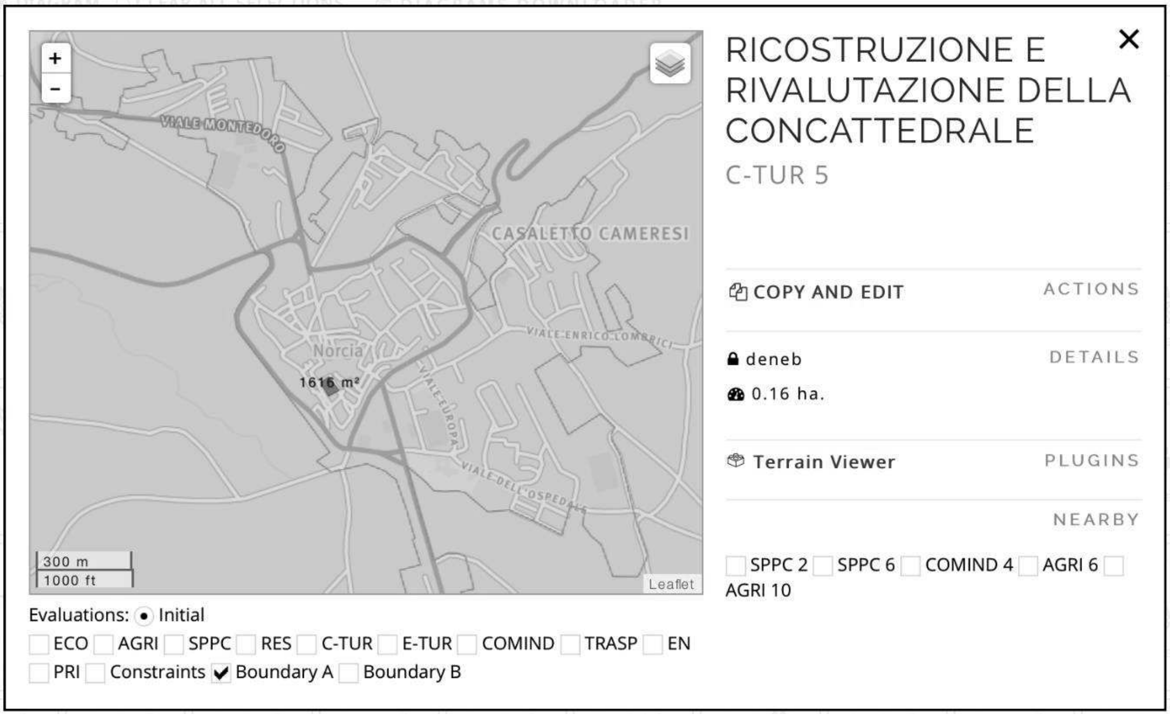


Fig.44: Reconstruction and requalification of the Cathedral. Source: Geodesign hub project interface.

Requalification of the historic railway

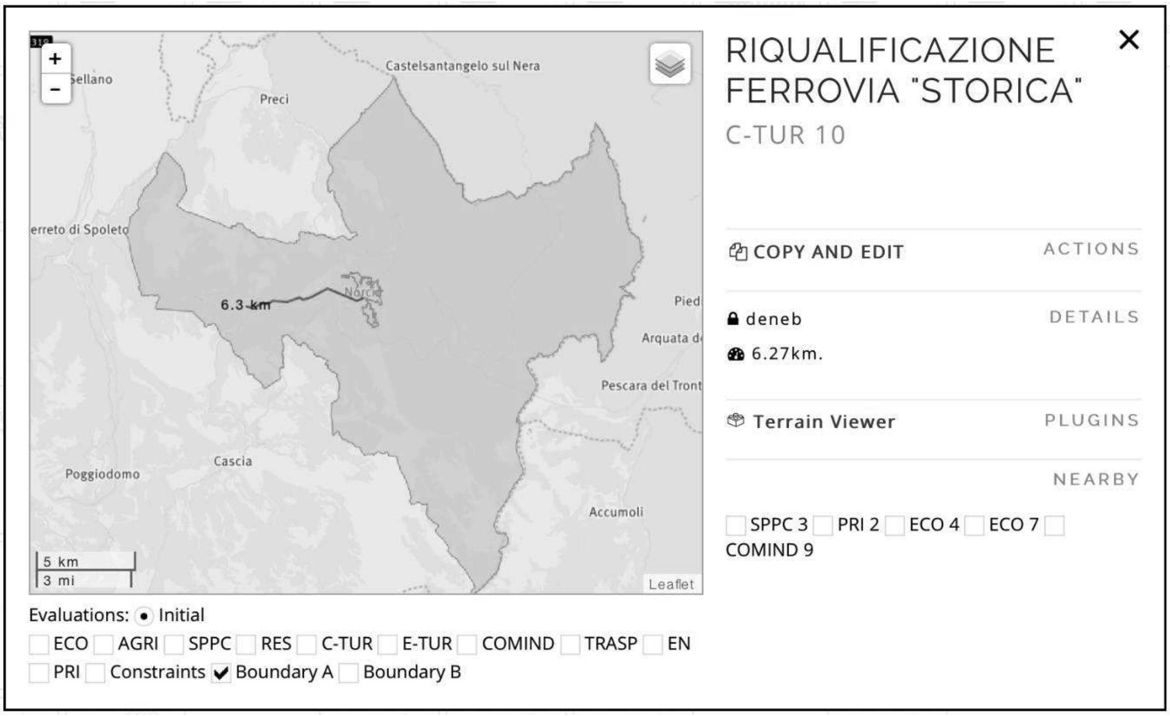


Fig.45: Requalification of the historic railway. Source: Geodesign hub project interface.

Regulation of urban traffic (limits to private vehicles)

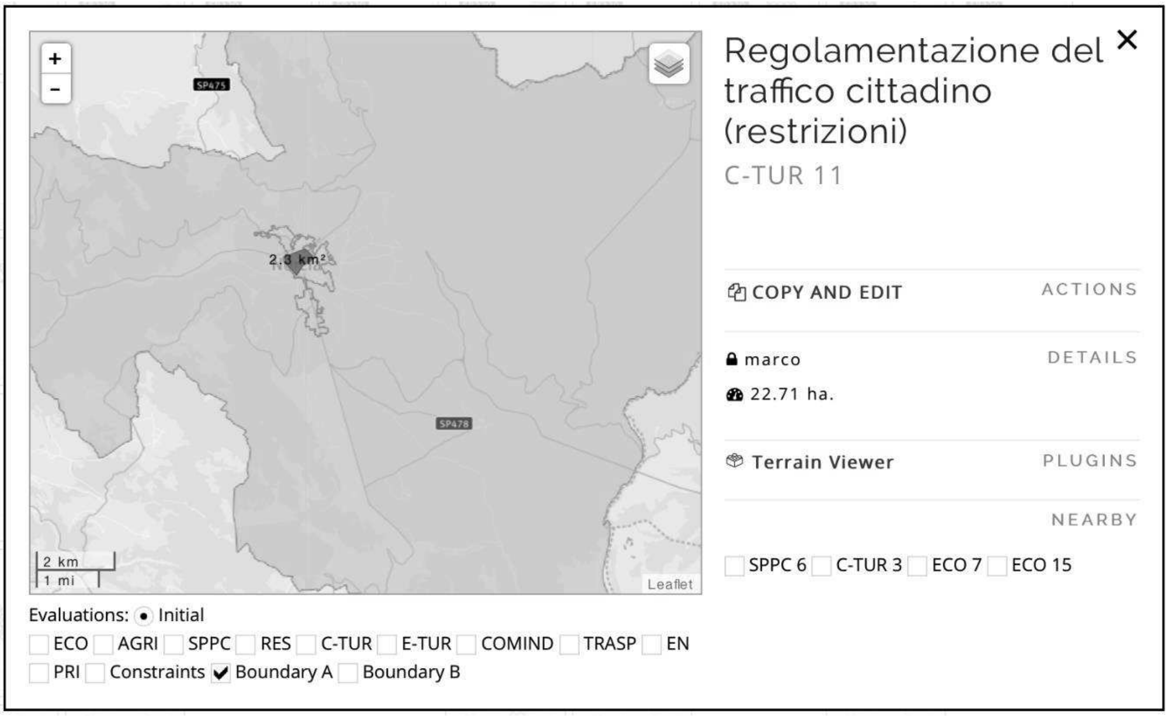


Fig.46: Regulation of urban traffic. Source: Geodesign hub project interface.

Empowerment of pedestrian path and trails

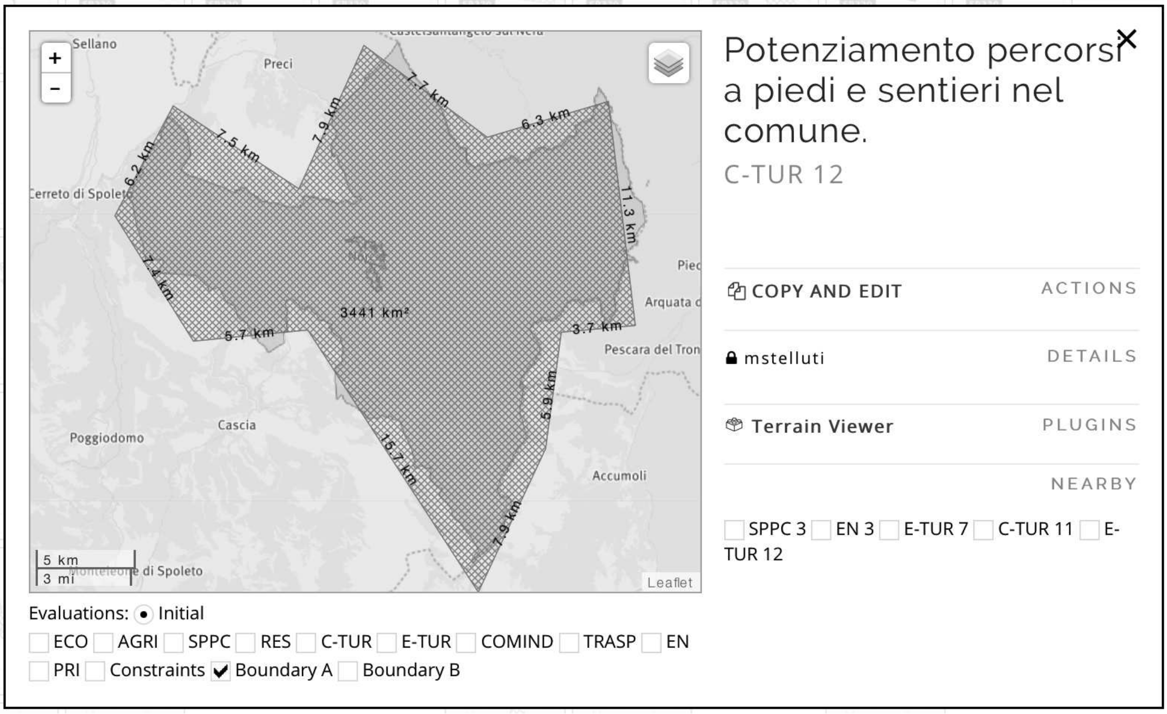


Fig.47: Empowerment of pedestrian path and trails. Source: Geodesign hub project interface.

5. RES

Protection policies for the historic city center

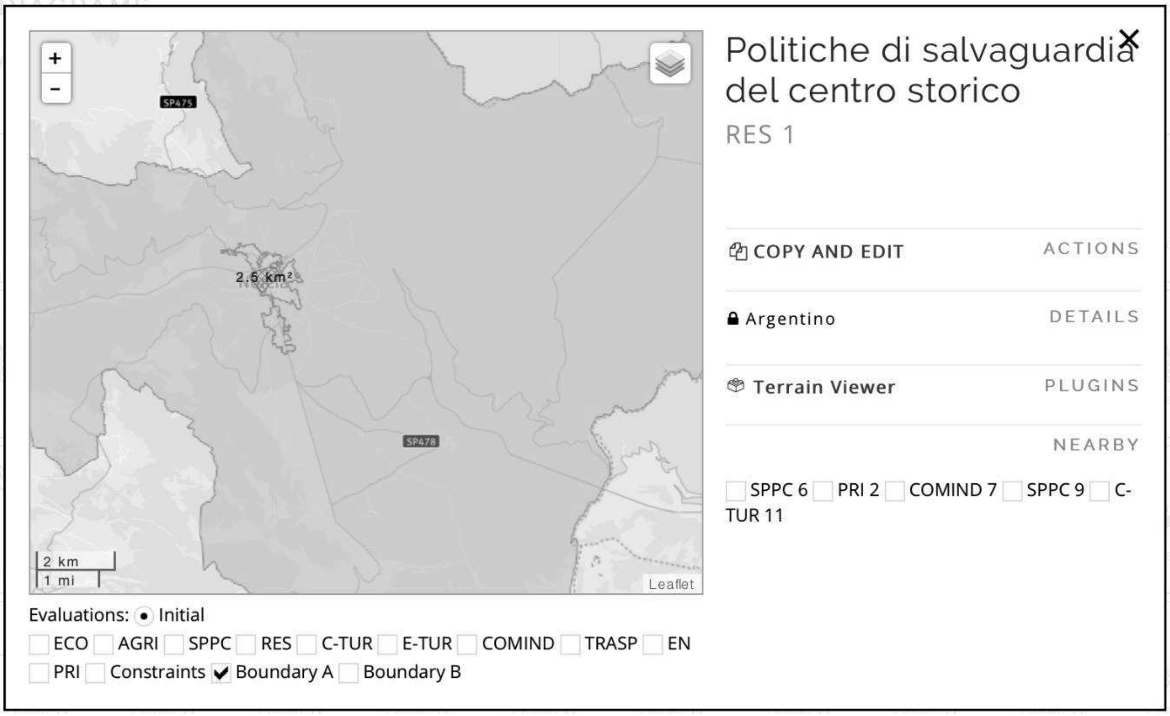


Fig.48: Protection policies for the historic city center. Source: Geodesign hub project interface.

Reconstruction and protection program for Castelluccio

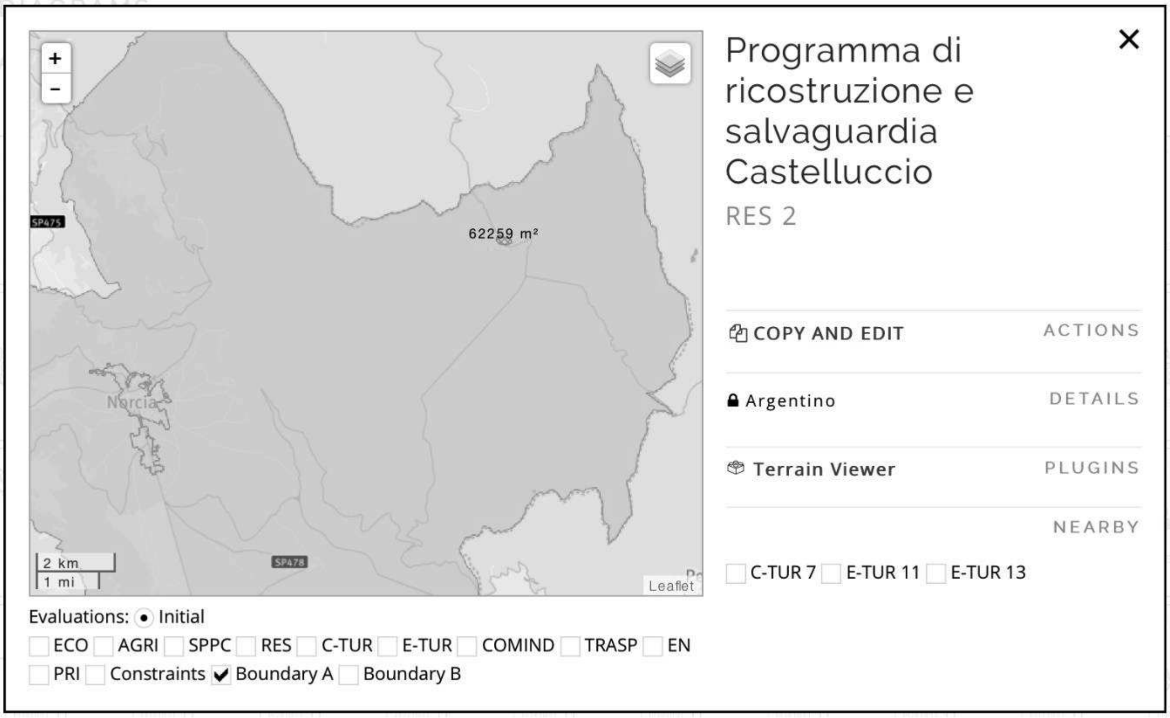


Fig.49: Reconstruction and protection program for Castelluccio. Source: Geodesign hub project interface.

Reconstruction and protection policies for Campi

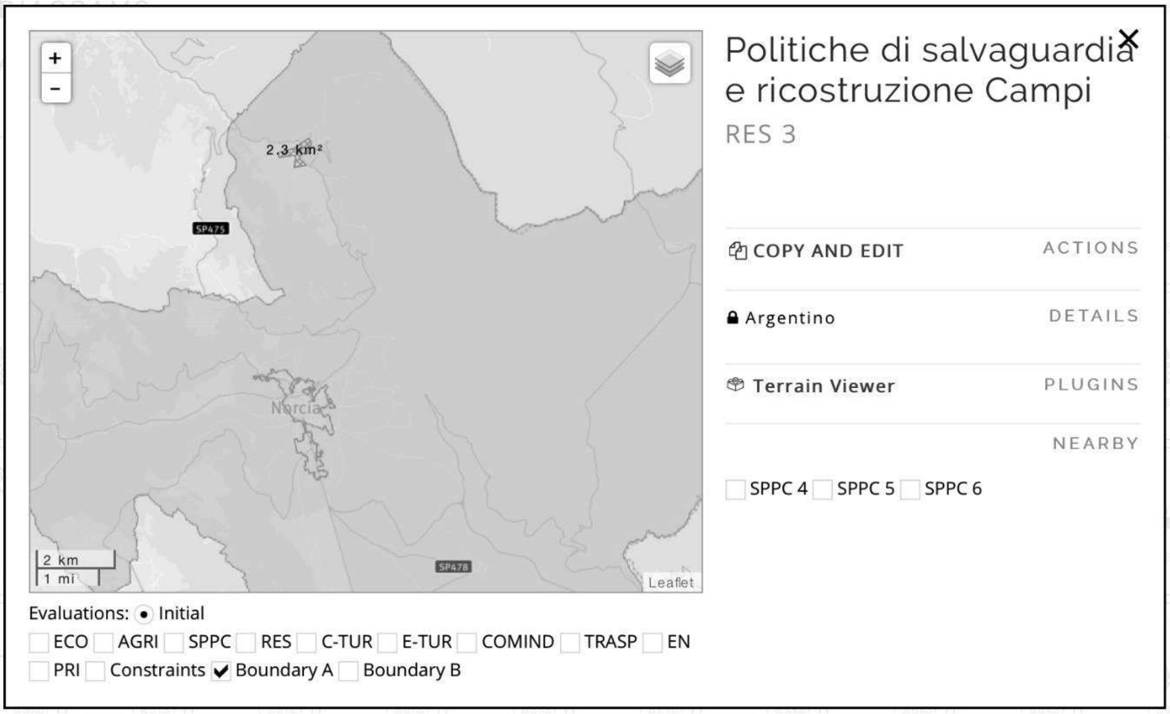


Fig.50: Reconstruction and protection policies for Campi. Source: Geodesign hub project interface.

Reconstruction and protection policies for S. Pellegrino

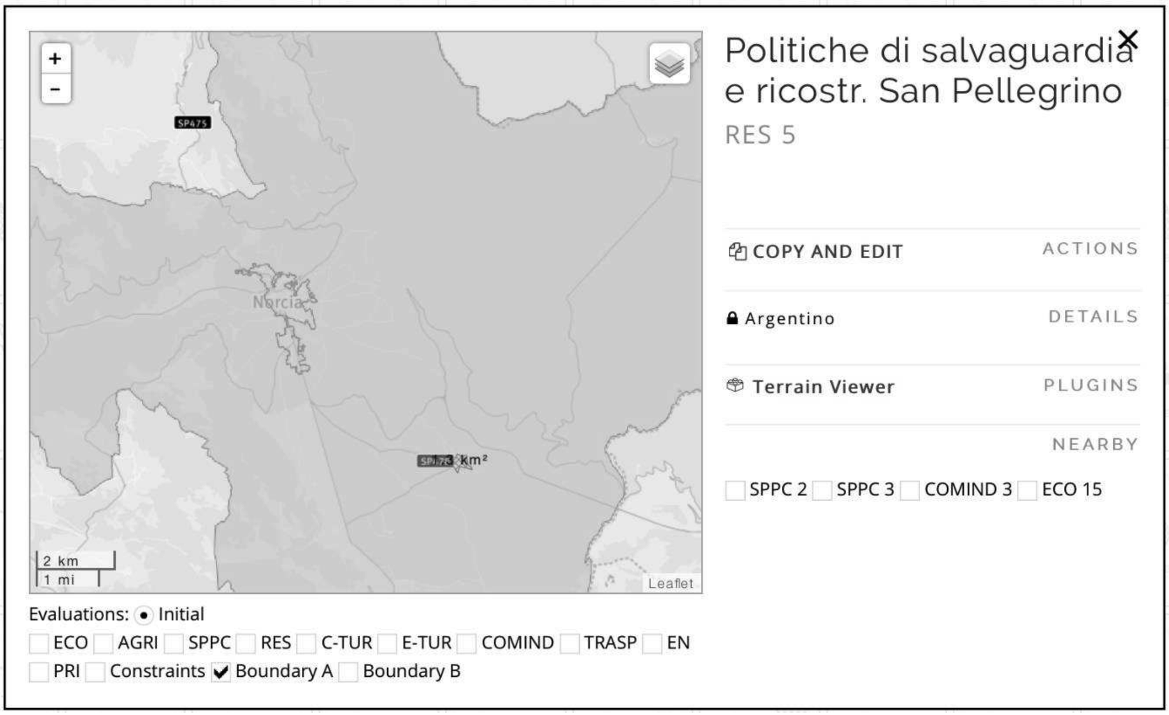


Fig.51: Reconstruction and protection policies for S. Pellegrino. Source: Geodesign hub project interface.

Reconstruction and requalification of North Norcia

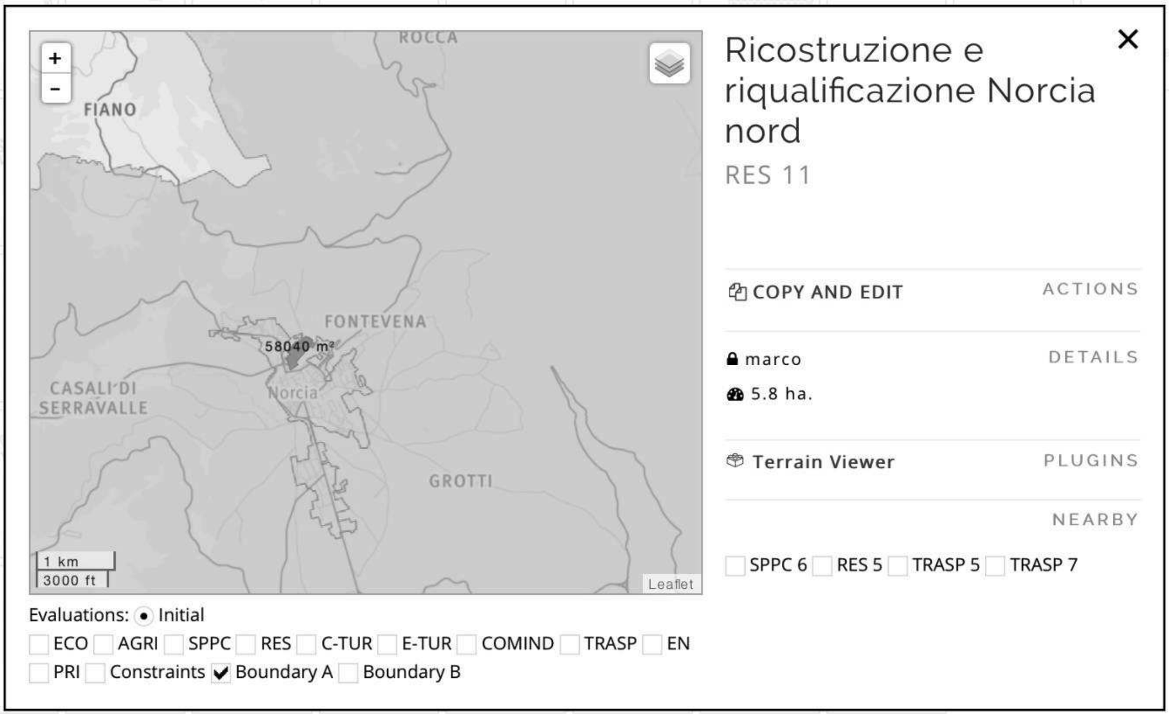


Fig.52: Reconstruction and requalification of North Norcia. Source: Geodesign hub project interface.

6. COMIND

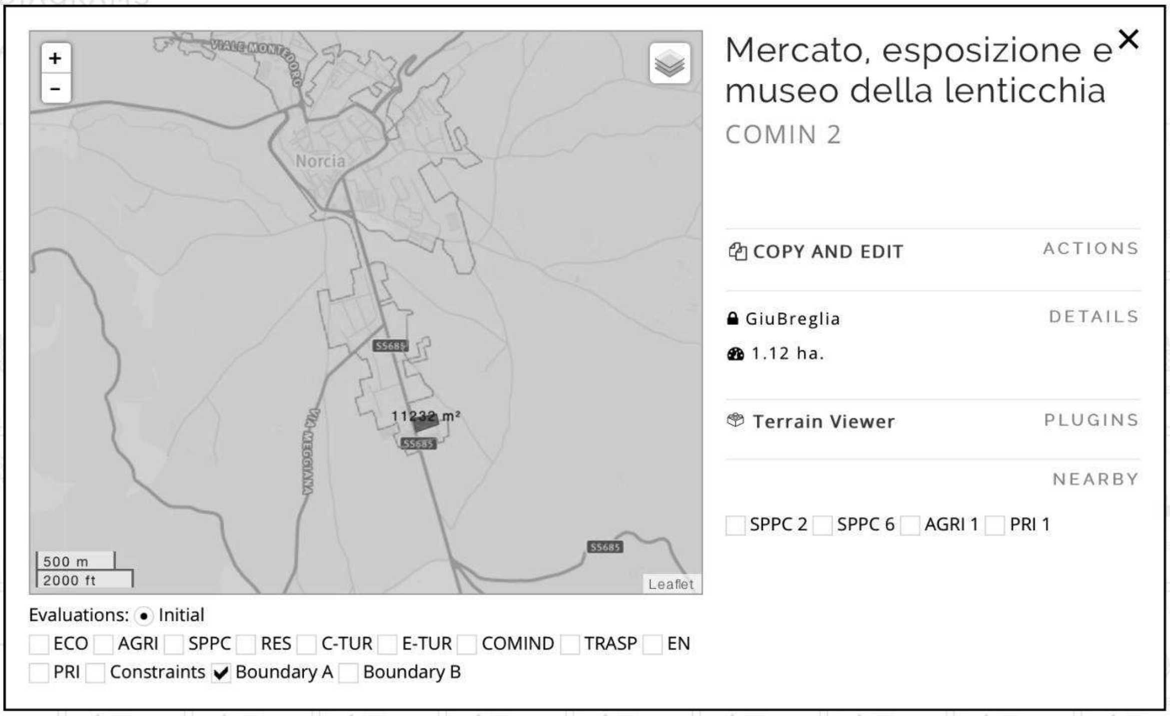
Market, trade show and museum of IGP lentils


Fig.53: Market, trade show and museum of IGP lentils. Source: Geodesign hub project interface.

Youth attraction for “we are Norcia” and change of organogram

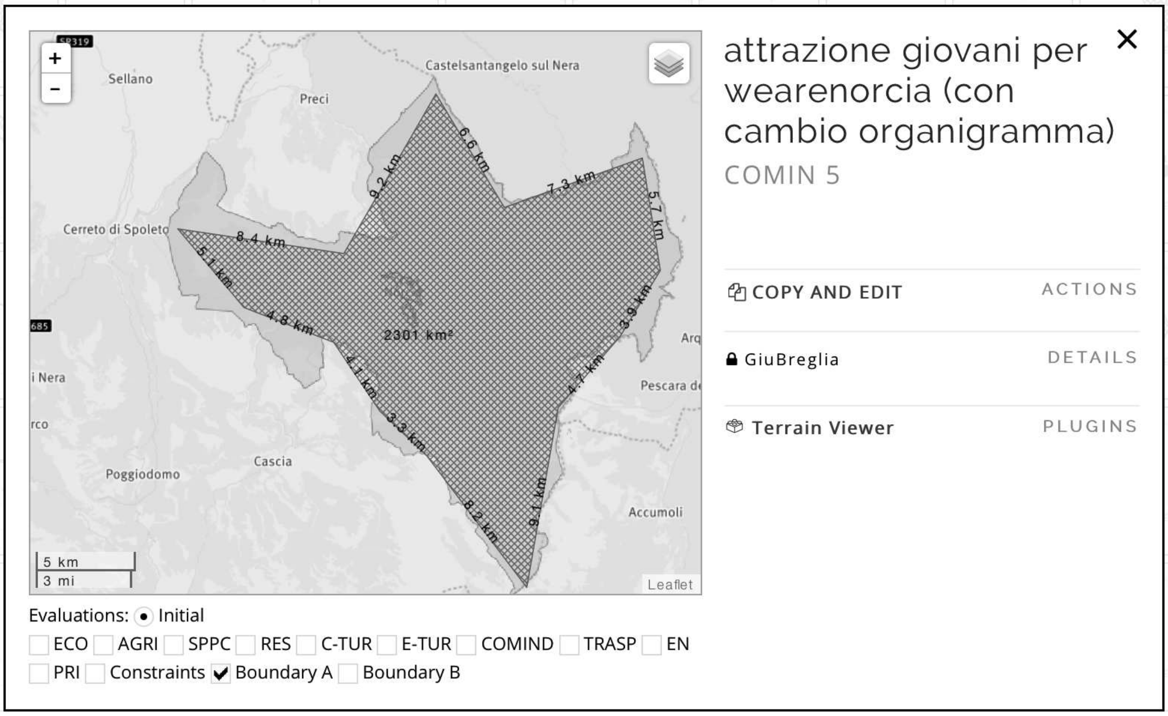


Fig.54: Youth attraction for "we are Norcia" and change of organogram. Source: Geodesign hub project interface.

Incentives for agricultural vehicles when damaged roads

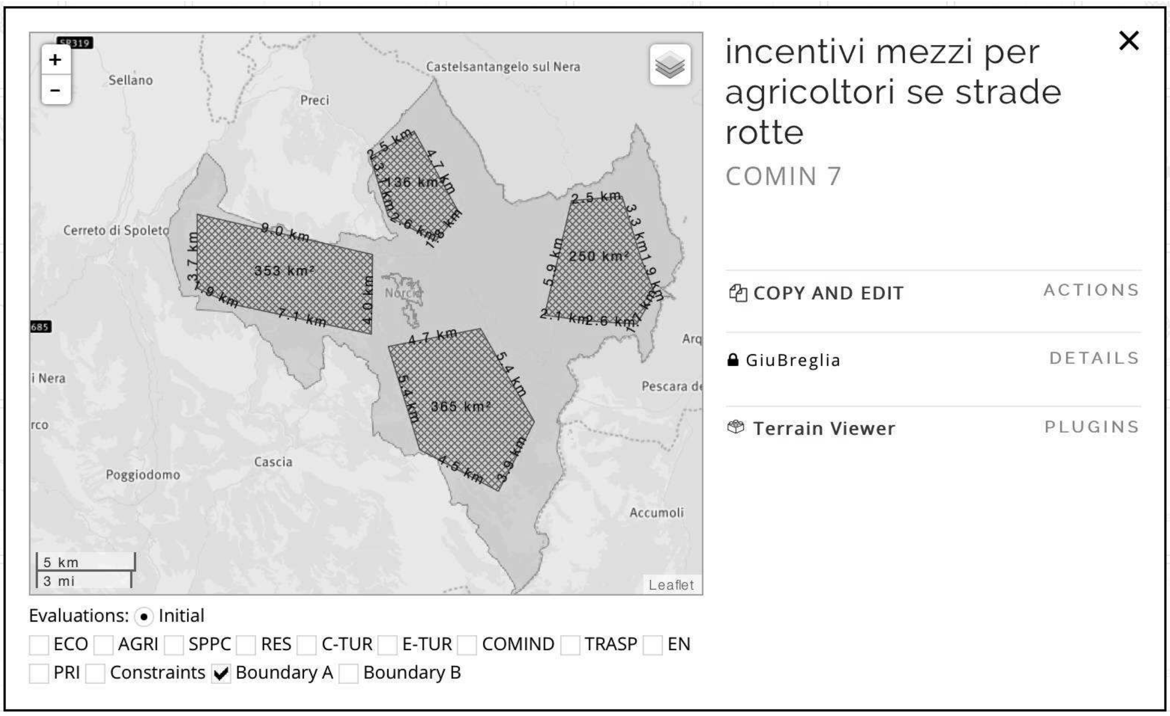


Fig.55: Incentives for agricultural vehicles when damaged roads. Source: Geodesign hub project interface.

7. TRASP

S. Pellegrino cycle path

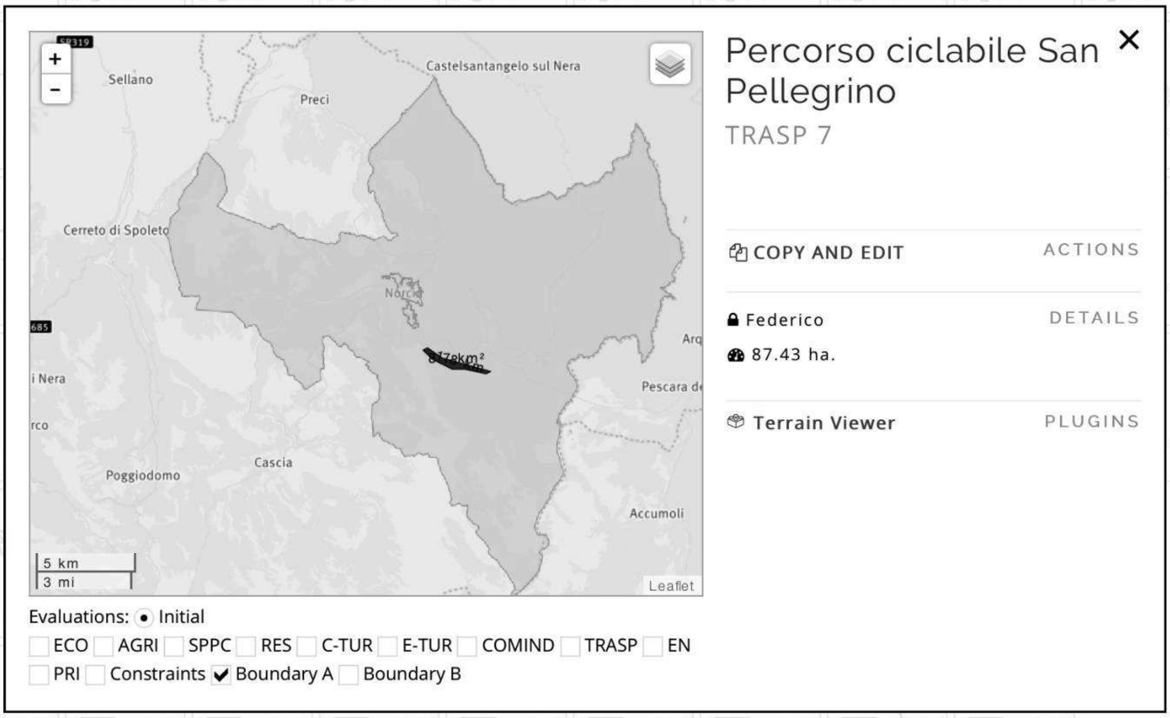


Fig.56: S. Pellegrino cycle path. Source: Geodesign hub project interface.

Piediripa cycle path

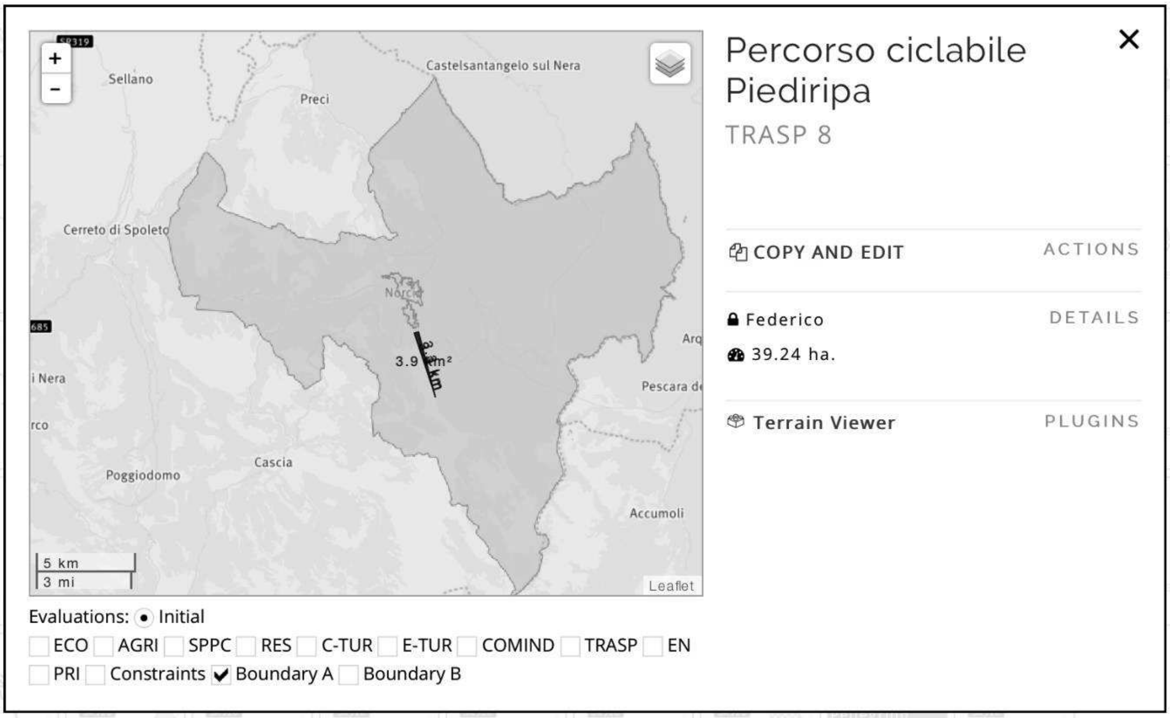


Fig.57: Piediripa cycle path. Source: Geodesign hub project interface.

Empowerment of connections between Norcia and Casali di Serravalle

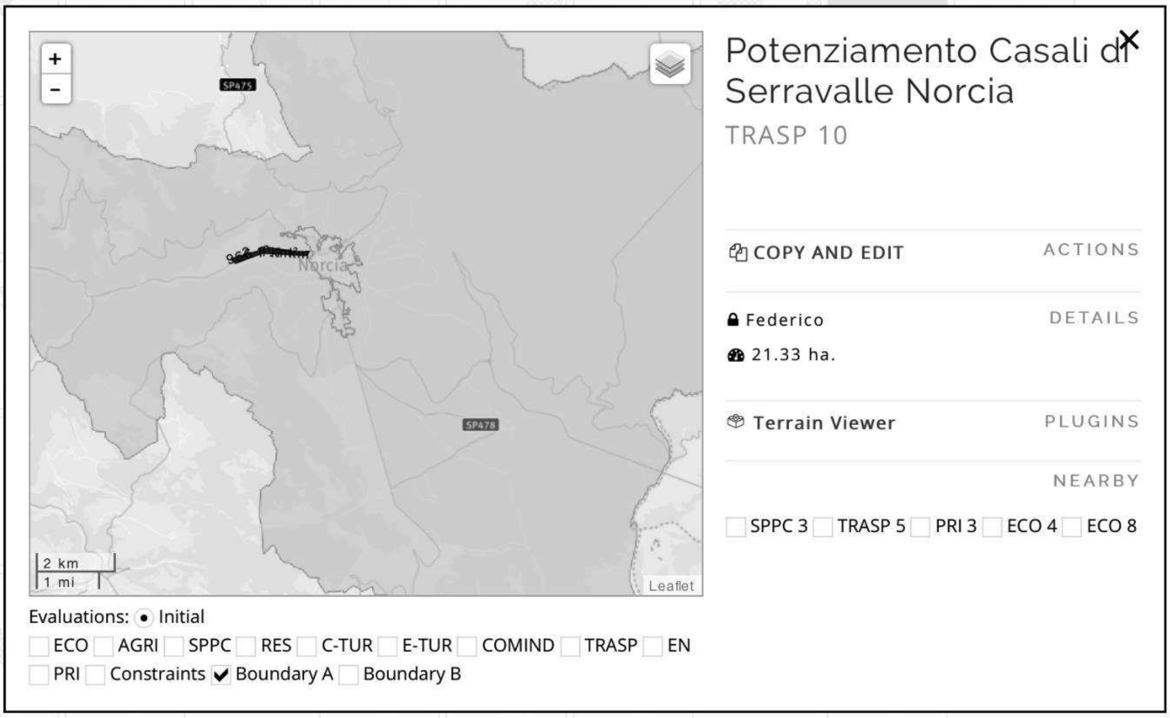


Fig.58: Empowerment of connections between Norcia and Casali di Serravalle. Source: Geodesign hub project interface.

Build road connection between Visso and Castelluccio

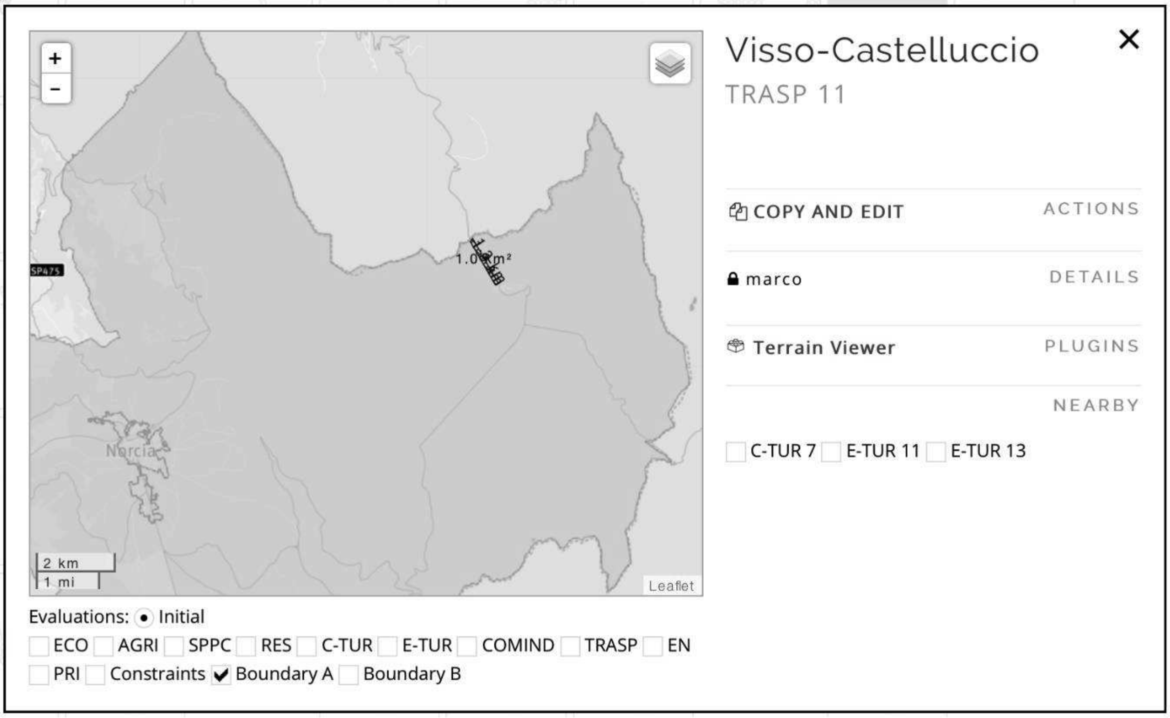


Fig.59: Build road connection between Visso and Castelluccio. Source: Geodesign hub project interface.

Safety intervention on road connection Serravalle-Casali

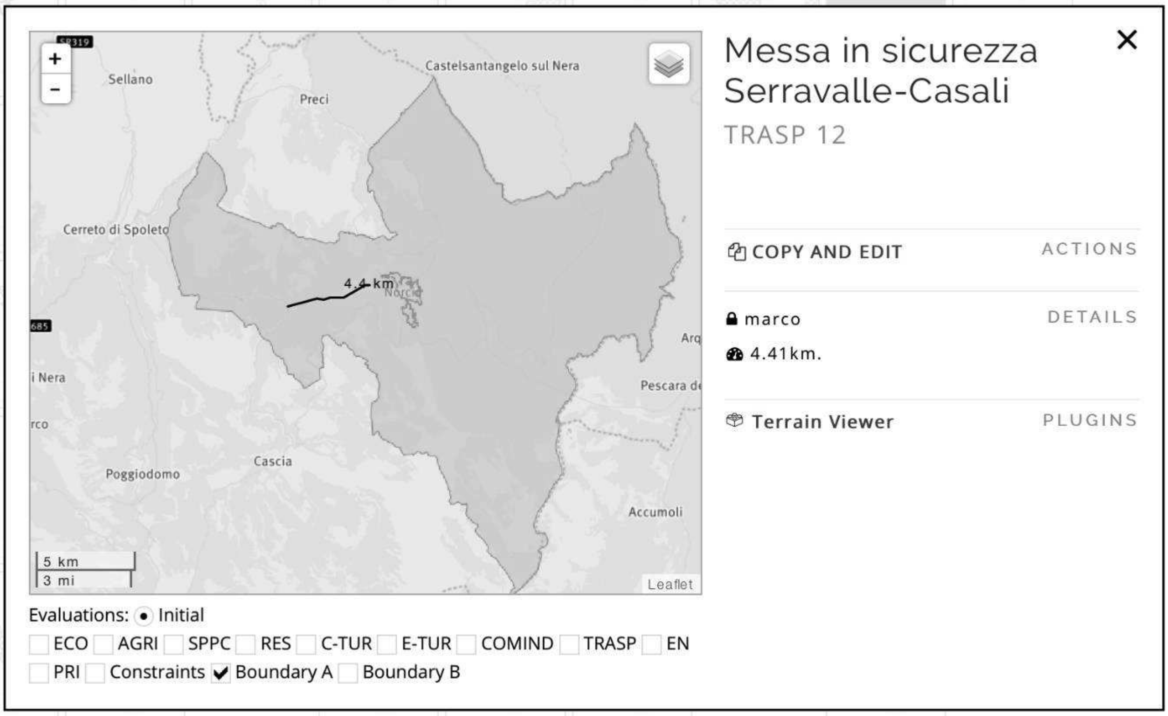


Fig.60: Safety intervention on road connection Serravalle-Casali. Source: Geodesign hub project interface.

8. EN

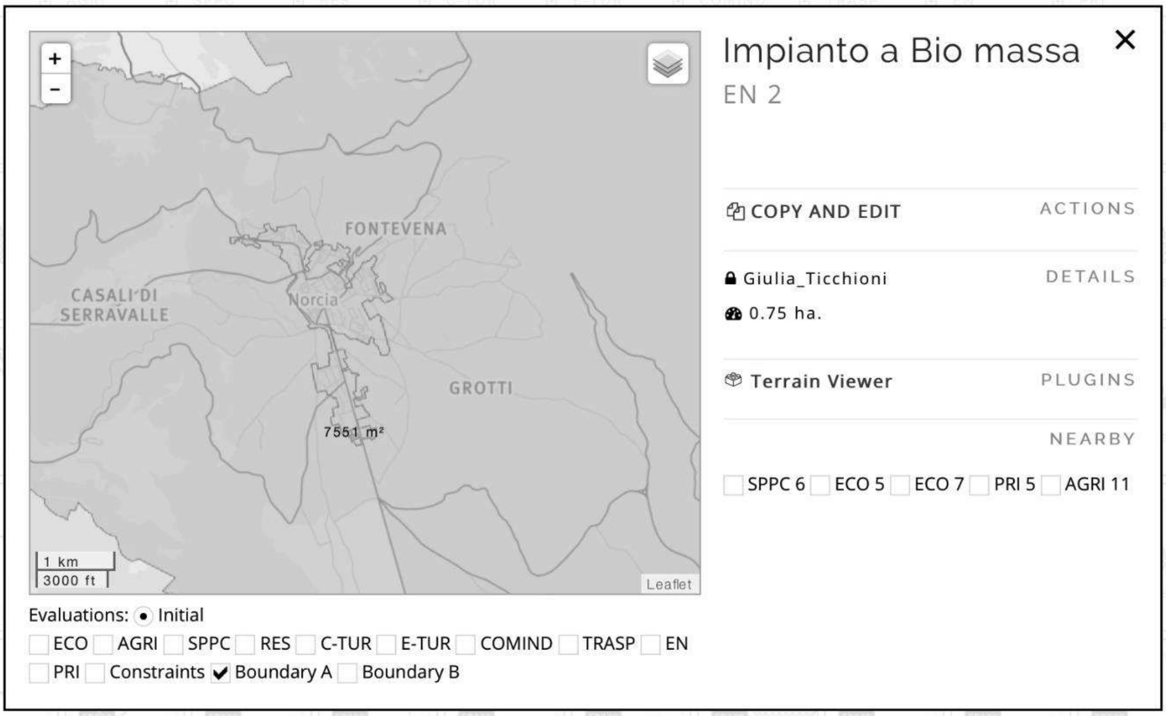
Biomass plant


Fig.61: Biomass plant. Source: Geodesign hub project interface.

Subsidies for solar panels

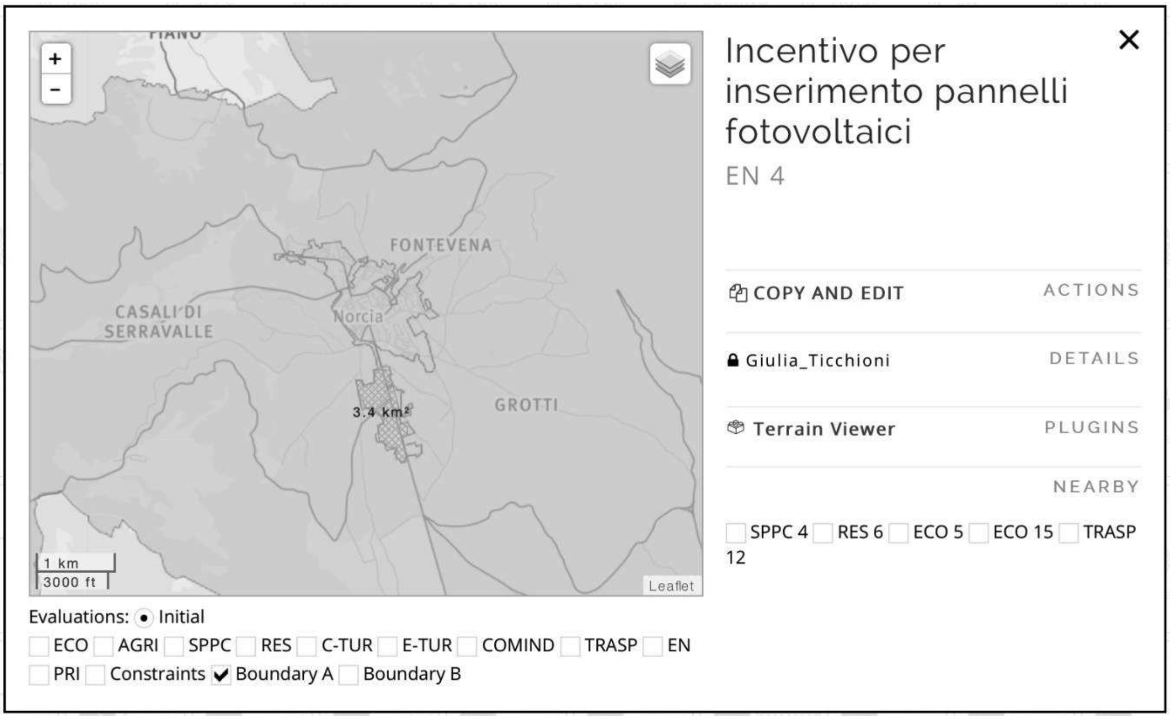


Fig.62: Subsidies for solar panels. Source: Geodesign hub project interface.

Wind farm

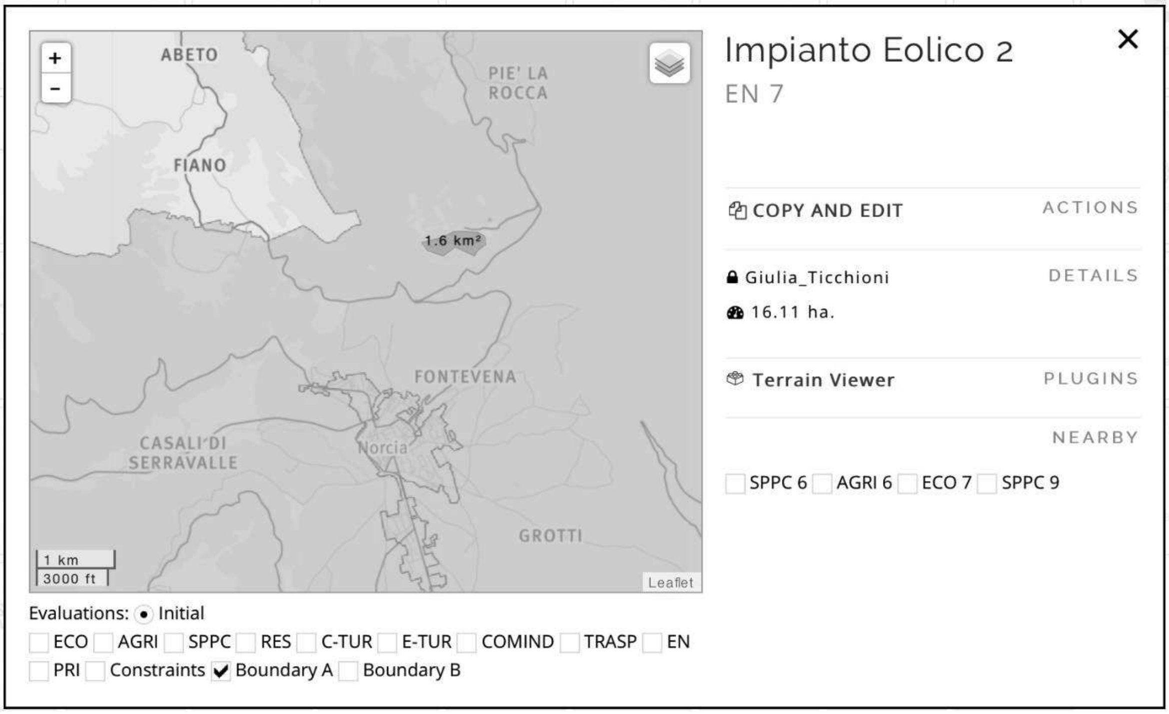


Fig.63: Wind farm. Source: Geodesign hub project interface.

9. PRI

Reactivation and improvement of driveability

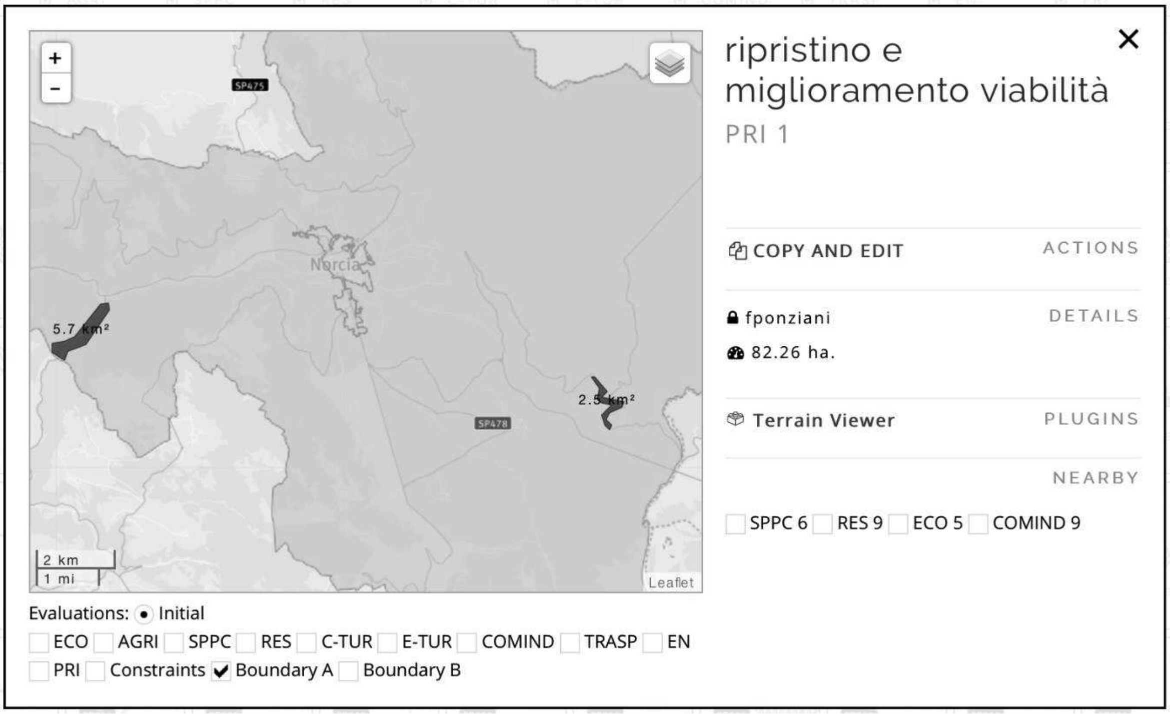


Fig.64: Reactivation and improvement of driveability. Source: Geodesign hub project interface.

Subsidies and incentives for productive activities

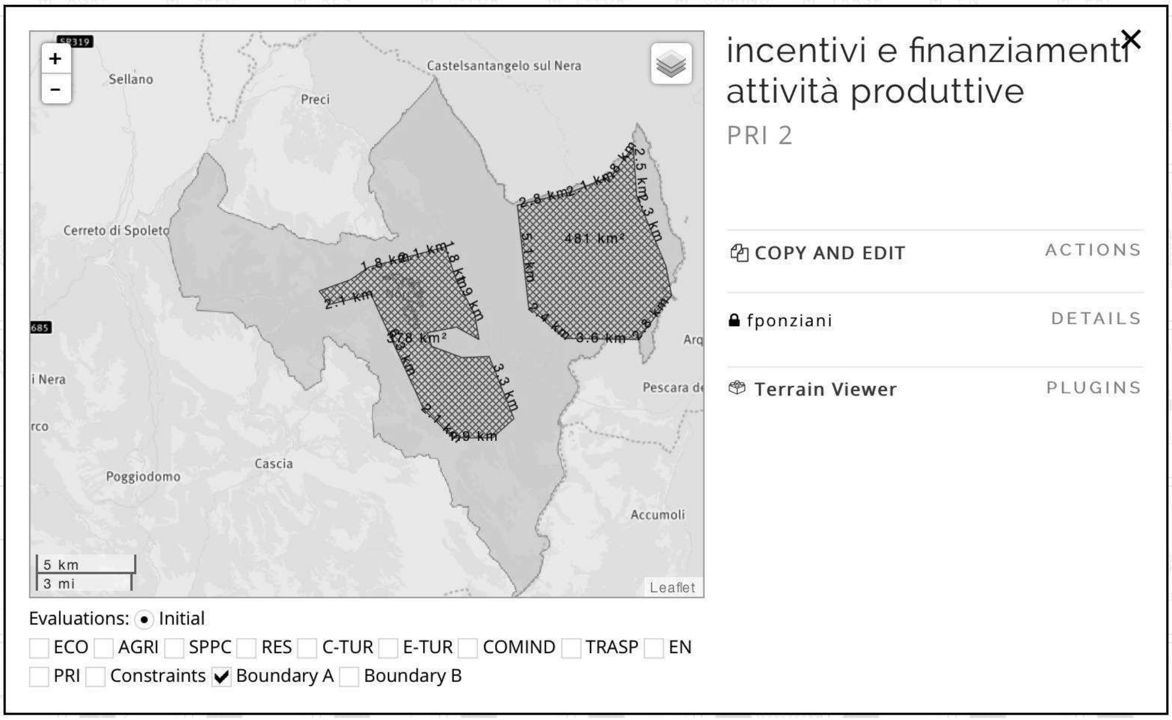


Fig.65: Subsidies and incentives for productive activities. Source: Geodesign hub project interface.

Microzoning and seismic risk reduction

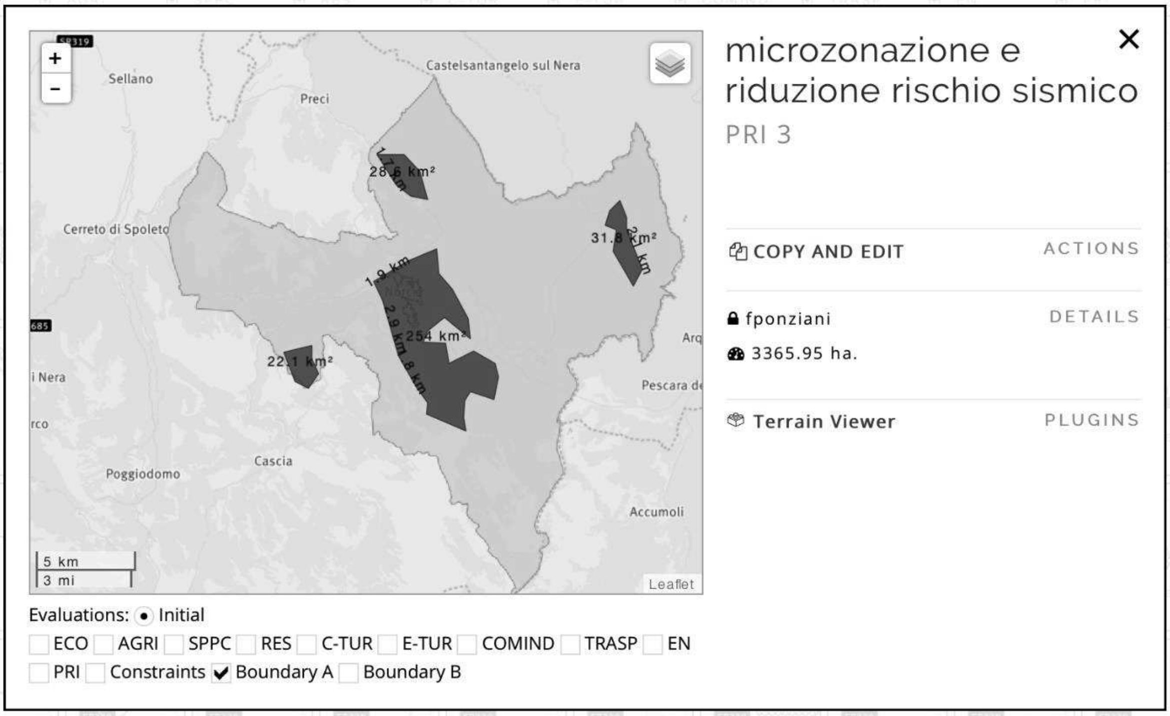


Fig.66: Microzoning and seismic risk reduction. Source: Geodesign hub project interface.

Civil protection plan development and share knowledge of seismic risk

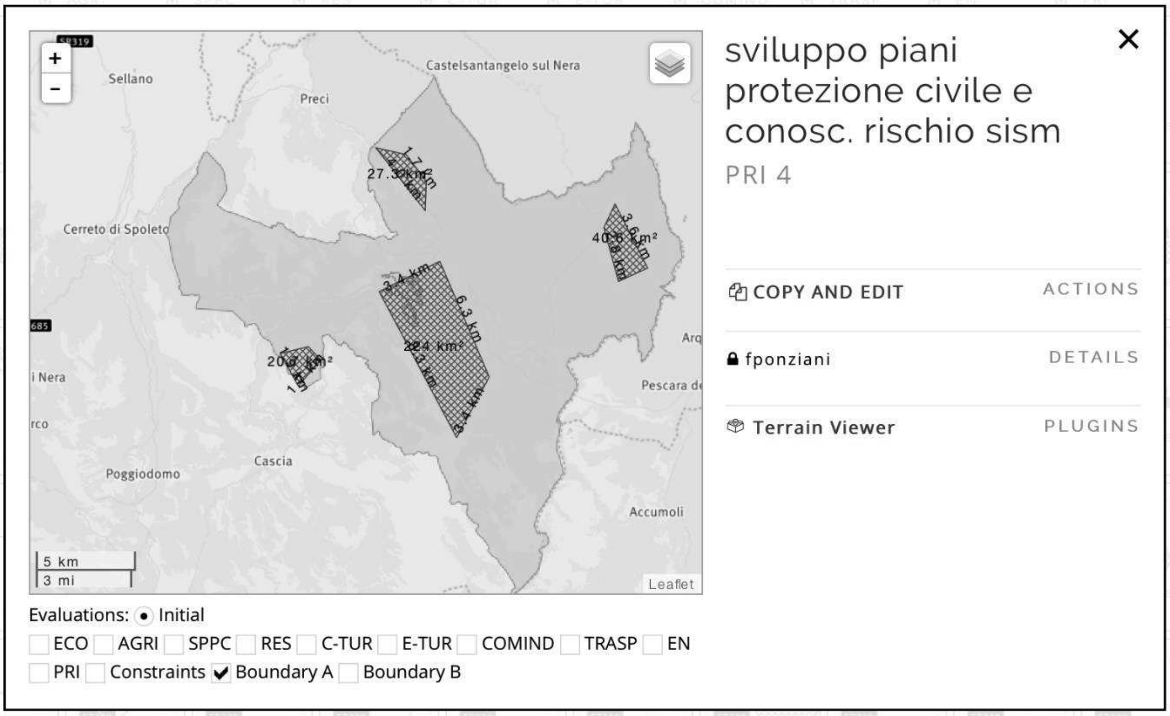


Fig.67: Civil protection plan development and share knowledge of seismic risk. Source: Geodesign hub project interface.

Development and empowerment of public transport

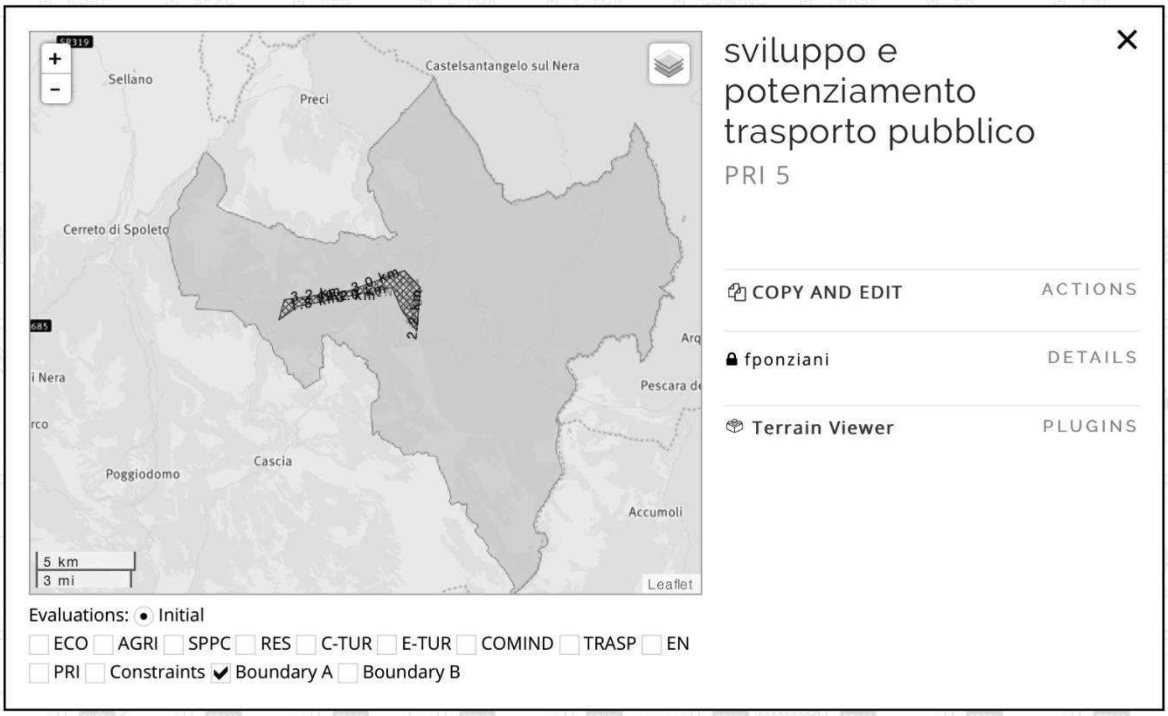


Fig.68: Development and empowerment of public transport. Source: Geodesign hub project interface.

Safety measures and employment of new hydro resource Torbidone river

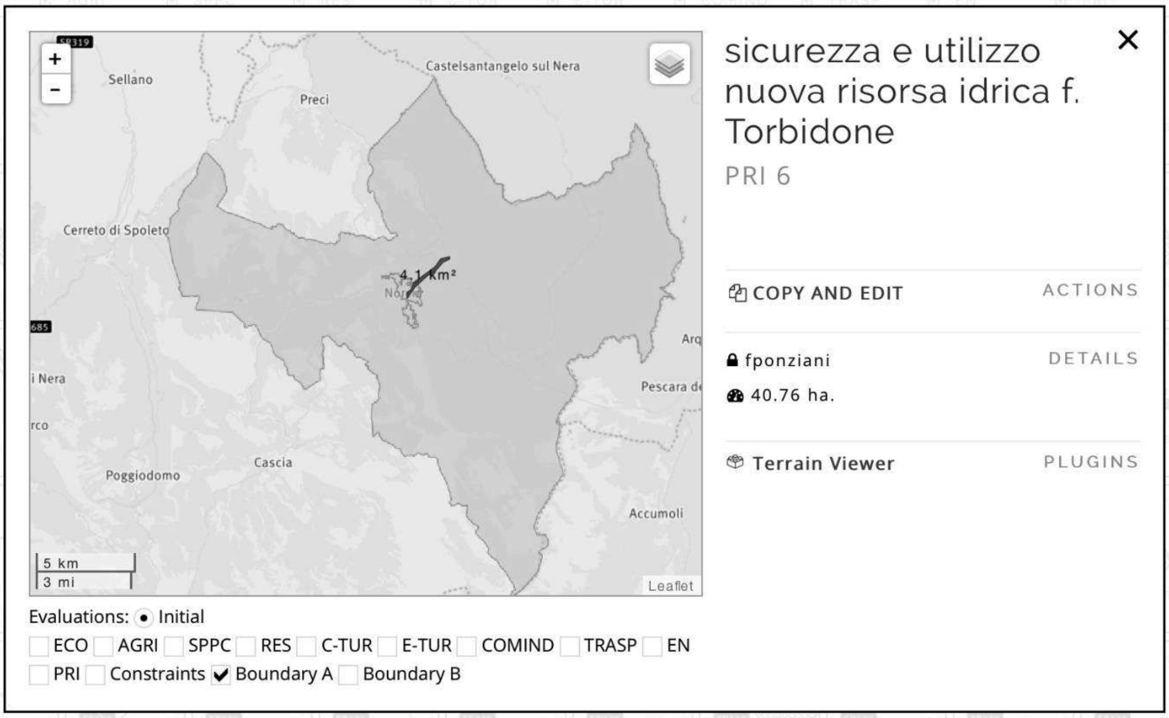


Fig.69: Safety measures and employment of new hydro resource Torbidone river. Source: Geodesign hub project interface.

10. E-TUR

Enhancement of local agricultural landscape

Fig.70: Enhancement of local agricultural landscape. Source: Geodesign hub project interface.

Natural and environmental education

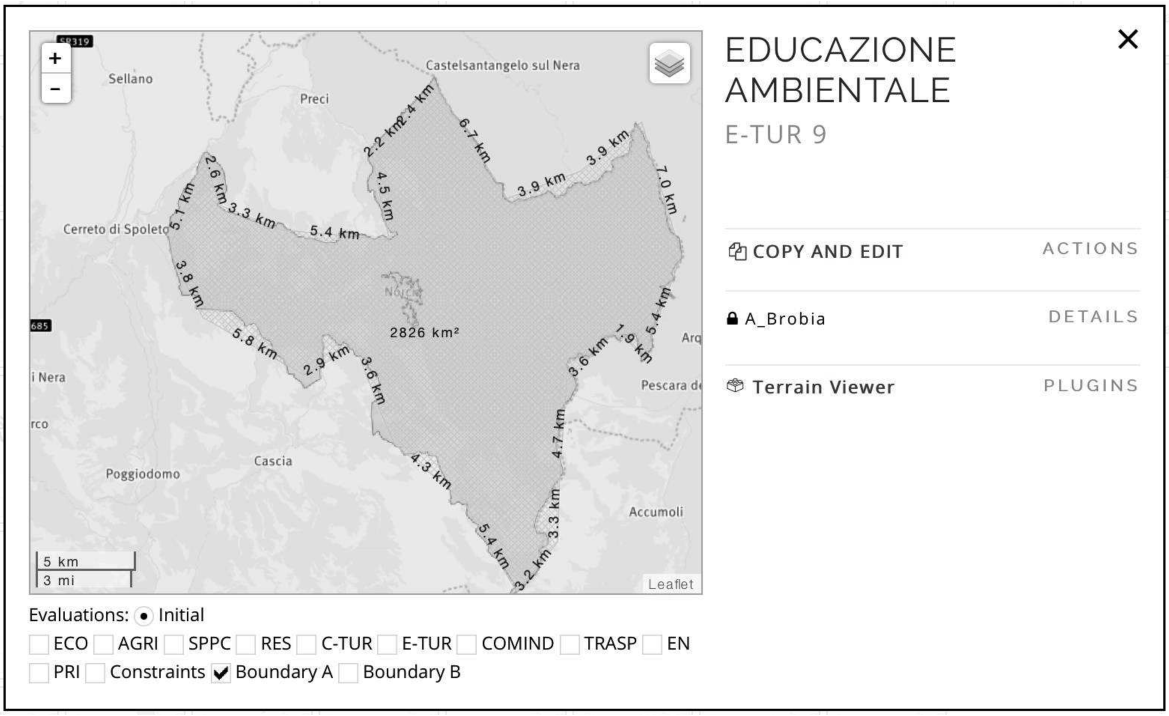


Fig.71: Natural and environmental education. Source: Geodesign hub project interface.

Territorial heritage itineraries

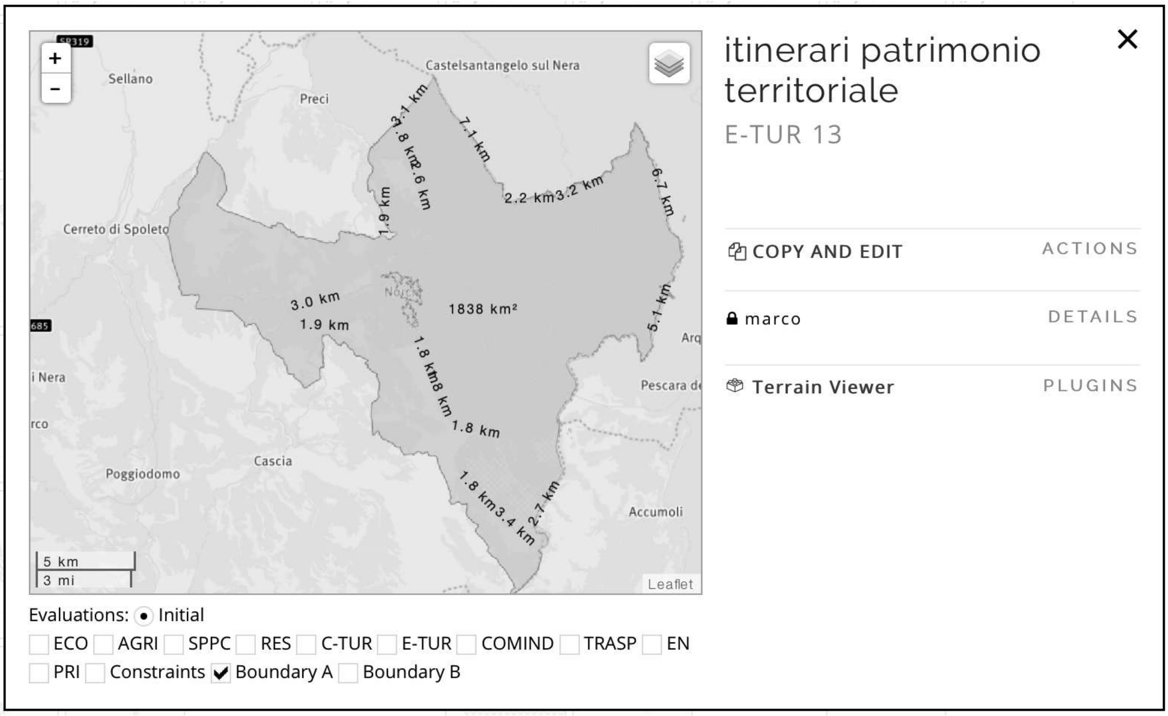


Fig.72: Territorial heritage itineraries. Source: Geodesign hub project interface.