Chapter

Moving Horizon, Design Praxis through Soil Transformation: A Landscape Manifesto

Vittoria Mencarini, Luca Emanueli and Gianni Lobosco

Abstract

Moving horizon was born as a doctoral investigation that moves across research and design dimension. It explores the relationship between landscape design and soil transformation, focusing on the mutual effects and potential disciplinary developments aiming at structurally linking the two fields. Soil is one of the most complex biomaterials on Earth in continuous exchange with the terrestrial systems. The starting assumption is that the soil is a condition of inherent shifting in landscape evolution both in physical and semantic relationship. The value of soil as an element of planning and design lies in handling live and dynamic physical matter. From being 'background' for the built environment, the soil transformations become the 'foreground' both in landscape design praxis and in theoretical implications, by embedding the soil as a 'palimpsest' in reading and writing the landscape. The framework produced by this assessment has been condensed in ten propositions, collected in form of a landscape manifesto. A first application of moving horizon approach has been developed and tested in the Ravenna Climate Change Adaptation Plan (Italy), by identifying a planning procedure capable of integrating territorial adaptation measures to climate change through an approach based on understanding and transforming the soil as a fundamental material of this process.

Keywords: moving horizon approach, landscape design, soil, adaptation, planning

1. Introduction

Soil is one of the most complex biomaterials on Earth [1] in continuous exchange with the terrestrial systems that together with the pedosphere make up our planet: lithosphere, hydrosphere, atmosphere and biosphere [1].

It behaves as an open, thermodynamic system highly responsive to inputs and outputs of chemical elements and energy [2]. It is divided into 'horizons' having their own physical, chemical and biological characteristics. Soil formation, the so-called pedogenesis, is the result of long processes of interaction between the elements that compose and interfere with it. As a result, soil is defined as a non-renewable resource in reasonable time [2].

Along the pedogenesis dynamism, the environmental conditions that determine the development and soil properties are climate, lithological substrate, morphology and relief, biota, time and also human activities. This last is described as the Sixth Soil-Forming Factor[1] [3, 4].

Echoing Logan's words, we suggest that 'A soil was not a thing … It was a web of relationships that stood in a certain state at a certain time' [5].

2. The soil as a palimpsest in reading and writing the Landscape

In western culture, the term landscape is the subject of several semantic discussions and interpretations. The erratic meanings refer to the terms which are treated by the numerous disciplines that affect the landscape and the aspects that make it up [6–14]. In the common and most widespread terminology, it refers to a portion of territory as it appears embraced by the gaze of a subject[2] [15–17]. In this establishment, it assumes a high degree of subjectivity, and hence, the landscape is perceived as a phenomenon [17].

Although they cannot give an univocal definition, the various interpretations of the term lead to the description of a place and to the interaction between the elements—anthropic and environmental—that compose and characterize it.

The sustained hypothesis is that this relationship is intrinsically linked to the soil shifting, creating ever new landscapes.[3]

This statement does not deny the approaches described above and finds support in the short essay drafted by the Austrian pedologist Peter Finke [18]. In 'Soil and Landscape' he affirms 'Soil is the part of the landscape that is less easily observed because it is below the surface. There exist however strong relations between the landscape that we see and the soil below. These relations exist because soil and landscape are affected by the same processes, and also because soils and landscape influence each other' [18]. In fact, these alterations define the spatial heterogeneity and the peculiarities. Therefore, the landscape is perceived in its diversity, even if this does not happen in a conscious way (**Figures 1**–**4**).

The discontinuity of edaphic factors contributes to the intriguing diversity of ecological patterns found in nature (**Figures 1**–**3**). Perception and spatial transformations are mutually linked and related to spatial arrangement in a symbiotic connection with soil shifting (**Figures 4** and **5**). They all combine to define the framework in which the discipline of landscape design stands and operates.

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1 Already at the beginning of 2000, Daniel Richter, a prominent soil scientist part of the Anthropocene Working Group, argued 'Humanity's expanding systems of food fiber, and water production are now entirely dependent on the management practiced on several billions of hectares of soil.' The Anthropocene Working Group (AWG) is an interdisciplinary research group dedicated to the study of the Anthropocene as a geological time unit supplementing the Holocene as first suggests by Paul Crutzen in 'Geology of Mankind' [4]—in which human activity shapes our planet more than nature itself.

2 Art. 1 European Landscape Convention: "'Landscape' means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Council of Europe, 2000).

3 This relationship between landscape and soil transformation can also be traced backwards by following the evolutionary trajectory of the term, which ethimologically meant an action operated on a site—characterizing it—through soil manipulation. In the Latin matrix 'pays-age' the term 'pays' derives from the Latin 'pango', with the meaning of delimiting by sticking pegs. In the Germanic root, 'land-schaft' refers to 'land schaffen', with the meaning of transforming a terrain. Over time, the literal relevance has charged with cultural values, which basically denote an identifiable tract of land influenced by human activities (even if it is simply the act of viewing). As such, in this approach, landscape literally describes the state of altered land as distinct from virgin land before human influence, rather than referring to the subject matter of physical transformations operated on the ground.

Figure 1.
Soil in natural condition at 2000 mt high, Brenta Dolomite (Italy), 2020. Source: author.

Figure 2.
Soil in anthropization condition at 1500 mt high, Brenta Dolomite (Italy), 2020. Source: author.

Figure 3.
Portion of non-cultivated field in Ravenna (Italy), affected by soil salinization, 2020. Even if the visual effect can be suggestive, salinization is considered a degradation factor in terms of soil health. Source: author.

Figure 4.
Valli del Mezzano reclaimed land, Ferrara, Italy. This satellite view shows the geomorphological element (sandy ancient alluvial meander) beneath the surface, in contrast with agricultural field pattern, in relationship to different soil texture. Source: Google Earth.

By putting the soil shifting at the center of the design scene, soil becomes a matter that moves over time and space under the action of environmental flows and anthropic agents.

The re-thinking of soil shifting as a primer for landscape design praxis toward a more open-ended and dynamic conceptualization, does not only affect our understanding of landscape on a speculative way. It also calls for a revision of the very

Figure 5.
Critical coastal area (actual situation); design arrangement for dynamic shoreline stabilization. Source: author, from SECAP 2020 Ravenna Authors. SECAP Ravenna 2020.

methods and procedures, we use to plan and design the territory[4] [19–22]. From being a 'background' for the built environment, soil transformations become the 'foreground' or primary order both in landscape design praxis and in theoretical implications, by embedding the soil as a palimpsest[5] [23, 24] in reading and writing[6] [25] the landscape.

[4] The concept of 'grounding morphology' emerges as the foreground, and the shaping praxis comes to define a common denominator between fundamental design aspects on several scales approaching territory to design. The most influential practitioners and theorists—in articulating and spreading the ideas of shaping landscape as a fundamental practice—are Charles Waldheim [19], James Corner [20] and Cristophe Girot [21, 22]. They do not directly refer to the word soil. They rather use 'terrain' [21], 'ground' [19, 20] and 'canvas' [22]. In many ways, these three concepts represent an extract of the original proposed research themes. Girot suggests to using a formal mathematical concept to think and design the landscape, by translating three-dimensional information into a two-dimensional surface (topology) [22]. For extension is reported a Girot's quote: 'Landscape is the canvas of multiple successive changes, and present-day modeling relates to this culture of change through sets of conventions and signs that eventually enable better choices on the terrain.' [22]

[5] Literary a 'palimpsest' is a manuscript or piece of writing material on which later writing has been superimposed on effaced earlier writing. The term comes from the Greek 'palin psaomai' and means scraped again. This word has been borrowed in other areas to allegorically express the act of rewriting and reprogramming something. According to Paolà Viganò [23] 'The metaphor of the palimpsest alludes to the meeting/clash between different times, endless modifications and transformations.' There is great convergence on the figure of the palimpsest. Architects, urban planners, landscape designers, sociologists and naturally historians of the city all seem to agree on the usefulness of the metaphor of the territory (or land) as a palimpsest [23, 24].

[6] In Ref. to James Corner suggestion in 'The Landscape Imagination' [25] "Landscape remains a profoundly imaginative project, requiring both a creative 'reading' and 'writing' of sites. [...] Here one might cite a movement from theory to practice, but it is more precise to recognize that both the writings and the designed works are in themselves projects, and they therefore share the same impulse: to project new possibilities for the field."

To make this effective, it is essential to have a systemic vision — made of visible and invisible connections — linked in an osmotic and symbiotic relationship that passes through soil envisioned as: a diaphragm, an environmental matrix, a project matter.

By proposing a critical rereading between theory and design praxis, the present investigation aims at improving the real impact of our disciplines on the topic.

3. Key to understanding, the soil as a living matter

The soil is an environmental matrix, formed by a highly variable mixture of minerals, organic matter, water, gas and microorganisms that interact with each other [2–4].

Richter [26] describes the soil as: 'the biomantle of unconsolidated material that makes life possible on planet Earth'. According to the researcher, soil is the hidden layer supporting our daily life. It is a great and extensive connective tissue, through which environmental networks spread and allow us to live our daily life as we imagine it today. The natural and the built environment are anchored to the ground through very complex relationships. The surface layer and the subsoil exchange matter, energy and information, in a sort of osmotic relation [27].

Soil-forming processes include atmospheric deposition of water, dust and solutes, mineral weathering, organic decomposition, pedoturbation, plant rooting, redox reactions, fire effects, chemical leaching and erosion. The combination of all these agents contributes to produce soil organic matter, organo-mineral complexes, secondary minerals, aggregates, clay skins, complex surface areas, soil pans and pore networks [26]. Many substances are stored, filtered and transformed in the soil including water, nutrients and carbon. Soil also provides a habitat for soil biota, and the preservation of its biodiversity is essential for maintaining processes and functions—like nutrient cycling, decomposition and bioturbation—thereby for maintaining a flow of ecosystem services[7] [1, 28, 29].

In this regard, in ecology, soil is considered the central processing unit of the Earth's environment [30].[8]

With humanity being nowadays the Earth's primary geomorphic agent, the quality of human life and the earth's environment have never been more related to soil management than it does today[9] [19, 27, 28, 33].

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7 Some ecosystem services [29] provided by soils [1, 28] include producing adequate quantities of nutritious and safe food, feed, fiber and other biomass for industries; storing and purifying water, regulating flows, recharging aquifers and reducing the impact of droughts and floods, thereby helping adaptation to climate change; capturing carbon from the atmosphere and reducing emission of greenhouse gases from soils, thereby contributing to climate mitigation; nutrient cycling supporting crop productivity and reducing contamination; preserving and protecting biodiversity by preserving habitats both above and within the soil; supporting the quality of our landscapes and greening of our towns and cities.

8 On the institutional level, the definition of the soil is not univocal [31, 32]. In the following pages we will talk about soil, meaning the thin porous and biologically active medium that represents 'the top layer of the earth's crust, formed by mineral particles, organic matter, water, air and living organisms. It is the interface between earth, air and water and hosts most of the biosphere.' [32], that can sustain the life of plants, characterized by its own flora and fauna and by a particular water economy.

9 The importance of soil protection is now recognized in international policy programs—such as AGENDA 2030, (SDGs ONU, 2015) or international scientific report, such as the Special Report on Climate Change and Land drafted by IPCC [19], the Report of the Mission Board for Soil health and food [24] drawn up by the EU [20] and FAO's report [33].

The President of the European Society for Soil Conservation, José Luis Rubio, thus clarifies the importance of soil in relation to major global challenges, echoing that 'Soil is a crucial link between global environmental problems such as climate change, water management and biodiversity loss' [34].

The new challenge facing soil science is how to create a policy to address its health[10] embracing the whole system instead of single soil properties or processes [1, 31]. As first conclusion, the value of soil as an element of planning and design [21, 22][11] lies in handling live and dynamic physical matter.

Soil is the vibrant matter that we interpret and draw up. Soil is alive and in continuous exchange. On very distant time horizons the soil itself compose and recompose its history and so ours.

4. The moving horizons approach

Starting from the proved correspondence between the soil transformation and landscape evolution, the approach named moving horizons has been traced for

- Increasing awareness, by exceeding human-sight sensing boundary and involving new spatiality across over-layered depths;
- Addressing the design workflow, in manipulating and transferring matter for performative grounds;
- Orientating the attitude in managing complexity, through a non-deterministic approach encompassing new parameters across the time-framed process.

The moving horizon approach implicitly criticizes traditional landscape practice's seemingly uncritical reproduction of stereotypical 'aestheticized' images.[12] It is not a question of rejecting or abandoning a formal and compositional language, but rather of encouraging a view that favors investigation and observation of reality in its different stratifications offered by embedding the soil as a palimpsest in 'reading' and 'writing' the landscape (**Figures 6**–**8**) [25].

The proposed approach is not a mere conceptual overcoming in a speculative sphere. It is rather presented as the attempt to concretely express the linkage between fixity and mutability features, capable of transcending the idea of still image. The horizon here is the line of the visible, a recognizable layer of soil and a time-framed process.

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[10] The soil health is considered as the most important, functional characteristic of any soil ecosystem service. The soil unhealth expresses its degradation.

[11] As evidenced by Girot on one hand 'This lack of understanding about terrain is quite typical of our modern age and has been detrimental to landscape in general, where it is always assumed that a site can be made flat to assume a program' [22]. On the other hand, Girot continues 'Understanding territorial continuity physically helps to better identify qualitative priorities in a landscape' [22].

[12] Over time the landscape appreciation has evolved. As we have seen through several examples from Corner [20, 36, 37], Belanger [38], Sjimons [39] and many others, contemporary landscape design approach is moving away from the ancient, controlled and Arcadian image, and it is embracing this new process framework of design.

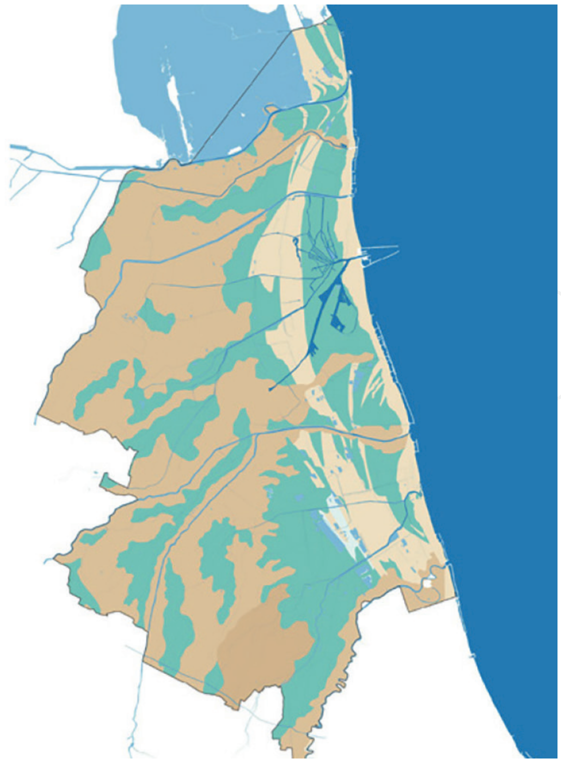

Figure 6.
Ravenna pedological units, used at the basis for understanding territorial asset and geo-pedological continuity. Source: Emilia Romagna GIS open source, author re-elaboration.

Figure 7.
Analysis vocation, reference pattern synthesis in south coast area, used as reference for landscape evolution. Source: SECAP Ravenna 2020.

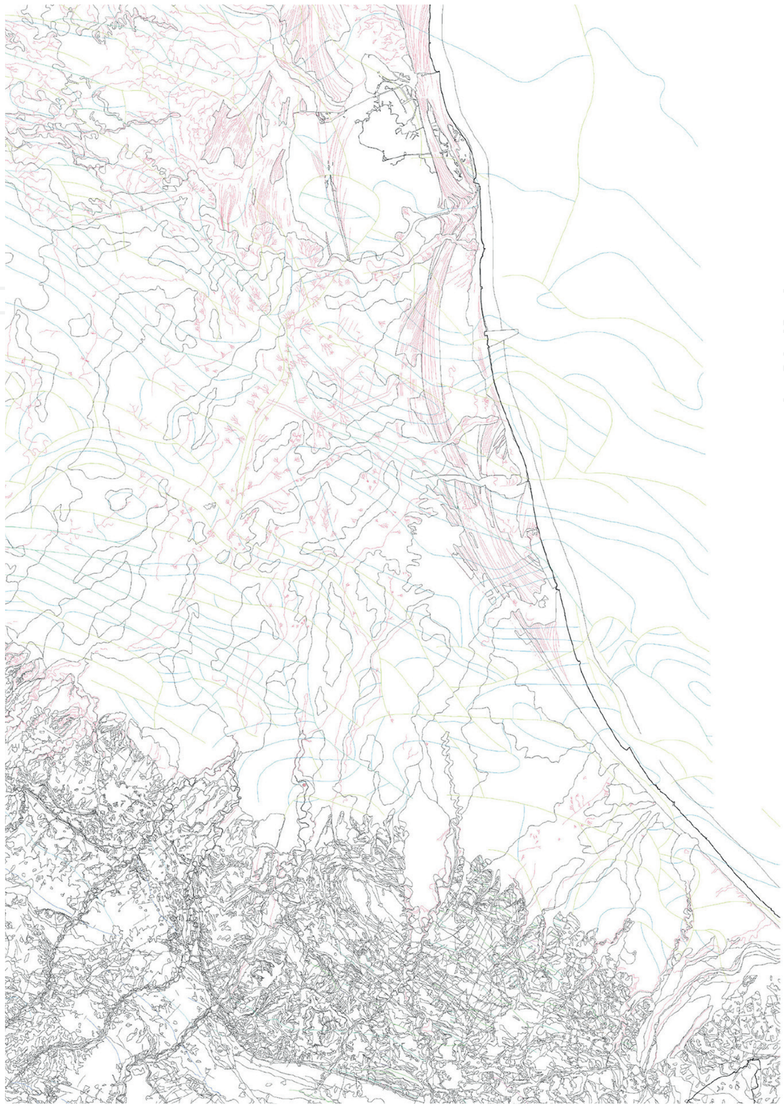

Figure 8.
Ravenna geomorphological units and isophreatic, used at the basis for understanding territorial underground asset and geomorphological continuity. Source: Emilia Romagna GIS open source, author re-elaboration.

The thesis methodology can be described as deductive process headed to set a model based on research by design. In this regard, research stand as 'development of new knowledge' and design as a 'counterintuitive thinking' [35].

The aim is to assist designers, scholars, and professionals involved in territorial transformations, as well as decision-makers, by elaborating and visualizing prospective landscape shifting on several scales.

5. Approaching planning and design scale

The mapping and visualization of data in design culture has changed both in relationship with the advancement of technology [19]—in bringing about the possibility of greater proximity between the real and its representation—and in the way of building landscape idea. The trajectory of representation—of concept and context—has moved from the material and physical description of the ground toward the depiction of unseen and often immaterial fields, forces and flows.

Moving horizons is an advance for mapping, manipulating, and designing with geospatial gaze, with the goal of transcending the flat[13] [19, 21, 22], static map into live documents that expand the representation of time and space—in order to better address the dynamic conditions for landscape project. The attempt is to develop a method capable of building a coherent relationship between planning and design scale, according to soil transformations.

The value of soil as spatial planning matrix lies in situating the parts in relation to the whole, by laying out the physical and spatial relationships at the dimension of a territory (mainly hydrogeological components both on surface both underground). The value of soil as design element lies in handling the physical dynamic matter, by preparing the ground across highly contextualized actions in terms of soil shape, coverage and composition.

Therefore, the interpretation of soil as a palimpsest[14] [30] requires a critical comparison between: (1) the pre-existing structural and perceptual hydrogeological arrangement to identify the valuable components and the main issues; (2) the current planning framework according to their systemic inclusion; (3) a diachronic and synchronic analysis of the territorial transformations according to plan predictions [40], to define management, requalification and valorization criteria starting from the critical points; (4) understanding about paleo-climates, biota, geomorphology, changes in geologic substrates and soil residence times; (5) incorporate ecological dynamicity, connecting biological, hydrological and pedological processes.

6. A first application: Ravenna Climate Change Adaptation Plan

A first application of this approach has been developed and tested in the Ravenna Climate Change Adaptation Plan [41, 42] (**Figures 5** and **6**), by identifying a planning procedure capable of integrating territorial adaptation measures to climate change through an approach based on soil's understanding and processing as fundamentals.

The whole research project for Ravenna assumes that climate change projections can only be described in probabilistic terms and over long-time horizons[15] [43–48].

Extreme events linked to climate change sometimes evolve at a speed that is difficult to manage with the current tools of planning. This may require anticipating the complexity of uncertainty by imagining the future through scenarios (**Figures 9**–**11**), relied on the comparative analysis of exploratory meta-projects stage. In such perspective, the two main attitudes explored deal with alternative perspectives on the soil management and transformation.

[13] According to Richter [30]: 'Understanding soils as polygenetic palimpsests requires much more understanding about paleo-climates, biota, geomorphology, changes in geologic substrates, and soil residence e times. While we can read the basics of many soils, we are far from understanding soil as an archive, and must realize that at some level the soil may always remain at least a bit shrouded in mystery.'

[14] For global sea level rise forecasts, reference data shall be based on studies from the Fifth IPCC Assessment Report [43] with time reference to 2100. These forecasts have been translated at a regional scale by ENEA [44], which estimated how many and which areas will be below sea level, and which are at risk of sea ingression [45–47].

[15] For climate data, Climate Projection Data Sheets 2021–2050 have been produced for homogeneous areas in the Emilia Romagna Region as part of the Regional Strategy for Mitigation and Adaptation to Climate Change, together with the ARPAE Climate Observatory and ART-ER [48].

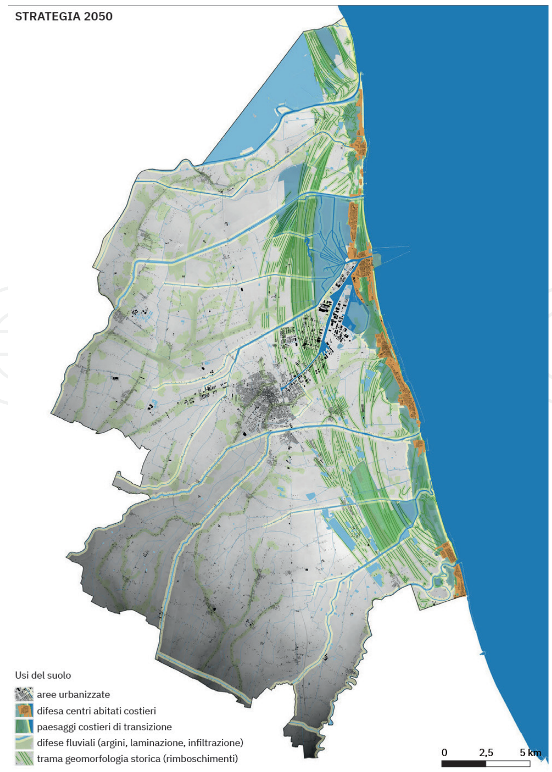

Figure 9.
SCENARIO TRANSFER 2050. Aerial view for Landscape evolution in Ravenna Climate Change Adaptation Plan 2020. Authors. SECAP Ravenna 2020.

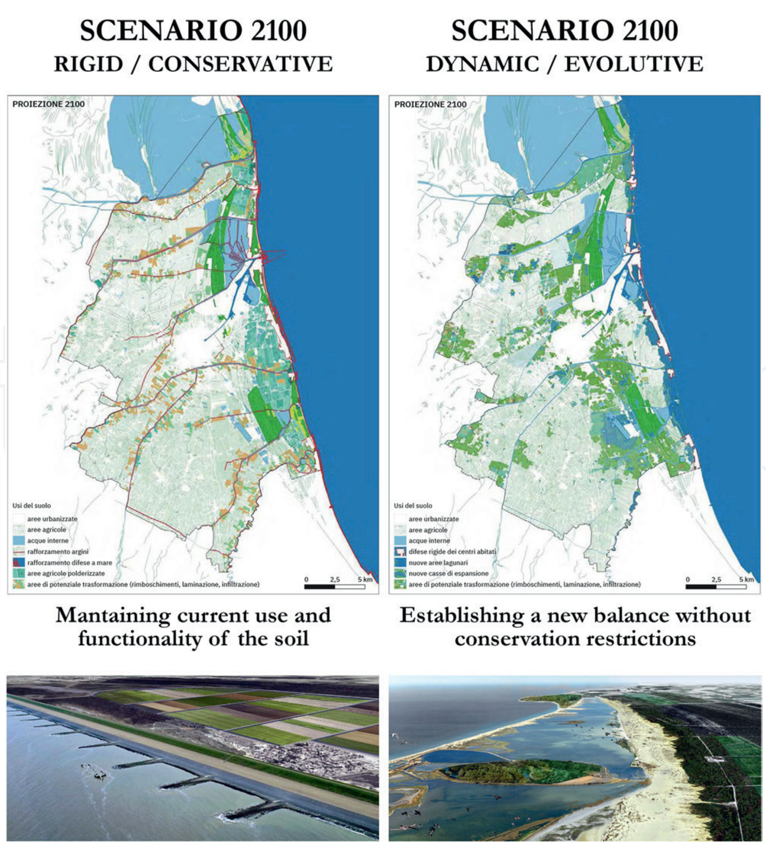

Figure 10.
Scenario's Reference: Preserving land use or accommodating geomorphological characteristics? Representation of the two phases of the adaptation strategy and the long-term projections summarized in the 'rigid' and 'soft' scenarios at 2100 (south coast area). Source: SECAP Ravenna 2020.

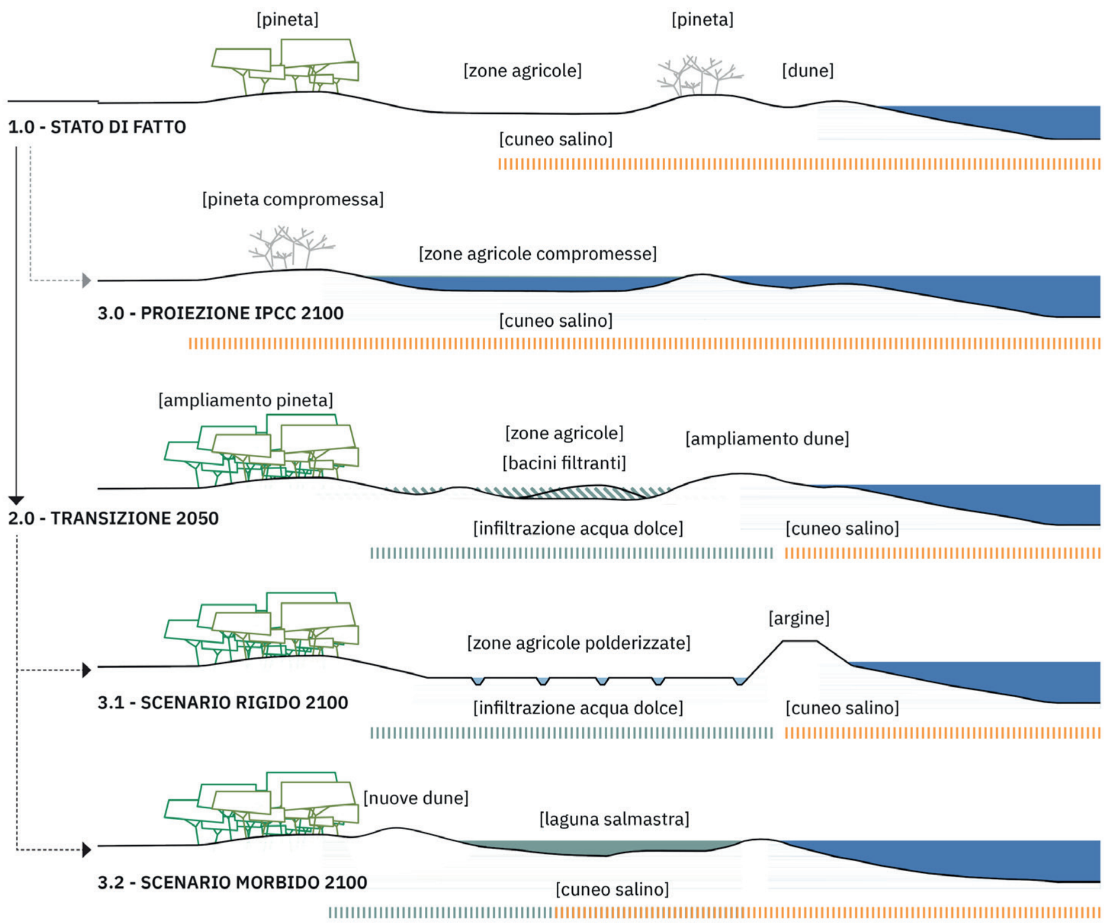

Figure 11.
Scenarios comparison through schematic section in south coastal area for landscape evolution in Ravenna Climate Change Adaptation Plan 2020. Authors. SECAP Ravenna 2020.

In a future Rigid Scenario, the priority of defending inhabited and productive areas aimed at maintaining soil use and functionality. Instead, the dynamic one landscape transformations addressed to establish a new balance between human and environmental systems, by assuming geomorphology as a referential state for soil-forming. The resultant synthesis—scenario transfer (**Figures 5**, **9**, **12** and **13**)—allows to represent in a more direct and better communicable way to the outside the consequences and the presuppositions of some actions on the territory.

The synthesis between these two long-run perspectives—both plausible in terms of scenario thinking [49]—results in an intermediate strategy, to be developed in the next few years, open to alternative futures.

The soil is strategically transformed into levels of essential infrastructures for an organic vision of the territory, capable of evolving in the space–time relationship. Thus, it acquires a new role following the international focus of adaptation to global challenges.

This step brings out the interdependence between spatial, anthropogenic, environmental and ecosystem aspects of the context, and how from these relationships arises the complexity of the city-territory system to which it refers, by considering soil as a primer in territorial arrangement. By analyzing this information through the cartographic study of biophysical and geospatial systems (geomorphology, topography, soil composition, etc.) (**Figures 6–8**), they have been reworked in the maps presented in the research and synthesized in some GIS cartographies through mapping overlay process.

Figure 12.
Scenario transfer 2050, South coastal area focus. Cartographic landscape evolution in Ravenna Climate Change Adaptation Plan 2020, supported by the geomorphological reshape and soil coverage. Authors. SECAP Ravenna 2020.

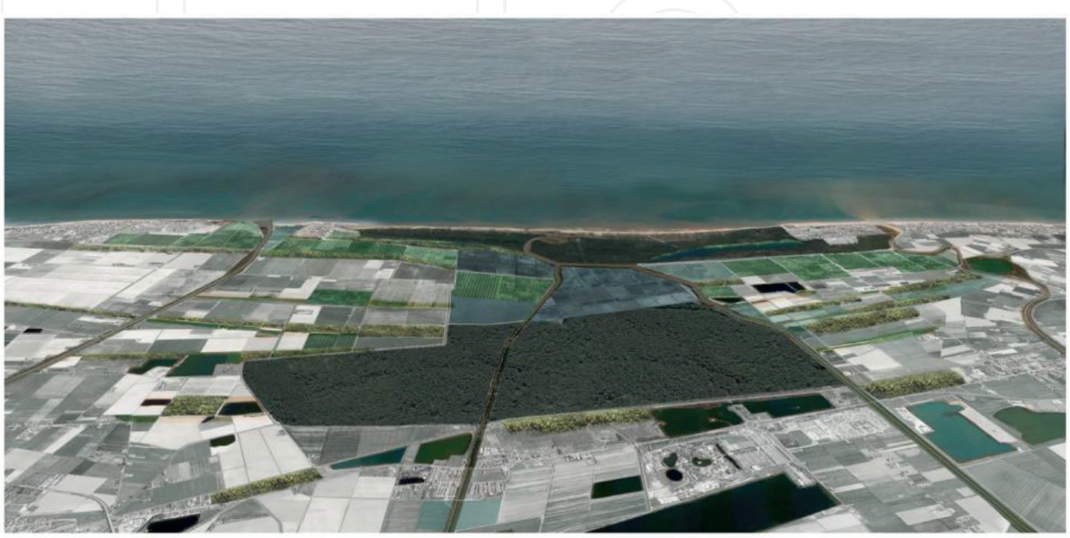

Figure 13.
Scenario transfer 2050, South coastal area focus. Aerial view for landscape evolution in Ravenna Climate Change Adaptation Plan 2020, supported by the geomorphological reshape and soil coverage. Authors. SECAP Ravenna 2020.

The evidence of this process lies in the identification of the transformation bands suitable to host interventions to increase resilient infrastructures and naturalness in those zones of friction between risks exposure, soil vocation and pressures, pointed out in the reference pattern outlined in the analytical phase (**Figures** 7 and **12**).

The related actions, as well as the overall approach, can be summarized in the propositions presented in the next paragraph in the form of a landscape manifesto.

7. A landscape manifesto

The strategy we have utilized in outlining the manifesto is the result of an effort to describe, in a simplified and understandable way, the soil as an emerging component of landscape complexity toward design praxis. Each statement is also inspired by the critical reading of transdisciplinary literature of prominent authors that are reported for each related point of the manifesto.

7.1 Screening the landscape imagery

Screening the landscape imagery since the landscape is not a passive scene anymore but is in fact an active working system connected to the human habitat, which it also supports [12, 13, 18, 21, 50–52].

The territorial structure is subject to a constant evolution, and so the aspect we perceive. Its components of fixity or dynamism are related to the vision and sharing of values that redefine the relationships between the parts in a logic of necessity. Visions that change in time along with the conformation that the territory are involved in an ongoing adaptation process that passes through the soil.

7.2 Crossing layer

Crossing layer refers to sharing information among manifold depths [52–56].

Landscape evolution does not proceed with regular continuity but is presented as a series of steps in height, age, value and size. The ability to driving decisions passes through the comprehension, codification and contextualization of those signs, signals and related meaning. Therefore, the model implies a series of steps that should bring to outline compressed and decompressed information that crosses the ground depths.

7.3 Crossing time

Crossing time refers to a diachronic and synchronic analysis of the territorial transformations according to plan predictions [57, 58].

In dynamic systems, we can only study and predict some behaviors of this process, but the real consequence can only be forecasted. The predictability is sensitive to initial conditions, and beyond a certain time it can no longer be predictable. Complexity of a system is not an internal characteristic, and it can only be analyzed and represented across time horizons.

7.4 Crossing scale

Because landscapes themselves are spatially heterogeneous entities, their structure, function and dynamics are scale dependent [20, 37, 59].

Scale generally refers to the spatial–temporal dimensions in which organisms, patterns or processes are recognizable. A worthwhile perspective can represent these different scales not as a nested hierarchy, but assuming the concept of multiscale. In this concept the global scale is not placed above the local one, but rather each scale is present and operates at the same time.

7.5 Building geography

We should interpret design as a geographic agent that is still focused on the physical configuration of human occupation of the ground [38, 57, 60].

The proposed approach foresees to first understand how natural processes and peculiarities, coupled with mankind activities, have contributed to mutually building geography, in terms of shaping territory and landscape, as the effects between these two forces, although reflexive to the spatially transcendent systems of flows and processes. Landscape design presupposes a reliable level of awareness in managing the aforementioned agents and a certain care about the consequences of the transformation impressed in a specific site by anthropic activities.

7.6 Grounding metabolism

Grounding metabolism suggests the need for a more explicit and systematic exploration of the geographical imprint of metabolic processes [60–63].

It interprets urban metabolism as an inherently geographic condition, investigating the possibility for a redefinition of the design context in a manner that can grasp both the fluidity of metabolic processes and their geographical engraving on the earth and soil, reshaping landscape. It builds upon an understanding of a contemporary design context that is not merely being upscaled but is in constant circulation through the weaving together of a multiplicity of variegated geographies.

7.7 Resetting spatiality

Every spatial arrangement is the product of structural information [12, 64–66].

Information has been considered as a basic property of the universe like energy and matter. Information refers to order, structure and organization. Moving materials and debris from one place to another for maintaining the status of human habitat means reshaping topography and creating new processes that lead to the creation of new topological and ecological patterns.

7.8 Shaping action

Design is envisioned as a series of actions that intentionally induce spatial alterations with the aim of putting in place a clear form of evolution [20, 22, 68].

The project is intended as a precise and sophisticated tool able to synthesize agents and complexities generating an alteration of place, and which the place itself will be able to metabolize through time and space. One has not to look for an appreciable formal composition in a still image, but rather has to seek the connections and relationships between the elements that make up a landscape, of visible and invisible components. Soil is the physical dynamic matter influencing these transformations.

7.9 From fragment to framework

Starting from the resolution of local issues through environmental specificities, soil is proposed as catalyst element involved in situating the parts in relation with the whole. The spatial configuration of contemporary territories is pervaded by the figure of the fragment and the dispersion. Reframing the soil as a palimpsest provides to detect the matrix of structural transformations approaching territorial scale to neighborhood unit. Thus, the fragments become framework components for a structure of connections, strategically transformed into levels of essential infrastructures as a qualification for an organic vision of the territory, capable of evolving in the space–time relationship by defining a direction of change [20, 21, 37, 69].

7.10 Processing possible reality

Processing possible reality affords the greater proximity to what exists and what is yet to come. In replacing natural dynamism and features, landscape design praxis should be addressed to take care of the impact of moving materials and energy flows and to analyze the design effects through several assessment scenarios. Simulating a field of possibilities offers the greatest closeness to the manifestation and manipulation of the ground itself, making the landscape present and vivid, as it exists and as it could be [19, 49].

8. Conclusions

As main conclusion, the study of literary sources combined with the study of concrete practical examples constitutes the basis for elaborating on the research objective and research questions toward an argued theory, which is not based on rigid consistency but on correspondences. The result is not the proof of a theorem but the discovery of an unexpected point of view.

The landscape design tries to interpret the contemporary needs in updating and adapting the territories to new challenges. The aim is to drive these values into the future by increasing the level of compatibility between the evolution of the human habitat and the maintenance of nature's regeneration times toward a novel esthetic.

The research offers a comprehensive and detailed overview on the topic without finalizing the debate on it. The lack of a specific bibliography and the high interdisciplinarity of the topic—landscape and soil—leads to this effort of creating a new approach, able to bring innovative contributions. For a matter of time and possibilities, the argument cannot be completed or ended but can be highly implemented both in speculative terms and in landscape design praxis.

Moving from theoretical frameworks to operational approaches is, however, still a challenge, for a number of issues, and one has to be aware that there are also difficulties for designers who want to conduct research by design. From an operative point of view, it can be deployed on more case studies in combination with parametric programs, and the interpolation of soil data could bring to design implementation and more effective and realistic forecasting in territorial transformation. Otherwise, the soil data and information basis are often not adequate—or it is at insufficient resolution, or it is contradictive—and the simulation tools that can be used to test the design hypotheses are not always as much reliable as needed.

Even if the recognition of the multifunctionality of soil was already present in the definition of soil quality, the difficulty of finding indicators able to describe this complexity remains a critical issue. Since soil data and simulation tools are constantly developed and their reliability is continually improved, their value for design hypothesis testing within research by design continuously increases.

The framework is flexible, in defining indicators and in calculating them. It can be used at different spatial scales and is capable to integrate new knowledge when available. In this view this framework opens new avenues for more research by design in the academic field of landscape architecture and environmental design in the future.

Nevertheless, for further implementation, William Bryant Logan work 'Dirt, the ecstatic skin of the Earth' [5] remains a good inspiration for those who are approaching to the topic: "We spend our lives hurrying away from the real, as though it were deadly to us. 'It must be up there somewhere on the horizon,' we think. And all the time it is in the soil, right beneath our feet."

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Since July 2021, Vittoria Mencarini has been working at the Municipality of Ravenna, as designer and building site director in Naturalistic Area office. She is also in charge to the SECAP dissemination and implementation. This work allows her to carry on applied research on the topic and to transfer the result of PhD thesis into reality.

Conflict of interest

The authors declare no conflict of interest.

Author details

Vittoria Mencarini*, Luca Emanueli and Gianni Lobosco
University of Ferrara, Ferrara, Italy

*Address all correspondence to: vittoria.mencarini@unife.it

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