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Landscapes and systemic design: Po river Delta (Italy) case

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Abstract In this work a model of regenerative systemic design was applied to the delta of the Po. The Po Delta is one of the most important ecological areas in Italy, (with over 370 species including resident birds, migratory birds and migratory birds) and the largest wetland in Europe, has been included, since 1999, in the list of Italian heritage sites by UNESCO and has been declared a Biosphere Reserve since 2013 by the UNESCO's Mab (Man and biosphere) program. Despite the economic development made possible by the biodiversity of the Po Delta, Italy and regions had not been able to guarantee in any way the environmental protection of the area. Pollution, aquaculture, fishing, climate change effects has become widespread in the area. A model of regeneration using systemic design is proposed.

Keywords: landscape ecology, landscape/seascape metabolism, geographical systemic design, regenerative design, blue economy

1. Introduction

Po Delta is World Heritage since 1999 and MaB Unesco Biosphere Reserve since 2015. In this area impacts of climate change can be easily predicted, it is clear that a more resilient landscape will be imperative if local society are to adapt and respond to the challenges of the future.

The needs of matching structural expressions of ecological integrity with cultural perceptions is particularly highlighted, by reference to the cultural bases for landscape perception and management (Nassauer, 1997), the landscape archetypes (Bell, 1999), and to the concepts of cultural and ecotone landscapes (Farina, 2006). These are examined for their potential role in creating a new synthesis of nature and culture.

Development of a realistic vision for Systemic Design in a regenerative landscape depends upon understanding the peculiar circumstances of its physical geography and biogeography linked to local history, culture and economic system (Bistagnino, 2011). The regeneration is based on scenarios of potential vegetation and hemerobiotic state of an area (the magnitude of the deviation from the potential natural vegetation caused by human activities, see Eurostat, 2017). The regeneration is also based on integration between Firms, Agricultural and wild habitats in order to reach a Blue Economy approach (Pauli, 2017).

The Blue economy concepts and the Circular economy agenda, as a set of strategic objectives, offer principles and guidance to identify blue economy potential for Po river Delta and its urban, landscape and coastal processes.

2. Methods

Robust ecosystems underpin resilience in landscape function. To achieve these, healthy soils, dune recover, better use and conservation of available rainfall, pragmatic use of vegetation and groundcover, and increasing biodiversity are key.

Following systemic design approach, the local economy will be based on:

- coastal landscape regeneration;

- production of new materials (paper, textiles, clothing, biodegradable plastics, paint, insulation, biofuel, food, and animal feed);

- increasing resilience to climatic changes, sea level rise;

- design a new production environment with a Biofactory system integrating food, material and energy production. Proposed system (based on rice, hemp, wood, weeds, and shells) can be

developed into a variety of commercial items including chemicals, paper, textiles, clothing, biodegradable plastics, paint, insulation, biofuel, food, and animal feed.

Analysis of the state-of-art and configuration of sustainable development scenarios have been performed by adopting the approach of Geographical Systemic Design: This allows local solutions to be addressed locally.

The priorities here are the enhancement of biodiversity and socio-economic growth, encouraging the possibility of carrying out multiple territorial functions based on sustainable development. Therefore, this area represents the possibility of experimenting with the sustainability and elaboration of proposals that realize this orientation for development, for the benefit of local communities.

Interviews and inspections have shown that the pivot of the context under study is the mollusc farming production system. Hence the hypothesis that:

- a) there is a potential for continual regeneration of the ecosystem
- b) the potential is linked to geographical, socio-economic, legal and planning factors
- c) the potential is spatially identifiable within specific areas characterized by factors

of dynamism

All these conditions can be considered as general feasibility conditions that reinforce the framework of spatial knowledge and provide input for designing regenerative strategies.

Regenerative model is linked to negotiated planning scenarios. This analysis has highlighted a sort of missing link in the planning system and territorial governance, in particular in relation to the following aspects:

- integration with other initiatives;
- cycle closure to avoid waste and waste;
- active role of primary sector operators.

With the help of the geographic approach, based on the use of GIS technologies combined with Systemic Design, a mapping of the local system has been designed, highlighting the links between the activities and the operators, which is the basis of the project proposal for regeneration of the territory with ecosystem value. The connections have highlighted new opportunities for economic, social and ecosystem growth in a logic that goes beyond the "input-output" scheme of the Circular Economy in the strict sense, outlining a strategy for transforming waste into precious resources to be reused at a territorial level.

In particular, the method applied to the study area highlights the opportunity for recycling the shells of the mollusc farming sector and the excavation sands of lagoon canals. Through the creation of a map of the places dedicated to regeneration, based on the reinterpretation of soil maps in terms of

potential vegetation superimposed on the information deriving from the real land use map, the research proposes an adaptive resilient model of application of the strategy " from waste to resource. The model as the goal to reduce pollution and waste of resources and to create the conditions for adaptation to climatic changes. The proposals are to apply on territorial areas that meet specific criteria are inspired by the "Blue Economy" case studies.

3. Results

We have also built some project proposals in details: they go in the direction of re-generating agricultural lands. They can be considered as a sort of business model, that means that the benefits by migration from business-as-usual to new ecological based business models has been defined, by given the numbers of economical value outcomes.

These are long-term solutions as we wanted to contribute to improve the resilience of the studied area.

Project proposals are inspired by the Blue Economy and can be summarised as follows:

The beach dunes and beach areas can be rebuild using only a reshaping of areas and beach management.

In the back-dune area the regenerate wetlands (dominated by *Phragmites australis*) will became a multifunctional ecotope, acting from water depuration to salt intrusion barrier. In this area a regenerative agriculture is also based in aquaculture waste recycling (Morris et al, 2018) is integrated into design of a new ecosystem mosaic: rice (*Oryza sativa*) - traditional in the Po river Delta agriculture landscape - and hemp cultivation (*Cannabis sativa*) can be integrated with phramites grooves and willow shrubs.

A *Quercus ilex* forests and psammophyl vegetation in coastal areas can be redesigned in rural landscape. The dunes can be built as is mainly due to successional stages linked to it, herbaceous vegetation of grey dunes and mantles using mollusc aquaculture waste (production of calcareous shells from *Mytilus galloprovincialis*, *Venerupis decussata*, *Tapes philippinarum*).

The rice and hemp will be integrated with grassland with *Vicia faba var. Minor* in order to regenerate agriculture and integrate it with pasture activities (*Ovis aries*). Pigs (*Sus scrofa domesticus*) will be growth in new woodlands (*Quercus ilex* forests).

Some of the benefits of proposed scenarios include:

- Reduction of flooding and sea storms risks.

- Effective erosion control.

- Reduced water consumption.

- Reduced maintenance costs and increasing local growth economy.

Increased natural capital and ecosystem value.

Elimination of chemical use.

Reduced visual impact of development.

Better soil conditions due to the use of native plants.

The regeneration is based on a potential ecosystem assessment (at scale of 1: 50,000). The model individuates 7 homogeneous fields (potential vegetation):

Homogeneous area "a" - Potential vegetation of lagoons and fishing valleys.

Homogeneous area "b" - Potential vegetation characterized by a mosaic of vegetations linked to the different water availability.

Homogeneous area "c" - Potential vegetation of the white, stabilized and fossil dunes.

Homogeneous area "d" - Potential vegetation of soils with good water availability but well drained.

Homogeneous field "e" - Potential vegetation of the soils with partial stagnation of water.

Homogeneous field "f" - Potential vegetation of sub-salt soils.



Figure 1. Map of regeneration places. Outcome of the Geographical Systemic Design approach. Localisation of the solutions.

The test verifies the hypothesis on limited portions of territory, in correspondence with the application of the proposals of 1%, 5% and 10%, or providing respectively total conversion areas of 73,04 hectares, 365,22 hectares and 730.05 hectares in the three scenarios.

Within this test the ecological connectivity is improved (from 10% of connected areas to 33%), and the carbon stock in soil is 120 tonnes, 540 tons and 1400 tons in the 3 scenarios.

Identification of regenerative design proposals, as a result of the study of the vegetation series, has allowed to outline a scenario of sustainable and resilient development of the territory that requires appropriate land management, in order to promote the conditions for the enhancement of biodiversity and of socio-economic growth through multiple territorial functions for the benefit of local communities. Geographical Systemic Design approach, based on the use of GIS technologies combined with the Systemic Design, maps of the local system. The model designed, highlighting the links between the activities and the operators, which is at the basis of the project proposal of regeneration of the territory with ecosystem value. The connections designed in the area under study have highlighted the opportunity to recycle the shells of the mollusc farming sector and the excavation sands of lagoon canals to be used as resources in the implementation of interventions in places dedicated to regeneration. Inspired by the Blue Economy case studies, the proposed solutions have highlighted new opportunities for economic, social and ecosystem growth in a logic that goes beyond the "input-output" scheme of the Circular Economy *sensu strictu*.

4. Conclusions

In Po Area regenerative coastal landscapes are proposed. Those landscapes are that restore the environment and encourage long-term sustainability, increased biodiversity, and enhanced resilience. A well-designed regenerative landscape can also complement property value, reduce water and maintenance costs, and create seamless, yet visually pleasing, harmony with surrounding natural open spaces.

The path that leads to the drafting of the hypothesised Adaptive Regenerative Plan based on the "waste to resource" strategy can be explored through the following steps:

- Phase A - Identify the main actors of the territory;
- Phase B - Analysis of the starting situation through systemic diagnosis, according to the Geographical Systemic Design approach and identification of the opportunities deriving from the circulation of waste materials, for key sectors, connected through material flows;

- Phase C - Definition of the expected strategic vision. All options must be identified and evaluated, taking also into consideration possible initiatives of similar territories;
- Phase D - Drafting of the actions of the Plan, by sectors and skills, through the definition of actions to be carried out in the short / medium / long term, taking care to envisage any risks and opportunities for each of them;
- Phase E - Implementation of the Strategic Plan, through the planning tools, favoring the adaptation of the already existing ones;
- Phase F - Evaluation of the results of the implementation of the strategy through a Monitoring Plan able to provide in good time the inputs to adapt the Plan adopted on the basis of the observed results.

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