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Mountain Water Management through Systemic Design: The Monviso Institute real-world laboratory

Carraro, Francesca, Barbero, Silvia and Luthe, Tobias

Mountain water management through systemic design: the Monviso Institute real-world laboratory

Francesca Carraro, Silvia Barbero, Tobias Luthe

This research deals with the sustainable management of water resources in rural areas, through the study and design of integrated water systems in a mountain environment. The work promotes a new model of sustainable use and treatment of water in a real context, created to be experimented by the public, by the research center and born from the need for the development of a new environmental activism, based on conscience and awareness. Thinking across scales of space and governance, a scalable and replicable system is outlined, based on cooperation between local actors, addressing current tensions while thinking of long-term effects. The trans-disciplinary approach joins systemic projects from different fields, brought together to model a single cooperating system. We outline the regenerative water management model at the campus of the MonViso Institute, a real-world laboratory advancing sustainability and regenerative design in the Italian Alps, as an illustrative case for the design of regenerative water systems.

The delineation of the project came to life thanks to a careful initial research phase, which clarified the identity of the chosen site and the local culture. These were the foundations for the design project of water systems on campus, applying the development of natural technologies, creation of connections and circularity as of reusing water and nutrient flows. The interaction between the components highlights the desired dependence between one and the other, which generates the value of the whole system.

Keywords: Water systems, Cross-scalar design, Systemic integration, Real-world laboratory, Water experience

Introduction

The progressive water scarcity at world level raises problems related to the appropriate resource and its close correlation with the mountain areas, the main suppliers of water also for the rest of urban areas, paying particular attention to the need for responsible and conscious management. It is necessary to consider the good governance of water in the mountains not only as a fundamental pillar for environmental protection and sustainability in the use of natural resources, but also as a decisive element for social, economic and productive wellbeing and for regeneration (Viviroli et al. 2011). By developing a sustainable water management system in the mountains, the MonViso Institute is considered a real-world illustration able to demonstrate the effectiveness of the proposed system, which includes systems for retention, storage, purification and circular reuse in a systemic whole. Each element has been studied in detail about its functionality and in the interaction with the entire integrated system, generating a network of connections and practices aimed at a correct use of the water resource and preservation of the related ecosystem services.

The design is developed starting from the main architectural structure present on the campus: the "Doppio", a duplex passive net-positive wooden house, the first re-built structure out of six abandoned stone ruins. We define water systems for internal use, purification systems, studying the availability and storage of water through the use of systems linked to natural principles and local materials, creating a close link with the territory and the environment in which it is located. The project is developed through the implementation of the management system of the MonViso Institute site and rises to the description of a possible scenario given by its application, within the valley in which the campus is located, to highlight its benefits and spread awareness.

In this paper we analyze technical, social and economic aspects through the study and visual representation of the various phases of research and design. The real interaction with the campus, the various actors and the institutions involved in the design represent an important element for the advancement of the research, giving way to the birth of collaboration and interaction with significantly impacting realities for the project, such as for the community and the local territory.

Hydrological systems are often conceived as a small component of a vast global complex. A holistic perspective is able to take into consideration the existing internal relationships and the interfaces of the various subsets, including the social, economic and institutional ones, perceiving water as an integral part of the (social) ecosystem itself. It includes quantitative and qualitative aspects, ground and surface water, which can be preserved by an improvement in sustainable water use patterns, by conservation and by minimizing waste. A fundamental role is also identified in the proper management of the soil and landscape planning, which are partly responsible for the increased pollution and eutrophication of water resources.

Project setup

This systemic design project dealt with an interconnected process, in which the retention, filtering and purification elements are integrated in a circle of use with the intention of using the water in a transitory way, re-introducing it purified at the end of the cycle into the environment. The system displays a new way of experiencing water within a mountain campus, avoiding the exclusive use of drinking water and taking care of the correct disposal of the water used, before returning it to nature. This is made possible by the participatory approach of the project, which includes workshops of creation and comparison. Furthermore, the layout of the technologies and the creation of "viewing areas" were studied, where visitors can consult their operation and guidelines. The campus under consideration currently has a single building built, treated by the research as a pilot project for the next buildings of both the MonViso Institute, the community of Ostana, and the surrounding valley.

The building scale water system

Focusing on the challenges related to the water resource inside the houses, it is appropriate to highlight the percentages of water consumption and usage types in the home, which, due to the hygienic-sanitary regulatory constraints, must use drinking water to be carried out. From an ISTAT (Istat 2020) research on domestic consumption emerges the differing usage in two almost equivalent halves: those that must necessarily come into contact with the inhabitants and those in which this does not happen, for which the use of non-potable water is sufficient. A rainwater tank collection system was designed for the use of the toilet and washing machine drain. The grey water of the system is conveyed into a tank specially designed and reused for the discharge of services, or purified through phyto-purification and used for irrigation.

By implementing the proposed model, a reduction in drinking water consumption is estimated from 160 liters per day to an indicative average of about 40 liters, thanks to the addition of 44 liters of grey water and 35 liters of rainwater.

This is made possible thanks to the use of:

- Jet reduction systems

- Rainwater accumulation systems

- Grey water reuse systems

- Purification systems

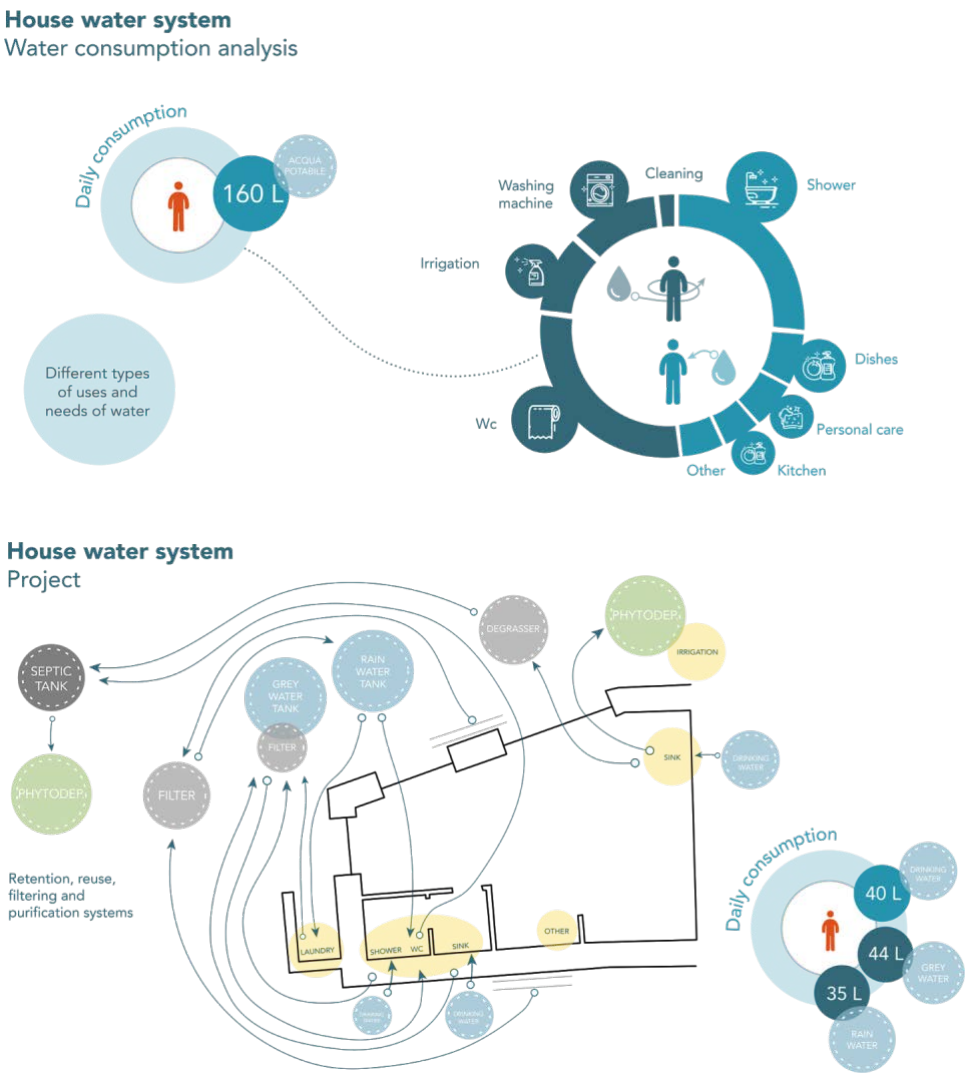

Figure 1. Graphical scheme of the designed water system (Carraro, 2021)

Purification system

The 40 liters of water estimated for the daily use per person within the campus are treated internally.

In particular, the black water (i. e. coming from the toilets) is conveyed through pipes up to two remotely positioned septic tanks. Here the first wastewater purification process takes place, composing the waste and dividing it into solid and liquid materials. The liquid one, after exceeding the capacity level of the pits, is generally poured into nature or into a river body. This practice is rather harmful for the territory, since septic tank water is contaminated with high concentrations of nitrates, phosphates and other harmful components, which, when pouring into the soil, lead to its progressive eutrophication. In this regard, a natural plant-based purification system has been designed to be positioned after the septic tanks, to purify the water that comes out of it.

The chosen purification system is a phytodepuration plant. This technology requires that the wastewater is purified using a waterproofed basin, in which several layers of gravel and vegetables purify the water flowing into the gravel bed, coming into contact with the roots of the plants in the system. This wetland system extracts the pollutants present in the water without the use of additional energy and electromechanical parts, a simple, reliable and regenerative system.

To achieve water circularity demands that purified water returns to nature. In our design we emphasize the ability of the selected plants to improve the conditions of the soil and avoid the overflow of sewage harmful to the environment. The choice to reuse the treated water falls within the guidelines of the project and coincides with the creation of a circular system, where the waste of one process is essential to be able to implement another. In

this case, the purified and revitalized wastewater from the innovative stone sculptures “flowform” (https://flowform.org) is rich in nutrients, providing an excellent water resource for fields and gardens. A flowform sculpture is a sculpture capable of exploiting the self-cleaning properties inherent in water, its rhythm and chemical-physical qualities. Water passing through these sculptures forms infinite curves, which allow the water to purify itself (Spencer 1995).

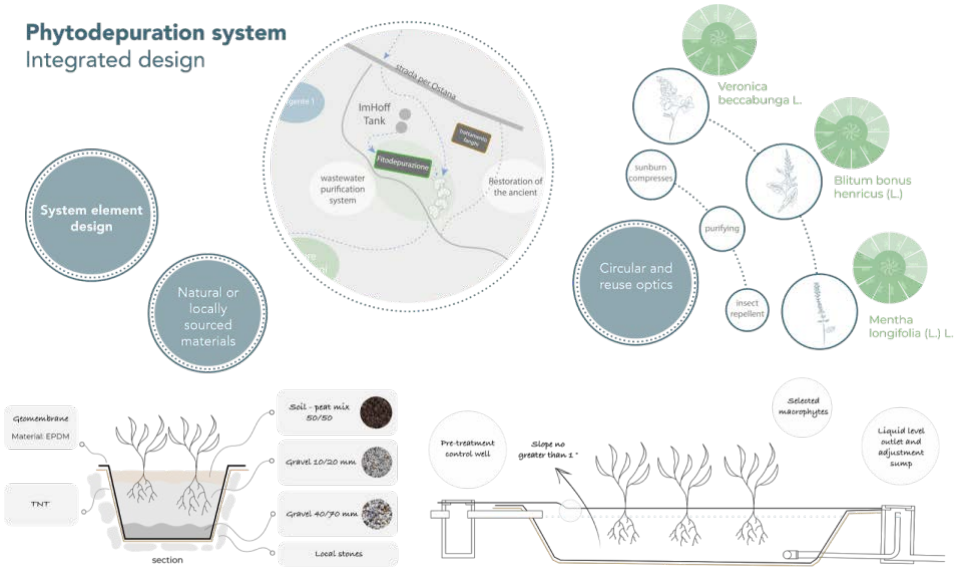

Figure 2. Graphical scheme of the designed phytodepuration system at Monviso Institute campus (Carraro, 2021)

Natural swimming pond and water reservoir

Among the systems developed and designed in this project, the design of a natural swimming pond and water reservoir stands out. This element represents an important factor for local biodiversity and for the availability of water in case of fire in the area. The humidity of the valley suffers in particular from progressive climate change, manifesting in the decrease of wetlands as natural environments necessary for the protection of local biodiversity.

The planned pond covers an area of approximately 100 square meters. The design started from the need to create three distinct areas of the natural pool:

- bathing area

- area for phytodepuration

- walkable external area

For water purification, the integrated phytodepuration system was chosen to create watercircularity without the use of a pumping system. In the construction of a bathing pond, biocompatible engineering techniques are used, avoiding overbuilding interventions. By adopting a sustainable approach based on the principles of the circular economy, natural materials such as local stone and wood were preferred for the construction of the constituent elements, fully embracing the philosophy of the MonViso Institute and recovering them on site, using natural stones and untreated wood, ensuring an organic effect with the surrounding environment and a methodology that is careful to reduce waste.

The location of the pond adheres to the extreme temperature range from hot summers to winters with temperatures down to minus twenty degrees Celsius which the selected plants have to deal with. Native plants have been selected that are used to an alpine environment, resistant with deep and well developed root systems, a high growth rate, non-toxic or pests and aesthetically attractive (i.e. visual blossoming). A key feature was to take into account the possible use of flowers and leaves of the plant species for the creation of products such as natural

spreads or washing detergents directly on campus. Embracing the philosophy of the MonViso Institute as of systemic design, the use of herbs and overall plant systems for the organization of workshops to spread principles of circularity are considered important to guests and outsiders.

The main water supply for the pond is a spring on the land of the MonViso Institute. The spring is connected to the pond through a diversion system for the course of the water flow, which branches off to a diversion pit. The water flowing out of the pond is joining the wetlands below, fundamental for the protection of the local biodiversity as a key point during each step of this systemic water design project.

The entire water management, also in the design of the system linked to the management of the pond, is based on the principle of the correct and responsible use of the water and the springs, which were included in the project without any purpose related to the exclusive consumption of the resource. The water passes through the pond, is being used as biotope and for humans to swim, being purified by the phytodepuration system and the flowform sculpture, and is then poured back into nature.

Once outlined all the elements studied for the generation of the system, a gigamap has been created and designed to define all the connections between parts and technologies.

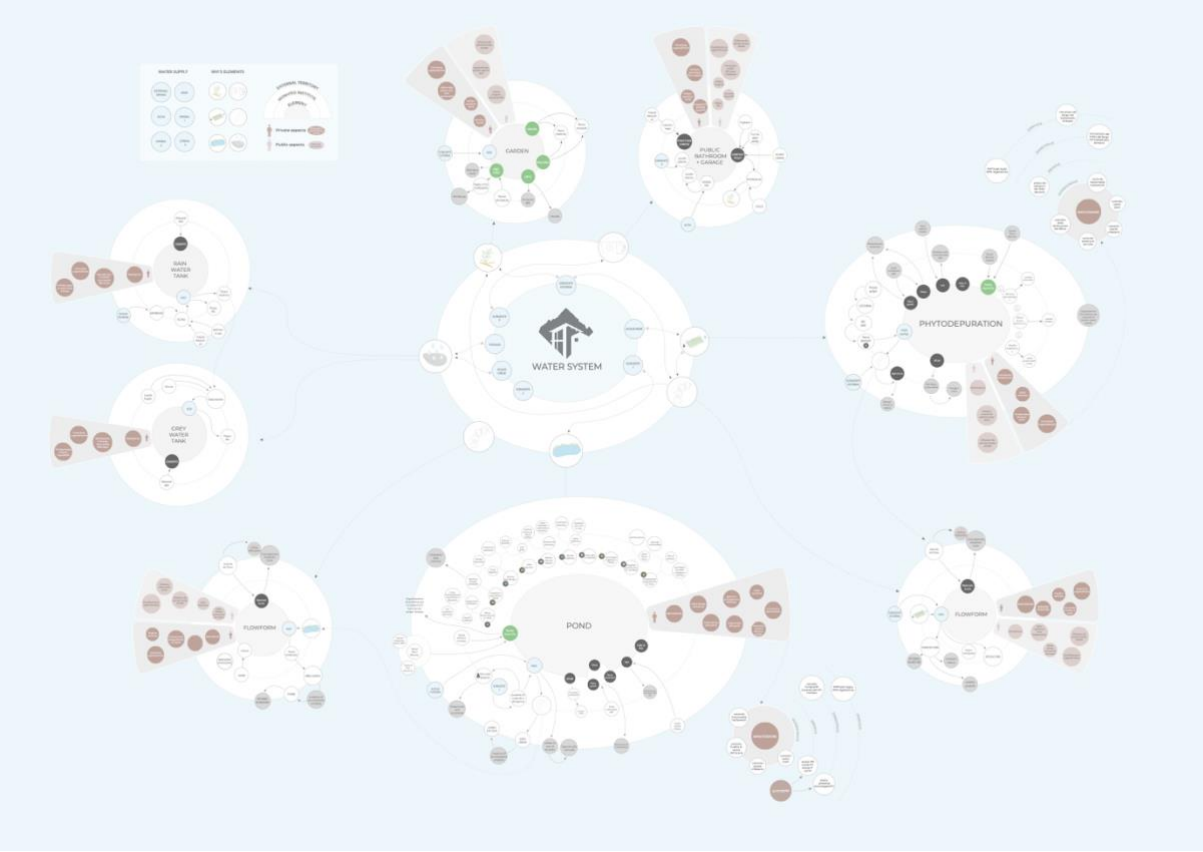

Figure 3. Gigamap of the system designed for the MonViso Institute campus (Carraro, 2021)

Conclusions

The replicability and upscaling of this systemic water design application and illustration are related with the awareness of water as a holistic resource and circularity element. Water must be perceived as an integral part of the ecosystem, as a natural resource and social-economic good, no longer as a detached and separate element. The system itself generates value, connecting people, materials, knowledge and technologies in a single complex network, regulating the functioning of the individual elements. The whole system created is worth more than the individual disconnected components. Systemic design as illustrated in this project is needed and beneficial to develop, implement and maintain such systems functions and systemic values.

The integrated management of water resources should be applied on a level of worldwide acceptance, thus leading us to start from small local realities following the famous motto quoted by René Dubòs: “Think global, act local”. Starting from the MonViso Institute as a real-world lab, the goal is to spread awareness for the urgency of a virtuous change towards a responsible and systemic relationship between man and natural resources, a pillar of sustainable and permanent social and economic development. Water as element and resource is a connecting enabler of such better understanding and relational driver.

This research treats the case study of the MonViso Institute as a replicable model, inserting the contextualized study in the reference valley. This arises from the need to demonstrate to the local community what the benefits of this paradigm shift can actually be, always bearing in mind that each system is in any case closely related to the context, thus delineating it as a reference case study and not as an invariable model.

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