Techno-ecological approach and Evidence-based Biophilic design for the implementation of Vertical Greenery Systems

Laboratory experimentation and Socio-ecological exploration in urban contexts

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Abstract

The increasing urbanization of densely populated areas poses environmental and social challenges that require sustainable and *nature-inspired* solutions. Green walls, as a crucial component of urban green infrastructure, are gaining momentum in enhancing urban sustainability and reintroducing nature into cities. This doctoral thesis tackles the dual challenge of an holistic urban sustainability through *data-driven* and *evidence-based* design for innovative vertical greenery systems.

The first work discussed in the present thesis develops a laboratory experiment evaluating six alternative growing media from local bioresources for the implemementation of a circular strategy in the territory. Findings underline the suitability of lignin-rich materials as effective growing media amendments for the tested plant species, providing crucial insights for the utilization of local lignin-rich bioresources in various geographical contexts. Through a multi-criteria matrix baseline as guiding tool, a design-by-components strategy is introduced as sustainable vertical greenery systems aproach for reducing life cycle impacts.

The second work investigates the social impacts of vertical greenery systems, employing a socio-ecological perspective to assess green walls Restorative capacity. Naturalistic observation and a survey reserach reveal high Perceived Restorative capacity of two real case study living walls, showing their ability to attract people and influence urban space use. This research addresses a literature gap on social benefits, contributing to *evidence-based* biophilic design and guiding urban policy for resilient, biophilic cities.

Collectively, these two interrelated studies contribute to introducing a *data-driven* and *evidence-based* biophilic design of vertical greenery systems in order to effectively guiding policy-making processes in urban planning and fostering the creation of resilient and biophilic cities. Furthermore, the examination of environmental and social concerns of green walls fosters the definition of a holistic dimension to the sustainability assessment of these structures in urban environments.