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Prototyping NBS: a living wall system to enhance the built environment resilience in mountain areas

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In recent decades, mountain villages have experienced significant depopulation, that, coupled with the devastating effects of climate change, has led to conditions of decay and neglect. Therefore, it is essential to implement measures aimed at promoting repopulation, enhancing tourism, and ensuring hydrogeological safety in these areas. In this context, Nature-based Solutions (NBS) represent a promising approach for the restoration of such locations, offering a range of services to address emerging societal and development challenges especially climate change, water security, human health, disaster risk and socio-economic development.

To address these needs, a greywater recovery and management systems has been developed within the framework of the NBS4MOV project [1]. The project is developing a stand-alone green wall technology to treat and reuse greywater (i.e. the wastewater generated from domestic activities excluding toilet flush) in buildings. This technology is made up of 3 levels of greenery and a collecting tank as a base. Each level is composed by 4 pots containing a mixture of perlite and coconut fibre and different plant species: *Carex morrowii, Hedera helix and Lonicera nitida*.

The pots are arranged to form 4 columns, each one representing an independent vertical flow intermittently supplied by greywater. The entire structure has been constructed primarily using durable and recyclable materials, assembled without adhesives to allow for disassembly and reuse of components at the end of their lifecycle, complying with circular economy principles.

The preliminary experimental phase included laboratory tests to assess the performance of the technology before field installation. Initially, tests were conducted on the substrate at varying moisture levels to evaluate its drainage capacity. This information is crucial for sizing the system based on the volume of greywater to be treated. Subsequently, as the prototype is intended for installation in a mountainous environment, tests were conducted in a cold chamber to evaluate the effects of external temperatures on system performance.

Results highlight that the limited thermal insulation of the structure and the small size of the pots led to rapid freezing. However, the presence of water in the substrate (with a moisture content of 50%) was found to delay freezing times. Possible solutions to address these challenges are currently under investigation.

Despite these challenges, the technology, designed as a living wall with a high level of customization, can be integrated with buildings, enhancing their architectural value, and adapting to the specific characteristics of the installation site. For these reasons, the system holds significant potential for the regeneration and development of resilient areas, not only in isolated rural villages but also in more urbanized contexts, with direct implications at urban and social levels.

[1] NBS4MOV is the acronym for Nature-based Solutions for Mountain Villages, and it is part of the project NODES which has received funding from the MUR – M4C2 1.5 of PNRR with grant agreement no. ECS00000036