Rebecco Farm: a community-based approach in energy retrofitting of a rural historic complex

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Abstract. In the field of sustainable retrofitting of historic buildings in marginal urban centres, the case of Rebecco Farm serves as an example of how a community-based approach can effectively integrate conservation and modernization efforts in historic rural architecture. This project was conducted under a long-term agreement, embodying a public-private partnership model to preserve local heritage and promote cultural development. The project focused on both developing human capital and the physical restoration of the two buildings of the farm. This dual approach aimed to ensure that the restored buildings were not only preserved but also became vibrant and sustainable community resources.
While the retrofitting involved restoration activities, the renovated buildings themselves became training grounds for technicians and students. The integration of traditional techniques with low environmental impact solutions facilitated knowledge sharing on sustainable conservation methods. Ultimately, this case study demonstrates how community involvement after interventions, through community-led projects, can effectively bridge the gap between a “static” conservation model and an active, planned conservation practice.

Keywords – Historic building; People involvement; Sustainability; Community-led project; Rural architectural heritage

1. Introduction

The debate surrounding the preservation of Italy's historic buildings in urban centres has expanded in recent decades - since the Gubbio Charter for the safeguarding and rehabilitation of historic centres (1960) [1] - to include reflections on the role of small towns and villages, where architectural conservation is closely tied to the protection and enhancement of local material and territorial identity [2-12]. The importance of this issue is also underscored by the statistics: in Italy, it is estimated that 60% of the territory is made up of small urban centres, due not only to the country's unique orographic features but also to the complex settlement dynamics that have shaped it. Many of these territories are historically and culturally significant minor areas [13].

A vast body of literature on these topics has highlighted how the vulnerability of architectural heritage in small historical centres is even more pronounced in rural and peripheral areas. The causes

behind this vulnerability are linked to a complex array of factors, including insufficient or ineffective flood and landslide prevention, distance from major urban centres, depopulation processes, and related phenomena, such as the decline of local retail businesses, the lack of services, and gentrification [14-16].

However, beyond the social and economic phenomena, the most concerning issue seems to be that, despite rural architectural heritage serving as a repository of cultural and social knowledge of ancient communities, it is often unrecognized for its importance and is being gradually destroyed under the pretext of 'modernization. This concern is not new: as early as 1979, a recommendation of the European Parliamentary Assembly [17] called for further studies and research on rural architectural heritage, arguing that preserving historic rural environments was essential to allow rural populations to develop their unique social and cultural values.

European attention to the issue of rural heritage recovery has been particularly prominent in the Faro Convention (2005), which emphasizes strategies that, rather than focusing solely on physical interventions, aim to trigger improvements based on a deep understanding of places and their potential. These strategies call for interventions that respect tradition while incorporating cutting-edge techniques to address the social, cultural, and economic dimensions that underpin this heritage [18].

In line with these developments, national scientific attention to this issue has been demonstrated in recent decades by the publication of specific *Guides for the Conservation, Maintenance, and Rehabilitation of Rural Architecture*, developed in different protected areas of the Italian territory to expand knowledge on rural artifacts [19-22].

At the political level, Italy's Ministry of Cultural Heritage (MiC) has also underscored the importance of preserving rural buildings in small urban areas as socio-cultural heritage by launching numerous public initiatives to promote slow, sustainable tourism [12, 23]. One of the most notable was the enactment of the "Save Villages" law (Italian: *Salva Borghi*, Law No. 158 of 6 October 2017) [24], which introduced measures for the redevelopment and recovery of historic centres, as well as the enhancement of these municipalities as "widespread hotels" [25].

The initiative "Attractiveness of Historic Villages," also funded by the MiC under the Next Generation Europe program and the National Recovery and Resilience Plan (PNRR), continues to focus on small villages [26]. The aim of this funding program is to support the restoration of built heritage and generate positive impacts on local communities. However, the strong emphasis on attracting external tourism seems disconnected from a genuine effort to revitalize isolated, depopulated, and underserved villages, with little attention to local communities or strategies for repopulation [12, 27].

As several studies have highlighted [27-31], an effective strategy to reconnect public policies with the realities of these places should involve complementary tools for intervention and enhancement that engage a range of stakeholders, including local communities, as well as private entities and institutions. For instance, appropriate development strategies for rural heritage may arise from cooperation between public and private stakeholders through joint ventures. Such partnerships can facilitate knowledge transfer, the alignment of strategic objectives, and the development of long-term relationships that focus on both conserving existing heritage and exploring solutions through place-based, participatory approaches.

In light of the considerations above, the multifaceted approach of the Rebecco Farm project is explored in the following sections. In this rural example, transformed into a hospitality complex, public and private partners—especially in the third sector—were involved, building opportunities for collaboration to address local needs by expanding, diversifying, and identifying innovative solutions for services and employment. Hence, the scope of this investigation is to show how the integration of conservation, education, and community involvement can serve as a model for sustainable retrofitting in historic rural architecture.

Figure 1 – General photo of the two rural buildings of the Rebecco Farm complex during a survey phase with students. At the bottom building A, where you can see that the roof is maca in some rooms; on the left, building B.
Figures 2, 3, 4 – Rebecco Farm. Some characteristic elements of the rural architecture of Val Trompia: pebble masonry, wooden roof slab, fireplace used also for cooking dairy products, internal wall system in wood mixed with hemp and lime.

2. The Rebecco Farm experience

The Rebecco Farm case originates from the intersectoral program “AttivAree,” initiated by the Cariplo Foundation in two areas of Lombardy: Oltrepò Pavese and the Trompia and Sabbia Valleys in Brescia [32, 33]. The program aimed to reactivate marginal areas within the Foundation's reference territory and increase their attractiveness to residents, potential investors, and nearby urban centres by leveraging local community resources.

Within AttivAree, the Mountain Communities of Valle Trompia and Valle Sabbia developed the “Valli Resilienti" project (2016-2020) [33, 34], which sought to promote youth employment and social enterprise activities in these valleys by strengthening cooperative and network models within the Brescia area in Lombardy.

The project initially focused on documenting and recovering rural architectural heritage to disseminate good practices in conservation. Recovery, conservation, and maintenance of traditional hydraulic factories in the Sabbia Valley and rural architecture in the Trompia Valley (such as farmhouses, mountain huts, barns, and stables) were central components of the action, which was spearheaded by the University of Brescia [35]. This effort involved cataloguing and surveying local

construction systems and artistic works in the two valleys. The primary goal was to promote practical conservation methods to recover ancient materials and techniques in a modern context.

Secondly, the process continued with the identification by the Mountain Communities of Trompia Valley of an inhabited nucleus for starting a methodological research and experimental activity; this was the Rebecco complex in Lavone di Pezzaze (Brescia), located near the Mella river, a watercourse running through the Trompia valley [36].

Historic rural village dated back in its origins to the 16th century and composed of two masonry buildings, it had been abandoned for many years; in the past, its strategic location once supported profitable activities, such as iron ore processing, but a downturn in the metalworking industry in the late 1800s caused the transformation of both buildings - formerly used as bunkers of the ancient smelting furnace - into stables and barns, and the conversion of surrounding land into agricultural fields [36]. The site's definitive abandonment in the 1970s was due to several factors, primarily the inability to generate sufficient income for its owners. Additionally, the progressive collapse of roofs, floors and portions of walls, have facilitated the gradual loss of interest in this historic rural building complex, supporting a change in its environmental and social balance [37].

2.1 The Rebecco Farm Community-Led project: a new model for conservation

The decision to restore and enhance the Rebecco complex was driven by a desire not only to preserve the buildings but also to safeguard a way of life and a sense of identity of the Val Trompia's community. Beyond its architectural significance, the complex looks deeply rooted in the historical local cultural and social frame.

In an effort to reconnect the site to its inhabitants and history, the Rebecco complex restoration – termed "Rebecco Farm" – was developed in successive phases with constant input from the local community and other stakeholders [36-39].

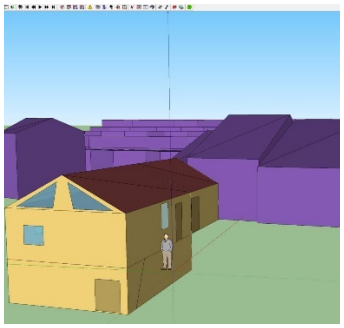
The first step was raising awareness among residents that rural architecture represents more than just a space available for construction. It is an artistic and cultural expression that contributes to local identity. Before architectural design began, several meetings were held to present the results of extensive archival research on the buildings, particularly focusing on materials used, conservation issues, and construction techniques. These meetings aimed to highlight the potential value of the complex if restored.

At the same time, public meetings organized by the Mountain Community aimed to understand local expectations for the recovery project and assess potential business ideas. For those interested in managing the restored asset, additional discussions were held to review examples of successful agricultural site management. During this process, the groups interested in taking on management roles were supported by experts who helped them assess the feasibility of their proposed ideas, not only in the short term but particularly in the long term, when they would be actively involved in managing the new business project. Workshops, focus groups, and empowerment sessions on specific topics were also organized to engage the local community.

Community involvement was not just a means to an end but a core objective of the project. By empowering local people with the knowledge and skills to care for their heritage, the project ensured that the community would remain engaged with the rural complex long after the restoration was completed. This sense of ownership has been critical for the ongoing preservation of historic buildings, fostering a culture of stewardship and pride in local heritage [37].

The involvement of the local community in a co-design made possible to define the project primary objective: the reactivation of the rural complex to support agricultural, ecological, and cultural development, with a focus on educational services [39].





Figures 5, 6 – Workshops and activities carried out with the local community and several stakeholders (e.g., institutions, universities, the Cariplo Foundation) were crucial in defining intervention actions.
Figures 7, 8 - The energy model developed by the Politecnico di Milano was used to verify the performance of the insulation materials implemented (left side, hemp blocks; righ side, bamboo canes). The study was also accompanied by a verification of the risk of mold and interstitial condensation [38].
Figure 9 – The wooden boiler serving the whole Rebecco complex is placed in the basement, with channels hidden underground and running between the two buildings.

Given that the site was subject to landscape constraints, discussions were held with the Superintendence of Archaeology, Fine Arts, and Landscape for the provinces of Bergamo and Brescia. A conservation strategy was agreed upon, ensuring that the project was a community-valued effort rather than an imposed development.

As already mentioned, before restoration, both buildings had significant structural issues, such as crumbling masonry and damaged roofs. The recovery project made all the existing spaces functional again. The two-storey building (A), once used ad barn, was converted into a bed-and-breakfast for tourists. Portions of the original walls were preserved, while missing sections were reconstructed to restore the building's original volume. An additional structure was built on the footprint of a former building identified in historical records, providing space for typical products and dairy production.

The single-storey building (B), once used as residential space, was equipped with the necessary amenities to serve as a multifunctional room for educational activities, gatherings, and meetings. The masonry was repaired – integrating it where necessary with pebbles from the Mella river - and reinforced, the damaged roof replaced, and the interiors restored.

The recovery works were completed in June 2020. The Rebecco Farm project was facilitated through a long-term partnership among Cariplo Foundation and Mountain Community culminating in the identification of a building manager for a renewable twenty-year fee. This long-term agreement ensured the sustainability of the project, both in terms of environmental impact and economic viability. Furthermore, the project programmatic and operational direction was shared with public administrations, which monitored the construction activity, along with academic institutions and the owners of the structures [36- 38].

This wide-ranging collaboration allowed for the pooling of resources and expertise, ensuring that intervention activities, included restoration, adhered to the highest standards of sustainability and cultural sensitivity. Such issue looks particularly significant in the context of a rural historic building conservation, where costs and complexities can be often prohibitive.

2.2 A sustainable conservation process

The conservation process followed principles aimed at preserving as much of the original material as possible, ensuring the historical authenticity of the buildings was maintained. With the involvement of Politecnico di Milano, eco-friendly solutions were integrated to make the buildings energy-efficient and environmentally sustainable [38].

For instance, the portions added to building A were constructed using load-bearing brick masonry, externally clad with wooden bark, a material that reflects local building traditions while making the new sections distinguishable from the historical ones. The existing walls, composed of river pebbles - larger at the base and smaller towards the top - were left exposed and selectively re-styled. Inside, the perimeter walls were covered with plasterboard panels, behind which hemp insulation blocks were placed to ensure better thermal comfort.

In building B, several experiments were conducted with a scientific approach, using different materials for thermal insulation. Detailed energy simulations were performed using software as EnergyPlus™ to model the building thermal performance. To support the energy model in defining the thermal characteristics of the opaque components of the building, the PAN 7.0® simulation software was used, which allows to calculate and verify the winter and summer thermal transmittance, the risk of mold and interstitial condensation, and the drying time of the structures. The results informed the selection of insulation materials, which led to a significant reduction in energy consumption.

In particular, in connection with the construction practice and materials historically used in Valle Trompia, the use of the woody part of the hemp plant in combination with lime was provided as insulation: easily available locally, it has enormous hygroscopic capacity and the high presence of silica inside it has made it possible to use it as an inert in hydrated lime-based mixtures. Hence, hemp blocks were chosen for the inner coat (V= 300 Kg/m^3, C = 1700 J/Kg K; λ = 0,070 W/mK; μ = 5; U= 0,187 W/m^2K), lime and hemp plaster (V= 600 Kg/m^3, C= 1250 J/Kg K; λ = 0,090 W/mK; μ = 5,3; U = 0,187 W/m^2K). In other walls, marsh reeds are used in panels then plastered with lime. Marsh reed, like hemp, is a rapidly renewable resource that grows in large quantities each year (V= 190 kg/m^3, C=1500 J/Kg.K, λ =0,055 W/mK, μ = 2). In the roofs instead wooden fibre panels were used as insulation [38].

Among the choices aimed at improving the efficiency of the rural complex, the decision to insert a second internal window in each room while preserving the existing historic openings aligns with the project's philosophy of preserving as much of the ancient fabric as possible.
From a thermal-engineering point of view, it was also decided to follow tradition by implementing a wood-burning heating system, contributing to the clearing of woods and undergrowth in the area.

The Rebecco Farm project also served as a practical learning experience, where participants were trained in sustainable conservation methods. Workshops and seminars were held to educate the broader community about the importance of heritage preservation and sustainable practices. This was achieved involving technicians, students, and local community members.

The farm itself became a living laboratory where traditional building techniques were revived and combined with modern, low-impact technologies. In this context, it is also important to highlight the collaboration between the company supplying the insulation materials and the construction company to ensure proper installation of the products on the ancient masonry, with the designer working to

find the most compatible solution. This collaborative approach facilitated a transfer of knowledge essential for the long-term sustainability of conservation efforts [37].

3. Conclusion

The Rebecco Farm project aligns closely with the principles outlined in the Faro Convention, which emphasizes the role of cultural heritage in fostering sustainable development and community identity. The Convention advocates for a dynamic interpretation of heritage, one that goes beyond mere preservation to actively engage communities in managing and using their cultural resources [18].

By embracing this approach, the Rebecco Farm experience was characterized by an interdisciplinary approach, involving architects, engineers, conservationists, construction companies and the local community. This collaborative effort ensured that the project addressed all aspects of a sustainable conservation process, from structural integrity to energy efficiency, and from historical accuracy to modern usability [36]. From a technical point of view, a significant aspect of the project was the use of traditional construction techniques combined with modern materials and solutions [38]. For instance, the restoration work involved the use of lime-based mortars, historically used in the region, alongside modern insulation materials that were compatible with the ancient structures. By integrating sustainable solutions, the project ensured that the buildings meeting comfort needs while retained their historical character for future generations.

However, the project was not only aimed to conserve the physical structures but also sought to revitalize the social and cultural life associated with the farm. Indeed, the project emphasized community involvement at every stage, from planning to execution [37]. Community members were not just consulted but actively participated in workshops, design input sessions, and the restoration work itself. This involvement fostered a sense of pride and ownership, ensuring that the restored farm would be a cherished community asset.

Today, the restored Rebecco Farm serves as a hub for community activities and a model of sustainable rural development. It hosts educational programs, cultural events, and operates as a bed and breakfast, attracting tourists and generating economic benefits for the area [39]. Self-sustaining, Rebecco Farm has become since 2019 as also the first network of agricultural companies in Italy, offering support to local farmers and breeders for selling their products in a shared platform.
The success of the project demonstrates, even more, how sustainable conservation can drive economic revitalization and community development [40].

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