Adaptive Reuse: generative matrices of environmental benefits guide the regeneration process for a comparative analysis of S. Maria in Grotta and S. Michele in Gualana

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Abstract. Environmental changes frequently redefine the characteristics of a monument, transforming it into an unconscious "record" and an involuntary witness to the "adaptive" processes that shape its identity over time. This paper compares two case studies that exemplify an adaptive process of conservation and rediscovery of historical heritage. The first case, with a centripetal dynamic, explores the relationship between anthropogenic interventions in the environment and their effects on built heritage, specifically the rock-hewn church of S. Maria in Grotta. The second one, with a centrifugal dynamic, addresses the redefinition of the environment by introducing new architecture, focusing on the uncovering of the rock-hewn cave of S. Michele in Gualana, which had fallen into oblivion due to the abandonment of the surrounding territory.

Keywords: Adaptive reuse; Centripetal matrix; Centrifugal matrix; Planned maintenance; Spontaneous maintenance.

Introduction to the method

The architectural heritage reflects the cultural identity and the memory of the past, integrating harmoniously with the environment. However, environmental changes, whether natural or anthropogenic, such as those induced by the climate, alter its balance and symbiotic relationship.

Often, environmental, economic, or social changes (or a combination thereof) can redefine the characteristics of a monument, or vice versa, through adaptive reuse dynamics that generate centripetal and/or centrifugal forces. Adaptive reuse, in the heritage conservation literature, is seen as a deliberate choice to preserve a heritage asset that is no longer usable for its original purpose, safeguarding it from the ravages of time and passing it on to future generations through adaptation to new uses, while carefully recognising its historical and cultural values (Damla and Kaˇgan, 2016). However, the literature presents adaptive reuse as a conscious decision by a *dominus*, from whom all the implications of the design choices within the cultural context that generated it arise. The literature (Yuan Li *et al*., 2019) does not address adaptive reuse as a spontaneous act driven by needs beyond conservation. Both deliberate and spontaneous adaptive reuse stem from a fundamental necessity, shaping centripetal or centrifugal dynamics. In the centrifugal one «the benefits are generated punctually but propagate to a more or less vast surrounding depending on the generating force of benefits the implementer has been able to generate [...], instead, in the centripetal model, the approach is holistic [...] and the benefits, generated by the wide-spread intervention, converge towards the punctiform elements inserted in the redeveloped urban environment» (Violano & Maio, 2024). The two case studies – the Church of S. Maria in Grotta (Rongolise) and the Grotta di S. Michele (Gualana) – illustrate these dynamics. The former exemplifies centripetal adaptive reuse, where local inhabitants preserve the site through religious symbolism and its role on the Via Francigena. The latter represents centrifugal reuse, transforming a religious site into a museum that reinterprets cultural identity under conservation principles.

Centripetal dynamics in adaptive reuse describe a site's ability to attract and retain cultural, social, and economic value around its core, whether physical or symbolic (Violano et al, 2024). This attraction stems from historical, artistic, and architectural significance, as well as community identity. Conservation through reuse reinforces belonging, fosters social cohesion, and stimulates economic activities.

In contrast, centrifugal dynamics, exemplified by the requalification of the Grotta di San Michele in Gualana, involve a deliberate act of a *dominus* to radiate cultural, social, and economic benefits outward. This planned transformation, aligned with modern conservation principles, enhances the surrounding urban fabric. Rather than dispersing value, centrifugal reuse amplifies and extends its impact, integrating heritage protection with sustainable development and local community engagement (Oppio et al, 2017). The ultimate goal is to demonstrate how adaptive reuse, applied according to centripetal or centrifugal dynamics, can trigger processes of reappropriation of cultural identity that lead to the regeneration of territories and the conservation of heritage. A comparative case study of S. Maria in Grotta and S. Michele in Gualana exemplifies this

The case of Santa Maria in Grotta in Rongolise

Since ancient times, the vast territory of Sessa Aurunca, the second largest municipality in Campania, has been characterised by anthropic phenomena. These have shaped its landscape, character, image, and places whose geography evokes scenic suggestions that enhance and merge with the *genius loci*, ready to suggest and dictate the architectures to be shaped and performed in its own image, amplifying the suggestions of the place.

It is a place, where Santa Maria in Grotta stands, where the elements of nature and architecture merge, where the built envionment is seamlessly part of the natural elements, where it is not clear where the natural ends and the artificial begins, where the eye perceives the architecture in the landscape accepting it as an element of the landscape (Fig. 1).

S. Maria in Grotta, is located a short distance from the hamlet of Rongolise in Sessa Aurunca (CE), near an ancient path leading from Sessa Aurunca to the Valle del Garigliano, close to the Via Francigena, in a reused tufa quarrystands. The small rock-hewn church is dedicated to S. Maria in Grotta, which, like a sentinel, overlooks the landscape entrusted to it. The presence of an active aqueduct collector carved beside one of the church's lateral chambers confirms the site's continuous use since ancient times. The tufa-carved spaces suggest a dual function, precisely one linked to water, evident in the rooms directly

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01 | Façade of S. Maria in Grotta, showcasing the harmonious interplay between human construction and natural topography

02 | S. Maria in Grotta: The interior of the cave with a truncated cone section in the tuff bank, with frescoed walls

03 | S. Maria in Grotta: Anthropised cave environments

04 | S. Maria in Grotta: A cycle of frescoes centred on the Virgin Mary, including a prominent depiction of her Dormition

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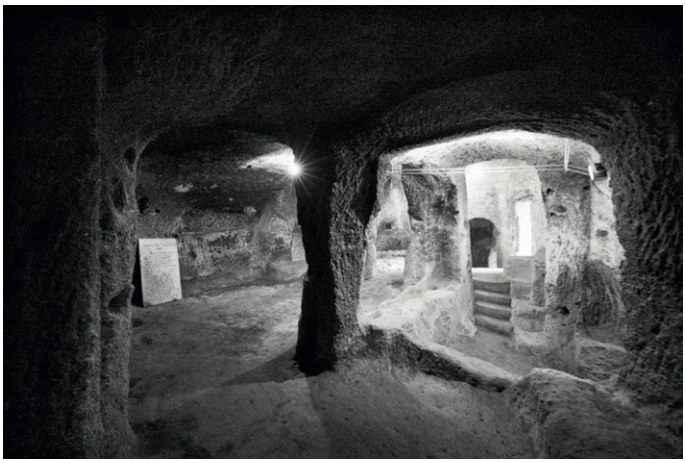 | 03

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connected to the channel, which seems to have a natural origin later integrated into the aqueduct system; and the other to the quarry. Over time, this space evolved into a sacred site, with frescoes adorning its walls since the 10th century. The reuse of this quarry indicates adaptive reuse of places (Fig. 2).

The façade of the small church does not reveal the rocky nature of the place. Once past the entrance portal, one enters a triangular-shaped tufa gallery with frescoed walls, at the bottom of which there is an altar and a lunette, also frescoed. A triangular shape that recalls the upper part of Sibyl's grotto in Cuma (Maiuri, 1926), a shape that most likely arose, for static reasons, from the extraction of tufa. The grotta then opens to other environments that contribute to increasing the suggestiveness of the places (Fig. 3). It is still unclear what the use of the grotto was. Perhaps created for agricultural purposes, it seems that as early as the 10th century it was used for worship, as evidenced by a panel depicting the Virgin Mary with the Child Jesus seated on a throne and wrapped in a dark red maphorion. A place where sacredness has been handed down from generation to generation, preserving the suggestion, preserving the matter that tells all this through the registers of frescoes that cover a thousand years of life (Fig. 4).

The position of the artefact, protected by the bend in the road that surrounds it, and inserted in a natural context where the presence of water feeds its ancestral suggestion, has consolidated the persistence of the *genius loci* as a tutelary deity. Nothing suggests that having crossed the anonymous entrance door, with its modest workmanship, one steps into a suggestive and enchanted spatial dimension where a sacredness can be perceived that induces the visitor to silence, along with the simultaneous discovery of new spaces that have nothing in common with what can be perceived externally.

The triangular, regular-shaped entrance suggests an initial use as a tufa quarry, a type commonly found in Cumae, such as in the Grotta della Sibilla. However, around the 10th century, the

space was converted into a sacred place. The religious sentiment of the local inhabitants spontaneously led to the adaptive reuse of the original quarry, integrating their needs for worship and gathering, as evidenced by the masonry remains built around and above the quarry. Additionally, a bell tower was constructed externally, serving as a "landmark" for the surrounding area, making the place visible from the nearby Via Francigena, thus becoming a point of reference and centripetal radiation.

The continued use over time is evidenced by cycles of frescoes, with Marian themes, that have covered eight centuries of history. Their preservation has been guaranteed through spontaneous maintenance by the local inhabitants who have cared for the site (Mohamed *et al*., 2017). The local community has been the true protagonist in the preservation of the church, through spontaneous maintenance and the transmission of the symbolic value of the place to future generations. The territorial context, such as the proximity to the Via Francigena and the historical and cultural value acquired over time, has strongly influenced the evolution of the church and its conservation.

The nature of the process, resulting from the adaptive reuse of the cave, was a spontaneous one, guided by the needs of the community and the previously existing sacredness of the place, determined by the presence of an anthropised cave also used for pastoral and Roman aqueduct purposes

In 2010, sudden water infiltrations affected the grotto, flooding the floor and causing severe condensation on the frescoed walls-an unprecedented phenomenon despite the site's proximity to an ancient aqueduct. Given its isolated hilltop location, leaks from upstream pipes were immediately ruled out.

Investigations on-site and in archives suggest that infiltrations stem from micro-cracks in the overlying road and rainwater accumulation on the tufaceous bank, exacerbated by anthropogenic alterations to the landscape. This aligns with Lorenz's butterfly effect, according to which, seemingly unrelated human interventions disrupted the site's delicate balance, potentially triggering a slow process of self-destruction within its evocative *genius loci*.

Saint Mary in the Grotto cannot be considered a mere artefact to be preserved without including the landscape and the territory that surrounds it in the safeguarding process. However, the peculiarity of the place demands reflection. What has allowed, or permitted, a structure in a somewhat isolated position, apparently devoid of a custodian or a religious[1] community, to have a continuous history? The presence of a decorative apparatus from the 10th century to the 18th century would justify the continuous use without interruption, and this would have guaranteed the minimum maintenance and custody necessary for the preservation of the artefact, but not for the last two centuries, which seem to be devoid of a continuous presence.

Saint Mary in the Grotto has represented and represents a guardian for the protection of the territory, a stop for pilgrims on the Via Francigena, a place of devotion and mystical refuge. Moreover, it is the *incolae* themselves, protected by the guardian, who represent protection of the territory, who exercise the *tutela* to protect the artefact, who have guaranteed and guarantee its continuous preservation since the 10th century. It is a suggestion to imagine the two-way relationship of respect and protection between the sacred place represented by Saint Mary in the grotto and the inhabitants of the *pagus*, but this relationship would justify the silent respect and protection on the part of the inhabitants-managers of the territory, and the sacredness that it still preserves today (Amoruso *et al*., 2020).

This relationship of mutual respect cannot, therefore, be considered confined to the spaces of the sacred but extended to the surrounding territory that generated it. The generative process is often forgotten. The generic user observes and enjoys the Cultural Heritage specularly and coincidentally with their own formation and their ability to perceive beauty, but rarely does the user associate the Heritage with the context that generated it, with the generative process associated with the technological processes underlying the creation of a Cultural Heritage.

Therefore, the Cultural Heritage cannot be dissociated from the territory that hosts it. It is both its expression and part of it, and this concept must also be extended to conservation and protection. Saint Mary in the Grotto represents the concept of a centrifugal matrix, which postulates the recovery of heritage, not only preserving it but also generating environmental benefits for the surrounding context, unconsciously promoting models of sustainable cultural, economic, and social development.

Such models can be attributed to the aspects of proactive conservation of architectural heritage, which plays a fundamental role in the protection and enhancement of historic buildings, combining innovative and traditional approaches to ensure the maintenance and sustainable use/reuse of structures (Talamo, 2013). This approach focuses on the early identification and mitigation of risks, avoiding late and costly interventions, guaranteeing, as in the case of Saint Mary in the Grotto, the minimum interventions necessary to maintain the integrity of historic buildings, respecting their material and cultural authenticity (Zhang & Dong, 2019), and maintaining the relationship and involvement of the local community. Conservation is, therefore, not limited to the building but includes the socio-cultural context, promoting the sustainable use of local resources and community participation (Darwish, 2016), even in spontaneous maintenance, characterised by emergency interventions, limited in scope and contingent on the availability of resources and immediate needs, with the active participation of local communities. Proactive conservation of architectural

heritage is, therefore, an indispensable strategy for preserving historical and cultural memory, integrating technological, participatory, and sustainable approaches to address the challenges of the future.

The case study of S. Michele in Gualana

S. Michele in Gualana, Sessa Aurunca (CE), is part of the same territorial context as S. Maria in Grotta. It is one of the 92 rock-cut churches surveyed in 2007, of which 37% were dedicated to the cult of Michael (Ebanista, 2007).

The reasons why the rock-hewn church of Saint Michael in Gualana, located in Fasani, Sessa Aurunca (CE), fell into oblivion are unknown. It could be due to political and social causes that led to its abandonment, or it could be the consequence of natural disasters, or perhaps it was a *damnatio memoriae*, a deliberate act that will destroy a monument and reclaim public spaces to redefine the identity of a place.

The complete absence of documents, references, and information in pastoral visits, as well as the lack of popular memory, suggests that it was abandoned before the Council of Trento, a neglect that led first to degradation and then to oblivion

We know what the chronicles tell us. A fortuitous discovery in the 1970s. Only after a little over 30 years from the discovery, and further abandonment, did the Diocese of Sessa Aurunca initiate a project to recover the site, not as a place for religious use. The purpose was to return to the community a space that would recover its own cultural identity through adaptive reuse with a centrifugal dynamic, reflecting modern conservation principles, and including, by an act of will, the aspects of programmed maintenance that such reuse entails. The project immediately set itself the goal of restoring the rock-hewn church as an exemplary case of how an innovative approach can revolutionise the conservation and enhancement of cultural heritage (Della Spina, 2020).

The operation involved "reinserting" the cave into its territorial context, analysing its relationships with the surrounding environment, landscapes, and human settlements, actively involving the local community in all phases of the project, from design to management, to foster a sense of belonging and responsibility, and to trigger phenomena of cultural tourism, environmental education, and scientific research (Foster, 2020).

At the heart of the concept is the adoption of a "centrifugal matrix" as an intervention methodology, which underlines the importance of considering cultural heritage not as an isolated object to be recovered, but as an integral part of a complex system of relationships with the physical, social, and cultural context to which it belongs. The cave must be "reinserted" into its territorial context, analysing the relationships with the surrounding environment, landscapes, and human settlements, actively involving the local community in all phases of the project, from design to management, to foster a sense of belonging and responsibility, and thus trigger phenomena of cultural tourism, environmental education, and scientific research.

The intervention programme also addressed the delicate issue of designing the recovery of spaces that had now lost their original characteristic of being a rock-hewn cave due to collapses, and whose morphology was not even known in the initial phase. Before the intervention, the site's original rock-cut cave morphology was obscured by collapses, leaving only a shallow 3x3 metre pit, 2.5 metres deep, filled with debris. The only visible element was the partially frescoed southern wall.

The initial phase of clearing and defining the perimeter revealed an architectural structure resembling S. Maria in Grotta, particularly in its masonry entrance. However, unlike S. Maria, S. Michele in Gualana incorporated Roman remains, including altars embedded in the masonry. Stone jambs marked the entrance, leading down steps into a compact space featuring a well and rock-hewn walls, forming a tripartite layout.

Considering the site's characteristics and the intent to restore its religious function, the project emphasises adaptive reuse as a balanced approach to conservation, sustainability, and territorial regeneration (Conejos *et al.*, 2011) (Fig. 5, 6, 7).

For its transformation into a museum, the intervention integrates the site into a broader regeneration strategy. A permanent cover over the archaeological excavation acts as both protection and showcase, preserving visibility of the façade elements, while allowing interior views through a transparent structure. This contemporary landmark, distinct yet respectful of the ancient, reinterprets the site's presence in the landscape. Unlike a traditional bell tower, it serves not a religious function but a mediating role between past and present, inviting engagement through its transparency. Positioned near the city's main entrance, it enhances recognition and strengthens the site's identity, triggering centrifugal dynamics with economic, social, and environmental benefits.

Adaptive reuse as a catalyst for territorial and community regeneration

The cases of Santa Maria in Grotta and San Michele in Gualana illustrate two distinct approaches to adaptive reuse, both responding to collective needs yet triggering different spatial and social dynamics.

In Santa Maria in Grotta, adaptive reuse emerges spontaneously from the local community, transforming the site into a spiritual and cultural landmark associated with pilgrimage activities. This centripetal process fosters preservation and continuous maintenance, reinforcing community identity. Conversely,

05 | S. Michele in Gualana: Entrance to the archaeological enclosure safeguarding the cave

06 | S. Michele in Gualana: Interior view of the cave, oriented towards the entrance, revealing archaeological evidence of Roman occupation

07 | S. Michele in Gualana: Internal perspective of the cave from the entrance, highlighting tufa lunettes embellished with medieval frescoes


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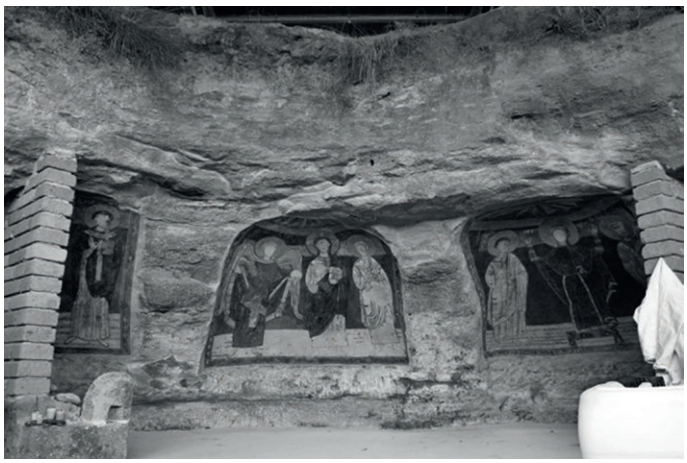
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in San Michele in Gualana, adaptive reuse is initiated by a *dominus* through a structured intervention, radiating cultural, economic, and environmental benefits outward. This centrifugal process regenerates the surrounding territory, restoring lost values and reconnecting the site to the community.
Both cases highlight the role of adaptive reuse in creating value linked to identity and belonging. In Santa Maria, deep-rooted local engagement ensured the site's survival over time. In San Michele, where the absence of a community led to neglect, reuse reestablished the connection between place and people.
A site with renewed value naturally becomes a landmark, both physically-as a recognisable territorial reference-and symbolically-as an anchor for cultural identity. The bell tower of Santa Maria and the museum structure of San Michele exemplify this dual role, enhancing visibility, fostering community ties, and attracting economic and social benefits.
Scholars such as Plevoets and Van Cleempoel (2019) have highlighted how adaptive reuse can trigger virtuous processes of socio-economic regeneration, promoting inclusion and innovation. Bullen and Love (2011) underline the role of proactive conservation, while other studies explore the economic sustainability of reuse.
The intervention, in a pioneering and anticipatory manner of cultural heritage recovery policies, has abandoned the traditional restoration intervention, shifting attention towards innovative concepts that enhance heritage as a dynamic resource, where the technological approach of possible quality and the circularity of solutions emphasise the ethics of recovery. This is the case today, at a time when the international debate focuses on the integration between conservation and sustainable development (UNESCO guidelines, Faro Convention, 2005), which promote the participation of local communities in the management of heritage, foreshadowing it as an innovative intervention of adaptive reuse.

Conclusion

This paper presents two case studies, Santa Maria in Grotta (Rongolise di Sessa Aurunca) and San Michele in Gualana (Fasani di Sessa Aurunca), to demonstrate how adaptive reuse can trigger (both spontaneously and intentionally) a series of centripetal and centrifugal dynamics that generate value and modify the environmental, economic, and social fabric of a territory, while preserving heritage. The first case demonstrates how spontaneous adaptive reuse, driven by a deep connection between the community and the territory, which hypothetically began around the 10th century, has allowed for the preservation of heritage, bringing it to the present day. In the second case, the lack of a community over the centuries led to the abandonment of the place and the surrounding area. However, the adaptive reuse of the cave has enabled the activation of a series of dynamics to restore the entire territory and generate a new sense of belonging.
By applying processes of reappropriation of cultural identity through adaptive reuse, it is possible to trigger a series of phenomena that can lead to the conservation of places, even through spontaneous maintenance by the local community, reducing the risk of abandonment and subsequent degradation of heritage. It is, therefore, important for the place to fulfill a

community need in order to generate a bond. A series of forces are thus activated, benefitting both the community dimension and larger dimensions related to economic, cultural, and environmental aspects.
The reappropriation of cultural identity can also potentially represent the key to achieving sustainability goals, educating communities to care for the territory, to efficiently manage flows and resources, generating knowledge and awareness, and thus the desire to participate in global dynamics
Rather than punctual interventions "on" heritage, there is a need for interventions "within" heritage, considering the subjects as part of a broad environmental and cultural context. These interventions should be resource-generating, promoting harmonious and balanced growth of the entire territory, understood as a heritage of cultural resources. They should foster interrelations between heritage, environment, and economic realities, as well as stimulate and support civil development processes, which are fundamental for heritage conservation and can act as leverage points for generating multiplicative benefits.

NOTES

[1] The presence of a masonry elevation and limited evidence of construction suggest the possibility of a stable, albeit small, settlement, which would justify the continuity of use evident in the creation of the decorative apparatus, carried out without interruption, as stated by Torriero G. and Speciale L. in their study of the rock church of Santa Maria in Grotta, Marina di Minturno, 1994

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