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Science, art, and legends in geotourism: A multidisciplinary geotrail approach in Alagna Valsesia, Sesia Val Grande Geopark (NW Italy)

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Abstract. This paper presents the results of a project based on a method that integrate geological knowledge and local cultural heritage within the Alagna Valsesia area located in the Sesia Val Grande Geopark (Italy). Through a multidisciplinary, co-creative approach, an artist's book was realized serving both as a guide to the geotrail and a communicative tool for broader educational outreach. Thanks to the engagement of members of the local Walser community and the cooperation of artists from *Dolomiticontemporanee* collective, the project blended geoscientific communication with indigenous storytelling to enhance understanding of the geological and cultural landscapes of the area. The artist's book combines scientific accuracy with vernacular insights gathered during the co-creation process, covering significant observation points that narrate geological phenomena and the legacy of the Walser people. The new artist's book represents an innovative way to communicate geoscience providing a valuable tool for visitors, educational institutions, and the local community, promoting conservation awareness through an immersive, narrative-driven experience. The method presented in this study is applicable in other settings and is particularly suitable for geopark areas, as it offers a new way of communicating geological heritage by integrating the work of geoscientists, artists and local communities. Moreover, this new strategy avoids the logistical obstacles associated with physical educational displays in mountainous terrains and underlines the benefits of accessible, multi-platform geoscientific engagement.

1 Introduction

Geotourism is a form of tourism driven by the curiosity to understand how landscapes have been shaped and the geological history behind their formation. It can serve as a tool in fostering a deeper appreciation and awareness of the environment, and supporting sustainable territorial development (Newsome and Dowling, 2010; Hose, 2016; Gordon, 2018). Developing geotourism opportunities may enhance both the visitors' and locals' experience increasing the awareness of geoheritage through the geoeducation, and promoting geoconservation (Farsani et al., 2011; AbdelMaksoud et al., 2021; Coratza et al., 2023). In practice, this often involves the use of classical interpretation tools, such as information panels and guides, that highlight the geological significance of particular sites, designated as geosites. Moreover, among geotourism initiatives it is possible to find the geotrails, which are designed to connect visitors to multiple geosites, guiding them through the landscape

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and telling its geological story (Hose, 2020). While there have been attempts in the literature to provide guidelines on how to

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construct and evaluate effective panels (Martin et al., 2010; Coratza et al., 2023), these have largely focused on the scientific and didactic content, with less attention paid to the communicative effectiveness of such tools. Such an approach may lead to the creation of interpretation tools that contain valuable scientific and didactic content, but which fail to capture the interest of the local population and visitors (Macadam, 2018). Nevertheless, geotouristic initiatives should encourage geoscientists to effectively communicate earth sciences, translating their technical knowledge for a general, non-specialist audience, especially in light of increasing geoenvironmental challenges.

Geoscience communication is still an emerging discipline (Illingworth et al., 2018), and it has progressed at a slower pace compared to the more thoroughly researched field of science communication (Weigold, 2001; Trench et al., 2014). For this reason, there remains a paucity of studies that assess the effectiveness of efforts in communication of scientists within geoscience (Wijnen et al., 2024). Additionally, many of these communication activities are developed based on empirical practices, often designed based on assumptions of a knowledge gap within the public (Rodrigues et al., 2023). However, effective communication is increasingly understood as a two-way interaction, where knowledge is not simply transmitted to the public, but is exchanged through dialogue about scientific topics that impact their lives (Stewart and Lewis, 2017). This reflection has enabled geoscience to adopt more dialogical approaches to the public(s) it seeks to engage with, also paving the way for a multidisciplinary approach. Indeed, in recent years, a growing number of studies has tested the integration of geoscience with creative elements such as art (Valentini et al., 2022), poetry (Illingworth and Jack, 2018; Nesci and Valentini, 2020; Flint, 2024), (video)games (Locritani et al., 2020), comics (Wings et al., 2023), and music (Nesci and Valentini, 2020), demonstrating how these elements facilitate both the ability to communicate complex issues to a non-expert audience and the ability to engage this audience generating dialogue between scientists and nonscientists (Nisbet et al., 2010; Stewart and Lewis, 2017; Illingworth, 2020). Our study aligns with and builds upon such research, combining scientific communication with artistic elements (illustrations and narrative). The aim is to showcase the informational richness in both cultural and geological sense of landscapes to a broader audience. At the same time, it suggests the potential efficacy of a methodology that engages the local community in a process of co-creation to define the elements to be communicated in order to attract visitors to know and experience these places.

The value of participatory approaches in citizen science arises from the growing complexity of real-world problems and contemporary social challenges, meaning that meaningful solutions can only be developed effectively by integrating inclusive methods like co-creation (Senabre Hidalgo et al., 2021). In this manner, geoscientists can learn more about the vision of local communities, treated as equals and not just as people to whom knowledge can be transmitted. Indeed, a non-hierarchical approach can facilitate effective dialogue, encouraging the public to contribute their knowledge and experience (Illingworth, 2023). This approach can provide new perspectives, such as a better chance of project success, a stronger sense of belonging for the local community, and the possibility of using local knowledge (Rock et al., 2018; van Beveren et al., 2022). The use of local knowledge and practices from communities, also known as "vernacular culture", can enhance the understanding of how man-made structures interact with natural ecosystems. A site-specific understanding of the relationship between the built and natural environment can play a critical role in better addressing the challenges of climate

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change and promoting effective strategies for adapting to its impacts (Hu et al., 2023). Ultimately, this integration supports sustainable development in the region by promoting resilience and environmental management.

Such a method can be particularly effective in geoheritage communication. Geoheritage, using geosites, can link geoscience and society offering a wide range of opportunities to use new communication approaches that allow science to reach a wider audience and to use new interpretation tools (Tormey, 2019; Shajahan et al., 2024). Thus, it would also be possible to promote territories through the fostering of conscious tourism (Higuchi and Yamanaka, 2017). Following this rationale and in accordance with the UNESCO definition (https://www.unesco.org/en/iggp/geoparks/about), geoparks appear to have the chance to become the ideal place to develop co-creation projects, which would then result in geotouristic offers characterized by a new method of communication. In fact, geoparks can be considered as places of special geological value, but also as open-air laboratories where projects can be developed that lead to the protection of the territory in a holistic sense.

In this paper, through the research question of the designation of a participatory geotrail, we present a methodology implemented in Alagna Valsesia area, located in the Sesia Val Grande UNESCO Global Geopark (Italy), which, through a multidisciplinary approach, integrates co-creation and artistic elements with geoscientific communication.

2 Motivation and objectives

The objective of this work was to stimulate a new perception of the landscape to the largest possible audience, starting from its aesthetic value and ultimately leading to a deeper understanding of its geological history, relation with local communities, environmental challenges, and vulnerabilities, all of which have participate in shaping the actual status.

Alagna Valsesia is a mountainous area located in the upper Sesia Valley at the foot of Mount Rose in the Piedmont Region and lies within the Sesia Val Grande UNESCO Global Geopark (Fig. 1). It has been the focus of various studies for its relevance in both geology, tourism, and culture. Its position between the Austroalpine and Pennine domains offers valuable insights into both continental and oceanic crust formations, making it significant for studying the Alpine orogenesis (Piana et al., 2017). Moreover, it is a significant tourist destination within the geopark, attracting visitors mostly during the winter season, and hosting the Walser, a local community that migrated from ???? during the Middle Ages (why?). The Walser are known for their climate resilience and for preserving centuries-old traditions that continue to shape the region's cultural landscape (Rizzi and Gianoglio, 2023).

To design a geological trail (geotrail) in Alagna Valsesia, that is already a well-established tourist destination, means, through the deeper comprehension of the geological and geomorphological processes that shaped the landscape and an effective communication, the public can gain a more meaningful connection to the region and fully appreciate it. Furthermore, the geotrail has an educational value and requires an effective narrative to guide visitors.

Consequently, another goal of the work was to define a communication strategy developed in collaboration with representatives of the local community through a co-creation process and integrated with the work of artists.

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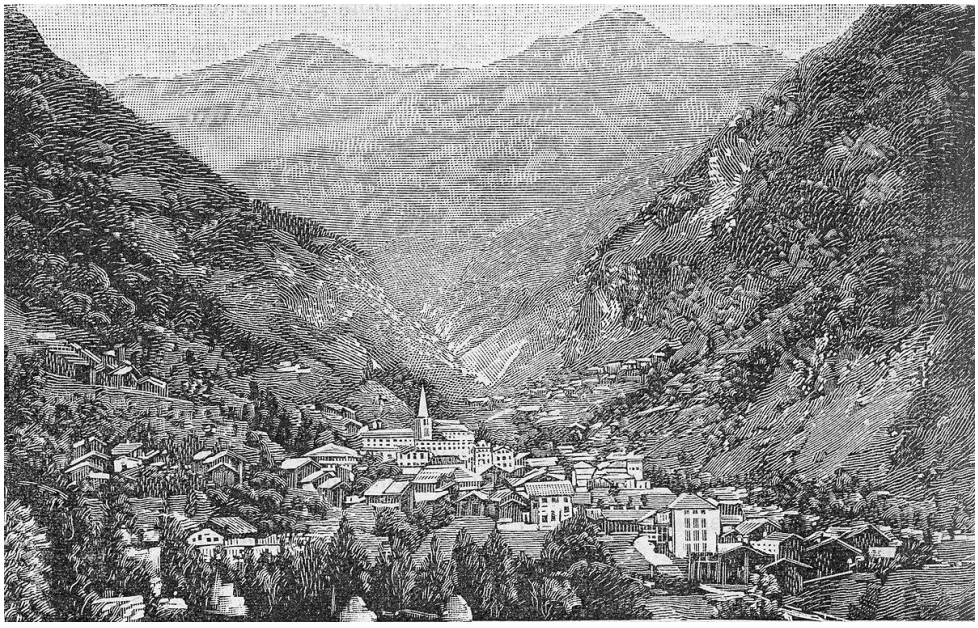

Figure 1: Ancient xylography of Alagna Valsesia. Image by Wikimedia Commons. Quote both link and Author, if possible, or the web source

3 The working method

The whole project took place thanks to a PhD research, initiated in 2022, aimed at fostering the geotourism opportunities in Alagna Valsesia, disseminating the Geoheritage through a multidisciplinary approach (quote the PhD dissertation) (Guerini, 2025). It was conducted in collaboration with key partners, including the *Dolomiticontemporanee* project (DC), the Sesia Val Grande Geopark, and the Alagna municipality. These organizations share a common interest in promoting deeper public awareness of the landscape while involving the local community in the process. The idea of a participatory geotrail was initially presented at national and international level in several conferences (e.g. Guerini et al., 2024). Then, to effectively communicate this to the public, we collaborated with our partners to offer to the public different products, the most important of which is a booklet guide of the geotrail, that adopted a multidisciplinary communication strategy that combines three key forms of expression: science, visual art, and narrative (see the supplement file). The following sections outline the method used to design the geotrail, incorporate local knowledge through co-creation, and engage artists to enrich the project's visual storytelling.

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3.1 Geotrail designation

In developing the geotrail designation for Alagna Valsesia, the initial step was an in-depth assessment of the environmental context of the region from a geological perspective. This involved the assessment of the geodiversity of the area and, among the geodiversity elements, the recognition of the sites that hold significant geological heritage, following the framework that has been established in previous studies (Guerini et al., 2024b). Secondly, the geotrail was carefully mapped out, with the intention of both making visible these geosites and presenting them in a logical sequence through narrative, in order to showcasing the rich geological, geomorphological, and cultural heritage of Alagna Valsesia. Indeed, the value of integrating both geosites and cultural sites into geoparks' development strategies has been demonstrated to foster a comprehensive appreciation and safeguard of the landscape (Guerini et al., 2023). The resulting geotrail is approximately 22 km long, mostly on easy hiking trails, in an elevation range of 1200 to 2450 meters a.s.l. with an elevation gain of 1,700 meters, offering a comprehensive, immersive experience into the landscape (Fig. 2). This trail can underscore the geological significance of the region, showing 25 different geosites of the area. Moreover, it can show the importance of geodiversity for local communities and for the natural environment, and how climate change is affecting it. Eventually, the trail is designed to reveal how the Walser community has interacted with and adapted to this unique environment over centuries.

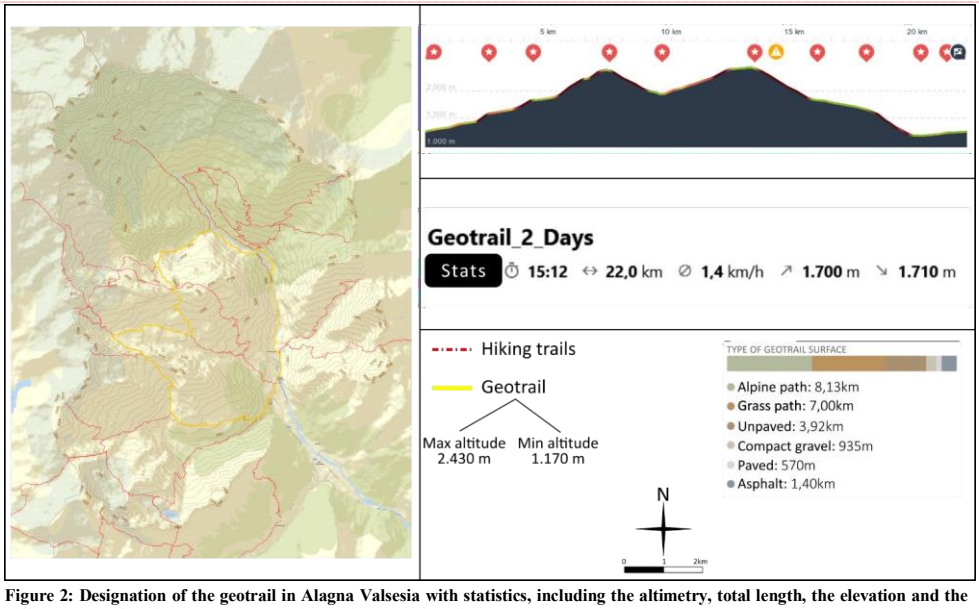

Figure 2: Designation of the geotrail in Alagna Valsesia with statistics, including the altimetry, total length, the elevation and the different type of surfaces. The basemap is provided by ESRI Standard. Altimetry by ©Komoot.

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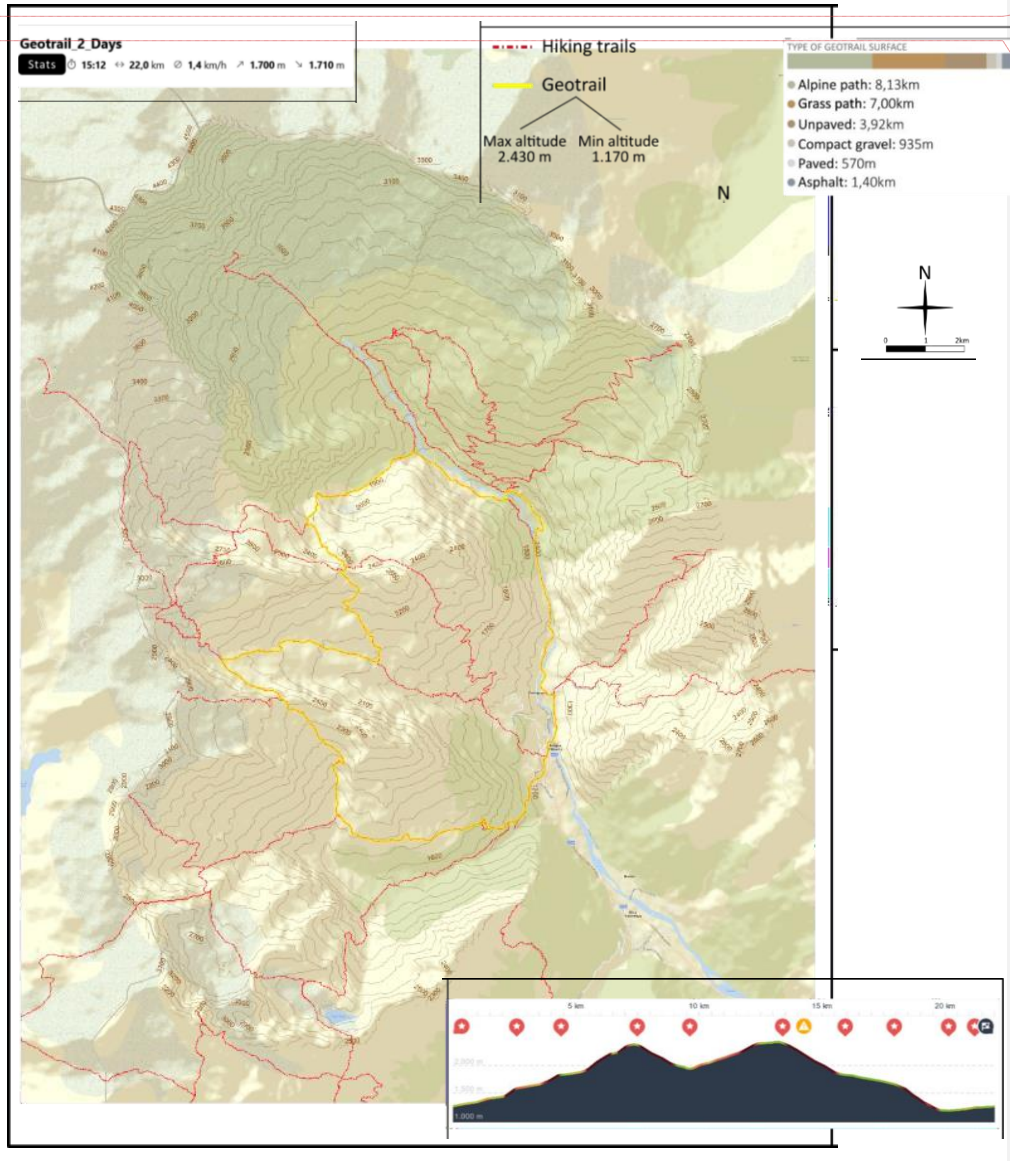

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Given its length and diversity, the trail is ideally suited for a two-day journey, promoting a slow tourism approach that fosters a more reflective and immersive connection with the area. This approach enhances the sustainability of geotourism offerings by encouraging a deeper engagement with the landscape (Widawski and Oleśniewicz, 2019). To support this experience, the trail includes four mountain huts where visitors can rest (also spending the night), taste and buy local products, and sample regional cuisine, thus enriching their connection to Alagna's cultural landscape (Fig. 3). By encouraging longer visits and more meaningful interactions with local heritage and services, slow tourism benefits both the visitor experience and the local economy (Wheeler, 1995). For visitors who prefer a briefer journey, alternative routes are available that do not include all the viewpoints and conclude the circuit of the trail in advance. However, these routes could offer a less comprehensive experience of the trail's themes.

Figure 3: Example of an alpine hut: this is the hut in the Bors valley, the second to be encountered along the geotrail route. Photo by the authors

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Finally, the trail passes through four distinct geological units, emphasizing the geologic diversity of the region. Additionally, in collaboration with the Walser community, whose insights were instrumental during the design phase, the trail traverses four alpine pastures and over ten traditional Walser villages (Fig. 4). This inclusion serves to acknowledge and enhance the Walser customs, integrating the regional cultural and natural heritage into a unified narrative.

Figure 4: Alpe Pianmisura. This is an example of a Walser alpine pasture visible along the geotrail. Photo by the authors

3.2 Co-creation and unstructured interview

The geotrail was initially mapped with a scientific focus to effectively highlight the geological heritage of the area, a central aspect of the geotourism experience. Intended as a comprehensive interpretation tool, the trail also aims to convey the geological history of the region while simultaneously enhancing the understanding of local customs and their interaction with the natural environment, thereby serving as a valuable instrument for geoeducation. Succeeding the design phase, we turned our attention to developing a strategy to effectively communicate these multifaceted elements to a diverse audience. Following the latest results on the geoscience communication effectiveness (Loroño-Leturiondo et al., 2019; Wibeck et al., 2022) we adopted a co-creation strategy with the Walser local community. To achieve this, we firstly contacted by email the

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local stakeholders, such as the Walser culture centers and the municipality. Then, we physically spent a whole month in the study area to foster the potential dialogue with the locals. Although it is evident that these communication and dialogue-seeking efforts have consistently been led by experts, employing a downstream approach, the objective of this phase was to favour an equitable exchange, thus avoiding perceiving citizens as individuals with a deficit in knowledge (Harris et al., 2021). Instead, they are regarded as integral members of the project, seeking equitable and constructive dialogue that would facilitate the advancement of outreach communication endeavours. Two-way communication can take many forms, but for the purpose of our study we preferred the face-to-face dialogues with locals, because this form effectively enables participants and researchers to bridge the gap in their understanding that often exists between them (Rangecroft et al., 2024). Particularly, we engaged members of the local community according to specific criteria:

- Representatives from Walser cultural centres and individuals knowledgeable in Walser traditions;
- Descendants of the Walser people;
- Residents and professionals in Alagna Valsesia who actively contribute to environmental conservation or cultural preservation.

This approach enabled us to gain insight into the local community and engage in informal discourse, which we documented through taking notes (Zhang and Wildemuth, 2017). Specifically, we presented each member of the local community with a trail map and elucidated the objective of our project. From this point of departure, we initiated a dialogue, primarily with the objective of:

- Collecting memories of Walser customs and traditions;
- Collecting the stories of Walser oral culture;
- Identifying the principal challenges facing the Alagna Valsesia area;
- Understanding how to utilize and communicate this vernacular knowledge within the geotrail.

We took advantage of the benefits associated with unstructured interviews, including enhanced practicality in diverse organizational contexts and spontaneous dialogue that was both voluntary (each participant gave verbal consent) and comfortable for members of the local community, without the constraints of a larger group (Chauhan, 2022). The objective of this co-creation process was to think to a communication strategy for the geotrail that reflected the actual challenges faced by the region and the traditions of the local Walser community. The goal is to convey the geological beauty of the area in conjunction with its local culture and customs, utilizing the vernacular knowledge of the Walser people as the foundation for the narrative of the geotrail. The principal outcomes of these dialogues were:

1. The identification of key elements of the Walser community to be enhanced. In particular, there was considerable discussion of the vernacular architecture and villages and pastures of the Otro Valley (Fig. 5). Other elements that emerged as significant were traditional clothing and festivals, including the bread festival and a procession known as the "Flowered Rosary" (Fig. 6);

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2. The ancient oral traditions (with legends and tales) and the vernacular knowledge were identified as a valuable resource for geotrail storytelling. This also resulted in the consultation of local and national bibliography, in which numerous legends are collected (Sibilla, 1980; Savi-Lopez, 1993; Wanner, 1995; Christillin et al., 2010);
3. The setting of some of these legends in the Alagna area and the integration of these with scientific knowledge. In particular, this emphasized a close relationship between the Walser community and high-altitude environments, as well as a connection with ice and glaciers;
4. A discussion regarding the current issues facing Alagna. At this stage, problems such as juvenile emigration (also a recurring element in Walser history), coexistence with wild animals, the protection of protected species, and the challenge of climate change for the Walser way of life emerged.

Figure 5:Typical Walser house, an example of vernacular architecture in Alagna Valsesia. Photo by the authors

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Figure 6: The picture shows a moment of the bread festival, an ancient Walser tradition in which bread was baked to meet the needs of the whole community throughout the winter. Photo by Federico Bierti

In agreement with the local community members, we decided that these were the main elements to be developed and integrated with the geological interpretation along the trekking. Looking at the map, to enhance the interpretative experience of the geotrail, we also selected ten observation points, or "geostops", each positioned to provide optimal views of the most notable geological formations and sites, and where vernacular knowledge could be integrated (Fig. 7). This allows to each geostop to serve as a focal point not only for seeing the geosites, but also for visual landscape interpretation of the whole trail (da Silva et al., 2020). Here, visitors will have access to interpretive elements that will guide them along the way.

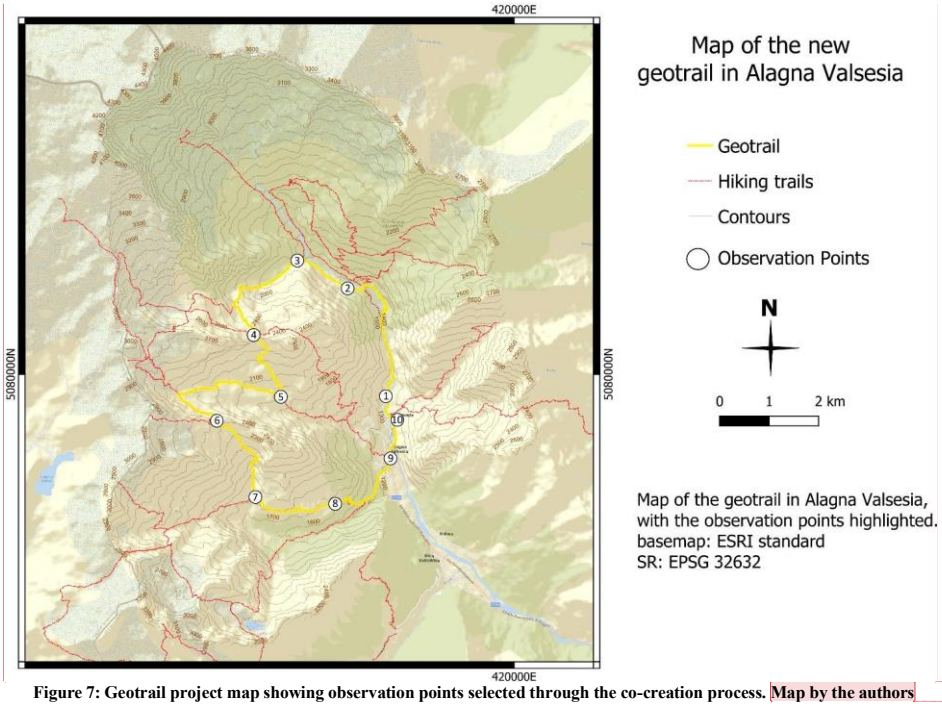

Figure 7: Geotrail project map showing observation points selected through the co-creation process. Map by the authors

However, at this point, in agreement with the local community, we did not ask the Walser people to merge their legends with geological knowledge. The co-creation process was mainly used to connect and share knowledge and to decide which elements to focus on in the communication, but no creative process was implemented. In fact, we took into account the many

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barriers and practical challenges to using creative practice in co-creation research, such as time, as creative methods often take a lot of time, both for the participants and for the researchers, and unfamiliarity, as participants are not always comfortable with engaging in creative practice (Van Loon et al., 2020). For this reason, the final phase of the project, which involved a creative approach that integrated art and science to effectively communicate the ten observation points along the geotrail, was conducted through the formation of a multidisciplinary team and the engagement of artists. The artists were responsible for two key tasks: firstly, the creation of new tales from the existing Walser legends, reinterpreting them in a contemporary style to address contemporary local issues; secondly, the production of a series of images and illustrations that would enhance the various elements that emerged during the co-creation phase. All these elements have been integrated in a final booklet guide of the geotrail.

3.3 Artistic collaboration

The integration of artistic collaboration into the design and communication of the geotrail in Alagna Valsesia represents a new approach to the elaboration of data gathered during the co-creation process. This phase of the project was conducted in collaboration with DC, an innovative project of art, networks, science, integrations between parts, that combines contemporary art and cultural practices to reactivate spaces with unused potential (dolomiti contemporanee, 2024). The geoscientists were hosted by DC through a residency and contagion process in the Dolomites, where DC has been active since 2011.

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In a context where the mountain is often represented in a comedic manner through cultivated stereotypes that correspond to aesthetic and psychological ready-mades, which serve to sell it to tourists, DC works to construct an intelligent, critical, and proactive idea of mountains (D'Incà Levis, 2016). It is imperative that the mountain be safeguarded in terms of its environmental value, while simultaneously encouraging the advancement of its cultural identity (Chan et al., 2016). Consequently, DC regards the mountain as a research laboratory in which we live and operate. Interdisciplinarity is a crucial anti-rhetorical and anti-speciesism factor in this context. In its international artistic residences and other DC's projects, the artist collaborates with scientists or experts on an environmental or landscape aspect. For instance, in the project entitled *Le fogge delle rocce* (2024), the artist works with a geologist on the subject of rock formations.

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This partnership facilitated the convergence of expertise and a reorganization of competencies, enabling a more comprehensive and integrated approach to research. By combining diverse perspectives and knowledge domains, the partnership fostered a more nuanced understanding of human landscapes and integrated forms of research and thought. Consequently, a diverse team of scientists, artists and a curator was constituted. In this context of multidisciplinarity, where the functions of design meet creative skills, new approaches to understanding the identity of places and their meaningful use were discussed. These approaches involve the development of appropriate communication models, which are experimental in nature and have begun to take shape. In particular, the artists engaged with the landscape as an active cultural and conceptual space, rather than a passive backdrop. They did so by treating scientific geological data, cultural data, and geotrail design, which were defined through the process of co-creation, as a basis for a productive exchange of ideas.

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A significant outcome of this collaboration was the transformation of the gathered scientific data into a form that could be interpreted and presented in an artistic manner. For example, illustrations, artistic maps and narrative stories were created to provide the geotrail guide. A guide who is capable of dealing with the subject of geodiversity and geoheritage of a mountain geotrail, disseminating the information in a way that is not exclusively scientific, seeking to popularize the subject in a meaningful and engaging manner, who can, while explaining, convey the essence of the topic with eloquence and clarity, and who can also evoke a sensitive and emotional understanding of the subject matter. In particular, these artistic elements served as a means of translating complex geological information into formats that could be readily comprehended and appreciated by non-specialist visitors. Moreover, the artists transformed the data collected through the co-creation process, rendering some of the Walser narratives contemporary and underscoring the significance and depth of vernacular knowledge held by local communities. The narratives, thus enhanced, convey technical, scientific and cultural information through the integration of diverse media, resulting in a multifaceted and polysemantic construct, accompanied by the visual element, entrusted to artistic expression. The resulting small guide is an experimental prototype, susceptible to further development in an accurate, organic, and inclusive manner. Culture and research do not generate a fixed product; instead, they create a malleable apparatus whose potential applications are numerous and diverse.

While collaboration has yielded numerous benefits, it has also brought to light a number of challenges. The integration of methodologies and priorities from distinct disciplinary traditions—science and art—necessitated a process of careful negotiation and a commitment to mutual understanding. Artists prioritized interpretation and emotional engagement, whereas scientists focused on precision and factual accuracy. Balancing these perspectives required time and effort, yet the resulting synthesis was both credible from a scientific perspective and convincing from an artistic perspective.

Despite the challenges, the integration of artistic collaboration significantly enhanced the efficacy of the geotrail in conveying geological knowledge in an inclusive and innovative way. The involvement of DC demonstrated how contemporary art can serve as an efficacious means of public engagement, transforming complex scientific data into experiences that inspire curiosity and appreciation for natural and cultural heritage. This experience underscores the potential of interdisciplinary partnerships as a model for future initiatives to bridge the gap between science, art, and society.

4 The final booklet guide

The final booklet representing the guide of the geotrail is the final outcome of the study. To address the diverse considerations inherent in geoscience communication, we incorporated elements emerged from the co-creation process into a multidisciplinary approach, working with artists to blend geological insights with narrative and visual art. These collaborations facilitated an interdisciplinary discourse on topics including scientific knowledge and information, and geotrails. In collaboration, we examined geoscientific communication as a vehicle for the dissemination of knowledge and content that pertain specifically to the mountains and their geomorphological features, ecosystems, and local contemporary society. We sought to establish a reciprocity of exchange between art and geology. The outcome was an artist's book that

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also served as a guide to this specific geotrail. In this project, the curator, geoscientists and artists collaborated to conceptualize the narrated and illustrated presentation of the geotrail and its geodiversity aspects. The final guide-book contains a comprehensive introduction, featuring an old Walser poem about the walking paths, a summary of the objectives of the geotrail, and a geotouristic map; and an in-depth explanation for each stage, that includes a detailed map, general description, an adapted Walser story by the artists, geological insights for the observation points, an interpretive box on geological or cultural aspects, brief commentary on nearby geosites, and custom illustrations created by the artists. The different stages are marked by the observation points. This approach fosters a layered exploration of the landscape, offering visitors a dual narrative journey. One journey delves into the cultural heritage and legends of the Walser, adapted with a modern perspective to highlight contemporary environmental issues and encourage cultural appreciation. The other is a geological journey back in time, guiding visitors through various observation points to explore changes from the last ice age to over 300 million years ago, unveiling the area's geological evolution. Through these integrated journeys, the guidebook supports a nuanced understanding of the landscape, encouraging visitors to interpret it through both geological and cultural lenses.

4.1 The Geotouristic map

A geotouristic map plays a crucial role in conveying scientific concepts to non-specialist audiences (Regolini-Bissig, 2010). In this study, the geotouristic map is a central communication element, fostering engagement with the geological heritage of the geotrail. By offering an accessible and visually compelling entry point, it attracts a broader audience and guides them through the narrative layers of the geotrail. To maximize its impact, it was critical to balance scientific accuracy with aesthetic appeal. Through collaboration with curator and artists, we opted to integrate both tourist and geoscientific components into the design (Fig. 8), resulting in an interpretive map (Regolini-Bissig, 2010). This map typology enables users, both scientists and non-specialists, to gain insight into geomorphological and geological phenomena, including landscape formation and evolution processes. Particularly in mountainous areas, such maps serve as effective geotourism tools, enhancing interpretation of complex landscapes and supporting a deeper appreciation of geological features (Bouzekraoui et al., 2018).

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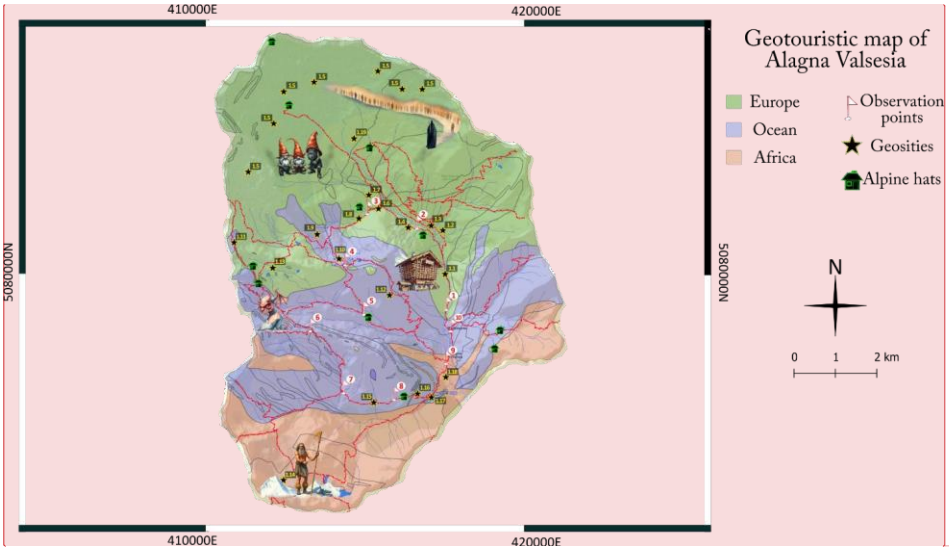

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Figure 8: Geotouristic map of Alagna Valsesia. it merges artistic and scientific elements, resulting in an artistic interpretation map. Map by the authors

To enhance the geological heritage, the geotourism map includes selected geosites and introductory interpretations of the geological environment, aiming to captivate visitors and provide an entry point into the narrative of the geotrail. The map distinguishes between three primary paleoenvironments: pre-Alpine European continental formations, the Tethys Ocean floor, and the African plate, displaying these geological units based on their formative environments. Designed to convey scientific accuracy, the map encourages a deeper understanding as visitors progress through the geotrail, stopping at each designated observation point chosen with the Walser community through the co-creation process.

In addition to geological insights, the map incorporates practical elements, such as hiking trails and support points like alpine huts, enhancing its utility for tourists. The artistic contributions also embed illustrations rooted in Walser folklore, highlighting locations associated with traditional legends. These illustrations are intended to both preserve Walser oral traditions, integrate contemporary art, and draw the attention of visitors. Like the geological components, they invite full comprehension when experienced along the trail, guiding visitors through layered narratives embedded in the guide.

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Figure 9: Interpreted glacial landscape in the upper part of Alagna Valsesia. This area is visible from the first observation point of the geotrail. Photo and illustration by the authors

4.2 The Journey back in the time

The primary layer of the geotrail narrative is related to the geology of the area. It invites visitors and readers of the guide to travel back in time by interpreting, step by step, visible rock formations and landforms from ten strategically selected observation points. These points, identified in collaboration with the local community through the co-creation process, represent the main points of the Alagna Valsesia territory, also giving significant insights of geology. At this layer, the emphasis is on geoscientific input, with minimal artistic contribution. During the co-creation process, all the participants expressed their surprise at understanding how old the rocks of Alagna Valsesia are, and how far back they come from, and it became clear how attractive the theme of a geological journey through time could be that would lead along the geotrail. Following this narrative thread, geoscientists interpreted the landscape for each observation point. Since Alagna Valsesia is situated in an alpine region, the geological narrative begins with the interpretation of recent glacial formations (Fig. 9), then proceeds deeper in time, detailing the processes of alpine orogenesis and rock formation.

This region is particularly well-suited to such an exploration due to its exceptional geodiversity (Guerini et al., 2024b), showcasing geological units from the European plate, the Adriatic plate, and the Tethys seafloor. The structure of this narrative sequence is illustrated in the table 1:

Table 1: Description of the scientific topics addressed at each observation point along the geotrail.

Viewpoint	Primary theme	Description
1	Geomorphology	It corresponds to the start of the geotrail, and contains a general introduction about Alagna landscape

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2	Geomorphology	offers a geomorphologic interpretation of the landscape, highlighting the glacial features formed during the Little Ice Age. From this viewpoint, visitors can see the seven Valsesian glaciers, as well as moraines and humpbacked rocks from this period. These features serve as a clear indicator of the ongoing climate change
3	Geology	It enables a geomorphological reading of the landscape, reaching back to the Last Glacial Maximum. Here, visitors can observe paleo-moraines, glacio-lacustrine plains, and hanging valleys, each illustrating the dynamic processes that have shaped this mountainous terrain over time
4	Geology	It offers an interpretation of the geology of the region. It is located at contact between two geological units, one belonging to the European margin and the other to the ancient ocean floor. This allows us to tell the story of the Alpine orogeny, which started about 60 million years ago, to interpret the current landscape and to show the geological contact zones
5	Geology	It takes the visitor even further back in time, to over 145 million years ago, revealing rock formations distinct from those previously observed. These rocks predate the convergence of the African and European plates, showcasing ophiolites, rock remnants of the ancient Tethys Ocean floor, with a medium degree of metamorphism. This viewpoint provides a unique opportunity to illustrate what would have been the seabed of the Tethys Ocean, effectively giving the impression of walking on a former ocean floor.
6	Geology	It is still located on ocean-forming rocks, but it is on an alpine pass, so the view is wider. In particular, from here it is possible to see the opposite side of the valley, which belongs to the Adria plate and thus to the African margin. From this observation point, the reader is thus invited to go back in time more than 200 million years, when the African rocks were formed before they converged towards the European margin
7,8,9	Human-nature relation	Viewpoints 7, 8 and 9 are dedicated to the Walser communities and are located in ancient hamlets, thus making the visitor take a big step forward in time. The first two are located in villages at high altitude, in a hanging valley, while the third is among the ancient villages in the present village of Alagna Valsesia, near a fountain that, with its 3 outlets, represents the 3 streams that flow in Alagna and that the visitor has crossed with the geo-trail. The interpretation of these viewpoints is mainly related to the relationship between man and nature and shows some elements of the Walser culture, how they adapted and exploited the local resources
10	Walser Culture	It is the last of the geotrail and is still focused on the Walser communities, since it corresponds to the Walser Museum in Alagna Valsesia

Storytelling is an important method of communicating geoscience to non-specialist audiences, allowing complex knowledge to be communicated to both adults and children, engaging audiences and making them more informed, better able to

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understand and interpret their environment, and more likely to fully appreciate it (Lidal et al., 2013; Matias et al., 2020). However, our study revealed the necessity to enrich the local culture, which is strongly connected to the landscape. To this end, we collaborated with curator and artists who facilitated the integration of a multidisciplinary approach, thereby incorporating a second narrative layer based on indigenous storytelling.

4.3 The tales

The second narrative level focuses on the vernacular knowledge of the Walser people. Vernacular knowledge covers a wide range of fields, including earth sciences, social sciences, architecture, and health. It combines these various domains into a coherent and holistic framework, which is frequently transmitted orally or through everyday actions (Smythe and Peele, 2021). Furthermore, this information is expressed in a variety of ways, including language, artistic expression, music, place names, dance, architecture, medications, environmental practices, storytelling, and so on. In our research, we concentrated on vernacular knowledge conveyed through practices and legends, which also preserve the typical Walser language. The co-creation process yielded a substantial corpus of these legends, which exemplify the oral tradition of the Walser. Once more, in collaboration with the local community, we selected the legends that are most deeply rooted and represent the community, their spiritual values, and their relationship to the environment. In particular, we jointly selected six legends and some specific aspects of the Walser traditions to be emphasized in the eight observation points (in the introductory and concluding points they were not considered). In the final stage of the co-creation process, we inquired of community members as to the principal challenges they perceived to be facing in their area and how these might be incorporated into the narratives. Thus, in collaboration with Walser members, we undertook a creative process whereby scientific and local community knowledge were integrated, and non-scientists were facilitated in being engaged in meaningful dialogue (Illingworth, 2020).

Subsequently, the artistic component was initiated. Based on the data gathered during the co-creation process, curator, artists and geoscientists collaborated by developing narratives and images that encapsulated both the local community and the contemporary issues prevalent in the area. These representations were created from their respective observation points (tab 2).

Table 2: Titles and descriptions of the tales told at each observation point. Each tale is derived from Walser legends and traditions and has been repurposed by an artist to address a local contemporary challenge.

Title of the tale	Description	Challenge
Procession of the dead souls	The legend is rooted in the glaciers of Monte Rosa, which are perceived as having a profound spiritual significance	Climate change
Hanging women	A legend is associated with Pisse Falls, which has a significant history of flooding. This illustrates the respect and apprehension that the Walser people held towards the environment	Environmental dynamic
The lost valley	The legend is about past prosperity, linked to Walser migrations	Mass tourism

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The wolf	The legend in question pertains to the respect that the Walser people have traditionally shown towards wild and protected species. This demonstrates their capacity for respecting their natural environment.	Generic danger of freeriding
The devil's stone	A legend related to the religious side of the Walser community, which takes place in the locality "stone of the devil".	Tourism offers
The wild man	Legend of a mysterious, almost mythological man who lives alone at high altitude: tells of the difficulties of living in a hostile environment.	Climate change
The signs of fate in nature	A legend that is related to the custom of the Walser community to read the future of their children in ice crystals.	Depopulation / reenactment of tradition
The fountains	Legend related to the importance of local resources and their sustainable use, especially water	Walser hamlets conservation

The result is a distinct form of storytelling, the indigenous one, that draws upon the rich traditions of local communities while infusing it with a contemporary sensibility. The potential of indigenous storytelling is to enhance conservation efforts by aligning actions with indigenous worldviews and fostering meaningful connections between people and their landscapes (Fernández-Llamazares and Cabeza, 2018). In our case, the promotion of indigenous storytelling can facilitate the transfer of Walser knowledge and language across generations, encourage local engagement, and enhance the resonance of geoconservation efforts.

5 Impact, implications and conclusion

This paper presents an innovative method of geoscience communication within the Sesia Val Grande Geopark. Projects with participatory approaches (Bollati et al., 2023) or trails for geological education (Perotti et al., 2020) have already been implemented in the geopark. In addition, geotrekking has recently been included in IGCP projects and, combined with multimedia tools, is considered an important tool for geoscience promotion and conservation in UNESCO Global Geoparks (Bollati et al., 2024). However, our work contributes to the advancement of the research landscape by proposing an innovative model for the development of communication strategies in the field of geoscience. This model integrates two key elements: co-creation and creative elements, both of which are essential for effective geoscience communication. Based on the successful integration of art with geoscientific communication (Nesci and Valentini, 2020) and the demonstration that

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two-way communication is optimal (Stewart and Lewis, 2017; Loroño-Leturiondo et al., 2019), this study integrated these two aspects by proposing a multidisciplinary approach for communicating the geological heritage of Alagna Valsesia through a geotrail. In a period during which an increasing number of geological trails are being established, these initiatives frequently fail to achieve their objective of disseminating geoscience due to their inability to attract and engage the public. In contrast, our approach enables the local community to perceive the project as their own matter, thereby enhancing its likelihood of success. Furthermore, through artistic collaboration, it permits the communication of geoscientific concepts by stimulating diverse audience segments, including the emotional one, which has been demonstrated to be a considerably more effective mode of communication than traditional methods (Ham, 2013).

This approach aligns well with UNESCO geoparks, which operate on a bottom-up model aimed at holistic territorial enhancement. Engaging indigenous communities in reciprocal communication supports objectives of UNESCO Global Geoparks by integrating vernacular knowledge, which, in turn, enhances geoscientific communication and responsiveness to local needs. This collaborative framework fosters community cohesion promotes sustainable land management, and, through artist involvement, cultivates a more comprehensive understanding of the region. Furthermore, the result of this project was an artist's book that also serves as a guide to geotrail, presenting a novel approach to science communication. This format not only provides a structured, guided experience for those walking the trail but also extends engagement opportunities beyond the physical site through the book and accompanying digital resources. Indeed, the guidebook was designed to be field-usable but is also suitable for distribution in schools or for sale as an art object that visually conveys Walser cultural heritage alongside the geological message. Additionally, this strategy eliminates the need for costly installations and maintenance of educational panels, which are particularly challenging in the complex and evolving environment of the Alps.

It is anticipated that the project will conclude the editorial development of the guide in the near future, thereby enabling its distribution to the general public. To facilitate the continuation of the co-creation process with the local community, it is essential that the inaugural presentation be held in Alagna. This event should engage not only select members of the Walser community but also the broader community at large. Indeed, the most significant limitation of this study is that it has not engaged the entire community. Additionally, as it is still in the planning phase, it has yet to make significant efforts to promote the geotrail. The presentation of the booklet, which is to be conducted as a workshop, may elicit new impressions of the guide and ideas regarding the future direction of work in Alagna Valsesia. Furthermore, future work should monitor the dissemination of the guidebook and the success of the geotrail through the use of questionnaires submitted to tourists or students traversing the geological trail.

Data availability

No data sets were used in this article.

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Author contributions

MG: Conceptualization, Methodology, Investigation, Resources, Validation, Supervision, Writing original draft, Writing editing and review; AF: Methodology, Investigation, Resources, Data Curation, Visualization, Writing editing and review; GdIL: Conceptualization, Resources, Supervision, Writing original draft

Competing interests

The corresponding author has declared that neither of the authors has any competing interests.

Ethical statement

This article was produced by the authors on a voluntary basis and received no funding from external sources or grants. Since this article does not contain any studies with human or animal subjects, and no personal or sensitive data were collected, it did not require an ethical review. Considerations of good ethical practice included the involvement of only participants aged 18 or over and ensuring the anonymity of data. Other areas of good ethical practice included the dissemination of results and outputs back to involved communities and participants where possible. Moreover, verbal informed consent was obtained from all subjects before the study.

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