

Co-creation as an approach for Ecomuseums and water sustainability: the case of Douiret-Sbâa (Morocco)

Vladimiro Andrea Boselli^{1,2}, Irene Leonardelli², Abdelkrim Boughoud³, Edo Bricchetti⁴, Giulio Castelli⁵, Elena Bresci⁵, and Eriberto Eulisse²*

¹Institute for the Electromagnetic Sensing of the Environment, CNR-IREA, Milan, Italy

²Global Network of Water Museums, WAMU-NET (UNESCO), Venice, Italy

³Douiret-Sbâa Association for Local Development, Beni Tadjite, Morocco

⁴International Council of Museums, ICOM – ITALIA, Milan, Italy

⁵Department of Agriculture, Food, Environment and Forestry (DAGRI), University of Florence, Florence, Italy

Abstract. In Morocco's dry Figuig region, the village of Douiret-Sbâa and its oasis showcase an enduring legacy of sustainable water management, drawing on centuries-old traditional knowledge passed down through generations. The village's water system is anchored by the Aïn Sbaâ spring. It follows a daily cycle where the spring feeds the main reservoir overnight, from which water is drawn and distributed across the oasis throughout the day. The village employs a notched wooden trunk, calibrated with nails and strings, to regulate irrigation shifts. To adapt to seasonal water fluctuations and needs, the community adjusts the duration of the complete irrigation cycle. Despite its localized scale, this precise water management system provides an exceptionally valuable case study. Its importance stems directly from its specificity, proving that vital lessons can be gleaned from deeply rooted, community-based practices. These lessons in sustainable governance, resilient human-water relationships, and climate adaptation offer a crucial complement to large-scale models. The knowledge embedded in such community-based systems provides a critical counterpoint and a resource for understanding sustainability in context, offering transferable principles for other regions facing similar environmental pressures. To preserve and enhance this living heritage, an ecomuseum framework with co-creative methodology is being implemented. Such a radical approach actively engages local communities, institutions and regional associations fostering the integration of knowledge and the development of a common vision. Fieldwork and local consultations have begun to map the water system's tangible and intangible heritage, through a participatory process. The work is in progress: like all ecomuseums, it will evolve rather than conclude. Advancing this project in Douiret-Sbâa can both value and strengthen its traditional water management system through grassroots

* Corresponding author: [boselli\[dot\]vladimiro\[at\]gmail\[dot\]com](mailto:boselli[dot]vladimiro[at]gmail[dot]com)

action as well as inspire community-driven efforts in other regions grappling with climate vulnerability and socio-demographic shifts.

1 Introduction

In an era of increasingly complex social and environmental challenges, traditional top-down approaches to knowledge production and resource management are proving inadequate [1]. This has prompted a significant shift toward more collaborative, inclusive, and democratic paradigms. Among these, co-creation has emerged as a powerful approach, defined as a collaborative process where diverse stakeholders work together to create desired outcomes through collective creativity. Co-creation is founded on principles of inclusivity, openness, legitimacy, and actionability, and is increasingly seen as a way to democratize research and practice across diverse fields, from public health to heritage management [1].

In the specific context of cultural and ecological sustainability, the ecomuseum approach presents a powerful, real-world vessel for co-creative principles. Moving beyond the traditional museum's focus on static collections, an ecomuseum is conceived as a dynamic, participatory process aimed at sustainable development and anchored in community ownership. It functions not as a building, but as a "community of relationships" actively promoting the involvement of its people and mobilizing various community segments [2]. This approach inherently challenges hierarchies and seeks to foster a more authentic connection between heritage, environment, and local people [3].

In this context, the community of Douiret-Sbâa has approached WAMU-NET to contribute to providing tools to value the local cultural and environmental heritage, specifically in relation to water management and governance.

In the past seven months, two field visits by the first author affiliated to WAMU-NET and several online exchanges between representatives of the community and WAMU-NET staff have paved the way for a fruitful collaboration between the network and the community, to work together towards the creation of the first ecomuseum of the oasis.

In this regard, the co-creation approach has been deemed as the preferred approach to engage in this collaborative work as it offers a robust framework for tackling complex issues. Co-creation provides the methodological foundation for interaction, emphasizing that value is generated through collaborative processes between different external facilitators (such as researchers and water museum experts affiliated to WAMU-NET) and local stakeholders [4]. When successfully implemented, this collaboration is characterized by core concepts such as dialogue, positioning, agency, and voice [5]. This article explores how the experimentation of this approach in the context of Douiret-Sbâa oasis can support local communities in valorizing traditional knowledge, and co-designing more sustainable water futures, specifically by co-creating an ecomuseum. In the next sections, we will present the context of Douiret-Sbâa and its community-led water management[†]. Thereafter, we will present the preliminary work that has been conducted to start engaging in the co-creation of the ecomuseum and the methodological approach that will guide the next phases of this collaborative work.

[†] This article is based on a contribution presented at the ICWES2025 conference. The co-creative process described herein led to the formal establishment of the Douiret-Sbâa Ecomuseum in December 2025. The publication of the proceedings follows this milestone, affirming the effectiveness of the outlined pathway.

1.1 Definition of an ecomuseum

An ecomuseum is a community-led, participatory heritage project focused on the sustainable development of a specific territory and its people. Unlike traditional museums, which operate within a building to collect, preserve, and display objects, an ecomuseum is a decentralized "museum without walls" [2]. While it may incorporate traditional exhibition spaces, its core subject is not a curated collection but the entirety of the living landscape. This encompasses the natural environment, cultural traditions, historical memories, and the community itself. It operates on the principle that the inhabitants are the true curators and interpreters of their own heritage, actively involved in safeguarding, interpreting, and managing it for future generations [2].

Central to the ecomuseum philosophy is the process of co-creation. This approach empowers communities to define their own heritage values and narratives in collaboration with external experts, such as researchers, NGOs, and institutions. It transforms heritage from a static relic into a dynamic resource for education, social cohesion, and sustainable development. By integrating tangible elements, like historic buildings, agricultural systems, and traditional tools, with intangible aspects such as local knowledge, skills, and social practices, an ecomuseum fosters a holistic understanding of place. It acts as a platform for intergenerational dialogue, encourages responsible cultural tourism, and helps communities address contemporary challenges such as water sustainability, climate adaptation, or economic resilience [3]. It does so by grounding solutions in their unique cultural and ecological identity, thereby offering fertile ground for interdisciplinary scientific research that moves beyond classical academic paradigms.

2 The community of Douiret-Sbâa and its water

The oasis of Douiret-Sbâa in Morocco's arid Figuig region (see Fig. 1) presents a compelling case for experimenting with the ecomuseum approach.

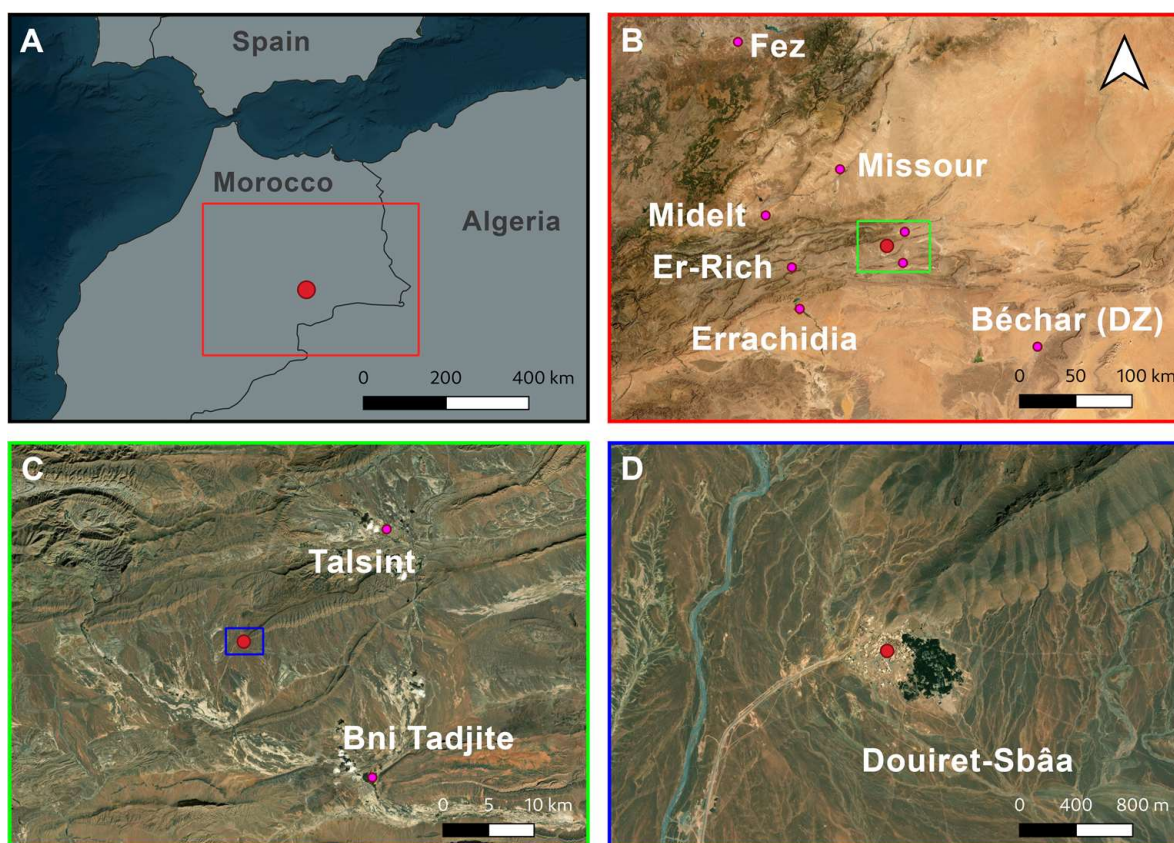


Fig. 1 Geographical framing of Douiret-Sbâa, zooming from A to B to C to D. The village is located 32°25'58'' N, 3°36'58'' W and its cultivated extension is about 0.3 square kilometers.

2.1 The village's history

The village was founded on 2 February 1565 by Sidi Mhamed Sbaâ, a renowned marabout from Fez, who was well known there for his teaching and wisdom. Its foundation rested on two pillars: the acquisition of the spring and the surrounding lands, purchased by Sidi Mhamed Sbaâ from shepherds who roamed the area, and the establishment of a Zawiya, a Quranic and law school [6]. Sidi Mhamed Sbaâ belonged to the Idrissid dynasty, a lineage the villagers still recall with pride. The founder had four sons, Ahmed, Abderrahman, Mhammed, and Brahim, which explains why the irrigated area is divided into four main sections. This division also dictates the irrigation cycle: 25 days in summer and 17 days in the cold season. In summer, each section receives six days of water, plus one day for the mosque; in the cold season, each receives four days, plus one for the mosque [6]. The mosque's irrigation day is justified because part of the cultivated land is communally owned. The income from this land supports the mosque's activities, primarily building maintenance and local welfare. While wheat and fruit trees were originally the primary crops, olive trees have recently become dominant. For centuries, the village functioned as a primary center for conflict mediation, a role derived from the authority of its Zawiya and the community's renowned capacity for equitable distribution of water and wealth. This importance was underscored in 1908 during the French advance from Algeria, when the village hosted the signing of an inter-tribal alliance to counteract colonial expansion. As a pivotal centre of resistance, it was subjected to severe reprisals after its eventual conquest: the French forced the entire population to abandon their homes for two years, a period during which the colonial forces looted and destroyed the Zawiya and village. Upon their return, the inhabitants restored the original systems of water distribution and local governance, which remain in practice today. The village's centuries-long resilience is secured by a sophisticated socio-

hydrological system centred on the Aïn Sbaâ spring. Governed by communal water-sharing practices that ensure equity, the system relies on a meticulously calibrated notched wooden trunk to time irrigation shifts. This technology is more than a tool; it is a living heritage that has fostered social cohesion and sustainable resource management for generations.

2.2 The Water Distribution System in Douiret-Sbaâ

The management of water from the Aïn Sbaâ spring is not merely a technical task but a social and cultural institution, based on a centuries-old model of mutual responsibility. The daily routine is built on specific, time-based tasks: each evening at sunset, the spring's flow is directed into a large reservoir for overnight storage. This nocturnal accumulation ensures that at sunrise, when the irrigation day begins, sufficient water is available for the fields [6]. The community has calculated the reservoir's maximum volume at 189 cubic meters. It is generally refilled by the spring's flow over approximately 12 hours at night when irrigation stops. This means the population has about 378 cubic meters of water per day to irrigate part of the oasis [6]. If natural fluctuations cause the basin to struggle with a regular flow, water can be diverted directly from the spring to the fields during the day as needed.

Water allocation is a public event. Every morning, a committee of well-respected wise persons, one from each of the four entities and co-opted by consensus, gathers at the reservoir. Using a carved wooden trunk placed vertically in the water, they mark individual water shares by hammering in nails. These shares represent complex fractions of the whole, ranging from $1/2$ down to $1/192$. This spatial measurement is translated into a temporal right, with each share corresponding to a strict amount of irrigation time during daylight hours. To ensure fairness and prevent disputes, the entire community uses the clock in the local mosque as the official timekeeper [6]. Users synchronize their watches to this clock before distribution begins. The first user of the day, who is also the person responsible for having closed the reservoir the previous evening, opens the outlet. They must carefully manage the flow to use exactly their allotted time without encroaching on others' shares. This responsibility rotates daily among beneficiaries through a lottery system [6]. The system's rhythm adapts to the seasons, dividing the year into a summer session of 25-day cycles and an autumn session of 17-day cycles [6]. As seasons change, most water shares are systematically reduced by one-third during the transition from summer to autumn. The system is upheld by a clear code of conduct. It is forbidden to pollute the spring, tamper with the measuring nails, or access the reservoir at night without authorization. Anyone whose negligence causes water loss, such as by failing to control their flow, must fully compensate the community from their own share. Remarkably, this hydraulic governance extends into social welfare. The system is connected to a tradition of hospitality: the family of the person who closes the reservoir on a given evening is also responsible for providing food and shelter to any stranger who arrives the following day. This rotating duty ensures the community's generosity is as reliable and well-managed as its water.

Wishing to experiment with new ways to valorize its water knowledge and traditional management systems, the community of Douiret-Sbaâ approached WAMU-NET for support. Contact was initiated after WAMU-NET and the Association for Local Development met in Errachidia in November 2023 during a conference on oases. A year and a half later, a collaboration began, foregrounding the idea to co-create an ecomuseum in Douiret-Sbaâ. The next section outlines the methodology of this collaboration and the planned activities for the coming months.

3 Methodology

The evolving paradigm of museology increasingly positions ecomuseums as vital agents for addressing socio-ecological challenges, with water sustainability representing a critical area of engagement. Defined as “*community-led heritage or museum project that supports sustainable development*” [7], ecomuseums find a natural focus in Ancient Hydro-Technologies (AHTs) and traditional water management systems, which serve as common ground for fruitful interdisciplinary and intercultural exchange [8, 9].

By their very nature, ecomuseums transcend the role of static repositories. They function as platforms for co-creative activities where diverse stakeholders, from local community members and elders to hydrologists and policymakers, can collaboratively experiment, learn, and innovate [10]. This approach creates a safe space for interactive creation, negotiation, and iterative rebuilding, making it perfectly suited to tackle complex issues like integrated water resource management [10].

Within this participatory framework, traditional water knowledge systems, such as the precise distribution rules and measurement techniques of Douiret-Sbâa, are not merely preserved as relics. Instead, they are actively integrated with modern scientific data to co-create adaptive strategies for climate resilience, equitable distribution, and ecosystem health. This grassroots, co-creative work aligns with and contributes to broader global sustainability agendas.

These efforts are championed by international bodies such as the International Council of Museums (ICOM), which emphasizes the role of museums in working with communities to raise public awareness and support research for planetary well-being, striving to mainstream sustainability into its core mission and values [11]. Furthermore, the “sustainability star” model, developed with input from ICOM, explicitly recognizes “Water” as a core dimension in the environmental sphere [12]. This framework validates the direct efforts of ecomuseums in protecting this vital resource, positioning their work as part of a holistic journey toward becoming truly sustainable cultural institutions.

3.1 Co-Creation Water Knowledge

The approach used can be summarized by the CCWK scheme (see Fig. 2) acknowledging that the process must be case-specific, we outline four overarching principles fundamental to every step of any co-creation process in water resources management and hydrology: inclusivity, openness, legitimacy, and actionability.

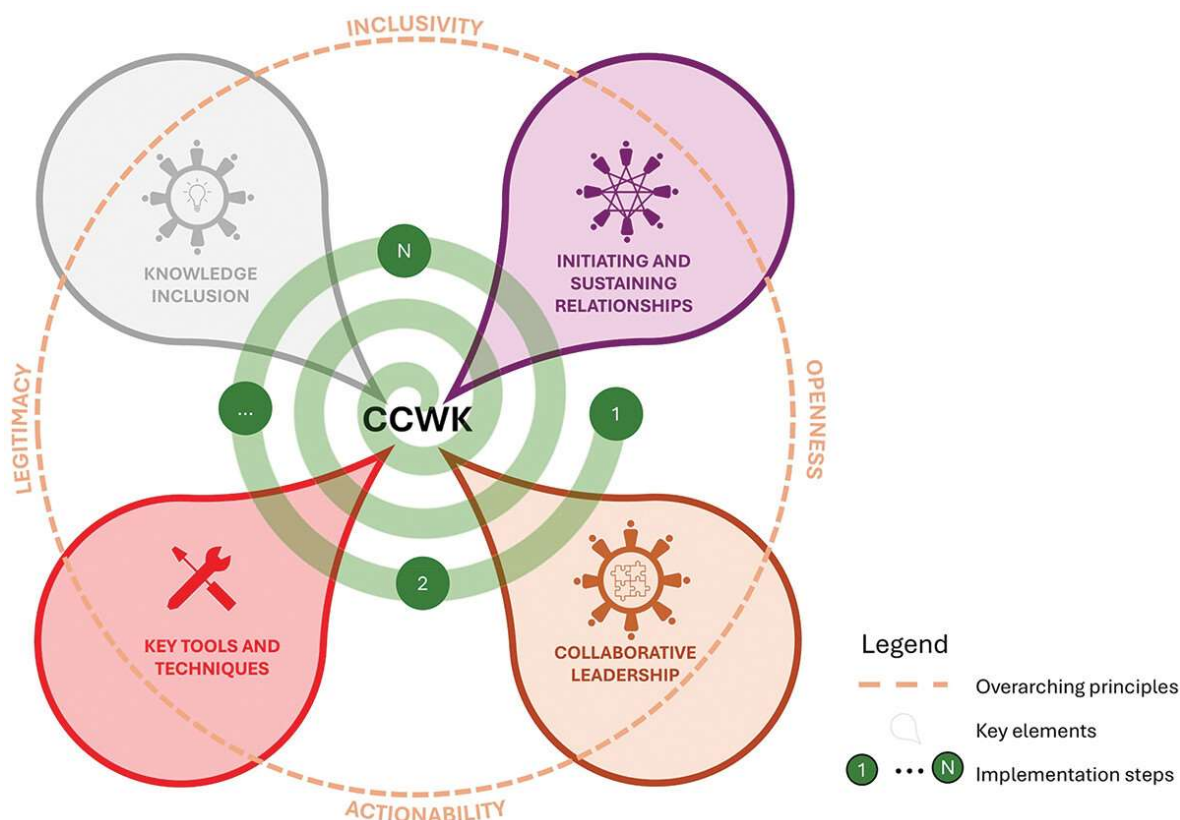


Fig. 2 Overview of the Co-Creation of Water Knowledge (CCWK) encircled by overarching principles (openness, legitimacy, inclusivity, and actionability, shown by the orange dashed line), evolving along an iterative implementation spiral (shown in green, the number and nature of steps defined by the specific context), and consisting of approaches falling into four key cornerstone elements that transcend the steps and principles, visualized here as four water droplets highlighting the importance of initiating and sustaining relationships (purple), collaborative leadership (orange), key tools and techniques (red), and knowledge inclusion (grey). Sourced from [1].

- **Inclusivity:** This principle ensures all involved or affected actors are represented and benefit equitably. It emphasizes mutual respect, diverse ways of knowing, and addressing power imbalances, while recognizing that not all actors must be involved in the same way.
- **Openness:** This principle fosters a transparent, trustworthy, and creative atmosphere receptive to different ways of thinking and communicating. It stresses open communication and flexibility, while respecting that some knowledge, such as Indigenous traditions, may be protected and not shared.
- **Legitimacy:** This principle ensures that local communities and non-academic actors are involved as equal partners in defining research aims and methodologies. It focuses on balancing power dynamics and having clear, agreed-upon roles for all participants from the start.
- **Actionability:** This principle highlights the use of appropriate, understandable, and useful tools and technologies. It promotes creating usable knowledge and systems, like environmental observatories, to ensure lasting benefits and encourage community participation in the long term.

3.2 Actors and engagement

Therefore, through co-creative activities, ecomuseums empower communities to steward their hydraulic heritage and demonstrate how local water management practices can serve as

inspiring models of sustainability beyond their immediate context. Based on this methodology, the first and third authors carried out preliminary activities to engage the local community through the Local Development Association, of which the third author is the elected president (see Fig. 3).



Fig. 3 Documentation and community consultations in Douiret-Sbâa oasis (October 2025). (A) Traditional water-carrying vessels, including buckets and cooked-earth jugs, documented as part of the local material culture. (B) Consultation with nomadic stakeholders roaming the oasis to include their perspectives in the ecomuseum activities. (C) Meeting with village residents to discuss the ecomuseum's creation and to identify key water-related issues to be addressed.

The term "local community" refers not only to permanent residents but also to the extended community [13]. This includes members living in various cities, even abroad, and families who left the village at different times in history, for example, around 1800, 1890, 1908, and 1934. However, for more urgent or localized decisions, the term refers specifically to the community currently residing in the village. Depending on the issue, decisions are made through various methods, such as consensus, consensus minus one, or qualified majority, involving all parts of the community, which reflects a traditional form of strong democratic practice.

The first author's initial on-site visit aimed to engage with different community members. The goals were to understand and document existing work to valorize local cultural heritage, particularly concerning water resources, and to identify community needs and desired support for enhancing this heritage. A second visit a few months later aimed to document the landscape and intangible heritage through the work of two young photographers, focusing on elements relevant to the newly established ecomuseum.

In the next subsection, we will outline the outcomes of these preliminary co-creative activities, which were instrumental in laying the groundwork for the ecomuseum, whose formal creation was planned for December 2025.

3.3 Safeguarding water heritage: the co-creative process for the Douiret-Sbâa ecomuseum

The community has articulated specific needs that center primarily on the dynamic conservation of their water distribution system. There is a clear desire to maintain the system's traditional framework while potentially enhancing its precision, particularly regarding the accurate measurement of water quantity distributed within the reservoir. This reflects a balanced approach that honors traditional knowledge while being open to technical improvements that could optimize the system's functionality.

Beyond hydrological concerns, the community demonstrates broader cultural and territorial conservation interests. They have expressed multiple needs related to preserving

both material heritage, including irrigation infrastructure, agricultural landscapes, and traditional tools, and intangible heritage, encompassing knowledge systems, social organizations, and traditional practices. Significantly, there is a strong willingness to engage in knowledge exchange, with community members expressing enthusiasm for sharing and collaboratively studying their cultural and territorial richness with experts and academics. This openness to external collaboration, while maintaining control over their heritage, positions the community as active partners rather than passive subjects of study, creating an ideal foundation for the ecomuseum's co-creative approach.

The community currently maintains an active and forward-looking approach to development, with several projects already at an advanced stage. Among the successfully implemented projects is the comprehensive restoration of the old village using traditional building techniques and earth architecture, ensuring both the preservation of architectural heritage and the application of ancestral knowledge. Significant protective measures have been implemented around the Ain Sbaâ spring, safeguarding this vital hydrological resource through structural reinforcements and environmental conservation efforts.

A crucial infrastructural achievement has been the provision of running water to all households, achieved through the development of a well discovered several kilometers from the village. This modern convenience coexists with the preservation of traditional water distribution systems, demonstrating the community's ability to integrate contemporary needs with historical practices.

In one of the restored traditional houses, the community has established an interpretive exhibition space dedicated to illustrating the rules, techniques, and social traditions governing water management and redistribution (see Fig. 4). This space serves as both an educational center for visitors and a repository of local hydrological knowledge.



Fig. 4 Key elements of the ecomuseum (October 2025). (A) The calibrated measuring stick used every day to measure water fractions. (B) A villager measuring his part of water during irrigation. (C) Traditional house adapted as an exposition place to explain and illustrate the traditional irrigation system and the rules for water distribution and water management.

Furthermore, the restoration program has included the adaptive reuse of several buildings to create dedicated accommodations for researchers and tourist facilities, indicating the community's commitment to knowledge exchange and cultural tourism. These developments reflect a strategic balance between heritage conservation and community development needs,

positioning Douiret-Sbâa as a living laboratory where traditional practices and modern requirements converge productively.

Nevertheless, the community also expressed the wish to be part of a larger network of actors interested in valuing water heritage and learning from other practices implemented in different areas of the world. In this regard, WAMU-NET is well suited to offer tools and engage in the process of co-creation with the local community. This approach also fits well in light of the history of the oases, which have always been networking hubs for commerce and cultural exchange.

4 Conclusions and way forward

In this article, we have shown that the co-creation of an ecomuseum represents a valuable pathway for the local community of Douiret-Sbâa to valorize its cultural heritage (see Fig. 5), with a particular focus on its water heritage. We have framed this as a co-creative process to foreground the community's needs and involve all stakeholders in collaboration with external actors, such as WAMU-NET, researchers, and water specialists. This approach helps ensure that the community's sophisticated water distribution system does not remain a static tradition but continues as a dynamic process of adaptation and knowledge exchange.

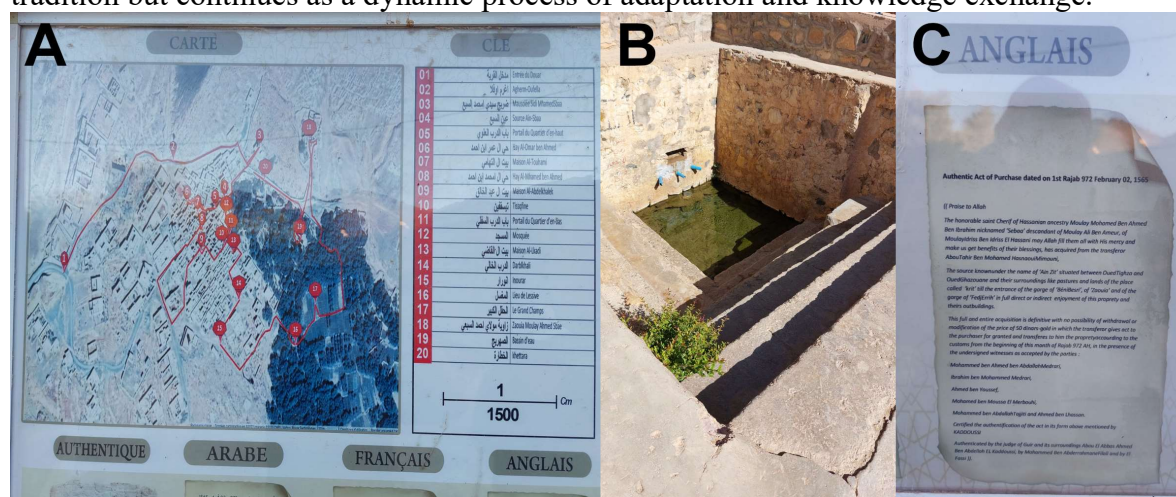


Fig. 5 Interventions at the water source in Douiret-Sbâa (October 2025). (A) An informational panel installed near the source, showing oasis itineraries, key sites, and displaying the historical deed of purchase for the water source in multiple languages. (B) The renovated source, made safe and accessible with protective features and secure steps. (C) A detail of the translated deed of purchase in English.

By providing a structured platform that values both ancestral techniques and modern tools, the ecomuseum facilitates a meaningful dialogue between generations and knowledge systems. The community's ongoing initiatives, from restoring traditional architecture to establishing interpretive spaces, illustrate how bottom-up stewardship, especially when supported by a wider network, can inspire sustainable water governance practices that are both culturally grounded and forward-looking.

In line with ecomuseum and co-creative principles, the processes described have led to the formal establishment of the Douiret-Sbâa Ecomuseum in December 2025, and will continue to evolve, fostering the community's constructive development. Ultimately, Douiret-Sbâa stands as an inspiring example of how vulnerable arid regions can leverage their hydrological heritage as a foundation for resilient community development, ensuring that traditional water management systems remain relevant and functional in a changing world.

References

1. G. Castelli, B. C. Howard, T. M. Adyel, A. AghaKouchak, A. Agramont, H. Aksoy, N. Ceperley, Co-creating water knowledge: a community perspective. *Hydrological Sciences Journal* (2025) <https://doi.org/10.1080/02626667.2025.2571065>
2. C. Gunter, NOT A MUSEUM, BUT A COMMUNITY OF RELATIONSHIPS: A CANADIAN ECOMUSEUM CASE STUDY. *Asia-Pacific Journal of Canadian Studies (APJCS)* **29.2** 105-125 (2023) <https://doi.org/10.22691/kacs290201>
3. P. Davis, P. Ecomuseums and the democratization of cultural tourism. *Tourism, Culture & Communication* **5(1)** 45 (2004) <https://doi.org/10.3727/1098304042781490>
4. C. L. Mijnheer, R. G. Jordan, Value co-creation at heritage visitor attractions: A case study of Gladstone's Land. *Tourism Management Perspectives* **32** 100567 (2019) <https://doi.org/10.1016/j.tmp.2019.100567>
5. M. Omland, M. Hontvedt, F. Siddiq, A. Amundrud, H. Hermansen, M. A. Mathisen, F. Reiersen, Co-creation in higher education: a conceptual systematic review. *Higher Education* **90** 1017-1047 (2025) <https://doi.org/10.1007/s10734-024-01364-1>
6. A. Boughoud, Les Techniques Ancestrales de la Gestion des Eaux Rares. *Association Douiret-Sbaa de Développement Local* (2021) <https://doi.org/10.5281/zenodo.17770999>
7. L. Pigozzi, N. Borrelli, R. Dal Santo, Ecomuseums, the SDGs and Climate Action: The Ecoheritage Project. in *Ecomuseums and Climate Change* **91** (2022)
8. S. Barontini, V. A. Boselli, A. Louki, Z. Ben Slima, F. E. Ghaouch, R. Labaran, ... B. Bacchi, Bridging Mediterranean cultures in the International Year of Soils 2015: A documentary exhibition on irrigation techniques in water scarcity conditions. *Hydrology Research* **48(3)** 789-801 (2017) <https://doi.org/10.2166/nh.2017.113>
9. L. Kabiri, P. Minoia, P. Fressoz, H. Benqlilou, ... R. Karim, Déclaration d'Errachidia et lignes directrices pour le développement durable des écosystèmes oasiens. *Proceedings of the ISMO 2023, 1st International Scientific Meeting on Oases*, Errachidia, Morocco, November 20-22 (2023) <https://dx.doi.org/10.5281/zenodo.10897394>
10. M. Ferretti, B. Di Leo, Making things. Practicing co-creation in the marginal territories of central Apennine. *Practices in Research* **04** 103-127 (2023) <https://doi.org/10.5281/zenodo.10567717>
11. International Council of Museums (ICOM). Sustainability and Local Development. Accessed October 26, (2023) <https://icom.museum/en/research/sustainability-and-local-development/>
12. International Council of Museums (ICOM). The sustainability star: a model for museums. Accessed October 26, (2023) <https://icom.museum/en/news/the-sustainability-star-a-model-for-museums/>
13. F. Cleaver, Paradoxes of participation: questioning participatory approaches to development. *Journal of International Development: The Journal of the Development Studies Association* **11(4)** 597-612, (1999) [https://doi.org/10.1002/\(SICI\)1099-1328\(199906\)11:4<597::AID-JID610>3.0.CO;2-Q](https://doi.org/10.1002/(SICI)1099-1328(199906)11:4<597::AID-JID610>3.0.CO;2-Q)