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Learning from the Subak World Heritage Property: The Importance of Co-Creation for Water Management and Climate Adaptation

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Abstract

The Cultural Landscape of Bali Province, a UNESCO World Heritage property in Indonesia, features ancient rice terraces and the *subak* irrigation system, reflecting a millennium-old harmony between humans, nature and the spiritual world. The *subak* landscape faces increasing challenges that threaten its sustainability. Alongside the pressure of rapidly expanding tourism, the *subak* system is increasingly vulnerable to water scarcity and shifting weather patterns due to climate change. This article examines the role of co-creation and local knowledge, advocating for the incorporation of community-led practices in the management of World Heritage properties. Co-creation can improve the effectiveness of management plans, align conservation goals with local communities' adaptive practices and enhance the resilience of the *subak* system. The article underscores the critical need for World Heritage management plans to integrate climate adaptation strategies rooted in local knowledge, ensuring a more responsive and sustainable approach to preserving the heritage landscape.

Policy Recommendations

- Integrating co-creation in heritage and water management strategies, such as those affecting the *subak* landscape, is crucial for ensuring the sustainability of cultural heritage sites and fostering resilient communities.

KEYWORDS

UNESCO World Heritage
Subak
cultural landscape
co-creation
local and traditional knowledge

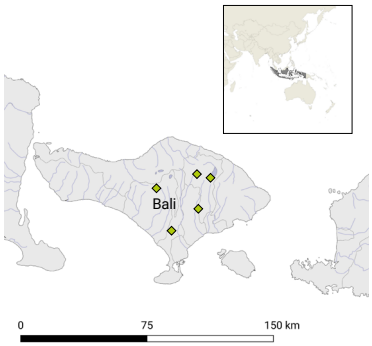
WATER ICONS



CLIMATE



Af: Tropical rainforest climate



< Fig. 1 Rice terraces of the *subak* landscape (Source: Diana Rahman, 2023).

Introduction: The *Subak* Landscape and the Challenge of Management

In 2012, UNESCO designated as World Heritage the Cultural Landscape of Bali Province: The Subak System as a Manifestation of the Tri Hita Karana Philosophy (fig. 1). The Balinese philosophy of Tri Hita Karana emphasizes the importance of harmony between human beings, the environment and the spiritual world. Recognized under criteria (ii) and (vi) of Outstanding Universal Value (OUV), the *subak* system represents a distinctive irrigation system and a living cultural tradition (UNESCO World Heritage Centre 2025). For the Balinese, the word *subak* has several meanings: it refers to the irrigation system, the agricultural landscape, the farmers and the organization responsible for managing rice fields and the irrigation system. These various meanings of *subak* reflect the way its value extends beyond the physical landscape and the living tradition.

For it to be managed sustainably, the *subak* system must be viewed as a holistic entity that encompasses not only tangible aspects, such as rice terraces, water temples and customary villages, but also the system's intangible elements. These include traditional knowledge, the Balinese social structure, farmers and customary laws, all of which reflect a complex network of values — social, religious, environmental and cultural (Rahman 2021). Together, these elements form an interconnected system that is integral to both the landscape and the community.

The World Heritage property featuring the *subak* landscape includes six clusters of rice terraces, alongside customary villages, lakes, forests and water temples. Each landscape component plays a role in safeguarding the water supply and the farming tradition. Contributing a significant proportion of Bali's rice production, the *subak* landscape depends heavily on water, making it especially vulnerable to climate change and water scarcity.

Several challenges in the *subak* landscape are highlighted in several State of Conservation (SOC) reports, periodic assessments prepared by UNESCO and national governments to monitor factors affecting the management and preservation of World Heritage properties. The challenges include tourism development, changes in traditional ways of life, population density, land conversion and governance, all of which UNESCO identifies as threats to its OUV (UNESCO World Heritage Committee 2023). These issues, however, remain contentious as the local community considers certain changes necessary to protect the sustainability of the landscape and practices.

The SOC report did not formally recognize climate change as a direct threat to the sustainability of the *subak* landscape. While this aspect may have been overlooked by the site managers, climate considerations — particularly changes in climate patterns — have been integrated into local agricultural practices and landscape management.

Holy Water and the Climate Crisis

Water is essential not only to the *subak* landscape but also to Balinese culture. Over 80 per cent of the island's population follows the Agama Tirtha, which is formally recognized as Hinduism by the Indonesian government, although it diverges significantly from Hinduism as practiced in South Asia (Lansing 1987; Picard 2011; Vickers 2012; Wright 2015; Hobart 2016). The Agama Tirtha (religion of the holy water), as its name suggests, incorporates water into nearly



^ Fig. 2 The *subak* irrigation system is intricately connected to water temples, which not only serve as sources of holy water but also play a key role in managing the flow of water to the *subak* landscape (Source: Diana Rahman, 2021).

every aspect of traditional and religious practices. Water is central to Balinese ceremonies, including those related to birth, death, agricultural cycles and others (Lansing 1987; Eiseman Jr. 1990).

The importance of water in Balinese culture underpins the strong connection between water and temples across Bali. Water sources, such as rivers, lakes and springs, are regarded as sacred and are safeguarded by traditional customs. The holiest water usually comes from the most sacred temples, such as the Tirta Empul water temple (fig. 2), which lies within the boundaries of the World Heritage property. Water temples thus play a dual role: they not only manage water for irrigation but are also crucial for the preservation of Balinese culture and tradition. Thus, water scarcity is not only a conservation or agricultural issue; it poses a profound threat to this water-centered society, so it is critical to recognize it as an existential challenge.

In recent years, the World Heritage community has recognized the irreversible damage caused by climate change to heritage sites worldwide (Rahman 2023; Falk and Hagsten 2024). Among other challenges, the challenges posed by climate change to agricultural landscapes include increased drought, changes in precipitation patterns and more frequent extreme weather events, which disrupt traditional farming practices and water management systems globally (Agnoletti and Santoro 2022; Aktürk and Dastgerdi 2021; Furtak and Wolińska 2023). Unpredictable rainfall and extended droughts can also affect the water supply, which can disrupt the planting cycle and decrease crop yields in the *subak* landscape. Rising temperatures and

excessive rainfall can impact soil fertility, crop resilience and the availability of water resources crucial to agricultural heritage landscapes (Agnoletti and Santoro 2022; Assen et al. 2024; UNESCO et al. 2013).

Within the *subak* landscape, inadequate implementation of the World Heritage proprty management plan may be the biggest factor contributing to the landscape's deterioration. While numerous regulations have been developed by the national government – including some specifically designed to protect the *subak* landscape from land conversion and to support *subak* organizations and safeguard traditional practices – implementing them has been difficult due to the frequent turnover of government officials, lack of coordination, limited resources and site managers and local communities not sharing the same priorities. Resistance and unwillingness to cooperate are also evident among communities across various areas of the *subak* landscape.

The local community does not uphold regulations because some of them are considered disadvantageous. They have expressed their disappointment over the lack of consultation in developing the World Heritage management plan for the *subak*, which, ultimately, led to a plan that is out of line with traditional practices and communal goals (Rahman 2021). The disconnect has contributed to weak management practices that do not adequately support the farming system by addressing the supports needed and challenges faced by farmers, such as rising production costs and declining market prices, which make sustaining the agricultural sector increasingly difficult. Thus, without incentives, the agricultural sector cannot provide adequate income for the local community.

Climate change and water scarcity also have a significant impact on agricultural activities in the *subak* landscape. Climate change has altered rainfall patterns, which has led to frequent and prolonged dry weather, erratic monsoons (Falk and Hagsten 2024). Water scarcity has been identified as a challenge by farmers in the *subak* landscape, as it leads to increased competition for water between agricultural and tourism-related uses (Strauß 2011; Rahman 2021).

Co-Creation in Water Management

Strategies intended to "protect" the *subak* landscape often fail to consider the system to which it belongs, meaning not only the irrigation structures but also the farmers and their livelihoods. For example, the World Heritage management plan has primarily focused on safeguarding the physical landscape without providing financial incentives that can support farmers' well-being. The plan also has yet to adequately address the restrictive rules and regulations of the World Heritage framework that hinder farmers' ability to adapt to modern economic challenges.

Another critical yet often overlooked aspect is the relationship between farmers and water temples, which serve as spiritual and social institutions regulating water distribution through traditional practices and rituals. These temples ensure that water remains available for both agricultural needs and cultural practices by coordinating irrigation schedules, resolving disputes and maintaining equitable access to water. While they do not possess formal sovereignty over water, the water temples exercise significant authority within the *subak* system, as their traditional rules and rituals are respected and followed by the farming communities (Lansing 1987).

Many changes in the *subak* landscape are social and cultural. Some of them, such as de-

partures from traditional farming techniques, the use of different rice varieties, and changes in planting schedules, are directly related to climate change. In *subak*, the customary laws and practices of the local community offer sustainable approaches to water allocation and conservation. Farmers have been scheduling irrigation based on a rotational model, thereby preventing conflicts over water between farmers. They also synchronize planting and irrigation schedules with water availability and climate conditions, further leading to adjustments in the timing of farming-related religious ceremonies. When water is limited, farmers may shift to cultivating crops with lower water requirements, allowing them to conserve resources while maintaining agricultural productivity. These changes help farmers become more resilient in the face of uncertain weather patterns. Farmers consider them necessary to sustain agricultural activities. They also enable more effective water management in response to the growing threat of water scarcity (Rahman 2021; Rahman 2023).

Sociocultural changes reflect both challenges and adaptations within *subak* communities as they seek to find a balance between preserving traditional practices and adapting to environmental and economic changes. The communities' capacity for adaptation is reflected in their *awig-awig* – a set of customary rules that serve as a foundation for managing water resources, farmers, irrigation systems and agricultural practices. *Awig-awig*, which outlines guidelines for the *subak* landscape, is based on traditional Balinese knowledge, but it can also accommodate change within the *subak* system, highlighting a general Balinese ability to adapt to environmental changes. These customary rules have long acknowledged shifts in climate and weather patterns and have helped farmers find a way to adapt and remain resilient.

The need for co-creation between the World Heritage property managers and local communities in managing *subak*, both the tangible and intangible aspects, is crucial because there has been persistent tension between management and the local community, especially due to knowledge gaps. Since the site's inscription in 2012, local communities have called for greater involvement in management planning, but this has not been seen so far. *Subak* representatives, often leaders of *subak* organizations within the World Heritage property boundaries, are occasionally included in discussions related to *subak* management. However, the limitations of this practice are twofold: first, many voices of farmers remain unheard as only *subak* representatives can offer opinions; and second, power dynamics in official meetings often restrict the contributions of *subak* representatives.

In 2023, responding to Indonesia's SOC report, the World Heritage Committee stressed that "some areas within the serial property are subject to development pressures, and it is not clear how the traditional and institutional decision-making structures work together" (UNESCO World Heritage Committee 2023). The Committee requested further details on how the national plan will support local knowledge and the traditional decision-making process.

Effective co-creation in World Heritage management, particularly for complex systems like *subak*, requires meaningful and ongoing collaboration among various stakeholders. Integrating local communities in heritage site management fosters not only more inclusive planning but also adaptive and sustainable solutions (Millar 2006). In the case of the *subak* system, bringing together farmers, scientists and policymakers can lead to effective and innovative water management that is context-appropriate and responsive to environmental challenges.

Sharing of knowledge and co-creation between site managers, the government and the local community can bridge the gaps in understanding the sociocultural changes happening in or affecting the *subak* landscape. Co-creation can also help decrease or prevent conflicts over water and management approaches, especially by establishing mutually agreed-upon practices that benefit all stakeholders. In Bali, people have long paid close attention to local weather and ecological patterns, and their expertise should be valued. Drawing on both local knowledge and modern science will enable a more contextual and holistic approach to managing water and the *subak* system. Furthermore, co-creation can foster a sense of ownership over management strategies, strengthening the local community's commitment to implementation.

Conclusion

The challenges affecting the cultural landscape of Bali Province's World Heritage property highlight the urgent need to address climate change impacts, including water scarcity, in the *subak* landscape. Increasing droughts, unpredictable weather patterns and limited water resources make it clear that the current management approach must be revised. Challenges in implementing management plans stem from limited financial and human resources, shifting and varying priorities on the part of site managers and local communities, and a lack of effective collaboration between local communities, site managers and local and central governments.

The *subak* system utilizes traditional laws and involves the community to ensure sustainable water allocation and conservation. This includes scheduling irrigation based on a rotational system, synchronizing planting and irrigation schedules with water availability and climate conditions, and diversifying crop varieties. Water temples ensure that water remains available for both agricultural needs and cultural practices. Integrating such local approaches into formal World Heritage management could help bridge knowledge gaps and align the priorities of site managers with those of local people.

Co-creation between site managers, policymakers and local communities is also essential for incorporating climate adaptation into heritage management. Local knowledge, as demonstrated in the customary laws of the *subak* system, offers invaluable insights, making possible a tailored, adaptive approach that supports both conservation and sustainability.

To strengthen the integration of traditional knowledge, community participation, and co-creation practices in managing Bali's cultural landscape, the following policy measures are recommended: Heritage management strategies should actively involve local communities at every stage, from planning to implementation. Capturing the depth and nuance of local expertise is essential to developing informed, context-specific, and sustainable management approaches. Co-creation should become the standard practice not only in heritage and climate change management but also in water governance. This collaborative approach fosters adaptive strategies, inclusivity, and a sense of shared ownership. Specifically, it entails incorporating local observations of climate patterns into water and landscape management and using this knowledge to address competing demands from agriculture, tourism, and urban development. In addition, policies should support co-creation initiatives that provide tangible economic benefits to *subak* communities. These may include agrotourism, sustainable agriculture, innovative farming methods, and cultural education programs—all of which can

help preserve the cultural and ecological integrity of Bali's traditional irrigation system.

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