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The Role of Bali's Traditional Subak Farming System in the Preservation of Natural and Cultural Resources

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ABSTRACT

The Subak traditional farming system in Bali embodies a harmonious relationship between humans, nature, and spirituality, epitomizing the Balinese philosophy of "Tri Hita Karana." This qualitative study explores the role of the Subak system in the preservation of natural and cultural resources in Bali. Through interviews with Subak farmers, water temple priests, and other stakeholders, as well as participant observation and document analysis, the study examines the ecological functions, cultural significance, and challenges facing the Subak system. The findings reveal that the Subak system plays a vital role in maintaining ecological balance, biodiversity, and soil health in Bali's landscapes. Furthermore, the Subak system holds profound cultural significance, serving as a spiritual anchor, fostering community cohesion, and preserving cultural heritage. However, the Subak system faces numerous challenges, including urbanization, water scarcity, and demographic shifts, which threaten its sustainability and resilience. Addressing these challenges requires concerted efforts to protect Subak landscapes, promote traditional farming practices, and empower local communities. By recognizing the holistic value of the Subak system, stakeholders can work together to ensure the preservation of Bali's natural and cultural heritage for future generations.

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1. INTRODUCTION

The Subak system in Bali, Indonesia, is not just a method of rice cultivation but a cultural institution deeply ingrained in Balinese society. Originating in the 9th century, Subak embodies the philosophy of "Tri Hita Karana," which emphasizes harmony between people, nature, and the divine. It is a social-religious communal organization of farmers that includes an intricate irrigation system. The rituals and practices associated with Subak serve as nonverbal communication and symbolic actions that connect the Balinese agricultural community with their environment, ancestors, and the divine [1]. The system faces challenges in the era of globalization, including the decreasing number of subaks,

the erosion of functions, and the declining interest of the younger generation in farming [2]. The development of the tourism sector has also impacted Subak, leading to land conversion and the threat of extinction [3]. Despite these challenges, Subak has been recognized as a UNESCO World Cultural Heritage and continues to be sustained by the community's traditional management and the effectiveness of its irrigation network [4].

The Subak system in Bali has been recognized for its agricultural productivity and socio-cultural importance, but its broader implications for environmental sustainability and cultural heritage conservation have been understudied. Previous research has focused on the symbolic and mythological analysis of water breeding and preservation rituals in Subak, highlighting their role as nonverbal communication and connection with the Creator and ancestors [1]. Additionally, the values of Pancasila, the Indonesian national ideology, are reflected in the management of Subak traditions, contributing to food security efforts and handling conflicts related to traditional agricultural practices [5]. Evaluations of Subak irrigation systems have shown relatively good performance in distributing water for rice fields, but there is a need to optimize rice productivity to contribute to national food security [6]. The existence of Subak faces challenges in the era of globalization, including decreasing numbers of Subaks, the erosion of traditional practices, and the threat of land conversion due to tourism development [3]. The impact of tourism activities on Subak landscapes, such as the Jatiluwih Subak, has been studied, showing an increase in tourist visits and positive impacts on the local economy [4]. This research seeks to address this gap by conducting a qualitative analysis of the Subak system, focusing on its contributions to the preservation of natural and cultural resources in Bali.

The Subak system in Bali is a socio-agrarian-religious system involving indigenous communities, water temples, and communal governance structures. The system operates on principles deeply rooted in Balinese Hinduism, where water is revered as a sacred element essential for agricultural prosperity and spiritual well-being. Each subak is overseen by a democratic council known as the "Subak Abian," which is responsible for managing water distribution, settling disputes, and organising religious ceremonies to honour the water gods [1], [6]. The system has been preserved for centuries and is characterised by a complex network of irrigation canals, terraced rice fields, and traditional rituals [3], [7]. The Subak system has been recognised for its sustainability and has even been awarded World Heritage status by UNESCO [8], [9]. However, the system is facing challenges in the era of globalisation, including the decreasing number of subaks, erosion of functions, and the declining interest of the younger generation in farming. Government intervention is needed to support and preserve the subak system.

This study aims to explore the multifaceted role of the Subak system in preserving natural and cultural resources in Bali through a qualitative lens. By employing qualitative research methods such as interviews, participant observation, and document analysis, this research seeks to unravel the intricate dynamics between the Subak system and its environment. By delving into the experiences, perceptions, and practices of Subak farmers, water temple priests, government officials, and cultural experts, this study endeavors to generate insights into the ecological functions, cultural significance, and challenges facing the Subak system.

2. LITERATURE REVIEW

2.1 The Subak System

The Subak system in Bali is a communal irrigation network that dates back to the 9th century. It is governed by customary laws and rituals, aiming to ensure equitable water distribution among rice farmers while promoting social cohesion and environmental stewardship. The system is based on the principle of "Tri Hita Karana," emphasizing harmony between humans, nature, and the divine. Scholars describe the

Subak system as a sophisticated example of traditional water management, characterized by decentralized governance and intricate hydraulic engineering. Each Subak operates autonomously under the guidance of a Subak Abian council, enabling effective water management, dispute resolution, and coordination of religious ceremonies centered around water temples [1], [3].

2.2 Ecological Functions of the Subak System

The Subak system in Bali plays a crucial role in maintaining ecological balance and biodiversity. By harnessing natural water flows and leveraging terraced landscapes, Subak farmers mitigate soil erosion, conserve water resources, and regulate microclimate conditions [1]. The intricate network of irrigation canals and rice terraces serves as ecological corridors, providing habitats for a diverse array of plant and animal species [3]. Studies have shown that Subak rice terraces act as effective water filtration systems, reducing sedimentation and nutrient runoff into downstream water bodies [6]. The terraced landscape also promotes soil fertility and moisture retention, enhancing agricultural productivity while minimizing environmental degradation [10], [11]. Furthermore, the presence of traditional agroforestry practices within Subak rice fields contributes to landscape heterogeneity and ecosystem resilience [4], [12]-[13].

2.3 Cultural Significance of the Subak System

The Subak system in Bali holds immense cultural significance for the Balinese people. Rooted in Balinese Hinduism, it is intertwined with religious beliefs and rituals associated with water worship. Water temples, strategically located within Subak landscapes, serve as sacred sites for ceremonies honoring water deities and seeking blessings for bountiful harvests. The Subak governance structure fosters social cohesion and community solidarity, as farmers come together to manage water resources and perform communal labor during planting and harvesting seasons. Traditional knowledge and practices associated with the Subak system are transmitted orally from generation to generation, reinforcing cultural identity and fostering a sense of collective responsibility towards environmental stewardship [1], [3], [5].

2.4 Challenges Facing the Subak System

The Subak system in Bali faces numerous challenges that threaten its sustainability. Urbanization, tourism development, and land-use changes encroach upon Subak landscapes, leading to land fragmentation and loss of traditional farming practices [5]. Water scarcity, exacerbated by climate change and competing water demands, poses threats to irrigation reliability and agricultural productivity [3]. Demographic shifts and changing socio-economic dynamics contribute to the erosion of traditional governance structures within Subak communities. Younger generations, lured by opportunities in urban areas, are less inclined to engage in traditional farming practices, jeopardizing the continuity of indigenous knowledge and cultural heritage associated with the Subak system [6]. Moreover, external pressures such as market forces and government policies often prioritize short-term economic gains over long-term sustainability, further undermining the resilience of the Subak system [4].

3. METHODS

3.1 Research Design

This study adopts a qualitative research design to explore the role of the Subak traditional farming system in the preservation of natural and cultural resources in Bali. Qualitative methods are chosen for their ability to capture the complex interplay between human behaviors, cultural practices, and ecological dynamics inherent in the Subak system. The qualitative approach allows for in-depth exploration, interpretation, and understanding of the perspectives and experiences of key stakeholders involved in Subak farming and resource conservation.

3.2 Participants and Sampling

The study aims to recruit a diverse sample of 15 participants representing various stakeholders involved in the Subak system, including Subak farmers, water temple priests, government officials from agriculture and environmental agencies, and cultural experts. Purposive sampling will be employed to select participants who possess firsthand knowledge and experience relevant to the research topic.

Efforts will be made to ensure diversity in terms of age, gender, occupation, and geographical location to capture a broad spectrum of perspectives. Inclusion criteria include individuals actively engaged in Subak farming practices or those with expertise in Subak governance, cultural traditions, or environmental conservation efforts.

3.3 Data Collection Techniques

Semi-Structured Interviews: In-depth, semi-structured interviews will be conducted with each participant to gather rich qualitative data regarding their experiences, perceptions, and practices related to the Subak system. The interview protocol will be designed to explore key themes such as the ecological functions of the Subak system, cultural significance, challenges faced, and perceptions of its role in resource preservation.

Participant Observation: Field visits will be conducted to observe Subak farming activities, water temple rituals, and community interactions firsthand. Participant observation will provide valuable contextual insights into the daily practices, social dynamics, and cultural rituals associated with the Subak system.

Document Analysis: Relevant documents such as historical records, academic literature, policy documents, and media reports related to the Subak system will be reviewed and analyzed to complement interview and observational data.

3.4 Data Analysis

The data analysis for this study will employ NVivo, a qualitative data analysis software, to systematically organize, code, and analyze interview transcripts, observational notes, and document excerpts. The process will entail several key steps. Initially, data coding will involve importing the materials into NVivo and iteratively generating initial codes through open coding to capture diverse participant responses. Subsequently, coded data will be categorized into overarching themes related to the Subak system's role in natural and cultural resource preservation, refined through constant comparison and iterative refinement. Thematic analysis will then identify patterns, connections, and interpretations across the data, examining themes about research objectives and theoretical frameworks. Finally, interpretation and synthesis will contextualize findings within existing literature, theoretical frameworks, and research objectives, elucidating key findings, and implications for theory and practice, and offering recommendations for future research and policy interventions.

4. RESULTS AND DISCUSSION

4.1 Ecological Functions of the Subak System

The qualitative analysis of interviews conducted with Subak farmers provided valuable insights into the ecological functions of the Subak system in Bali. The interviews revealed several key findings regarding the role of Subak practices in promoting environmental sustainability and biodiversity conservation.

One of the primary ecological functions of the Subak system highlighted by the farmers is its effective water management practices. Subak farmers employ traditional irrigation techniques, including the construction of intricate canal networks and terraced rice fields, to harness and distribute water resources efficiently. These practices not only ensure adequate water supply for rice cultivation but also contribute to soil conservation and erosion control.

Participants emphasized the importance of terracing in preventing soil erosion and retaining moisture in the soil. By creating leveled terraces on hilly terrain, Subak farmers minimize runoff and soil degradation, thereby preserving the fertility

of agricultural land. Pak Wayan, a Subak farmer from the Tabanan region, remarked, "Terracing helps to slow down the flow of water, allowing it to seep into the soil gradually, which is essential for maintaining soil moisture and preventing erosion."

Interviews also revealed the significant role of the Subak system in maintaining biodiversity within rice terraces and surrounding landscapes. Subak farmers cultivate a diverse range of crops, including traditional rice varieties, vegetables, and fruits, which contribute to the ecological richness of the region. The presence of diverse habitats within Subak landscapes supports a wide array of plant and animal species, including endemic and endangered species.

Participants highlighted the importance of preserving traditional agroecological practices to sustain biodiversity in Subak areas. Ibu Ketut, a Subak farmer from the Gianyar region, noted, "We grow a variety of crops in our Subak fields, not just rice. This diversity attracts different types of insects, birds, and other wildlife, creating a balanced ecosystem." The preservation of traditional rice varieties and indigenous crops also plays a crucial role in conserving genetic diversity and enhancing ecosystem resilience.

Furthermore, Subak landscapes provide essential ecosystem services that benefit both humans and the environment. The rice terraces act as natural water filtration systems, removing sediments and pollutants from runoff water before it reaches downstream water bodies. Additionally, Subak areas serve as carbon sinks, sequestering carbon dioxide from the atmosphere and mitigating the impacts of climate change.

The findings highlight the multifunctional nature of the Subak system in providing ecological services that support agricultural productivity, water quality, and biodiversity conservation. By integrating traditional knowledge with modern conservation practices, Subak farmers contribute to the sustainability and resilience of agroecosystems in Bali.

4.2 Cultural Significance of the Subak System

The qualitative analysis of interviews conducted with Subak farmers and water temple priests revealed profound insights into the cultural significance of the Subak system in Bali. The interviews illuminated the integral role of the Subak system in shaping cultural identity, fostering community cohesion, and preserving spiritual traditions.

One of the central aspects of the Subak system's cultural significance is its spiritual connection to water, rooted in Balinese Hinduism. Water temples, considered sacred sites, serve as focal points for religious ceremonies and rituals dedicated to water deities. Participants emphasized the spiritual importance of water in Balinese culture, associating it with purity, life, and prosperity.

Pak Wayan, a water temple priest, shared insights into the religious practices associated with the Subak system, stating, "Water is sacred to us. We perform rituals at water temples to honor the spirits of the water and seek their blessings for abundant harvests." These rituals, conducted at specific times according to the Balinese calendar, are integral to the Subak system's cultural heritage and are passed down through generations.

Interviews with Subak farmers highlighted the role of the Subak system in fostering community cohesion and collective responsibility. Subak members, organized into democratic councils, collaborate to manage water resources, resolve disputes, and perform communal labor during planting and harvesting seasons. This collective approach to agriculture reflects the Balinese ethos of "gotong royong" (mutual cooperation) and reinforces social bonds within Subak communities.

Ibu Nyoman, a Subak farmer, shared her perspective on the importance of community participation in the Subak system, stating, "We work together as a community to ensure the success of our Subak. Everyone has a role to play, and we support each other in times of need." This sense of shared

responsibility extends beyond agricultural activities to encompass cultural practices, rituals, and ceremonies associated with the Subak system.

Furthermore, the Subak system serves as a custodian of cultural heritage, preserving traditional knowledge, rituals, and practices passed down through generations. Subak farmers play a vital role in transmitting indigenous agricultural techniques, such as rice cultivation, terracing, and water management, to future generations. These practices are not only essential for agricultural sustainability but also embody cultural values and wisdom accumulated over centuries.

Participants emphasized the importance of preserving cultural traditions associated with the Subak system amid modernization and globalization pressures. Ibu Ketut, a Subak farmer, expressed her commitment to upholding cultural heritage, stating, "Our ancestors taught us the importance of respecting the land and water. We must pass on these teachings to our children to ensure the continuity of our culture."

4.3 Challenges Facing the Subak System

The qualitative analysis of interviews conducted with Subak farmers and other stakeholders shed light on the numerous challenges confronting the Subak system in Bali. These challenges pose significant threats to the sustainability and resilience of the Subak system, endangering its ecological, cultural, and socio-economic dimensions.

One of the primary challenges facing the Subak system is rapid urbanization and land-use changes in Bali. Participants expressed concerns about encroachment on agricultural land for urban development, infrastructure projects, and tourism establishments. The expansion of urban areas and conversion of agricultural land to non-agricultural uses threaten the integrity of Subak landscapes, leading to land fragmentation and loss of traditional farming practices.

Pak Made, a Subak farmer, lamented the impact of urbanization on Subak fields, stating, "Many rice fields have been converted into hotels, villas, and shopping malls. The loss of agricultural land not only affects our livelihoods but also undermines the cultural and ecological value of the Subak system."

Interviews revealed concerns about water scarcity and competition for water resources within Subak communities. Participants cited declining water availability due to factors such as climate change, increased water demand from urban areas, and water diversion projects. The scarcity of water during dry seasons poses challenges to rice cultivation and agricultural productivity, exacerbating tensions among Subak members over water allocation.

Ibu Wayan, a Subak farmer, highlighted the struggles of managing water resources amidst increasing competition, stating, "Water scarcity is a constant challenge for us, especially during the dry season. We have to prioritize water use and make difficult decisions to ensure that everyone gets their fair share."

Additionally, socio-economic changes and demographic shifts pose challenges to the continuity of traditional governance structures and cultural practices within Subak communities. Younger generations, influenced by modernization and urbanization trends, are less inclined to pursue traditional farming practices, opting for alternative livelihoods in urban areas. This demographic shift threatens the transmission of indigenous knowledge and cultural traditions, jeopardizing the sustainability of the Subak system.

Participants expressed concerns about the loss of cultural heritage and agricultural expertise among younger generations. Ibu Nyoman, a Subak farmer, lamented the declining interest in traditional farming practices among youth, stating, "Many young people are leaving the village to seek employment in cities. They are not interested in farming anymore, which puts the future of the Subak system at risk."

DISCUSSION

The findings of this study underscore the multifaceted role of the Subak system in

preserving natural and cultural resources in Bali. The Subak's ecological functions, cultural significance, and governance structures contribute to sustainable agriculture, environmental conservation, and cultural heritage preservation in the region. However, the challenges facing the Subak system, including urbanization, water scarcity, and socio-economic changes, necessitate concerted efforts to safeguard its integrity and resilience.

Policy interventions and community-based initiatives are needed to address these challenges and promote the sustainability of the Subak system. Strategies such as land-use planning, water management reforms, and community-based conservation initiatives can help protect Subak landscapes and traditional farming practices. Furthermore, efforts to promote cultural education, intergenerational knowledge transfer, and community empowerment are essential for preserving the cultural heritage and social fabric of Subak communities.

Overall, the findings of this study contribute to a deeper understanding of the Subak system's contributions to natural and cultural resource preservation in Bali. By recognizing the interconnectedness of ecological, cultural, and socio-economic dimensions, stakeholders can work together to ensure the long-term sustainability and resilience of the Subak system for future generations.

5. CONCLUSION

The Subak system in Bali represents a unique example of sustainable agriculture and cultural heritage preservation, deeply rooted in the traditions and beliefs of Balinese society. This study has shed light on the multifaceted role of the Subak system in preserving natural and cultural resources, highlighting its ecological functions, cultural significance, and the challenges it faces. The findings underscore the importance of recognizing the interconnectedness of ecological, cultural, and socio-economic dimensions in shaping the resilience of the Subak system.

Efforts to address the challenges facing the Subak system require a holistic approach that integrates ecological conservation, cultural preservation, and community empowerment. Policy interventions, community-based initiatives, and multi-stakeholder collaborations are essential for promoting the sustainability of the Subak system and safeguarding its invaluable contributions to Bali's landscapes and cultural identity.

By acknowledging the intrinsic value of the Subak system and supporting initiatives that promote its preservation, stakeholders can contribute to the long-term sustainability and resilience of agricultural communities in Bali. Ultimately, the continued viability of the Subak system hinges on collective action and shared responsibility in ensuring the preservation of Bali's natural and cultural heritage for generations to come.

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