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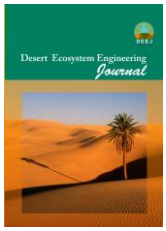

Exploration and Analysis of Indigenous Knowledge for Sustainable Living in Desert Regions

Masoumeh Pazoki,[*1] Seyed Jafar Seyed Akhlaghi[2]

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Extended Abstract

Introduction: Arid and semi-arid regions are among the most ecologically fragile ecosystems on Earth. Environmental stressors in these zones—including water scarcity, soil degradation, and extreme temperature fluctuations—inhibit the establishment of sufficient vegetative cover, thereby hindering erosion control and ecological balance. Persistent threats from desertification further challenge environmental resilience and the sustainability of local livelihoods.

Within this context, Indigenous Knowledge Systems (IKS)—understood as dynamic, experiential, and place-based knowledge developed through the long-term interaction of local communities with their environments—play a critical role. These knowledge systems offer practical solutions for natural resource management, particularly in soil and water conservation, sustainable agriculture, and climate adaptation. However, in many arid regions, notably Iran, this invaluable body of knowledge is increasingly threatened by marginalization, a lack of formal documentation, and methodological neglect in mainstream planning.

This study seeks to address this gap by systematically identifying, analyzing, and synthesizing the key components of indigenous knowledge related to environmental and livelihood sustainability in Garmsar County, an arid region of Iran. Transmitted informally across generations, this knowledge remains underutilized in contemporary policy and development planning. By documenting and integrating it into regional strategies, there is significant potential to enhance ecological resilience and foster community-based sustainable development.

Methodology: This study adopted a qualitative approach, utilizing thematic analysis (Braun & Clarke, 2006) to investigate the structure and content of indigenous knowledge. Data were collected through semi-structured interviews with 15 key informants—including local elders, farmers, pastoralists, and holders of traditional ecological knowledge—selected for their deep-rooted experience in agriculture and resource management within desert landscapes. Participants were identified through purposive sampling to ensure they met predefined criteria of expertise and long-term local engagement. Data collection continued until theoretical saturation was achieved.

The analysis followed Braun and Clarke's (2006) six-step model: (1) familiarization with the data, (2) generation of initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the final report. To ensure analytical rigor, inter-coder reliability was assessed using Cohen's Kappa coefficient. The calculated value of 0.6875 ($p < 0.0005$) indicates a strong level of agreement and consistency between coders.

Results: Thematic analysis identified seven core themes that reflect the structure and application of indigenous knowledge for sustainable living in Garmsar County. These themes encompass strategies for resource management, social organization, and adaptive practice.

1. Indigenous Water and Soil Conservation: This theme encompasses techniques directly aimed at combating desertification. Practices include constructing earthen bunds and stone lines for erosion control, employing rainfall harvesting calendars, and applying ash or burying organic waste to enhance soil moisture retention and fertility.

1. Assistant Professor, Department of Agricultural Economic, Social and Extension Research, Agricultural Research and Education Center and Natural Resources of Semnan Province, Agricultural Research Education and Extension Organization (AREEO), Semnan, Iran; Email: m.pazoki@areeo.ac.ir

2. Assistant Professor, Desert Research Division, Research Institute of Forests and Rangelands, Agricultural Research Education and Extension Organization (AREEO), Tehran, Iran; Email: sjsa47@gmail.com

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2. Revitalization of Traditional Hydraulic Infrastructure: A key finding is the community-led restoration and maintenance of traditional water systems, such as qanats (subterranean canals) and cisterns. This revitalization often occurs through collaborative efforts aligned with local development projects.
3. Knowledge Transmission and Community Cohesion: Indigenous knowledge is actively sustained through intergenerational exchange. Mechanisms include localized oral education, storytelling, and the purposeful involvement of youth and women in traditional practices, which reinforces social cohesion and cultural identity.
4. Climate-Resilient Agronomic Practices: Adaptive agricultural strategies are central to livelihood sustainability. These include cultivating drought-resistant native crops (e.g., millet, sesame), utilizing flexible planting schedules based on traditional phenological calendars, and employing dryland farming techniques.
5. Customary Land and Resource Governance: The sustainable management of farms and rangelands is guided by established customary norms. Practices such as regulated seasonal grazing, crop rotation, and contour plowing are communally upheld to optimize the use of marginal ecosystems.
6. Synergistic Integration with Scientific Knowledge: Findings reveal a practical co-production of knowledge, where modern tools (e.g., soil moisture sensors) are strategically integrated with local experiential wisdom. This synergy enhances decision-making without displacing indigenous systems.
7. Ecologically-Based Soil Fertility Management: Traditional soil enrichment relies on low-external-input methods. These include the application of ash, in-situ decomposition of organic matter, and biological pest management, which collectively maintain long-term soil productivity.

Discussion and Conclusion: This study demonstrates that the indigenous knowledge system of Garmsar County functions not as static historical memory but as a dynamic, living framework—one that is responsive, adaptive, and grounded in a deep ecological logic. The documented techniques are deeply embedded within local social structures and are continuously informed by collective, long-term environmental experience.

The analysis reveals that the revitalization of traditional infrastructure, particularly when coupled with appropriate institutional support, presents a viable pathway for bridging formal development goals with community-based resilience. Furthermore, the intergenerational transmission of knowledge and the empowerment of marginalized groups are critical social mechanisms that reinforce the system's long-term sustainability. These findings align with international perspectives, such as that of the UN Scientific Advisory Board (2016), which recognizes local and indigenous knowledge as a foundational pillar for achieving climate resilience and the Sustainable Development Goals.

8. Significantly, the observed integration of traditional practices with modern technologies illustrates a productive model of knowledge co-creation. This synergy, as corroborated by global research (e.g., Pretty et al., 2011; Kupika et al., 2025), is essential for developing locally relevant, culturally appropriate, and climate-adaptive policies.

In summary, the indigenous knowledge of Garmsar County constitutes a coherent and multifunctional framework for sustainability, integrating ecological, social, and cultural dimensions. It offers invaluable, place-based insights for addressing contemporary challenges of desertification, natural resource management, and rural livelihood resilience. Therefore, systematically recognizing, documenting, and mainstreaming this knowledge is imperative. It serves not as a replacement for, but as a vital complement to scientific expertise, and it holds significant potential to inform future policies for desert conservation, climate adaptation, and sustainable development.

Keywords: Environmental Resilience, Natural Resource Management, Local Development, Climate Change Adaptation, Conservation.