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Exploring Main drivers of ecological culture of stakeholders in semiarid ecosystems

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Abstract

Stakeholders' hop spots for conservation are crucial for preserving current arid ecosystems and halting the projected trend of habitat loss. In managing arid environments, stakeholder culture for ecosystem conservation has received little attention. The aim of this study was to assess ecological culture and its main drivers in the context of dry ecosystem conservation. Cultural indicators were used to map ecological culture in study region. Questionnaires were used to collect data. Results showed that forests were among the most important land covers in terms of ecological culture ($p<0.05$). Using PCA, the most important drivers affecting ecological culture were identified, and then the contribution of each driver to ecological culture was identified using structural equation model (SEM). The results showed that in total, the direct and indirect relationships of urbanization ($p<0.001$) and agriculture ($p<0.01$) negatively and climate ($p<0.01$), topography ($p<0.01$) and income ($p<0.01$) positively affected ecological culture. Results in this study can be used by policymakers to identify social hotspots where people-led landscape conservation could be feasible with controlling main drivers.

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Introduction

The equilibrium between people and the natural world constitutes the foundation of sustainable development for both people societies and ecosystems (Houng and Houng, 2018). Numerous ancient civilizations and governing bodies encountered failures in ecosystem management due to their inability to establish a harmonious balance between anthropogenic activities and natural ecology (Degroot et al., 2021). The interplay between social systems and ecosystems has emerged as a pivotal focus of inquiry within the domains of ecology and sustainability science in recent years (Steffen et al., 2020). Social responsibility towards natural ecosystems represents a relatively novel approach that has been proposed to enhance the health of these ecosystems (Liu et al., 2022). Environmental dilemmas invariably manifest as social challenges. Should people beings and entire societies amend their current detrimental practices, the resolution of environmental issues is plausible (Kinzig et al., 2013). People beings conserve nature in accordance with the values they ascribe to the environment. These values are instrumental in shaping our intrinsic motivations, which are influenced by societal culture (Lillehammer, 2017). Ecological culture is conceptualized as a form of expression concerning material and spiritual values that arise from people creativity, thereby reflecting a state of harmony with nature (Houng and Houng, 2018).

Culture is conceptualized as the quintessence of the people intellect, emerging from the arduous people endeavor against two formidable forces, specifically time and nature, which serves as a testament to peopleity's resilience in surmounting various challenges and adversities in life and sustenance to attain salvation and contentment (Sayago, 2023). According to Salehi (2022) showed that among the components of ecological culture, awareness of the severity of the risk had the greatest impact on the ability to protect the rural community. Structural modeling has also confirmed the impact of ecological culture on the village's environmental protection capacity. Goolmeer and Costello (2024) showed that indigenous peoples around the world are actively seeking to better understand plants and animals that are of high cultural significance. Participatory management of cultural institutions plays an important role in the conservation of biodiversity, as well as the health and well-being of indigenous peoples. Sima et al. (2024) examined the socio-cultural values provided by coastal ecosystems using the perspectives of tourists. The results of the study of the ecological culture of visitors indicate a high emotional attachment of beach visitors and concern for the preservation of coastal areas and the protection of the place. Tourists suggested various management options to better protect coastal areas and promote sustainable tourism without compromising the uniqueness of the space.

Since, local knowledge and the experiential wisdom of individuals are crucial for comprehending the intrinsic value of landscapes, neglecting to integrate local and indigenous knowledge in landscape-related decision-making results in the erosion of the social significance of the existential and cultural contributions of landscapes (Chebus , 2018;). The socio-cultural context, age, and the interaction of local communities with their surrounding natural resources significantly impact the accumulation of indigenous knowledge (Alsaleh, 2024). Notwithstanding the critical importance of indigenous knowledge in ecological conservation, as well as in the provision of food, medicine, and other indigenous resources, such knowledge is infrequently acknowledged in ecosystem management endeavors (Singh, 2007), and the conservation policies and technologies devised are typically executed without recognizing indigenous knowledge or the involvement of local populations and their traditional institutions (Tran et al., 2020). Consequently, management strategies seldom play a pivotal role in safeguarding and fostering local knowledge for ecosystem conservation (particularly among younger generations) and enhancing people livelihoods (Li et al., 2024b). There are very limited studies investigating the motivation of indigenous people to protect ecosystems in Iran. Given the urgent and ongoing need for biodiversity conservation and recognition of local role in ecosystem conservation, this study is aimed to delineate the spatial distribution of ecological culture of stockholders and to identify the principal drivers of ecological culture of stockholders.

Methods and Materials

Study area

The study area is Jiroft basin located in Kerman province in southeastern Iran (56˚ 50´ to 58˚ 20´ E and 28˚ 10´ to 29˚ 15´ N). The area of this region is about 864,428 ha and includes diverse landscapes from mountains in the north to flat plains in the south. The region receives an average annual rainfall of 290 mm, most of which falls in the winter. The region is located between the Irano-Turanian and Indus-Saharan phytocoria. As a result, it has a rich flora consisting of several communities and different vegetation. The most important land covers include rangelands, forests, and agricultural lands (Figure 1). Jiroft basin has a long cultural history. From an archaeological perspective, the "Jiroft civilization" or "Halilrud civilization" refers to a cultural complex that existed in the third millennium BC in the south of Kerman province (Madjidzadeh and Pittman, 2008; Eskandari et al., 2019).

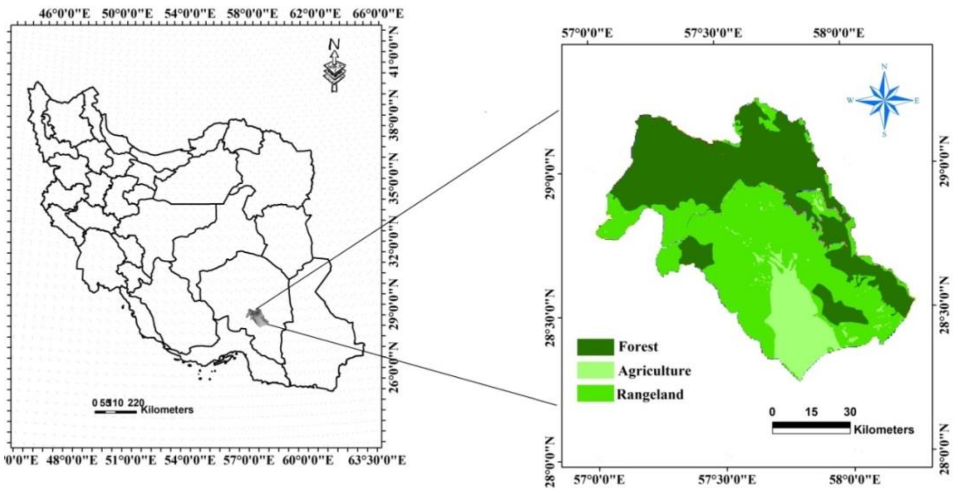

Figure 1. Map of land covers of study region

Data Collection

Ecological culture

Local stakeholders in the Jiroft Basin settlements made up our research population. Based on Cochran's method (1997), a sample size of 185 individuals was selected from 15 villages using non-proportional quota sampling (Tashakkori and Teddlie, 2003). A conventional questionnaire and in-person interviews were used to gather data. To make sure that respondents' views of the questions were the same, the reliability of the questionnaire was assessed using the Cronbach's alpha coefficient. There were two primary sections of the questionnaire. Questions about the respondents' age, gender, experience of exploitation, and educational attainment were included in the first section. Questions about ecological cultural variables were added in the second section. A five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), was used to evaluate each variable in the second section. Abedi-Sarvestani and Shahvali (2008), Karimi and Amir Saghaleini (2021), Hossain and Lamb (2020), Huong and Huong (2018), and other prior research were consulted while determining the indicators for each criterion (Table 1). Ecological culture was measured as the average of standardized indicators (ranging from 0 to 1). Using Arc GIS (Hernandez-Stefanoni and Ponce-Hernandez, 2006) and GS+ (Gamma design software Version 5.1.1, 2001), the spatial distribution of ecological culture in the basin was mapped using ordinary kriging interpolation.

Table 1. Indicators of ecological culture

Indicators	References
Waste from households is not discharged into the environment.	(Barr, 2003)
Save maximum resources in building and use energy source in nature	(Huong and Huong, 2018)
Makes sustainable environment demand more effort in the future	(Huong and Huong, 2018)
People is responsible only toward some alive beings	(Abedi-Sarvestani and Shahvali, 2008)
There are sufficient resources and time to conserve ecosystems	(Karimi and Amir Saghaleini, 2021)
People is responsible toward s God's creations	(Abedi-Sarvestani and Shahvali, 2008)

Data Analysis

Kolmogorov–Smirnov normality test was used to check data for normal distribution. Principal Component Analysis (PCA) was used to reveal the most important drivers of ecological culture. The most important variables can be selected based on the significant loading factors of each PC axis (Curz-Cardenas ´ et al., 2014).The Structural Equation Model (SEM) was utilized to evaluate both the direct and indirect determinants influencing habitat quality and ecological culture. SEM represents a statistical approach that integrates regression analysis with confirmatory factor analysis and has progressively become a favored method for elucidating the intricate relationships among components of ecosystems (Awang et al., 2015). Composite reliability (CR) and average variance extracted (AVE) were employed to assess the reliability and validity of the SEM, utilizing SmartPLS v2 (Bido et al., 2014). Furthermore, Analysis of Variance (ANOVA) and the Least Significant Difference (LSD) test were applied to compare land cover characteristics in relation to ecological culture.

Results

55% of respondents were male and 59% were adults. 29% had low incomes, 65% had lived in the area for more than 10 years, 15% had low income dependence on ecosystems, and 51% had moderate social activity (Table 2). The minimum ecological culture is 0.13 and the maximum ecological culture is 0.83 in the Jiroft basin. LSD analysis showed that forests had the highest ecological culture value with a mean of 0.516±0.125. Rangelands were in second place with a mean of 0.439±0.113, and the lowest ecological culture value belonged to agricultural lands with a mean of 0.324±0.107 (Table 3). Significant drivers of ecological culture was determined using PCA (Table 4).

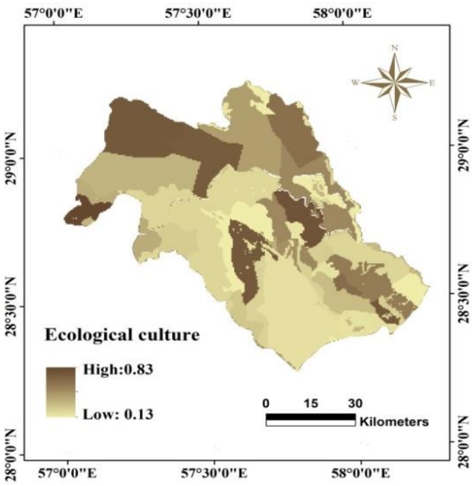

Figure 2. Map of ecological culture in study region

Table 2. Socio-economic characteristics of respondents

Characteristics		Frequency	Percent
Gender	Female	83	45
	Male	102	55
Age (year)	Young	76	41
	Adult	109	59
Education	Less than high school	43	23
	High school	49	27
	Bachelor	56	30
	Master or doctorate	37	20
Annual income	Low	53	29
	Middle	87	47
	High	45	24
Land tenure	Private	79	43
	Public	106	57
Duration of residence (year)	<1	23	12
	1-10	43	23
	10-30	84	45
	30<	35	20
Income dependency on ecosystems	Low	27	15
	Middle	75	40
	High	83	45
Social activity	Low	42	23
	Middle	96	51
	High	47	26

Table 3. Analysis of Variance results and Least Significant Difference test results among land covers in terms of ecological culture

Land covers	**Cultural diversity**	
	Average	**SD**
Rangeland	0.439b	0.113
Forest	0.516c	0.125
Agriculture	0.324a	0.107
F	5.12**	

Table 4. The contribution of ecological culture's drivers using two first axes of PCA

Variable	**PCA1**	**PCA2**
Age	0.123	0.052
Agriculture	0.215*	-0.123
Climate	-0.352**	-0.162
Duration of residence	0.132	0.211*
Education	0.261	0.128
Gender	0.135	0.281*
Grazing	0.052	-0.265*
Health	-0.144	0.032
Immigration	0.132	-0.035
Income	-0.038	0.356**
Income dependency to ecosystems	0.156	0.112
Land covers	0.274*	0.112
Landscape	-0.025	0.135
Language	0.218*	-0.145
Land tenure	0.205*	0.025
Occupation	0.103	-0.215*
Ownership	-0.112	0.169
Population	0.137	0.033
Migration	-0.023	-0.237*
Social network	0.018	0.163
Topography	0.265*	-0.041
Urbanization	-0.368**	0.155

Table 5. Composite reliability (CR) and convergent validity (AVE) of impacts of ecological and social characters on ecological culture (AVE >0.5, CR>0.7)

Criteria	Ecological culture	
	AVE	**CR**
Climate	0.745	0.827
Land cover	0.718	0.835
Agriculture	0.792	0.837
Language	0.825	0.844
Land tenure	0.784	0.912
Topography	0.738	0.927
Urbanization	0.685	0.927
Grazing	0.812	0.933
Gender	0.745	0.957
Income	0.812	0.957
Education	0.892	0.958
Duration of residence	0.782	0.961
Ecological culture	0.827	0.967
Migration	0.628	0.974
Occupation	0.795	0.987

For the reliability and validity of the SEM model, two CR and AVE indices were used (Table 5). For both habitat quality and ecological culture models, all model variables had AVE greater than 0.5 and CR greater than 0.7. Also, the CR value was higher than the AVE value, which indicates the validity of the two models of habitat quality and ecological culture. Figure 6 shows the direct and indirect relationships of ecological and social variables on ecological culture, which in total, the direct and indirect relationships of urbanization (p<0.001) and agriculture (p<0.01) negatively and climate (p<0.01), topography (p<0.01) and income (p<0.01) positively affected ecological culture (Figure 3).

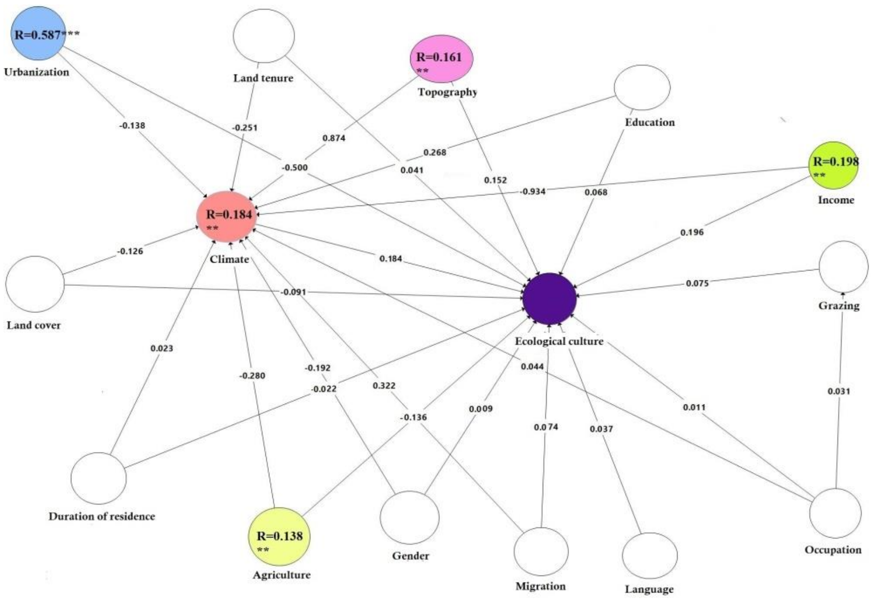

Figure 3. Structural equation modeling (SEM) examining impacts of ecological and social characters on ecological culture

Discussion

Mapping ecological culture

Additionally, the distribution of ecological culture was not uniform throughout the research area. The areas north and west of the Jiroft basin have the highest ecological culture. According to a previous study, culture is not evenly distributed, and the distribution of cultural heritage in southwest China was most affected by natural factors like the percentage of mountainous areas, river density, and average annual sunshine, as well as human factors like urbanization rates (Li et al., 2024a). 15% of our region had high ecological culture, which was primarily found in highlands and forests, which are important places for social protection because ecological culture can increase the resilience of social systems (Harmon, 2002). Preserving ecological culture and indigenous knowledge in the future will increase the ability of social systems to adapt to future environmental and management changes (Ingelbrecht, 2024). According to our research, 50% of the area had a low ecological culture, which requires promotion. The setting in which cultural traits emerge influences their development to some extent. Climate is one of the elements influencing ecological culture, as the environment or weather has an impact on some situations of population growth or decline, migration, and cultural transmission (Hsiang et al., 2013). Additionally, 41% of the area has poor habitat quality. Overall, our findings demonstrated that ecological culture loss is more vulnerable to dangers than habitat quality. According to Oliveira et al. (2019), ecological culture is dynamic and subject to change. Nowadays, culture is viewed in cultural sociology as an ongoing dynamic process that not only exists but also evolves throughout time. To preserve and improve ecosystem use's distinctiveness and sustainability, future management strategies must give greater consideration to the utilization of these cultural resources (Ingelbrecht, 2024). The improvement of human systems in response to environmental changes is necessary to maintain ecological culture. Integrated social-environmental management is necessary to enhance cultural development plans and initiatives in rural areas. New cultural planning requires a fresh perspective on rural society's cultural problems, fighting social injustice, preventing habitat degradation, fostering local identity, promoting traditional culture, empowering villagers through their involvement, democratic support for cultural policies, a deeper comprehension of the populace, etc.

Threats to ecological culture

Our study's findings clarified the detrimental effects of urbanization on ecological culture. Numerous researches have shown that urbanization negatively impacts indigenous epistemologies in terms of cultural aspects (Gaoue et al., 2017; Ferreira-Júnior et al., 2016; Rangel et al., 2024). Our results showed that one of the favorable factors affecting ecological culture was economic status. For food security and income creation, rural populations are more dependent on habitat quality (Cordero et al., 2020). They have maintained a significant amount of ecological knowledge and have a deeper grasp of their surroundings. Rural residents believe that areas with higher habitat quality are associated with higher quality of life (Rangel et al., 2024). As a result, these areas were found to have the strongest ecological awareness and cultural ties. Additionally, people are more likely to interact with gardens and green areas in metropolitan areas (Peroni et al., 2016; Ávila et al., 2017). Prior studies have demonstrated that city people are less likely to engage with nature (da Cunha Ávila et al., 2015; Arjona-García et al., 2021), especially younger populations with less knowledge (Sousa et al., 2022).

. By eliminating ecosystem-based livelihoods and the indigenous knowledge that underpins them, urbanization's commercialization of resources and diversification of livelihoods endangers ecological culture (Fu et al., 2023). The adoption of new commercial resources in a region or the desire for a consumer lifestyle could be the cause of these changes (Wang and Zhang, 2024). Therefore, it is best to avoid creating urbanization policies that hinder cultural integration (Shao et al., 2024). By developing policies that promote the incorporation of cultural elements into urban development, government policy frameworks and incentives can play a crucial role (Wang and Zhang, 2024). This could include financing for studies into sustainable methods that respect cultural traditions, rules protecting historic locations, and financial incentives for developers that use traditional aspects in their designs.

Conclusions

One of the issues facing sustainable landscape conservation is the trade-off of several ecological and societal factors. Urbanization, a harmful human activity, posed the most threat to landscape conservation's goal of preserving the interaction between humans and nature. Cities in developing nations will continue to grow, and new socioeconomic circumstances should be taken into account based on the needs of the populace. Carefully adjusting a variety of cultural values in connection to habitat quality to new socioeconomic circumstances should be a part of landscape conservation programs. Local communities, managers, and conservationists need to be made aware of the relationship between the loss of the natural environment and their cultural practices, as well as how innovative approaches to nature conservation may integrate people's cultures. Results in this study can be used by policymakers to identify social hotspots where people-led landscape conservation could be feasible with controlling main drivers.

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