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Original Research Article

Environmental Wisdom*

Indigenous Knowledge and the Role of Ecological Factors in Planning and the Construction of Kamu Village, Iran

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Abstract | The natural environment and its elements have always been a determining factor in the location and distribution of settlements, the construction of human facilities, and organizing spaces. The stability of natural environment has a direct relationship with the characteristics of habitable areas, natural threats and environmental management and planning method. Therefore, finding the best location depends on parameters such as context geomorphology, water resources, soil and so on that affect the livelihood, culture, and community of the villages. In Kamu, the role of natural elements in the formation of the village and the adaptation of its context with nature in the physical, functional, and semantic layers is important. Therefore, the nature and the type of human activities related to the environment will be effective in the way of reading the manifestations of this cultural system. By analyzing the structure of Kamu Village based on the ecological factors, this paper, while re-reading the role of these factors, examines the adaptation and continuity ratio of the residential habitat under study and how to manage and plan its inhabitants in relation to each one of the natural elements. The research findings show that the Kamu structure is formed based on indigenous knowledge, intelligent utilization of ecological elements and inspiration from its natural bed, and the management method of this context is based on the nature-based solutions, which shows the environmental wisdom of its inhabitants.

Keywords | *Ecological elements, Human-nature system, Indigenous knowledge, Environmental wisdom, Kamu Village.*

Introduction | Human habitats are the product of human civilization, population concentration, and production activities in the complex socioeconomic-natural ecosystem (Wang, Li, Hu & Li, 2011). The development and pattern of the establishment of habitats in geographical spaces depend on the existence of human survival tools, human activities developments, and environmental capabilities (Mamat, Zhao, Yan & Xue, 2012) and their quality directly affects the lives of residents and indirectly affects economic and social progress (Song, Yang & Wu, 2019). Therefore, studying the importance of the environment in the relationship between human being and nature is among the main topics in the researches of rural development planning to increase sustainability and reduce the effects of adverse human activities on the environment (Liu et al., 2007; Liu, Hull, Ouyang & Zhang, 2016; Nazarian, Karimi & Roshani, 2009). In this regard, Nature-Human Integrated Ecological Planning, by recognizing the effects of human activities and ecological planning methods (site selection, spatial organization, land use patterns) analyzes the effective natural indicators in the formation of the structure of villages (Zheng, Han, Wang & Ouyang, 2018). In the settlements of Iran, the first coherent uses of the natural environment have also started with rangeland and farming, and climatic and environmental conditions have been the determining factor of regional divisions, and the spatial order of human facilities and civilization (Makhdoum, 2011; Nazarian, 2011; Shahmari Ardejani, 2015; Khammar, 2011).

The adaptation of the inhabitants of the settlements to the environmental conditions has created environmental wisdom, and indigenous knowledge about the environment and the

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methods adopted in the field of production, culture, and society due to adaptation to the ecosystem, is a form of sustainable development (Jomepour, 2014). Thus, indigenous knowledge is known as one of the main paradigms of rural sustainable development in human-nature systems. By explaining the concept of indigenous knowledge and examining the ecological factors of Kamu Village and analyzing how people interact with these factors, this study explains the relationship between the human-nature system, environmental planning, and management structures, furthermore, answers the question that how residents' perception of the natural environment led to the formation of indigenous knowledge, environmental wisdom, and sustainable livelihood in Kamu Village.

Hypothesis

In Kamu, through the formation of a human-nature system, the activities of the inhabitants and the type of their relationship with the natural environment have created indigenous knowledge, based on which the natural-base solutions and ecological patterns have been formed. This indigenous knowledge has affected the livelihood of the residents in three dimensions namely, conceptual and symbolic, cognitive, and functional and has been converted into environmental wisdom through collective experiences and understanding the natural environment.

Materials and method

• Study area

Kamu Village is located 85 km southwest of Kashan and is limited to the southern slopes of the Karkas Heights in three directions, and with the altitude of 2,345 meters above sea level has a dry and cold climate. The development of this village, together with Chowgan and Jowsheqan, was the result of the river of Kabir Kamu or Kasrud (in the form of a large lake in ancient times) (Derakhshani & Mahlouji, 2004). Archaeological evidence considered Kamu as the first point in the early geologic periods emerged from underwater. Due to the existence of caves in the heart of the mountain, it is among the first origins of mankind's appearance (Najafzadeh, 2017). Given the ecologic-geomorphologic features and the type of structural and spatial planning such as locating, lands use, architectural pattern, and water system, Kamu is one of the valuable examples of sustainable settlements in adaptation to nature (Fig. 1).

• Research method

The use of integrated models is essential for the analysis of biological habitats (Costanza et al., 2017). In order to study the planning structure of Kamu Village and to investigate the role of natural factors in this structure, this research has used the principles of the ethnographic approach and the model of indigenous environmental knowledge (symbolic (Kosmos), cognitive (Corpus) and management (Praxis)). Ethnography is an interdisciplinary approach that studies how human groups view nature through beliefs and the knowledge of using natural resources for management (Toledo, 2002, 514).

The triple model of symbolic-cognitive-management, derived from the ethnographic approach, examines the inseparable links between beliefs, knowledge, and natural resource management, analyzes, and evaluates the knowledge of indigenous people in ecologic-cultural contexts. Unlike other models that mainly explain the relationship between humans and the environment through the identification of ecosystems and environmental patterns, this model analyzes how to understand, recognize, use and manage landscape (Barrera-Bassols & Toledo, 2005) (Fig. 2). In completing this model, this research has used Ackoff's systematic thinking hierarchy model to examine the process of transforming indigenous knowledge into environmental wisdom in the village of Kamu. This article firstly by expressing the concepts of knowledge, wisdom, and indigenous knowledge addresses the issue of what environmental wisdom means, and by analyzing a case study according to the three principles of the indigenous knowledge model explains at first values and beliefs associated with ecologic components. Secondly, it examines the ecological features and elements effective in locating and selecting a

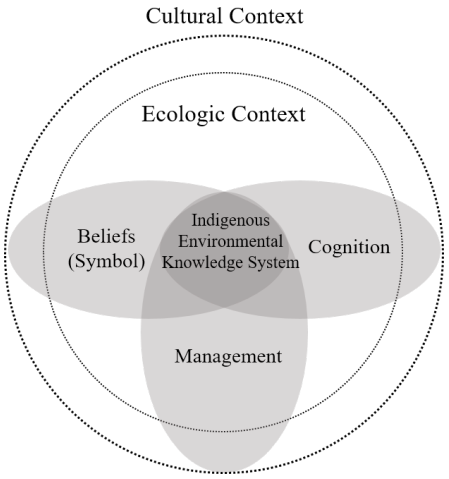

Fig. 2. Indigenous Environmental Knowledge Model (Symbolic- Cognitive-Management). Source: Barrera-Bassols & Zinck, 2003.

Fig. 1. Landscape of the Kamu Village on the Slopes of the Karkas. Photo: Ghazal Nafisi, 2018

site, physical-spatial structure and land use, and thirdly, by studying the setting of the environmental conditions and the affecting processes on the environmental quality, it deals with the management method of ecologic structures and its functions. Data collection has been performed through written sources, articles, maps, information available on the websites of organizations, field observations, and interviews with residents of the area.

Theoretical foundations

• The concept of knowledge and wisdom

Russell Ackoff, by classifying the content of the human mind into five categories, names the process of transforming data and environmental information into knowledge and then wisdom as a systematic thinking hierarchy (Bellinger, Castro & Mills, 2004):

-Data: What does not matter beyond its own existence has no meaning, and can be usable or unusable.

-Information: Data that is meaningful through relationship.

-Knowledge: The set of proper information to be useful.

-Understanding: An introverted process in which new knowledge is produced.

-Wisdom: An extroverted process that is unique in humans and is related to future decision makings (Fig. 3).

In the relationship between human and nature, natural elements are the only raw and meaningless data. After perceiving the residents and how they intervene, these elements are manifested in the form of constructive symbols of beliefs, cognition of the environment, the use and management of natural resources, and construct the basis of indigenous knowledge.

• The conceptual framework of indigenous knowledge

Indigenous knowledge or local knowledge or traditional knowledge refers to the continuous knowledge of the society encountering the problems that have formed their cultural foundations, adapted to the environment, and is the basis of decision makings and responding to challenges (Khayyam, 1995; Rezaei Moghadam, 1996). This knowledge is naturally produced on the basis of a specific geographical area and is related to agricultural activities, environmental knowledge, power, and talent of indigenous people and experiments of indigenous people (Chambers, 1987).

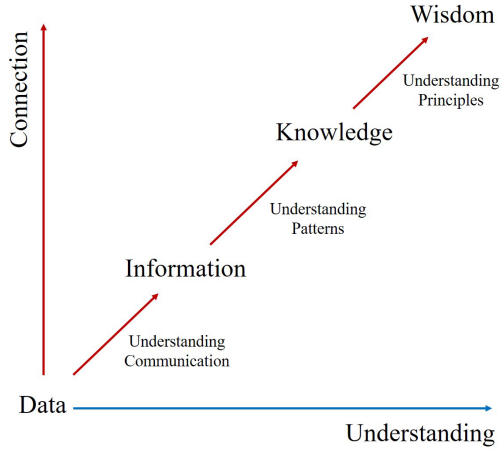

Fig. 3. Ackoff's Systematic Thinking Hierarchy. Source: Bellinger et al., 2004.

Indigenous knowledge in human-nature systems is an accurate representation of the forces that shape the diversity and conditions of past and present environments (Gadgil, Berkes & Folke, 1993; Berkes, 2012), based on trial and error method, and depending on people's beliefs and values (Salimi Kouchi & Ebrahimi, 2017) and is transmitted by intergenerational culture (Berkes, 2008). This knowledge is a complex system based on individual and social experiences that nature, culture, and production are constructive variables of it and they are under the supervision of social institutions (Barrera-Bassols & Toledo, 2005). In other words, it is a combination of action, power and credibility, spiritual values and social and cultural local organizations (Turnbull, 1997, 560) and the resulted solutions are important in terms of creating numerous indicators over a long time interval, accumulating and accessing qualitative data and creating a collective mental model (Berkes & Kislalioglu Berkes, 2009). Toledo has designed a system of indigenous knowledge based on the model of beliefs, cognition and methods of nature management (Toledo, 2002) in which 1) beliefs, refer to the worldview system of local people including their symbolic values and beliefs about the environment and natural elements; 2) cognition, refers to the environmental knowledge obtained from natural elements, and 3) management methods refer to a set of practical activities to exploit natural resources. This model presents an integrated approach to study how the human's capture process is in the ecologic context (physical or mental) and the emergence of culture. In a similar model, Gadgil introduces knowledge, practice, and belief as the components of the indigenous knowledge system and considered social rituals and religious beliefs as determinants of the rules of this system (Gadgil et al., 1993, 154).

• From Indigenous Knowledge to Environmental Wisdom

Natural elements are like environmental data that are converted into information in a human-nature system. Locating of this environment, is the result of form, activity, and meaning and has three dimensions including physical, functional, and perceptual-cognitive (Canter, 1977). By adapting the way of human interventions in an ecologic context and the Toledo's indigenous knowledge system model, environmental information can be defined in three levels of meaning, body, and function:

1) Meaning, as the first level, is the beliefs and intellectual foundations of societies and indicates the type of their mentality, 2) Body of nature is perceived through the senses and leads to the recognition of natural mechanisms and the knowledge of the inhabitants about ecologic context, 3) Awareness of the context and experience of natural events and processes

leads ethnic groups to choose intelligent solutions to deal with or adapt to nature and environmental management. The integration of these three levels for social institutions is a kind of cultural asset that is transmitted through cultural methods (Singh, Pretty & Pilgrim, 2010), and reciting and re-reading it interprets the formal-semantic layers of human-nature systems. The development of indigenous knowledge and the valuation of the natural context and its constituent elements forms a cultural system and an ideological view of social institutions towards the environment and the production of the sets of rules, norms, and patterns (Gunderson & Holling, 2002). This cultural system is a growing system; growth does not need to increase the value, but development requires an increase in wisdom, understanding, knowledge, and information. Wisdom deals with values and judges them (Ackoff, 1999). In fact, data, information, knowledge, and understanding are the affair relevant to the past status and increase efficiency; while wisdom is the ability to increase effectiveness. Therefore, in the growing systems, the collective wisdom of the communities becomes important.

The emergence of this wisdom stems from the collective experience and depends on the view and the mentality of groups, and its principles for ethnic groups are different from each other. The indigenous knowledge of social institutions in the cultural context has found value and epistemological dimension in which judgment-based knowledge, determination of intelligent criteria, foresight, and prioritization of affairs, distinguishing between good and bad and expediency, create environmental wisdom.

Case study: Analysis of Kamu Village based on indigenous environmental knowledge model

• Beliefs

In many societies, believing in its natural elements including sacred creatures with natural and supernatural powers (Toledo, 2002) has been the basis of land and resource use. Knowledge and practice have been merged into each other in the form of an integrated cultural system as tangible and intangible symbols; therefore, recognizing and studying the natural environment helps explain cultural patterns (Pitzl, 2004).

Cultural practices such as ritual, language, art, names, stories, myths, and so on in the village of Kamu indicate that ecologic elements have a special value and have become cultural symbols in the historical context. For example, the red color of the bed soil (Karkas Slopes) is the main color of the architecture of village houses and details such as garden edge stones or cemetery stones, which have also extended to the art of the villagers (the hand-made women clothing and Kamu tablecloth) (Figs. 4 & 5). Naming the peaks has been performed based on multiplicity, color, legends, and myths such as the peaks of Gargash, Kharanjoun, Kamar Siah, Kama Sefid, Ghoroghchi, Chal and Parand (Najafzadeh, 2017). Products such as grapes and red flowers have been among the most important motifs used in the carpets of this region (Joafshan Vishkayi, 2018), and due to their sacred and practical aspects, they have caused the emergence of sacred ceremonies and rituals in the village. The physical crystallization of water makes this habitat meaningful and is an identification for its location and activity structures. Examining the expansion of settlements based on water leads to the identification of the body and texture of that settlement and results in important information about public tendencies and their behavior in the landscape (Mansouri & Habibi, 2011). The deep fault of the Karkas Mountains, as the source of the emergence of spring and the Kamu River, meaning the fount of the water, is the symbol of life and indicates the concept of the power of the village. The Kamu River forms the hierarchy of power in the three levels of position (social), agriculture (economic) and physical, and is the superior aspect of the village compared to other villages (Bahrami & Saboonchi, 2019).

• Recognizing the Context

The spatial context of villages and their complications and phenomena are important in terms of resistance against events, soil production for agriculture, infiltration of surface waters and locating, distribution, area of influence, physical development, communication and the appearance of human settlements (Soltani & Aligholizadeh Firouzjaei, 2001; Saeidi, 1998). Recognition of Kamu residents can be examined from the natural-ecological indicators of the region in the components of geomorphology, soil and agriculture, and water resources.

Fig. 4. Utilizing the Red Soil of the Karkas Mountains in the Architecture of Village Houses. Photo: Azarnoosh Amiri, 2018.

Fig. 5. Kamu Sofreh with Colors and Motifs Taken from Nature. Source: Tanavoli, 1998.

- Geomorphologic Context

Kamu Village in the mountainous unit on the slopes of Karkas is known as Iran's center of gravity. In this unit, the glacier process and the water process have caused the formation of glacier circuits and U-shaped settlement river valleys, up to the height of 2,000 meters (Hamidian, Shekari Badi & Amir Ahmadi, 2016; Giahchi, Alemi Saf Aval, Jedari Eyvazi & Servati, 2017) (Fig. 7). In Kamu, like Natanz, Niasar, Ghamsar, Barzok, and Jowsheqan, the glacier process is the most important factor in the formation of the bed, and the river valleys are the most important geomorphologic landforms (Hamidian et al., 2016). Therefore, the initial locating of the village was around Cheshmeh Kamu, which due to the change in the level of the base and the governance of arid to semi-arid conditions after the glacier period, the waterway has been stabilized on the conical surface of the region (Kamu River) (Yamani, Jedari Eyvazi & Gorabi, 2007) (Fig. 6). As a result, this point and the existence of numerous faults and the risk of earthquakes, the original settlement has been transferred to the southern parts with low height and lower slope adjacent to the river. The type of locating and the village being restricted in three ways by the peaks while providing security, has been a barrier against rainy clouds and prevents the infiltration of hot currents from desert areas.

- Soil and agriculture

The geomorphologic bed and climatic factors affect the soil type, fertile lands, and the bed of the village settlement. One of the main factors in the expansion of the village in the southern parts is the suitable soil for cultivation and the general slope is from north to south because the spring located in the northern heights is the main source of water supply for the Kabir Kamu River.

- Water System

The main structure for the formation of the village is based on the direction of the flow of the river. The Kamu River is a natural ventilation corridor and the creator of the micro-climate of the village in the middle of a mountain bed. The river is the factor of the formation of several villages of its downstream, and Kamu is the first village fed by this source. The linear structure of the north-south of the village, based on the movement of the river, has regulated the formation and development of spaces in the texture and appearance of the village. Kamu Spatial Organization includes 1) architectural buildings on both sides of the river with the extroverted and introverted system of the central courtyard, 2) the core of the village that is the confluence of the river and the center of the neighborhood including Mirza Agha Khan Tower, Water Reservoir Basin, Darband Mosque, and Darband Water Mill, 3) the green matrix of the village consists of spots (farms and gardens behind the architectural layer), green corridors (garden alleys) and green spots (house yards and old trees), and 4) Organic Chess Road Network of the passages under the influence of the Earth's natural slope and main roads towards

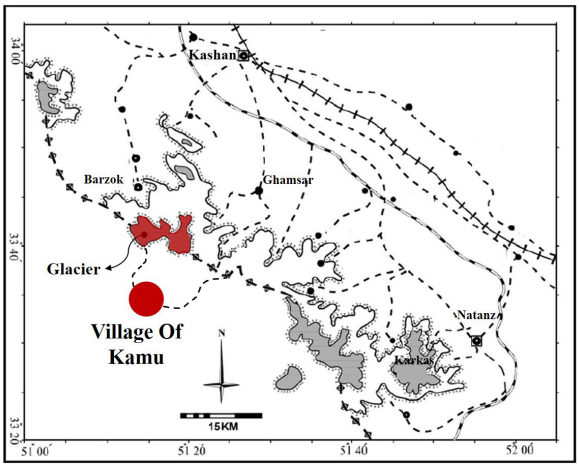

Fig. 6. Extent of Glaciers Expansion in Northern Part of Kamu. Source: Authors Taken from Yamani et al., 2007.

the North-South slope, and side passages with a more gentle slope that are perpendicular to them (Bahrami & Saboonchi, 2019), (Fig. 7).

• Resources management

Planning and measures in the village of Kamu under the influence of environmental factors and climate-based measures, the management of the water system and runoffs are examples of practical measures of indigenous knowledge.

- Regulation of environmental conditions by using nature-based solutions

The selection of small scales, enclosure, dense texture and the establishment of buildings in the direction of sunlight (Ghobadiaon, 2011), creation of the main passages along the ground level line and side passages in the direction of the slope are among the climatic measures of the village texture against the cold weather. Planting Tabrizi and poplar trees has been done for more confinement and the reduction of wind speed in winter. In the village profile, the mountains are located in the three directions of north, west, and east, and the farms are located in the middle and the buildings are located in the

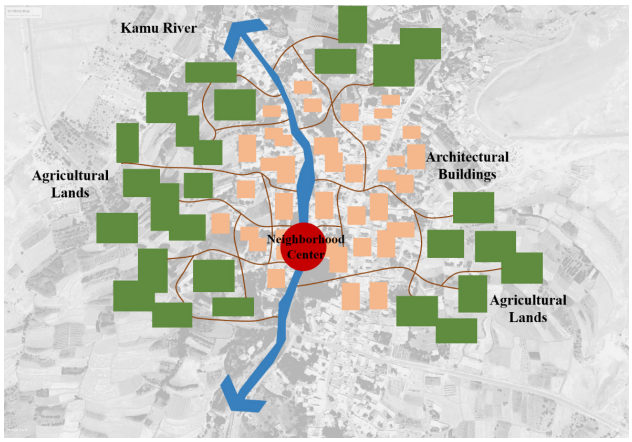

Fig. 7. Structure of the Village of Kamu, including river, architectural buildings, the neighborhood center, gardens and agricultural lands, and road network. Source: Authors.

central part. The form of the buildings is mainly based on introverted buildings with central courtyards, low external surfaces, flat roofs, small openings, sunny porches, thick walls and the use of eco-friendly materials (red soil with hematite-iron, resistant to rain penetration)(Khosravi, 2013). Introverted housing typology, while minimizing energy loss levels, makes service distribution and access to resources possible and helps to regulate the micro-climate of the village (Fig. 8).

- Water and runoff system management

In the past, Kamu has been the homeland of water mills, including the Bozorgian Mill and Darband Mosque (R Chapeh) and numerous aqueducts in using underground aquifers such as Mazraif Aqueduct, Parand Aqueduct, Chalehbolour Aqueduct, and so on (Nasl-e Farda, 2015). The short distance to the river and the risk of flooding, and being flooded have led to the construction of structures from the river bed to increase the resilience and construction of aquifers. Aquifer holes are constructed to control flooding and heavy rains and have transported water to underground aquifers to store floodwaters. Bido Hole at the top of Kamu, Chahar Bagh Hole at the bottom, Marghzar Hole in the middle section, and Central Hole were the main aquifers of the city (Motavalli, 2018). The existence of these holes and agricultural lands above and around the village, by creating a spongy bed, has significantly increased the ratio of permeable surfaces to the constructed sections. Among other water management measures, the water rights of agricultural lands have been as an asset that can be transacted in addition to the land ownership right, that by accurately determining the amount of water volume used for agricultural lands, considering the area and time scheduling and forecasting the drought and the rainy period situation has converted the irrigation system of the village to an intelligent affair.

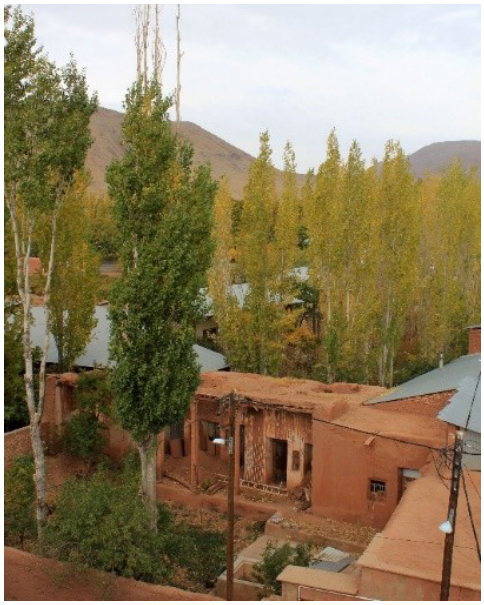

Fig. 8. Compact Form of Housing and climatic Planting System. Photo: Arezoo Khanmohammadi, 2018.

Environmental wisdom in Kamu

The measures and activities of the people of Kamu in the human-nature system are the basis for the development of the Kamu landscape, based on which other activities have been organized and arranged. Beyond their functional role in a representative way, natural details refer to a blend of values and beliefs that make the audience's comprehension of the rural environment. the natural elements are interceding between beliefs and awareness of the encompassing environment and affect the management and organization of the environment (Abarghouei Fard & Saboonchi, 2020). The natural, climatic, water, soil, and plant contexts are Kamu's environmental data, that understanding them as meaningful, formal, and functional phenomena in the form of a set of information, indigenous knowledge and patterns, and environmental wisdom. Environmental wisdom is a means for recognizing, understanding and using environmental information that is formed due to understanding the environment and defining principles for future planning, which on the one hand depends on the condition of context and the bed, and on the other hand, adapts to the thoughts and minds of residents. Over time, this thinking has adapted to the environment and has affected other aspects of the residents' livelihoods. Actions taken for the water system, planting, architecture, locating and physical displacement, lands use, and so on have been the signs of environmental wisdom and weighting and prioritizing various conditions to create a sustainable situation in the village.

Conclusion

The formation, structure, and development of the village of Kamu are socially, culturally, and economically directly related to the understanding of the environment and its elements, and this village takes its identity from the aforementioned elements. These elements are regarded as environmental data that during formal, functional, and semantic interventions and processes form people's indigenous knowledge in the three areas of beliefs, cognition, and resource management. The collective experience and an accurate understanding of the environment throughout many years, in addition to sustaining the ecosystem, performances and processes, and maximum coordination with the natural environment, have caused the emergence of symbolic values and cultural context that originated from the natural environment. The set of nature-based solutions and planning based on the ecological context and residents' more and more connection with the environment have created a human-nature system. Locating the village, lands-use in accordance with the natural context, access to water resources, appropriate scale, use of optimal forms in construction patterns, accurate management and presenting nature-based solutions for the water system, planting system appropriate to climatic conditions, and so on are among the examples of the cognition and indigenous knowledge of the Kamu people that as a result of understanding the principles, have led to their environmental wisdom (Fig. 9).

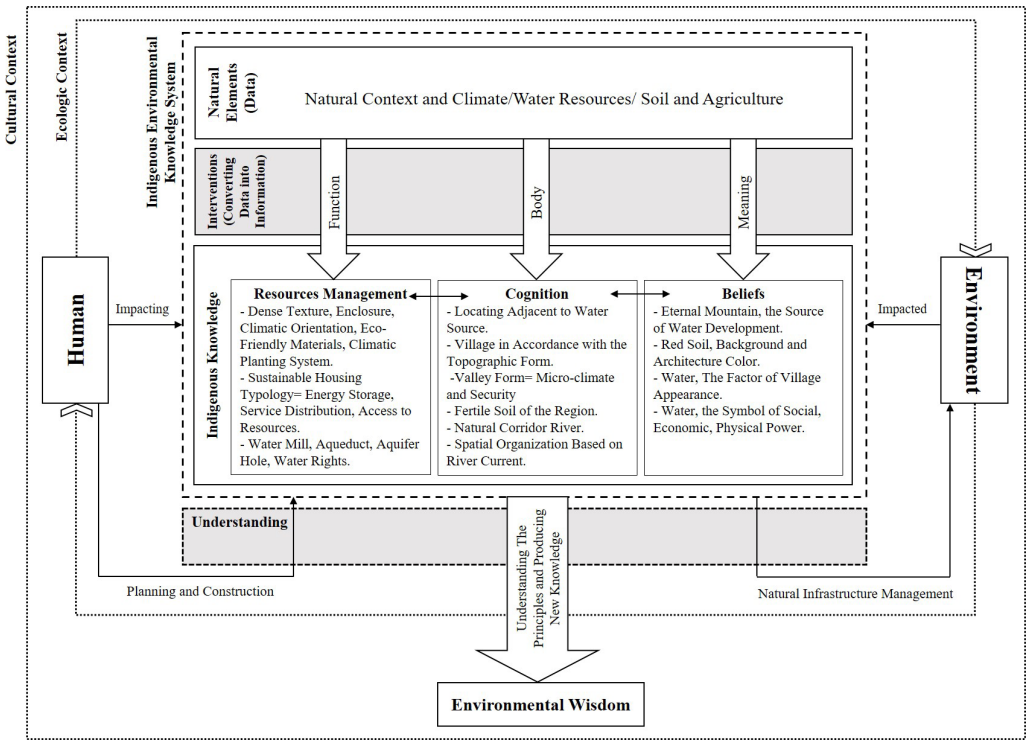

Fig. 9. The Role of Natural Elements in the Formation of Environmental Wisdom in the Village of Kamu Based on the development of the Model of the Indigenous Knowledge System According to the Systematic Thinking Hierarchy. Source: Authors.

Endnote

*This article is based on a field trip report, entitled: "The Tourism of Kamu Native Landscape" which was held in 2018 under the supervision of "Dr. Seyed Amir Mansouri", and funded by Nazar Research Center.

1.The first research about habitats was conducted in 1958 following the science plan of human habitats by Doxiadis (Xie, Zeng & Li, 2014).

2.The valleys (erosion of mountainous areas) and glacier circuses (ponds and glacier feeding centers) are some of the landforms that resulted from glaciers (Hamidian et al., 2016).

3.The temperature figure of the hillsides of Karkas for the last glacier period has been estimated to be 3-4 degrees, which is not consistent with the current average temperature of the region, 18-20 degrees (Meteorological Organization Report, 1992-2002), and indicates the emergence of this region due to the glacier process.

4.Like the earthquakes of 1778 A.D. in Kashan, 1844 A.D. in Ghohroud, the earthquake of 982 A.H. in the Safavi era and earthquakes in the 11th and 12th A.D. (Ghaed Rahmati & Fazel, 2014; Nikoo Hemmat, 1979).

5.Once winter begins, most winds blow from the northwest, while the prevailing wind in other seasons is from the northeast and in the form of hot and dusty winds (Meteorological Organization Report, 2019).

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