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Management of Water Resources and Health Promotion in Drought: An Indigenous Knowledge-Based Qualitative Study

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ABSTRACT

Introduction: Drought is a slow-onset natural disasters and a gradual concern. Throughout the centuries, Iranians have applied various methods to preserve water resources and adjust themselves to the drought. This study was conducted with the aim of preserving water resources by households during a drought with the approach of indigenous knowledge.

Material and Methods: The study was carried out from April 2017 to June 2018. A qualitative content analysis method was used to obtain insight into personal experiences. A purposive sampling method was used to select 15 participants. The research population consisted of native villagers who lived in rural areas near the three main plains of Yazd province (Yazd-Ardakan plain, Abarkouh plain, and Herat Va Marvast plain). Thematic analysis was used to analyze the data.

Results: The components related to indigenous knowledge were placed in 4 categories and 15 sub-categories. The main categories were personal hygiene, conservation of scarce resources, prediction of drought, and classification of water in terms of quality and its supply sources.

Conclusion: Indigenous knowledge reflects several generations of experience. This knowledge is a valuable resource about how local communities interact with their ever-changing environments. We must pay attention to personal health behaviors and how our ancestors used and preserved scarce resources. It is necessary to identify and correct these behaviors and support them through proper management and financial resources at the community level. To preserve water resources in droughts, it is essential to use appropriate management and policy-making and motivational methods, and educate families.

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Introduction

Disasters are a part of people's lives, and no place on the planet is safe from disasters [1]. A large number of people affected by disasters in the world live in Asia[2]. One of the critical subjects in natural disaster studies is droughts [3]. The analysis of soil moisture and drought indicators show the increased risk of droughts in the 21st century [4]. The high speed of the impact of weather-related disasters, especially droughts, in the world and Iran. Among all the natural hazards of the 20th century, droughts had been the most damaging effects [5]. Statistics published by the Emergencies and Disasters Data Bank (EM-DAT) during 1900-2011 in Iran show

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that in terms of the average human population affected and the average economic losses (more than 1.6 billion dollars), drought is ranked first[6] . Moreover, the drought trend is increasing[7]. Droughts have caused water shortage, desertification, and dust storms with dry air in rural and urban areas [8]. In addition, droughts have led to significant changes in water quality[9, 10].

According to the history of drought in Iran, people used different strategies to adapt to water shortage [11]. We must learn what our ancestors did regarding the lack of water [12]. This knowledge can help us to adapt effectively to climate change in affordable, inclusive, and sustainable ways [13]. Indigenous knowledge has a vital role in reducing the undesirable effect of risks [14] and it is passed on orally from parents to children and from neighbor to neighbor [15]. With the death of experienced people, a large amount of this knowledge will be lost in different societies [16].

Water is a necessary commodity for survival and development [17], and the gap between water supply and demand needs to be revised. This issue has attracted especial attention recently, as Iran is a vast country with little rainfall [18], and the world's per capita water consumption has been increasing (400 to 800 m^3)[19].

Moreover, the total drinking water consumption per capita in Iran (including commercial, industrial, domestic, green spaces, and so on) is estimated at around 220 liters per day [20]. Today, people can access water more efficiently compared to the past, which has made people indifferent to its preservation. Traditional water protection systems are being destroyed, and serious efforts are needed to restore and maintain these resources [21].

Considering the history of drought and the spread and the possibility of a water crisis in the world, and taking into account the importance of this knowledge in preserving water resources, this research was conducted to investigate how to preserve water resources by households using the approach of indigenous knowledge. So far, many studies have been done on water resources management, but approaching this subject from the perspective of indigenous knowledge is the innovation of this research.

Material and Methods

Study design

This study was carried out from April 2017 to June 2018, and qualitative content analysis was used to obtain personal experiences [22]. Through this method, a more profound understanding was achieved [23, 24] and a better comprehension of these concepts would not be possible with other methods [25].

Setting

This study was conducted in Yazd, one of the driest regions of Iran, where 85% of the land area has a dry and desert climate [26].

Participants

The research population included all native people living in the three main plains of Yazd province (Yazd-Ardakan plain, Abarkouh plain, and Herat Va Marvast plain). Regardless of gender and education level, the inclusion criteria consisted of people aged 50 years or older, native residents of the villages, living in the village since childhood and recalling memories, and having willingness to participate in the study.

Data collection

As is the characteristic of qualitative research, the researcher was the most important data collection tool [27]. Also, the audio recorder and the interview guide prepared with the help of the supervisors were the other tools of the study. The interview guide was designed according to the research objectives to conduct a semi-structured interview.

The participant determined the time and place of the interviews. To collect the data, purposive sampling was continued (to reach the right participants) until reaching information saturation [23]. After that, the duration of each interview was determined depending on the circumstances. The average for each interview was 25 minutes and 48 seconds (interview durations ranging between 15 to 55 minutes). After 12 interviews, the data was saturated, but three more interviews were conducted to ensure data saturation, and after 15

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interviews, data sampling was ended.

All interviews were recorded with the participants' consent, and the recorded interview was transcribed using the Word software word by word. The resulting text was then analyzed using the constant comparative method. In this method, data were collected and analyzed simultaneously; therefore each interview was coded before the next interview.

Rigor

In order to acquire precision and accuracy of the interviewee's answers, the codes and results were presented to the participants for confirmation. Also, a disaster health experts outside the group was asked to give his opinion about the results[28].

Data analysis

The "thematic analysis" approach was used to analyze the data [22]. The MAXQD software version 9 was used to manage the data.

Ethical issue

The present study has been approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.RETECH.REC.1396.1151). According to the written consent form the ethics committee, informed consent was obtained from all individuals who participated in the study.

Results

The demographic characteristics of the participants showed that 40% were men and 60% were women. The mean age of the participants was 71.4 years, 100% of the participants were married, and in terms of education, 27% (4 people) were illiterate, 47% had primary education, 20% (3 people) had a high school diploma, and 6% (1 person) had a doctorate.

According to Table 1, the findings of indigenous knowledge of the people were placed in 4 categories, including personal hygiene (bathing, toilet, and cleanliness, daily washing of the body, washing clothes, washing dishes), preserving water resources (managing the use of resources, the culture of using resources), predicting drought (paying attention to weather conditions, using superstitious methods), classifying water in terms of quality and sources of supply (drinking and cooking, washing dishes related to eating and drinking, washing things not related to eating and drinking such as clothes and carpets, body washing, green space, and agriculture).

Table 1: Categories and sub-categories derived from coding of interviews in this study

Category	Sub-category	Code
Personal hygiene	Bathing	✓Native washing materials ✓Bathing frequency in adults ✓Frequency of bathing in children and babies ✓Bathroom location ✓Use indigenous methods if water is not available ✓Type of bathroom
	Toilet and cleanliness	✓Materials used ✓Location of toilet ✓Type of toilet ✓Washing hands ✓Purifying with reliable materials (when water is not available)
	Daily washing of the body	✓Native herbal detergents ✓Allocating a special place at home ✓Believing in the purity of the body to perform religious duties
	Washing clothes	✓Using nature-friendly and reversible materials ✓Place used for washing ✓Reuse of recycled water ✓Washing rules and supervision by people
	Washing dishes	✓Using natural and available materials with local ingredients ✓Use of safe and cleaning materials ✓Reuse of recycled water ✓Washing rules and supervision by people

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Category	Sub-category	Code
Preserving water resources	Managing the use of resources	✓Water reuse ✓Make public ✓Reuse of recycled water
	Culture of using resources	✓Public supervision ✓Thrift ✓Accuracy in religious health orders
Predicting drought	Paying attention to weather conditions	✓Time and amount of snow and rain ✓Snow on the top of the mountains
	Using superstitious methods	✓Use of animal viscera ✓Air humidity
Classifying water in terms of quality and sources of supply	Drinking and cooking	✓Beginning of the spring water ✓Early morning or midnight water in streams ✓Urban Ab Anbars ✓Sangab ✓Household Ab Anbars
	Washing dishes related to eating and drinking	✓Second-class quality water, such as home pond water or water from streams or domestic wells
	Washing things not related to eating and drinking such as clothes and carpets	✓Lower-quality water like streams every hour of the day and night
	Body washing	✓Streams or well water
	Green space and agriculture	✓Recycled water from drinking and washing

Personal hygiene

A. Bathing

Among the things that were mentioned about bathing were the materials used by people including a substance called Sefidab, soaps made with sheep's skin and fat, the use of a mountain plant called Ashnum, which has foaming and cleansing properties, and also the use of henna or Tragacanth (named ketira in local dialect). Most of the interviews showed that the frequency of bathing for adults was between 10 and 15 days, as well as for children aged one month or two weeks, and for babies even up to one year. Therefore, materials such as lemon peel and salt to soak the soles of adults, or various oils such as olive oil or almond oil for the heads of babies are used to make washing easier.

Also, the use of depilatory materials and cleanliness of the body was of special attention. This department had a charity system and was provided free of charge to all people. Women's bathroom paraphernalia were made of copper, which has antimicrobial properties.

"Cleanliness was so important to them that all bathrooms had a section to remove excess body hair." P13

"It was Abarkohi soap. It was Ashnum. There was also Sefidab." P1

"How often do you take a bath? Every ten to fifteen days." P6

"Approximately one year after the birth of the baby, they took him to the bathroom. During this year, washing was done at home." P10

The importance of the obligatory ghusl and purification under any circumstances has played a significant role in the cleanliness of people.

"For example, one of our rooms was dedicated to washing the body quickly, which, of course, did not have a water drainage system." P13

B. Toilet and cleanliness

Research findings show that in the past, toilets were located in the courtyards of the houses and were pit-type. Moreover, they used toilet wastes as manure for agriculture, or sometimes sold it. In order to be clean for performing religious rites, if they were in a place where they did not have access to water, they used a piece of cloth to prevent the spread of impurity to the clothes. Furthermore, as soon as they had access to water, they would wash from the waist down. In order to wash their hands after using the toilet, they mainly mentioned using water (without soap or other

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detergents).

"When we wanted to go out, we would take one or two pieces of cloth with us so that if we did not have a water bottle, we would use it whenever we needed. Then, we would wash from the waist down when we came home." P9

"There was no soap, and we used to wash our hands with mud or ashes or Ashnum." P14

C. Daily washing of the body

As mentioned, due to the problems of bathing in the old days and the requirement to be clean to perform some religious rites, they did this washing in any possible way. Some people allocated a room in their house for quick washing that only requires a little water. Some people washed themselves in the pool of gardens or the pond of houses. Children's hands are also carefully washed with soap and bath tissue weekly.

D. Washing clothes

Another thing mentioned regarding personal hygiene was how to wash clothes. Washing in the springs was forbidden, since drinking water was provided from there. In addition to the strict public monitoring of this matter, people considered it a great sin and refused to do it. The material used for washing clothes was a mountain plant called Ashnum.

"The clothes were put in water and washed with Ashnum." P6

E. Washing dishes

The findings show that the materials used to wash the dishes were natural materials such as Ashnum or ash or mud straw. Also, hot water was used to wash greasy dishes better. In one of the interviews, it was mentioned to boil greasy dishes with water and ash to clean them better. A mixture of fig leaves, sawdust, ash, and a little salt was also used for washing dishes.

Furthermore, the findings show that people used water from Qanats, house ponds, swimming pools, and wells to wash their clothes, and the majority of them mentioned washing in streams. The notable point was the preservation of water sources, since, in any case, the wastewater from their washing would either reach the agricultural area or enter the gardens of the houses.

"It was a fig leaf. They cut it and mixed it with wood shavings, ash, and a pinch of salt. It made the dishes as white as snow." P9

"The water at the beginning of the spring was for drinking. Then the rest of the water flowing in the streams was used to wash dishes and clothes. Moreover, at the end, the water was used for agriculture." P6

Conservation of scarce resources

Table 1 shows that the conservation of scarce resources including two sub-themes of managing the use of resources and resource use for culture. Managing the use of resources consisted of 3 sub-categories including water reuse, making public, and reuse of recycled water. The culture of using resources included three sub-categories including public supervision, thrift, and accuracy in religious health orders.

Managing the use of resources

Our findings show that there was no wastage of water, and the reused water in agriculture and the materials used for washing were all eco-friendly and did not harm agriculture.

"The water at the beginning of the spring was for drinking. Then the rest of the water flowing in the streams was used for washing dishes and clothes. At the end, the water was used for agriculture." P6

In order to make water available to the public, people used to use public baths or an Ab-Anbar that was for public use and everyone could benefit from it for free.

The sewage disposal system was in the form of pit toilets at the end of the yard; when the pits were filled, they emptied them and used their sewage as fertilizer in the agricultural sector.

Culture of using resources

The results showed spontaneous monitoring of people in the correct use of resources. They closely monitored their own and others' behaviors, so that the water did not get polluted at its source.

The research findings show that they paid attention to religious orders regarding body hygiene and not wasting water. As mentioned

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above, they were careful to maintain water hygiene while taking water from the source and believed that polluting water a great sin. In addition, they monitored the behavior of others and warned them if they observed wrong behavior.

"Does anyone wash clothes or dishes at the spring? No, they don't dare. People would not approve." P3

On the other hand, due to being bound to perform obligatory ablutions, they washed their bodies in any way possible.

Predicting droughts

In the past, the prediction of drought was done in two ways; paying attention to weather conditions; and using superstitious methods.

In the method of paying attention to the weather conditions, based on experience, they found out whether they might have a drought or not by carefully observing the amount of rain or snow and the time of its precipitation.

Also, they predicted the drought by marking the snow on certain days of the year on the mountains.

"If it was snowing in December and the mountains had turned white, or in November, a white mark would be left on the mountain, it was said that this year was not a drought year." P1

Another way that was mentioned more than others was superstitious methods.

"If the beginning of the intestine of the sheep that was killed was empty so that the end of its intestine could be seen, they used to say it was a good year." P1

Classifying water in terms of quality and sources of supply

According to Table 1, this category is divided into five sub-categories. The first one is the consumption of water for drinking and cooking, where high quality and ensuring water health is essential.

The sources identified to meet the needs of this category included spring water, stream water in the early morning or midnight, urban Ab-Anbars, Sangab, household Ab-Anbars, and domestic covered wells.

"They had Ab-Anbar. People could go to an Ab-Anbar during the day and get water from there. We used to drink the water of the Ezzatabad Qanat because it was clean; there was also a stream, which we used in the middle of the night or early in the morning when no one had used the water." P6

The following sub-category is related to washing the dishes, which is of the next importance due to its relation with eating and drinking. It can also play an important role in family health. According to the acquired indigenous knowledge, the sources of water supply in this sub-category were water from domestic ponds, Qanats, or domestic wells.

The third sub-category was related to washing clothes. Water quality was less important at this stage, and the water from the streams or rivers was used all day and night.

"Our house was next to the river. We used to wash clothes there." P3

The fourth sub-category was used for bathing, and this water was supplied from wells or Qanats.

Discussion

In this study, for the first time, the conservation of drinking water resources during droughts was investigated in the household level using indigenous knowledge. To this end, four main themes were identified, including personal hygiene, conservation of scarce resources, drought prediction, and classification of water in terms of quality and sources of supply.

1- Personal hygiene

The research findings show that personal hygiene in indigenous knowledge is divided into five main subcategories related to bathing, toilet, and cleanliness, daily washing of the body, washing clothes, and washing dishes. According to the old water supply system, each case had its conditions and methods. Paying attention to personal hygiene and using water resources to meet this need can affect the health of people and the preservation of water resources. In ancient Iran, washing the body was important and essential in religious texts. Water has been considered one of the cleaning materials[29]. Also, the purity of the

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body and clothes (Wudu and Ghusl) is one of the preliminaries to worship, showing Islam's particular attention to purity[30], which is in line with the findings of this research.

All interviews referred to how people accessed water to perform obligatory Ghusl.

One of the positive points observed in the findings was the emphasis of all people on performing obligatory religious Ghusls even several times a week, despite the problems that existed at that time to go to the bathroom, and this behavior played a significant role in their health. Research has shown that purity is considered a precondition for accepting many acts of worship in Islam. As a general rule, Islam considers cleanliness a matter of faith. Therefore, a person must recognize the principles of cleanliness while being a believer [29, 31]. Also, as we know, water and sewage recovery are one of the main priorities after disasters, so public health education about personal hygiene, liquid soap, and clean water for cleaning hands is critical [32]. Melki et al. found a significant relationship between personal hygiene and the absence of some skin and hair related diseases. They also stated that personal hygiene significantly reduces the incidence of these problems[33]. Therefore, the proper and sufficient use of water for daily washing of the body to perform the obligatory ghusl even in drought with the correct method and without wasting water improves people's health.

Regarding washing clothes, the findings show that there was no specific time for washing clothes. Washing was done in Qanat or rivers. Washing in the springs was forbidden, and in addition to strict public supervision, people refused to do it, since it was considered a great sin. The material used for washing clothes was Ashnum.

One of the positive points of this data was that people carefully tried to prevent the contamination of drinking water, one of the effects of which could be the reduction of various diseases including diarrhea in people. In his research, Esterhameyan stated that the outbreak of diarrheal disease can be caused by the entry of microbial and viral contamination into the water distribution network. He also states that it is necessary to prevent the occurrence of such cases by educating and informing people about personal hygiene, and continuous assessment of water resources[34].

The requirement to maintain the health of drinking water sources, not contaminating them, and using natural materials are all positive points that were extracted from the findings.

Washing the dishes is another task that needs to be taken into account to maintain personal hygiene and avoid diseases. As mentioned earlier, natural cleaning materials such as ash or Ashnum powder, clay straw, or even hot water or a mixture of fig leaves, wood dust, ash, and a little salt have been used to wash dishes. Washing in springs was forbidden, and people automatically avoided doing it. Moreover, they used Qanat or house ponds or swimming pools and well water, and the majority of them mentioned washing in water from streams. It is crucial to preserve the water sources in this stage because the wastewater from washing would either reach the agricultural area or enter the garden of the houses.

Hurlimann et al. conducted a study on household use of alternative water sources and their satisfaction with this issue in Victoria, Australia. They stated that families felt satisfied with using alternative water. Irrigation of the garden was aimed at using alternative water. In general, 41.6% of the respondents sometimes used an alternative water source to irrigate their garden. The most common alternative water source to irrigate gardens was the water previously used in washing clothes[35]. Khodarahimi et al. also point out the importance of using recycled water to irrigate gardens to deal with mental health problems caused by the lack of drinking water[36].Therefore, the present study results confirmed the findings of the studies of Hurlimann and Khodarahimi, in which the native people tried not to waste water and were very careful in recycling water.

2- Preserving water resources

The behaviors of the natives showed that they did not waste any water, but all the water was

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circulating on the ground and was used again in agriculture. The washing materials used were eco-friendly and did not hinder agriculture. Morover, the baths were public, water pollution was prevented at the source with public supervision, and people were prevented from overusing the bath. The drinking water supply system by the Ab-Anbars was for public use, and everyone could benefit from it for free.

DeNicola et al. also mentioned in their research that wastewater recycling and water reuse can help reduce pressure on water resources [37].

Frizenschaf et al. also mentioned in their study that one of the influential factors in responding to water demand and ensuring water quality is using recycled water for non-drinking purposes [38].

The present study findings indicate that water recycling could be seen in the natives' behaviors. The distinction between bathing and drinking water, which was the necessity of their time, was the positive thing in managing scarce resources.

There was public supervision in using water resources and preventing water pollution, as well as the amount of water used for public baths. In addition, a prevailing culture prevented people from going to more extended baths than customary. All these factors have led to saving and optimal water consumption.

As a result, culture is an essential factor in the management of water resources [39]. Therefore, some strategies are suggested including changing water consumption pattern of families and their lifestyles, educating people, teaching to save water from childhood, launching campaigns to inform the public about water shortage, information, and providing public consultations [40].

3- Predicting drought

The management of water resources should be done according to climate changes, and during the drought, preventive measures should be emphasized [41]. However, the behavior of natives in predicting drought was not scientific, and according to the conditions of their time, they behaved more on guesswork, which could not guide them to predict the future weather accurately. This problem is now partially solved by advanced weather forecasting tools. Therefore, it is necessary to set up a suitable adaptation strategy, so that the conditions of climate change and other influencing factors, such as the growing demand for water and its impact on the supply system are considered [42].

Samadi stated that having a timely and comprehensive early warning system can help reduce damage to various sectors of society, including agriculture, industry, economy, and others [43].

Madadgar also states that accurate climate change forecasting is vital in preparing appropriate policies for available water resources. He mentioned that observing the effects of climate change on floods and droughts in different regions of the world shows the need for more complex methods in weather forecasting [44].

4- Classifying water in terms of quality and sources of supply

The research findings show that water could be divided into 5 sub-categories in terms of its quality and source of supply. The first one is the consumption of water for drinking and cooking, where high quality and ensuring water health are essential in this sub-category.

According to the findings of indigenous knowledge, to meet these needs, people used spring water, untouched water in the early morning or midnight of streams, urban Ab-Anbars, Sangab, household Ab-Anbars, and domestic covered wells.

The next level of need is washing the dishes, which is important due to its connection with eating and drinking and can play an essential role in the family's health. In indigenous knowledge, sources of water supply for this class were water from house ponds, Qanat, and water from domestic wells.

The third stage was related to hygiene and washing clothes. The quality of water could have been better at this stage, and the water of the Qanat was used at all hours of the day and night.

The fourth stage was used for bathing and

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washing the body, the water of which was supplied from wells or Qanats. Moreover, finally, the last stage of water use was related to agriculture, which had the lowest water. In other words, recycled water resulting from high needs was dedicated to agriculture.

It is essential to establish that drinking water is more suitable for food purposes; and recycled water is more suitable for irrigation, car washing, and household washing purposes [35, 45, 46]. In other words, water reuse for non-drinking purposes should be emphasized [38, 47]. Therefore, it is suggested that policymakers pay due attention to this issue.

The researchers mentioned that one of the influential factors in responding to water demand and ensuring water quality is the use of recycled water for non-drinking purposes [38]. The findings of the present study showed that water recycling, which was seen in the behavior of the natives, is one of the positive things in the management of scarce resources, and it is possible to get ideas from their positive behaviors and use them in times of crisis.

Conclusion

One of the necessities of health and improving health is the availability of safe water. Maintaining and promoting health in drought conditions is achievable. By acquiring local knowledge and analyzing and adjusting it with modern science, measures can be taken to preserve water resources, such as water recycling in homes and at the place of consumption, which was also mentioned abundantly in local knowledge.

In this research, in confirming the importance of indigenous knowledge, we found that this knowledge is necessary, useful, and valuable, and it corresponds with the local people's culture, habits, and customs. However, new science- based methods have to be applied instead of superstitions.

In general, it can be concluded that indigenous knowledge needs to be carefully identified, recorded, and subjected to scientific analysis to eliminate superstitious and incorrect methods from it. Promoting traditional methods compatible with culture and customs that are correct and do not require expensive technologies is recommended. These methods should be revived, and their information should be made available to people.

Acknowledgment

The present study has been approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.RETECH.REC. 1396.1151). According to the written consent form approved by the ethics committee, informed consent was obtained from all individuals who participated in the study.

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Conflict of interest

The authors declare that they have no conflict of interest.

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