Climate Change and Gender: Mapping Drought and Gender Gap in Literacy and Employment Sections in Iran between 2011 and 2016

Sanaz Sohrabizadeh[1,2]*[iD], Amirhosein Bahramzadeh[2], Ahmad Ali Hanafi-Bojd[3]

Abstract

Background: Drought is one of the most frequent natural hazards in Iran. Gender analysis can highlight the different needs and capacities of men and women to manage drought hazards. Thus, the present study aimed to map drought and the gender gap in drought data based on the provincial zones in 2011 and 2016.

Methods: This cross-sectional study was conducted in 2 stages establishing a database and spatial analysis. Data mapping was done based on provincial divisions, sex-disaggregated distribution of literacy, and employment rate as well as drought patterns in Iran in 2011 and 2016 using ArcGIS software. Descriptive statistics were applied to analyze and report the sex-disaggregated literacy and employment data.

Results: About 80.73% and 75.27% of women and 80.89% and 74.74% of men experienced severe and very severe droughts in 2011 and 2016, respectively. Gender inequality in the aspects of literacy and employment in drought-affected regions was found in 2011 and 2016.

Conclusion: Community-based planning and management in regions exposed to climate change are suggested for reducing the consequences of climatic disasters such as droughts. Women need to be empowered and trained for innovative livelihood activities in rural and urban areas in Iran and other developing countries affected by long-term droughts.

Keywords: Gender, Drought, Literacy, Employment, Geographic Information System, Iran

Introduction

Climate change is one of the serious environmental issues that cause harmful consequences for humanity (1). Drought, as an extreme weather event, is the on-set complex climate-related hazard that has globally caused eco-hydrological and socioeconomic effects such as the increase of wildfire risk, water shortage, loss of crops and livestock, migration, and health impacts. Droughts are categorized as hydrological, meteorological, agricultural, and socioeconomic (2-4).

The effects of droughts on human populations are dif-

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Corresponding author: Dr Sanaz Sohrabizadeh, Sohrabizadeh@sbmu.ac.ir

1. Air Quality and Climate Change Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran
2. Department of Health in Disasters and Emergencies, School of Public Health and Safety, Shahid Beheshti University of Medical Sciences, Tehran, Iran
3. Department of Medical Entomology & Vector Control, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

↑What is "already known" in this topic:
Drought is a prolonged disaster that can worsen the current gender inequality in Iran. This disaster can negatively affect employment, education, gender gap, and other development criteria.

→What this article adds:
In this study, we collected and analyzed the national data on droughts, employment, and literacy based on gender in Iran in 2011 and 2016. This research provides the audience with an overall picture of gender inequality in employment and literacy in all droughts-affected regions. The findings can inform policymakers about the necessity of reforming current prevention and development strategies considering men's and women's participation.

ferent based on the social factors that result in unequal needs, capacities, and roles (1). On the other hand, social, economic, and environmental factors are supposed to be the underlying causes of worsening or declining drought impacts in the various geographical regions (5-7). That is, human activities and communities are sensitive to climatic hazards in different ways (8).

Gender can affect how men and women access socioeconomic resources in a community because it shapes the power relationships between them (8). In other words, gender, as the socially constructed activities, roles, and expectations of a man or woman, is found as a substantial analytical framework in the context of climatic disasters (9, 10). The contrasting demands and abilities of men and women to control and mitigate climate risks at the community level can be highlighted through gender analysis (11).

The impacts of climate change vary between men and women due to gender-based differences in needs, access to information, and cultural and socioeconomic roles (8). Women and men differently experience and respond to drought. The disciplines of drought mitigation and adaptation policy, however, have continued to be gender-blind (12).

Several climatic hazards reported the linkages between gender and droughts. For instance, the study of social constructions of drought in 2 Australian states Queensland and New South Wales found that drought experiences have been affected by gender-based vulnerability and capacity (13). The study of communal cattle farming in drought-affected regions in Zimbabwe showed that men dominate the decision-making affairs that determine the application of cattle for drought mitigation (14). The study of gender differentiation of drought vulnerability in rural communities in Nicaragua reported that women and men applied different coping and adaptation strategies during short- and long-term droughts (15). Some gender studies have emphasized gender inequality and the higher vulnerability of women at the time of drought. For example, research worked on how rural men and women try to survive in drought indicated that drought influences women more than men as the result of their reproductive and productive roles (16). Furthermore, the gender-disaggregated study of adopting technology for drought risk in Uganda showed that women had much lower adoption due to differences in access to resources and information (17). Similarly, rural women in Ghana tried to respond to climate extremes through support networks and spiritual assistance during the time of prolonged droughts (18). However, the gendered approach to drought study should not only include women and girls. Men also respond to the effects of drought in their ways (8). For example, the study of gendered reactions against drought in India found that male farmers adopted a new loan as a solution for facing the effects of drought, while female farmers were supported by their family members (19).

Drought is one of the most frequent natural hazards in Iran. Iranian populations have suffered from 27 droughts experiences during the past 40 years. Drought has been considered a normal part of the climate for the major sec-

tions of the country (20). The socioeconomic impacts of drought, especially in rural regions of Iran, have been reported by several studies. The examples are as follows: reduction of household income; workload increase; food insecurity and malnutrition; reduced access to water, health services, and education; conflict; migration; inappropriate quality of life; psychological and emotional effects, such as happiness reduction; and disintegration of community and changed plans in families, such as divorce (20-25). Of these, some research analyzed vulnerability to drought by geographic information system (GIS) analysis in several districts in Iran without considering the different gender-based needs and roles in worsening or reducing the drought vulnerability (26-28). Furthermore, a few drought studies considered gender as a social factor. However, they just focused on women's status without mentioning the gap between women and men who lived in droughts-affected regions. For example, evidence reported that rural women experienced higher socioeconomic and health effects due to droughts without analyzing the gender gap (29).

The need to address climate change and gender inequality has been reflected in Transforming Our World: the 2030 Agenda for Sustainable Development, which determined 17 sustainable development goals (SDGs) to improve people's living conditions. The SDGs that are specifically relevant here consist of SDG5 to "achieve gender equality and empower all women and girls" and SDG 13 to "take action to combat climate change and its impacts." (30) Mainstreaming gender into climate change research can facilitate the recognition of gender-based capacities and vulnerabilities and support effective emergency management in drought-affected regions (31, 32). Iran has suffered from a prolonged and severe drought as well as a gender gap score of 0.584 (33). That is, the dual incidence of prolonged droughts and gender-based discrimination can widen the gender gap in the aspects of economic participation and access to education in Iran. Accordingly, the present study aimed to map the drought pattern and gender inequality in the employment and education section based on the provincial zones between 2011 and 2016. These maps showed the trend of droughts and gender inequality over 5 years in Iran. Illustrating a holistic gender gap in drought-affected regions can be used for drought mitigation and adaptation policy and planning based on gender differences in the context of Iran.

Methods

This was a cross-sectional study that included all provinces of Iran for 2 time series (2011 and 2016). The study population was the total number of men and women who were living in the provinces.

Setting

Iran, as a Middle Eastern country, is located in the arid and semi-arid belt. In Iran, more than 50% of the land area includes mountains and about 30% of the total land area suffers from low annual precipitation (50-250 mm) (2). Thus, drought is experienced by approximately 97% of the country and Iran may face a difficult situation due to se-

vere rainfall fluctuations and scarcity of water resources (34). Iran has a population of about 80 million people, is divided into 31 provinces, and has a gender distribution that is almost equal (49.3% women and 50.7% men) (35).

Study Design

This cross-sectional study was conducted in 2 stages of database generation and mapping.

Database Generation

Drought data, based on the Drought Severity Index (DSI), were obtained from the Iranian Meteorological Organization as well as the National Research Center of Drought (36, 37). The DSI is defined as "a composite index that assimilates variables of vegetation and evapotranspiration" and is used for measuring meteorological and agriculture droughts (38).

Furthermore, sex-disaggregated data based on literacy and employment activities were collected from the Statistical Center of Iran as well as the Ministry of Cooperative Labor and Social Welfare. The literacy rate is defined as "the percentage of the population of a given age group that can read and write" (39). The percentage of people ages 6 and above who can both read and write was collected for the final analysis based on the Statistical Center of Iran literacy data (40, 41). Furthermore, the employment rate is defined as "a measure of the extent to which available labor resources (people available to work) are being used." (42). In the present study, the list of people aged 15 and above who were employed by labor sections was obtained from the Statistical Center of Iran and Ministry of Cooperative Labor and Social Welfare databases (40, 41).

Since the national census is carried out every 5 years in Iran, the 2011 and 2016 socioeconomic data were the most recent ones to be applied in the present research. Datasets were created in Excel sheets to be analyzed by ArcGIS at the next step. All droughts and gender-based data were entered and categorized based on provinces for both time series. The database was used for mapping the droughts and gender-based literacy and employment status in 2011 and 2016.

Data Analysis and Mapping

In this stage, data analysis, data zoning, and mapping were conducted by exploring the relationship between gender factors and the drought phenomenon. For this purpose, the map of Iran was coded separately for each time series, and 5 types of codes including very high (100-80), high (80-60), medium (60-40), low (40-20), and very low (20-0) were assigned for the drought data obtained from the databases of Iranian Meteorological organization (36, 37). Then, the numerical values of gender factors were entered into the information layer of the map for each province. The quantity symbology and drought code were used separately to zoning and preparing the drought map in each time series respectively with a separate color assigned to each type. Chart symbology was used for the gender data based on literacy and employment status. Furthermore, the assigned values were entered in each of the maps for both men and women. ArcGIS software Version 10.2 was applied for geographic data analysis.

In addition, descriptive statistical analysis was conducted using SPSS software Version 24. The frequency of the male and female populations affected by different levels of droughts (very severe, severe, moderate, low, and very low) was measured for the years 2011 and 2016. For example, the frequency of women affected by very severe droughts was calculated as follows:

$$N = \sum women\ in\ provinces\ with\ Very\ severe\ Drought$$

Furthermore, the following example can show measuring the percentage of the male and female population affected by droughts:

$$N(\%) = \frac{\sum women\ in\ provinces\ with\ Very\ severe\ Drought}{Total\ population} * 100$$

Results

A total of 19 provinces that suffered from severe droughts in 2011 were reduced to 13 provinces in 2016. The provinces with low or very low drought increased from 1 province in 2011 to 10 provinces in 2016. The total population affected by drought increased in 2016.

According to the data, 80.8% of all populations, including 80.73% of women and 80.89% of men, experienced severe and very severe droughts in 2011. In addition, 75% of people were affected by severe and very severe droughts in 2016, including 75.27% of women and 74.74% of men (Table 1). In total, 49.51% and 49.99% of the affected population were women and 50.49% and 50.1% were men in 2011 and 2016, respectively.

Literacy

Of the illiterate population, about 64.57% and 63.32% of women and 35.43% and 36.68% of men were illiterate in 2011 and 2016, respectively. Tehran province benefited from the lowest numbers of illiterate populations and Sistan va Baluchestan province had the highest number of

Table 1. Drought-affected people based on gender

Droughts	2011				2016			
	Female		Male		Female		Male	
	N	%	N	%	N	%	N	%
Very severe	24579361	65.99549	25082765	66.17154	23081701	57.01750	22637886	55.89816
Severe	5487907	14.73501	5580804	14.72287	7387648	18.24931	7629376	18.83869
Intermediate	5927791	15.91610	6010167	15.85559	1606900	03.96944	1658319	04.09477
low	1248941	03.35340	1231933	03.25000	5430483	13.41463	5516440	13.62136
Very low	0	0.0	0	0.0	2975054	07.34911	3056421	07.54701
Total	37244000	%100	37905669	%100	40481786	%100	40498442	%100
Total population (N)	75149669				80980228			

illiteracy in 2011 and 2016. These provinces suffered from severe droughts in the years 2011 and 2016 as well.

As it has been illustrated in Figures 1 and 2, the gender gap in literacy and access to education facilities was almost the same in 2011 and 2016. Comparing men's and women's literacy status showed the continuous gender inequality in the aspect of literacy in the drought-affected regions during the last 5 years (Figs. 1 and 2).

Employment

Of all economically active populations in Iran, 15.45% and 17.15% of women and 84.55% and 82.85% of men were employed in 2011 and 2016, respectively. Tehran province had the highest level of jobless population and Semnan province benefited from the lowest unemployed populations in 2011 and 2016. The average unemployment among women was much higher than among men in all drought-affected provinces in 2011 and 2016.

Based on Figures 3 and 4, gender inequality in employment rates of the economically active population is a considerable issue shown on the maps. The gender gap pattern based on employment and economic participation can be found in all provinces in 2011 and 2016. This employment inequality even exists in the Northern provinces
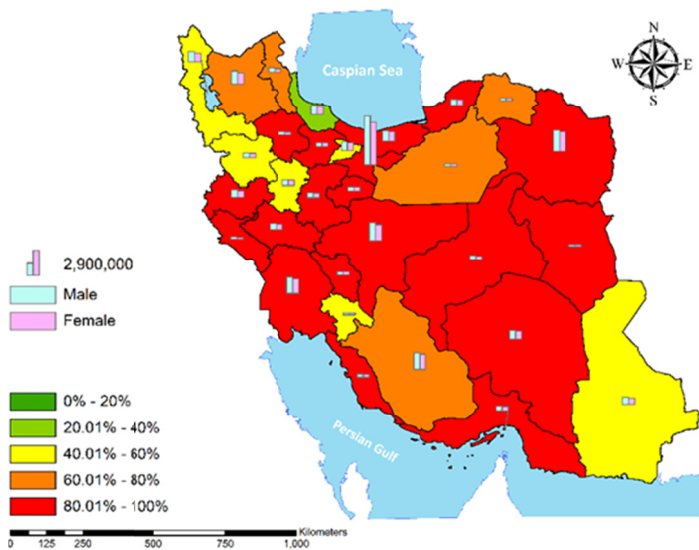

Fig. 1. Gender inequality in literacy level in drought-affected regions in 2011.
This figure illustrates the droughts-affected regions that have been shown in the red (very severe), orange (severe), yellow (moderate), and green (low and very low) colors as well as the sex-disaggregated literacy frequency in the blue (literate men) and pink (literate women) colors. Based on the figure, all provinces were affected by droughts in 2011.
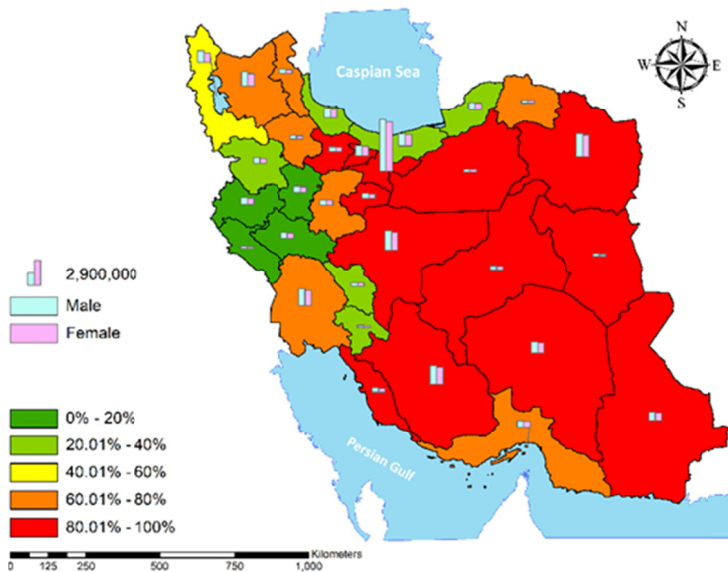

Fig. 2. Gender inequality in literacy level in drought-affected regions in 2016.
This figure shows the droughts-affected regions in the red (very severe), orange (severe), yellow (moderate), and green (low and very low) colors as well as the sex-disaggregated literacy frequency in the blue (literate men) and pink (literate women) colors in 2016. Based on the figure, the provinces with low and very low droughts increased in 2016, however, gender inequality in literacy level has not positively changed after 5 years.
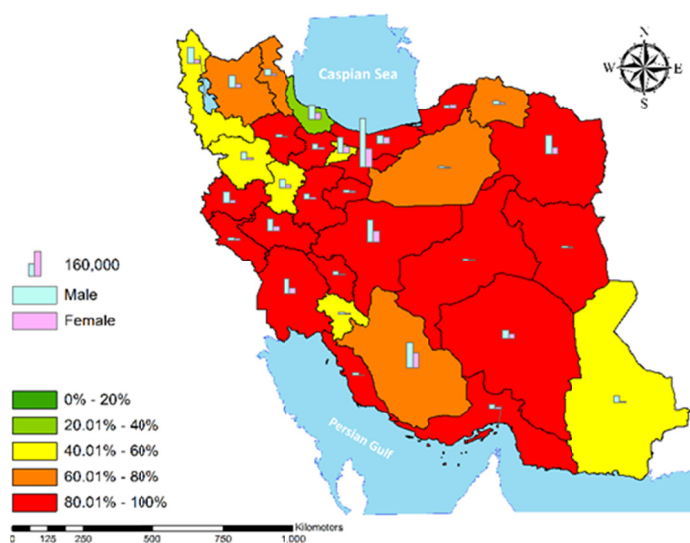
Fig. 3. Gender inequality based on employment rates in drought-affected regions in 2011.
This figure shows the droughts-affected regions in the red (very severe), orange (severe), yellow (moderate), and green (low and very low) colors as well as the sex-disaggregated employment frequency in the blue (employed men) and pink (employed women) colors in 2011. Based on the figure, a considerable gender gap exists in all provinces, especially ones affected by severe and very severe droughts.
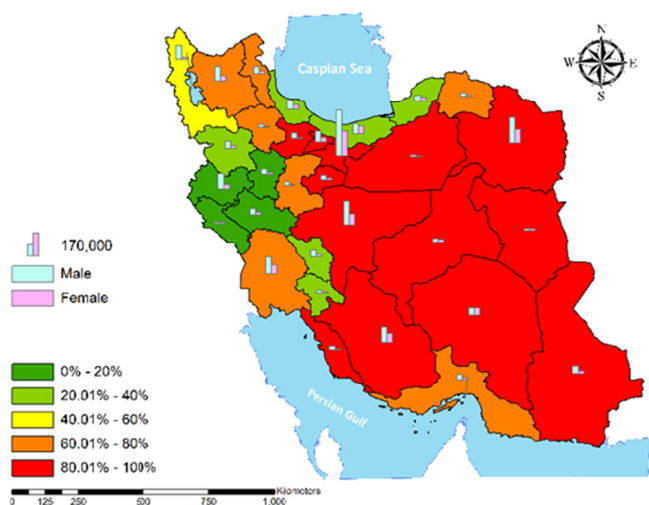

Fig. 4. Gender inequality based on employment rates in drought-affected regions in 2016.
This figure shows the droughts-affected regions in the red (very severe), orange (severe), yellow (moderate), and green (low and very low) colors as well as the sex-disaggregated employment frequency in the blue (employed men) and pink (employed women) colors in 2016. Based on the figure, although the provinces with severe and very severe drought decreased in 2016 and the opportunity for employment in the agriculture sector increased, the gender gap in employment level has not positively changed after 5 years.

where female farmers are substantially active in the agricultural sector due to the lack of drought incidence (Figs. 3 & 4).

Discussion

Our findings showed that major parts of the Iranian population were affected by severe and very severe droughts in 2011 and 2016. The effects of drought on populations can worsen by the gender gap in the aspects of education and employment, especially among female populations. Furthermore, a few variations were seen in the trend of the socioeconomic status of women and men during a 5-year time interval. Women suffered from gender inequality that made them more susceptible to the effects of long-term droughts in Iran.

Climate change, gender equality, women empowerment, education as well as decent work, and economic growth were determined as some important SDGs, which need to be achieved by all countries by 2030. By our findings, the report on gender equality across the SDGs (2019) indicat-

ed that women spend 3 times as many hours as men each day in unpaid care and domestic work. In addition, women comprised 39% of the workforce in 2018 but held only 27% of managerial positions. An estimated 15 million girls and 10 million boys of primary school age are out of school. Globally, 38.7% of employed women are working in agriculture, forestry, and fisheries, but only 13.8% of landholders are women (30). The lack of sex-disaggregated data in the climate change domain affects the development and implementation of effective policies and programs to address the gender-environment challenges. However, according to the Global Gender Gap report (2020), a considerable gender gap based on 4 aspects of economic participation and opportunity, educational attainment, health, and survival as well as political empowerment exists in Iran (33). This issue may postpone achieving some SDGs, including gender equality and women empowerment, education, economic development, and climate change management in Iran.

Vulnerability to droughts has an important relationship with the socioeconomic status of drought-affected regions (43). However, gender, as one of the main social factors, can cross-cut the socioeconomic and drought vulnerabilities (1). For example, Singh et al (2013) concluded that although climatic disasters such as droughts and floods affect both women and men in India, the female population is more vulnerable due to their different roles and responsibilities. The authors suggested empowering women with the required education and skills as well as providing sufficient resources to improve their capacities in drought-affected districts (1). In addition, the study of vulnerabilities and coping capacities of rural women in drought-affected regions of Zimbabwe revealed that the lack of land ownership and livelihood options along with low rainfall played important roles in the vulnerability of rural women to droughts. The inclusion of women in drought mitigation planning and implementation was suggested as an important strategy for reducing the drought impacts among droughts-affected populations (44). Similarly, gender inequality in Ethiopia resulted in the higher vulnerability of pastoral women to climate change consequences, such as food insecurity and poverty. Although women had more contributed to drought adaptations at the household level, men benefited from more given advantages, including decision power, wealth ownership, and inheritance as well as healthy life (45). However, a drought risk assessment study in Lisbon (1983-2016) reported that the male population was affected more than the female population by droughts (46).

The study of the social and agroecological impacts of droughts in Bangladesh indicated that literacy and social impacts of droughts had a significant correlation. That is, the literacy and awareness level of populations can reduce the social impacts of droughts (47). Furthermore, the study of social vulnerability assessments among Iranian farmers showed that farmers' vulnerability to droughts was reduced due to increasing their awareness through community-based education (20, 47). According to our findings, the literacy rate of women was lower than men in all drought-affected provinces in both 2011 and 2016.

This issue may not be considered a serious challenge on the maps, however, it can affect the vulnerability and coping capacity of women in regions with severe and very severe droughts in Iran. Similarly, some studies indicated gender gaps in literacy levels in drought-affected regions in the world. These studies showed that the lack of literacy can reduce the coping capacities of women for drought mitigation and adaptation (1, 48). For example, establishing a rural women's literacy campaign in the East Guji Zone Drought Vulnerable regions in Ethiopia provided the opportunity to participate in literacy classes for illiterate women who lived in this drought-affected area. Literate women were more independent and had a higher coping capacity to manage the socioeconomic impacts of droughts (49). Furthermore, rural women can mitigate the economic impacts of droughts through entrepreneurship operations such as networking, digital technologies, and family labor (50). Based on our findings, the gender gap was highly seen in the employment status of economically active populations of men and women in the affected provinces in 2011 and 2016. Employment inequality was reported in Northern provinces that have not suffered from widespread droughts in Iran between 2011 and 2016. Accordingly, some authors demonstrated that poor economic status can increase the population's vulnerability to climatic hazards such as droughts (51, 52). The case study of farmers in Nigeria implied that female farmers were more concerned with the food security of their households and suggested that female farmers should be involved in agricultural production (53). The study of social experiences of droughts in the rural regions of Iran reported that female farmers worked hard to do their duties. In addition, they were more concerned about the effects of the lack of income and supported their families (21). Recurrent drought conditions in Ethiopia changed gender roles so that women's workload and income-earning opportunities increased in farming. This study implied that the gender roles of farmers were changed to ensure livelihood and survival during droughts (32). It can be concluded that literacy and economic participation are identified as important factors for strengthening the adaptive capacities among drought-affected populations. Both men and women are significant partners in improving the adaptive capacities in regions affected by droughts. Participation of educated women in the livelihood and economic developments of drought-prone communities can positively affect their adaptive and coping capacities for upcoming climatic disasters. Droughts diminish the coping and adaptation skills of vulnerable individuals, such as poor and uneducated women, who are unable to successfully deal with droughts.

Limitations

The researchers faced several limitations during the research process. The data that were collected from the Statistical Center of Iran are updated every 5 years. Therefore, the 2016 and 2011 data were the most recent ones that we could collect and include in our analysis. Access to data was the other limitation of the study. The researchers were required to find valid secondary data that were

collected in the same time interval as the input of the mapping. Multiple databases were comprehensively searched to overcome this limitation.

Conclusion

Our findings showed a gender gap in the aspects of literacy and employment in the regions affected by droughts between 2011 and 2016. In comparison to men, women had significantly greater rates of unemployment and illiteracy. Accordingly, it is highly suggested to employ women's capability for coping with drought consequences rather than marginalize them as helpless victims. In drought-affected areas, policymakers and managers should give women the chance to pursue an education and participate in the economy to increase their ability to deal with the effects of the drought. Community-based planning and management in regions exposed to climate change are suggested for reducing the consequences of climatic disasters such as droughts. Women need to be empowered and trained for innovative livelihood activities in rural and urban areas in Iran and other developing countries affected by long-term droughts.

Further research is needed to estimate the effect of droughts on the socioeconomic conditions of exposed communities focusing on gender. Measuring the impacts of droughts needs developing a valid and reliable tool. Furthermore, several qualitative research is required to explore gender-based coping strategies that people apply for mitigating the negative consequences of recurrent droughts. Mainstreaming gender in the future socioeconomic studies of climatic hazards such as droughts can reduce the vulnerability of susceptible communities and save more lives and livelihoods.

Ethical Considerations

This study was approved by the ethics committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran (IR.SBMU.PHNS.REC.1397.003).

Authors' Contributions

S.S. designed the study, collected data, and drafted the manuscript. A.H.B. contributed to data collection and writing the paper. A.A.H.B. contributed to data analysis and writing the article. All authors read and approved the final manuscript.

Abbreviations

GIS: Geographic Information System
SDG: Sustainable Development Goals
DSI: Drought Severity Index

Conflict of Interests

The authors declare that they have no competing interests.

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