DESERT

Desert
Online at http://desert.ut.ac.ir

Desert 21-1 (2016) – 56-64

Identifying and explaining the effects of drought in rural areas in Iran from viewpoints of farmers (Case Study: Esfejin village, Zanjan county)

R. Rezaei[a*], E. Gholifar[b], L. Safa[a]

[a] *Faculty of Agriculture, University of Zanjan, Zanjan, Iran*
[b] *Department of Agricultural Extension and Education, Tarbiat Modares University, Tehran, Iran*

Received: 27 September 2015; Received in revised form: 15 March 2016; Accepted: 14 May 2016

Abstract

The main purpose of this study was to identify and explain the effects of drought in rural areas of Iran. The statistical population of this study consisted of all the heads of households of Esfejin village in Zanjan County (N = 2932). A sample of 340 persons was selected using a method of simple random sampling. Data were collected from face-to-face interviews with respondents based on a structured questionnaire. A pilot study was conducted to establish reliability of the questionnaire. Cronbach's alpha coefficient was used for the main scale of questionnaire, which scored more than 0.75, confirming its appropriate reliability. The results revealed that four factors can be considered as important for identifying and explaining the effects of drought in Esfejin village and these factors were economic, environmental, social and psychological. The findings of this study contribute to a better understanding of the effects of drought in rural areas and can be implemented in future planning of proper programs to overcome these effects.

Keywords: Drought; Effects; Zanjan County; Iran

1. Introduction

Any unexpected natural event that brings about the means of economical, social, and physical weakening, or destruction, of the capabilities and a decline in job opportunities in society, is considered as a natural disaster (Keshavarz and Karami, 2008). In recent decades, frequency and severity of drought have been predominated among the other natural disasters which influence the human societies (Wilhite, 1992). Droughts rank first among all natural hazards when measured in terms of the number of people affected (Obasi, 1994; Hewitt, 1997; Wilhite, 2000b). Although as a natural hazard, droughts differ from other natural hazards in several ways (Wilhite, 2000a; Ashok *et al*., 2010). First, the onset and the end of a drought are difficult to determine, the impacts of a drought increase slowly, often accumulate over a considerable period and may linger for years after termination. Therefore, a drought is often referred to as a creeping phenomenon. Second, it is difficult to define a drought which leads to confusion for not having a universal definition of drought. Third, drought impacts are nonstructural and spread over large geographical areas than damages that may result from other natural hazards. In contrast to floods, hurricanes, earthquakes, and tornadoes, a drought affects water bodies of water resources structures and it seldom results in structural damage. For this reason, the quantification of the impact and the provision for relief are far more difficult for droughts than for other natural hazards (Wilhite, 2000a; Ashok *et al.*, 2010).

* Corresponding author. Tel.: +98 24 33052340, Fax: +98 24 33052340.
E-mail address: rohollahrezaei@yahoo.com

Fourth, human activities can directly trigger a drought unlike other natural hazards, with exacerbating factors such as over-farming, excessive irrigation, deforestation, over-exploiting available water, and erosion, adversely impacting the ability of the land to capture and hold water (Ashok *et al.*, 2010). However, drought is a normal, recurrent feature of climate that occurs in virtually all climate zones, from very wet to very dry (IFAS, 2008). Drought is a temporary aberration from normal climatic conditions, thus it can vary greatly from one region to another. Drought is different than aridity, which is a permanent feature of climate in regions where low precipitation is the norm, as in a desert (Wilhite, 1992). As mentioned, drought is difficult to define precisely, but operational definitions often help define the onset, severity, and end of droughts (Ashok *et al.*, 2010). No single operational definition of drought works in all circumstances, and this is a big part of why policy makers, resource planners and others have more trouble recognizing and planning for drought than for other natural disasters. In fact, most drought planners now rely on mathematic indices to decide when to start implementing water conservation or measures in response to drought (IFAS, 1998). However, differences in hydro-meteorological variables and socioeconomic factors as well as the stochastic nature of water demands in different regions around the world have become an obstacle to having a precise definition of drought. Yevjevich (1967) stated that widely diverse views of drought definitions are those one of the principal obstacles to investigations of droughts. When defining a drought, it is important to distinguish between conceptual and operational definitions (Wilhite and Glantz, 1987). Conceptual definitions those stated in relative terms (e.g., a drought is a long, dry period), whereas operational definitions, on the other hand, attempt to identify the onset, severity, and termination of drought periods. Generally, operationally defined droughts can be used to analyze drought frequency, severity, and duration for a given return period (for example, Mishra *et al.*, 2009). Some of the commonly used definitions are: (1) The World Meteorological Organization (WMO, 1986) defines 'drought means a sustained, extended deficiency in precipitation.' (2) The UN Convention to Combat Drought and Desertification (UN Secretariat General, 1994) defines 'drought means the naturally occurring phenomenon that exists when precipitation has been considerably below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems.' (3) The Food and Agriculture Organization (FAO, 1983) of the United Nations defines a drought hazard as 'the percentage of years when crops fail from the lack of moisture.' (4) The encyclopedia of climate and weather (Schneider, 1996) defines a drought as 'an extended period- a season, a year, or several years- of deficient rainfall relative to the statistical multi- year mean for a region.' (5) Gumbel (1963) defined a 'drought as the smallest annual value of daily stream flow.' (6) Palmer (1965) described a 'drought as a significant deviation from the normal hydrologic conditions of an area.' (7) Linseley *et al.* (1959) defined 'drought as a sustained period of time without substantial rainfall.' However, drought definitions vary, depending on the variable used to describe the drought (Ashok *et al.*, 2010). Hence, drought definitions can be classified into different categories which are discussed below (Wilhite and Glantz, 1985; American Meteorological Society, 2004):

1- Meteorological drought is usually measured by how far from normal the precipitation has been over some period of time. These definitions are usually region-specific, and presumably based on a thorough understanding of regional climates. Under any circumstances, meteorological measurements are the first indicators of drought.

2- Hydrological drought refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow, and as lake, reservoir and ground water levels. There is a time lag between lack of rain and less water in streams, rivers, lakes and reservoirs, so hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period of time, this shortage will be reflected in declining surface and subsurface water levels.

3- Agricultural drought occurs when there isn't enough soil moisture to meet the needs of a particular crop at a particular time. Agriculture is usually the first economic sector to be affected by drought.

4- Socioeconomic drought is what happens when physical water shortage starts to affect people, individually and collectively. Or, in more abstract terms, most socioeconomic definitions of drought associate it with the supply and demand of economic goods.

On a global scale, the frequency, duration and severity of droughts have increased substantially in recent decades (Dai, 2011), especially in arid and semi-arid regions (Solomon, 2007). In fact, as earlier mentioned, drought is a global phenomenon that occurs virtually in all landscapes causing significant damage both in natural environment and in human lives (Lambers *et al.*, 2008, Mishra and Desai, 2009). Drought has major ecological effects on population and structure of both fauna and flora. Loss of habitat, poor water and land quality, weak biotic interactions, changes in nutrient cycling, and reduction of primary productivity have major effects on the ecosystem functionality and are associated with social and economic implications (Keshavarz and Karami, 2016). However, due to changing spatial and temporal characteristics of drought and complex ecosystem attributes, it is difficult to monitor and assess the potential effects of droughts (Wang *et al.*, 2014). Several drought indices, typically based on a combination of precipitation, temperature and soil moisture, have been derived in recent decades to assess the effects of droughts and define different drought parameters, which include intensity, duration, severity and spatial extent (Carrao *et al.*, 2016). In spite of this fact, as yet, there is no unified framework to assess drought effects compared to different assessment criteria. In this regard, Lei *et al.*, (2015) presented a new framework of a quantitative evaluation on the effects of drought on ecosystems and used it to evaluate the damage to ecosystem function and serve under different drought situations. Based on the framework, the assessment of the effects of droughts on ecosystems includes a series of important steps: 1) clearly defining drought scenarios, such as moderate, severe and extreme drought; 2) selecting an appropriate indicator of drought impact; 3) selecting an appropriate ecosystem model and verifying its capabilities, calibrating the bias and assessing the uncertainty; 4) assigning a level of unacceptable impact of drought on the indicator; 5) determining the response of the indicator to drought and normal weather state under global change; and 6) investigating the unacceptable impact of drought at different spatial scales. The framework is comprehensive and scientific, allows rapid assessment of the unacceptable effects of the single factor drought, and can find wide application in decision-making. Not only it can be used to assess the effects of drought on ecosystems such as forests, grasslands, wetlands, and croplands, but it also can be extended to estimate the influence of drought on economics and societal functions by using appropriate models (Lei *et al.*, 2015).

Iran is located in one of the driest parts of the world where a lack of water has always been an obstacle to agricultural development (Hasheminnia, 2004). Regarding the geographical position of Iran, and its location in a dry region with a lack of rainfall, it should be acknowledged that potential of crises from water deficiency and drought are important characteristics of Iran's climate. Studying this phenomenon in Iran suggests that although such crises do not take place nationwide, no area is secure from the phenomenon and that these crises can have a devastating effect (Ghayour, 1996). Meanwhile results reported in Golian *et al.* (2015) the most severe drought for 30 years recorded in 1998-2001. For example, in August 1999, approximately 90% of the country was affected by drought, with approximately 70% under exceptional drought conditions. During the same period, drought occurred across other parts of Asia, Europe, and the USA. In this period, records show that sea surface temperatures in the eastern Pacific were persistently cold while sea surface temperatures in the Indian and western Pacific were warm (Hoerling and Kumar 2003). Numerous studies have been done on the effect of sea surface temperature on drought in the USA and Europe (Barlow *et al.* 2002). However, there has been little research in this field relating to Iran. The 1998– 2001 drought in Iran may have resulted from anomalous sea surface temperature related to ENSO (El Nino Southern Oscillation). ENSO substantially alters precipitation patterns across the tropics and areas of mid-latitude. In 1999, 2000, and 2001, average precipitation in Iran was 72%, 62%, and 80% below the long-term climatology levels, respectively (Darvishi *et al.*, 2008). This highlights that the cold phase of ENSO (La Niña) has a significant effect on precipitation patterns across Iran (Nazemosadat and Ghasemi 2004). Analyses of drought duration and severity show that SPI recognized 23 drought events lasting 2 months or more. Consistent with previous studies, the most severe drought on record in Iran started in August 1998 and lasted 27 months until November 2000. The Standardized Soil Moisture Index (SSI) indicated 20 drought events, the most severe of which started in November 1998 and lasted for 25 months until

December 2000. The Multivariate Standardized Drought Index (MSDI) on the other hand, detected 19 drought events with the longest drought lasted for 28 months, from July 1998 to November 2000 (Golian *et al.*, 2015). According to the mentioned trends in meteorological and agricultural droughts in Iran, Zanjan County, located northwest of Iran, is among those areas that experienced exceptional drought. However, it should also be noted that due to climate variation in different areas of the county, drought and its effects were not the same; in some villages the effects were intense, and they were weaker in others areas. The effects of drought were so intense in some areas that many people lost their jobs and emmigrated to the cities leaving the villages uninhabited. There are many factors that influence the emergence of drought or stimulate a water crisis that are beyond the means for control and adaptation to the crisis of drought is problematic for human beings (Kardavani, 2001). Drought under no circumstances is entirely preventable, however some actions can be taken to abate its economic and social effects, but these are not easily determined (Walker and Thers, 1996). It seems that precise identification and understanding of the phenomenon and its effects, especially in rural areas that are more vulnerable to drought, serve as the first step and provide a base on which appropriate strategies and policies can be adopted to prevent drought and its adverse effects. Despite the importance of this issue, no comprehensive study has been done in rural areas of Zanjan County to examine the occurrence of drought and its effects, which makes the development of preventive programs ineffective and fraught with difficulty. Thus, the main questions for this research was to determine: what are the most important effects of drought in the rural areas of Zanjan County? And, which aspects of rural life are more affected by drought? According to these research questions, the main purpose of the study was to identify and explain the effects of drought in the rural areas of Zanjan County. With regards to this aim the major hypothesis of the study was that drought effects rural life including economic, environmental, social and psychological aspects in the rural areas of Zanjan County.

2. Materials and Methods

A descriptive research survey was conducted for the purpose of the study. The statistical population consisted of all the heads of households of Esfejin village in Zanjan County (N = 2932). Esfejin village is located west of Zanjan County and is 30 kilometers away from the center of the province, Zanjan city. Zanjan County has three districts; Markazi, Zanjanrod and Ghareh Pashtelo. The Markazi district has six rural agglomerations; Bonab, Boughdakandi, Taham, Zanjanrod-e-Baala, Mojezat and Ghaltough. Esfejin village is located in the Zanjanrod-e- Baala rural agglomeration. The village is in a mountainous area. Most of the rural people of this village simultaneously practice both agricultural (i.e. horticulture and agronomy) and livestock activities. Potato, onion, barley, wheat, grape and apricot are the main agricultural products of the village. The land surrounding Esfejin village is mainly rain- fed and its livelihood is therefore directly dependent on rainfall.

According to the Krejcie and Morgan (1970) table, a sample of 340 persons was selected using the simple random sampling method. In statistics, a simple random sample is a subset of individuals (a sample) chosen from a larger set (a population). Each individual is chosen randomly and entirely by chance, such that each individual has the same probability of being chosen at any stage during the sampling process, and each subset of k individuals has the same probability of being chosen for the sample as any other subset of k individuals. In this study, the population was all of the 2932 persons, and the sample was random because each person had an equal chance of being chosen. Data were collected from face-to-face interviews with respondents based on a structured questionnaire. The questionnaire was based on published literature on related topics in Iran and other countries; Huang and Chen (2000), Mansouri (2003), Shahnooshi (2004), Nicholas *et al.*, (2008), Boulton and Lake (2008), Bates *et al.*, (2009), Salami *et al.*, (2009) and Gray and Mueller (2011). In general, the questionnaire consisted of two parts including respondents' characteristics (5 variables) and respondents' viewpoints about the importance of each drought effect (32 variables). A five-point Likert scale (from 1= very low to 5= very high) was used to measure the second part. The validity of the instrument was established by a panel of experts in the field related to agricultural extension and education. A pilot instrument that included the study abstract, problem statement, and research objectives was subjected to review by the jury. In the cover letter they were asked to identify those

statements that are applicable for various parts of the questionnaire; to delete any which were not, and to add any items that they felt should be included in the final instrument and to make them understandable, comprehensive and appropriate. After securing experts' critiques of its make-up and content, all necessary revisions and modifications were made to the instrument to incorporate the suggestions and opinions of the jury. In order to test the reliability of the questionnaire, the validated version was sent to 25 farmers who had not been selected as samples for the study. Reliability refers to the extent to which a test consistently measures whatever it purports to measure. According to Gay (1981), reliability is expressed numerically as a coefficient, where a high coefficient equals high reliability. If a test were perfectly reliable, the coefficient would be 1.00. Cronbach's alpha coefficient for the main scale of the questionnaire, including the importance of each of the drought effects from farmers' viewpoints, was 0.88 indicating that the research questionnaire was reliable. The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS).

In this research, descriptive and inferential statistics were used to analyze the collected data. Descriptive statistics included frequency percentage and mean and inferential statistics employed the technique of exploratory factor analysis. The main objective of this technique was to classify a large number of variables into a smaller number of factors based on relationships among the variables. For this purpose, 32 variables were selected for the analysis. To determine the appropriateness of data and to measure the homogeneity of the variables on drought effects from the farmers' viewpoints, Kaiser- Meyer- Olkin (KMO) and Bartlett's test were applied. These statistics showed the extent to which the indicators of a construct belonged to each other. KMO and Bartlett's test results obtained for these variables showed that the data were appropriate for the factor analysis as indicated in Table (1). The Kaiser Criterion also was employed to arrive at a specific number of factors for extraction. Based on this criterion, only those factors with eigenvalues greater than one were retained.

Table 1. KMO measure and Bartlett's Test to assess appropriateness of the data for factor analysis

KMO	Bartlett's Test of Sphericity	
0.775	Approx. chi- square	Sig.
	1123.159	0.000

3. Results and discussion

According to the results, the majority of the respondents (94.5%) were marriage and only 5.5% were single. The average age of the respondents was about 51.2 years, ranging from 19 to 71 years. The results revealed that the majority of respondents (37%) were illiterate. The period of a farmer's work experience ranged from 1 to 34 years (21.28 years, in average). Furthermore, based on these findings, most of the respondents were active arable and livestock farmers (79.3), whereas about 17.4 percent were only arable farmers and 3.3 percent were only livestock farmers.

In the study, 32 variables were loaded into four factors. These factors represented 64.66 percent of the total variance in drought effects in Esfejin village in Zanjan County. According to the Kaiser criterion, four factors with eigenvalues over one were extracted. The eigenvalues and percentages of variance represented by each factor are shown in Table 2. Eigenvalues drive the variances represented by each factor. Sum of squares of factor loadings (eigenvalue) indicated the relative importance of each factor in accounting for the variance associated with the set of variables under analysis. According to Table (2), eigenvalues for factors 1 through 4 are 9.202, 6.852, 3.935 and 1.866 respectively. The percentage of trace (variance explained by each of the four factors) is also shown in Table 2.

Table 2. Number of extracted factors, eigenvalues, variance and Cronbach's alpha represented by each factor

Factors	Numbers of loaded variable	Eigenvalue	% of variance	Cumulative %	Cronbach's alpha coefficient
1	13	9.202	27.12	27.12	0.84
2	10	6.852	20.33	47.45	0.85
3	6	3.935	11.45	58.90	0.89
4	3	1.866	5.76	64.66	0.94

The Varimax rotated factor analysis is shown in Table 3. In determining factors, those factor loadings greater than 0.50 were considered as significant. As anticipated, the first factor accounts for 27.12 percent of variance and 13 variables were loaded significant. A relevant name for this loading pattern is "economic effects". The eigenvalue of this factor is 9.202, which is placed at the first priority among the drought effects in Esfejin village in Zanjan County. The second factor is associated mostly with the variables related to environmental aspects; thus this factor can be named as "environmental effects". The eigenvalue for this factor was 6.852, which represents 20.33 percent of the total variance. The name assigned to the third factor is "social effects". This factor, with an eigenvalue of 3.935, represents 11.45 percent of the total variance of drought effects in Esfejin village. Finally, the fourth factor contains 3 variables relating to "psychological effects". These variables represent 5.76 percent of the total variance (Table 3).

Table 3. Variables loaded in the four factors using Varimax rotated factor analysis

Name of factor	Variables loaded in the factor	Factor loading
Economic	Decrease in agricultural production revenue	0.842
	Increase in inputs prices	0.831
	Increase in production costs	0.812
	Decline in rural properties value (land, garden …)	0.789
	Changes in farming systems	0.765
	Decline in rural families' capital	0.712
	Decrease in agricultural inputs supplying	0.689
	Increase in debts to the state organizations	0.671
	Reduce in biomass and yield	0.651
	Decrease in peripheral incomes of farmers	0.637
	Fall in farmers salaries due to unemployment and lack of enough occupational opportunities	0.613
	Decline in investment motivations in village	0.581
	Increase in investment risk	0.538
Environmental	Reduce in surface and underground water resources	0.801
	Drying the wells and springs	0.784
	Deteriorate in water quality	0.751
	Reduce in stream flow	0.711
	Infestation of pests to farms	0.688
	Destruction in wildlife habits	0.672
	Low relative humidity and high temperature	0.642
	Soil erosion and desertification	0.608
	Increase in evaporation and transpiration	0.563
	Diminish in power generation	0.522
Social	Increase in immigration from rural areas	0.755
	Inequality in facilities and supportive loans distribution among the rural	0.731
	Increase in local conflicts and disputes over the villages	0.684
	Tendency of rural towards false jobs	0.632
	Weakening the authority of local institutions and organizations	0.601
	Hesitate in conventional opinions and beliefs in village	0.514
Psychological	Decrease in sympathetic spirit among the rural	0.695
	Fall in rural motivation to develop their economic activities	0.598
	Emergence of emotional and mental tensions	0.528

As the results show, the economic factor had the first priority and constituted a high portion of the variance. In this regard, one of the most important effects of drought was the decreased revenue from agricultural production, because most of the land in the region is rain- fed and agricultural activities are completely dependent on precipitation. Continuous drought has led to decreased production of the main agricultural products; grain, potato, grape and apricot. Furthermore, drought has affected the quality and quantity of pastures so that livestock farming has also decreased. In short, because the main activities of rural people in the region were connected to agriculture and livestock, they have faced serious financial difficulties. Likewise, drought conditions have led to decreasing supplies of inputs and increasing prices of these inputs. Another important consequence of drought is that it has led to unemployment in Esfejin village especially among the young people further decreasing income potential. Unemployment ratio amounted to 11.5 percent after drought occurrence, this constitutes a 5.2 percent increase.

Economic effects of drought were not limited to what has been already been mentioned, there was also a decline in property value (land and gardens), therefore rural families suffered loss of capital value, peripheral income of farmers, and motivation for investment in the village as well as increasing debt to the state organizations; all aspects of rural life affected by the impact of drought in the region. The economic effects of drought have finally led to changes in farming systems in the region toward less diversity in cultivation, decreasing cultivation of high-yielding crop varieties and even changes to rural land use. For example, many rural people were changing land use from agricultural to residential use in Esfejin village. These findings are consistent with similar findings from Huang and Chen (2000), Mansouri (2003), Shahnooshi (2004), Salami *et al.* (2009).

According to the results of factor analysis, environmental effects are another important factor that revealed the second priority and constituted a considerable amount of variance. In this dimension, some more important impacts are a reduction in surface and underground water resources, running dry of wells and springs, deterioration of water quality. However, considering the continuity of drought in the region for several years, it seems that gradually drought has turned from meteorological drought to hydrological drought the main characteristic of which is a reduction of stream flow and diminished underground water resources that has become obvious in the region. It is noteworthy that underground water level has gone down to about 1.5 meters. Furthermore, the illegal over-exploitation by beneficiaries has intensified low water levels in wells and springs. Additionally, drought exposes some plant species to danger and causes a reduction of plant diversity in the region; infestation of pests to farms, destruction of wildlife habitats, low relative humidity and high temperature are among the many environmental impacts of drought. Finally, continuity of drought and decreasing water resources have led to soil erosion especially in land around the village so that desertification is on the increase. These findings are supported by several quantitative studies (e.g. Huang and Chen (2000); Nicholas *et al.*, (2008); Boulton and Lake (2008) and Bates *et al.*, (2009).

Based on the results of the factor analysis, the third factor after economic and environmental factors was the social effect. In this regard, one of the most remarkable effects of drought in the region was the increase in migration from the village that was mostly as a result of reduced income from farming, a lack of local employment opportunities especially for young people as a result of drought. Hence most of the youth have emigrated to Zanjan (the center of the province) to find a job, which has the demographic effect of leaving behind older populations in rural areas. It is notable that village populations have decreased by 31 percent relative to the statistics from before the occurrence of drought. Furthermore, limitation of credit allocated for drought in the village and the priority of access to credit that is given to some specific groups like local elites and rich farmers has led to local conflicts due to an unequal distribution of credit and supportive loans and limited access of poor people to this financial aid. This problem also caused diminishing trust in rural people to each other and especially to governmental institutions and organizations such as banks and agricultural service centers. Regarding the social dimension, a critical point is that rural people tend to doubt conventional opinions and policies because of poverty and health issues. These findings are consistent with similar findings from Huang and Chen (2000), Kenny (2008) and Gray and Mueller (2011). According to the research results, some other negative effects of drought were categorized as the psychological factor, which had the least relative importance. In this context, one of the most negative effects of drought was that rural people became dispirited. In fact, the negative changes brought about by drought affected many economic and social aspects of rural life, and caused a decline in social trust among local people, reducing social capital so they became less inclined to be sympathetic and to support each other in handling their problems. Also, as most rural people are dependent on agriculture and livestock farming they are directly affected by climatic conditions, thus, drought caused an economic slump and people lost the motivation to develop economic activities because of lack of initial conditions. This was particularly apparent in relation to water shortages and as mentioned in the social factor, most villagers chose to immigrate to urban areas and to seek employment elsewhere. In addition, the continuation of drought caused emotional and mental tension among villagers, such as depression and feelings of isolation and they lost faith that conditions would improve for themselves and families in the future.

4. Conclusion

Planners' continuous monitoring, evaluations and awareness of drought and its effects is a key factor in effective management for preventing and reducing the negative effects of this phenomenon in rural areas. Undoubtedly, the existence of valid data and information on the effects of drought, which access to them is possible through formulating and implementing accurate and comprehensive indicators, can provide a strong basis for effective planning. Accordingly, the study aimed to investigate and identify indicators to measure the effects of drought that this issue has been overlooked in previous studies. The scale developed in this study can be applied to measure the effects of drought in rural areas. However, most studies in the field of drought in recent years have been based on analyses of meteorological data and viewpoints of villagers directly exposed to drought damage, have been largely overlooked. However, any action or program to deal with drought and its destructive effects will be effective, only if they are based on first-hand data taken from villagers. Finally, as the results of this study showed, drought is a complex phenomenon that affects economic, environmental, social and psychological dimensions. Therefore, any study will be incomplete without a holistic and systematic view and could not provide useful information for decision makers and policy makers to deal with the effects of drought. While, previous studies in the field of drought have a relatively one-dimensional approach and consider only the effects of meteorological and agricultural drought; they have paid little attention to other aspects of drought including social, economic and psychological dimensions. This issue is very important, taking into account the fact that these dimensions have an intangible nature and have a long term impact and can be significantly more destructive compared to other effects of drought.

Based on the main results of this survey, several mechanisms and suggestions are herewith presented in order to manage and reduce the negative effects of drought in the study area, they are as follows:

1- In the economic dimension: provision of grant loans or interest free grants based on household income and monitoring practices on the distribution of loans to ensure equitable distribution of facilities. There needs to be more attention from the government to insurance of funding for agricultural products as an effective strategy for crisis management through timely payment for damages and the complete support and funding of employment opportunities and the devoting sufficient funds for creating employment in the study area;

2- In the environmental dimension: identification and extension of appropriate varieties and species compatible with the regional climate as a substitute for crops with high water requirements and the development and extension of horticultural crops compatible with regional climate in drought conditions. The provision of a sustainable developmental infrastructure of water resources such as drainage, drip irrigation systems and the building of reservoir dams;

3- In the social/ psychological dimension: creating the appropriate judicial/ legal organizations and structures to resolve internal conflicts in the use of water and pasture; to develop advisory strategies and programs to reduce stress and anxiety in critical drought conditions and to develop effective protection laws and strategies to support families affected by drought.

References

American Meteorological Society, 2004. Statement on meteorological drought. Bull. Am. Meteorol. Soc., 85; 771-773.

Ashok, K., A. Mishra, P. Vijay, B. Singh, 2010. A review of drought concepts. Journal of Hydrology, 391; 202-216.

Barlow, M., H. Cullen, B. Lyon, 2002. Drought in central and Southwest Asia: LaNiña, the warm pool, and Indian ocean precipitation. Journal of Climate, 15; 697-700.

Bates, B.C., Z.W. Kundzewicz, S. Wu, J.P. Palutikof, 2008. Climate change and water. Technical Paper, International Panel on Climate Change (IPCC) Secretariat, Geneva.

Boulton, A.J., P.S. Lake, 2008. Effects of drought on stream insects and its ecological consequences. In Lancaster J., Briers R.A., editors. Aquatic insects: Challenges to populations. UK: CAB International Press; pp. 132-142.

Carrao, H., M. Russo, G. Sepulcre-Canto, P. Barbosa, 2016. An empirical standardized soil moisture index for agricultural drought assessment from remotely sensed data. International Journal of Applied Earth Observation and Geoformation, 48; 74-84.

Dai, A., 2011. Drought under global warming: A review. Wiley Interdiscip. Rev. Clim. Chang., 2; 45-65.

Darvishi A., S. Arkhi, A. Ebrahimi, 2008. Risk and disaster management to mitigate the effects of droughts in Iran. In Proceeding of the Conference on Drought in Charmahal-Bakhtiari, Shahrekord, The University of Shahrekord, 22-23 August, pp.1-10.

Food and Agriculture Organization, 1983. Guidelines: Land evaluation for rain-fed agriculture. FAO Press, Rome.

Gay, L.R., 1981. Educational research: Competencies for analysis and application. Merrill Publishing Co., USA.

Ghayor, H., 1996. Magnitude, scope and frequency of drought in Iran. Journal of Geographic Research, 26(45); 25-39.

Golian, S., O. Mazdiyasni, A. AghaKouchak, 2015. Trends in meteorological and agricultural droughts in Iran. Theoretical and Applied Climatology, 119(3); 679-688.

Gray, C., V. Mueller, 2011. Drought and population mobility in rural Ethiopia. Journal of World Development, 40(1); 134-145.

Gumbel, E.J., 1963. Statistical forecast of droughts. Bull. Int. Assoc. Sci. Hydrol., 8(1); 5-23.

Hasheminai, M., 2005. Water management in agriculture. University of Ferdowsi Press, Mashhad.

Hewitt, K., 1997. Regions at risk: A geographical introduction to disasters. Addison-Wesley Longman Press, UK.

Hoerling, M., A. Kumar, 2003. The perfect ocean for drought. Science, 299; 691-694.

Huang, C., Y. Chen, K. Li, 2000. The impacts of drought in China: Recent experiences. In: Wilhite, D.A., editors. Drought: A global assessment. London: Routledge Press; pp. 421-438.

IFAS, 2008. What is drought? The disaster handbook. University of Florida Press, USA.

Kenny, P., 2008. Assessment of the social impacts of drought and related government and non-government social support services. Issues Paper, Drought Policy Review Expert Social Panel, pp. 1-14.

Keshavarz, M., E. Karami, 2008. Effective components on farmers' drought management and its consequences: Use structural equation model. Journal of Agriculture and Natural Resources Science and Technology, 12(43); 267-283.

Keshavarz, M., E. Karami, 2016. Farmers' pro-environmental behavior under drought: Application of protection motivation theory. Journal of Arid Environments, 127; 128-136.

Kordavani, P. 2001. Drought and ways to cope with it in Iran. Tehran University Press, Tehran.

Krejcie, R.V., D.W. Morgan, 1970. Determining sample size for research activities. Educational and Psychological Measurement, 30(2); 607-10.

Lambers, H., F. Chapin, T. Pons, 2008. Plant water relations. Springer Press, USA.

Lei, T., J. Wu, X. Li, G. Geng, C. Shao, H. Zhou, Q. Wang, L. Liu, 2015. A new framework for evaluating the impacts of drought on net primary productivity of grassland. Science of the Total Environment, 536; 161-172.

Linsely Jr., R.K., Kohler, M.A., Paulhus, 1959. Applied hydrology. McGraw Hill Press, New York.

Mansouri, B., 2003. Impact of drought on main macroeconomic variables: An empirical examination of the Moroccan Case. In Proceeding of 5th International Conference on the Economics and Finance of the Middle East and North Africa, Lebanese American University, 11-12 March, pp. 1-12.

Meteorological Office, 2010. Meteorological reports in 2009. Meteorological Office of Zanjan Province. Report number: 2, 108 p.

Mishra, A., V. Desai, 2009. Drought forecasting using stochastic models. Stoch Environ Res Risk Assess, 19; 326-339.

Mishra, A.K., V.P. Singh, V.R. Desai, 2009. Drought characterization: A probabilistic approach. Stoch. Environmental Research Risk, 23(1); 41-55.

Nazemosadat, M., A. Ghasemi, 2004. Quantifying the ENSO-related shifts in the intensity and probability of drought and wet periods in Iran. J Clim., 17; 4005-4018.

Nicholas, R., P.S. Bond, Lake, H. Arthington, 2008. The impacts of drought on freshwater ecosystems: An Australian perspective. Journal of Hydrobiology, 600; 3-16

Obasi, G.O., 1994. WMO's role in the international decade for natural disaster reduction. Bull. Am. Meteorol. Soc., 75(9); 1655-1661.

Palmer, W.C., 1965. Meteorological drought. US Department of Commerce, Weather Bureau. Research: 45, 67 p.

Salami, H., N. Shahnooshi, K. Thomson 2009. The economic impacts of drought on the economy of Iran: An integration of linear programming and macro-econometric modeling approaches. Journal of Ecological Economics, 68; 1032-1039.

Schneider, S.H., 1996. Encyclopedia of climate and weather. Oxford University Press, UK.

Shahnooshi, N., 2004. Economic effects of drought on the agricultural sector and economy of Iran: A macro-econometric analysis. Ph.D. thesis, Agricultural Development and Economics Dep., University of Tehran, Tehran, Iran.

Solomon, S., 2007. Climate change 2007-The Physical science basis. Cambridge University. Report number: 4, 88 p.

UN Secretariat General, 1994. United Nations convention to combat drought and desertification in countries experiencing serious droughts and/or desertification, Particularly in Africa. UN Press, New York.

Walker, M., A. Thers, 1996. Drought as a natural hazard. Drought: A Global Assessment, 1(5); 3-18.

Wang, Y., Y. Hao, X, Cui, H. Zhao, C. Xu, X. Zhou, 2014. Responses of soil respiration and its components to drought stress. J. Soils Sediments, 14; 99-109.

Wilhite, D.A., 1992. Preparing for drought: A guidebook for developing countries. Climate Unit Press, United Nations Environment Program, Kenya.

Wilhite, D.A., 2000. Drought as a natural hazard: Concepts and definitions. Drought: A Global Assessment, 2(3); 58-71.

Wilhite, D.A., 2000. Drought. Drought: A Global Assessment, 1(2); 429-448.

Wilhite, D.A., M. Glantz, 1987. Understanding the drought phenomena: The role of definitions. Planning of Drought: Towards a Reduction of Societal Vulnerability, 12; 11-27.

World Meteorological Organization, 1975. Drought and agriculture. WMO, Geneva, Switzerland. Report number: 138, 114 p.

Yevjevich, V., 1967. An objective approach to definitions and investigations of continental hydrologic drought. Hydrology, 23; 1-18.