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Economic Impacts of Agricultural Drought in Tarom-e Olia County, Iran: Pathways for Management

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Abstract

Drought is associated with a host of complex and interwoven detrimental effects which not only affect socio-economic activities in one region but also exert influence on surrounding areas. Knowledge about the effects of this natural hazard helps reduce risks long before the phenomenon actually takes place particularly when making necessary decisions. This paper focuses on the economic consequences of drought for agriculture sector and relevant management strategies in Tarom-e Olia County, Zanjan Province, Iran. This survey takes a descriptive-correlational approach and its statistical population consists of all farmers residing in Tarom-e Olia County (N=۱۲۰۰۰). Using Cochran's formula and stratified sampling method ۳۷۵farmers were selected. The research instrument was a questionnaire. A panel of faculty members and experts confirmed the validity of the questionnaire. To test the reliability of scales, Alpha Cronbach's coefficient was used which proved to be acceptable (۰,۹۰۸).Descriptive statistics were used to determine frequencies. Also, factor analysis was applied to summarize mechanisms in smaller number of factors. Results of the ranking of the economic effects of drought revealed that "increase in demand for loan" and "lower purchasing power" and "scarcity of irrigation water" are at the top of the list. ۲۶ economic effects of drought were extracted in ٦ factors. Also, results of multiple regression analysis revealed that ٤٧٪ of the variance is explained by ٥ variables including "environmental vulnerability", "size of mechanized orchards", "use of under pressure irrigation system", "participation in agricultural training programs", and "agricultural insurance".

Keywords: Drought, Economic Effects, Farmers, Agricultural Drought, Drought Management, Tarom-e Olia County

Introduction

As a natural hazard, drought has globally affected people's livelihoods at different scales. Of all the ۲۰th century natural hazards, droughts have had the greatest devastating impact (Bruce, ۱۹۹٤).With regard to the number of people affected, as Obasi (۱۹۹٤) declares, drought stands first among other natural hazards. Nearly half of the earth's terrestrial surfaces are vulnerable to droughts. Remarkably, almost all of the major agricultural and arable lands are located there (USDA, ۱۹۹٤). Rather than being influenced by topographic and geological factors (Smith, ۲۰۰۱), drought is more related to climate change issues. However, unlike other meteorological and geological natural hazards such as floods, hurricanes, volcanic eruptions, and earthquakes, which occur over finite periods of time and result in visually recognizable damage, drought as a climatic phenomenon is more gradual and quiet and lacks highly visible impacts which in turn, make it difficult to quantify its overall socio-economic impacts. Yet, there is no consensus on the definition of drought around the world since various variables are applied to describe the phenomenon. Undoubtedly, however, the term "drought" for many is synonymous to dry lands and reminds the image of devastation of crop yield and struggle for survival. More scientifically, according to Mishra and Singh (۲۰۱۰), drought can be classified into four categories including meteorological drought, hydrological drought, agricultural drought, and socio-economic drought. Earlier studies (e.g. Shantz, ۱۹۲۷) indicate that drought does not necessarily occur when there is no rain. It takes place, he continues, when plant's root is not able to absorb water from soil. More generally, World Meteorological Organization (WMO, ۱۹۸٦) defines drought as a continuous extended deficiency in precipitation. From agricultural perspective, Food and Agriculture Organization (FAO, ۱۹۸۳) of the United Nations defines a drought hazards 'the percentage of years when crops fail from the lack of moisture.' Based on these definitions, drought can be described as a sustained period of time without considerable rainfall which leads to damage of agricultural crops and significant decrease in performance.

In agriculture sector, as Ding et al. (۲۰۱۰) maintain, drought impacts are most eye-catching. Since, agricultural sector is highly sensitive to deficiency of water, end results of drought usually first appear in this sector and then impacts food production, water resources and farmer's livelihood. In this regard, drought impacts both surface and groundwater resources and can lead to reduced water supply, worsened water quality, crop failure, reduced range productivity, and suspended recreation activities and can affect a host of economic and social activities (Riebsame et al., ۱۹۹۱). Ekpoh and Mortimore (۱۹۹۹) mention that repeated crop failures and declining yields leads to lower farm income and other problems such as food shortage, malnutrition and poverty. Economists maintain that drought can result in famine, starvation, malnutrition, migration, harmed welfare and poor hygiene conditions, increased social vulnerabilities, endangered habitats, deficiency of ground water resources, difficulties within power generation industries dependent on water supplies (Abunoori, ۱۹۸۸). According to Salem (۲۰۰۷), drought can slow down the pace of development. Accordingly, drought can contribute to the serious reduction of the number of heavy weight livestock, serious change in the ratio of light weight livestock, reduction in the average weight of livestock, reduction in the quantity of hand made products, and decreased farmer households' income. Adding to this list, several scholars have enumerated other effects of drought such as rise in prices of crops and livestock, increase in demand for low-interest loans, reduction in the number of people residing in the area, increase in water supply costs, decrease of food production, and increased tendency for import, to name only a few (Changnon and Easterling, ۱۹۸۹;Krattson et al., ۱۹۹۸; Combs, ۲۰۰۰; Gupta and Gupta, ۲۰۰۳).Given that rural economy is highly dependent on agricultural activities the impacts of drought on rural people are more severe than on their urban counterparts. For example, besides cash crops, rural people allocate part of their lands to crops that are used for self-consumption purposes (Saleh and Mokhtari, ۲۰۰۷). But, certainly, in drought years this strategy will not work properly.

Drought impacts are both direct and indirect. Accordingly, reduced crop product because of drought is a direct production effect. Drought directly affects farmers' lives and livelihood patterns. Therefore,

drought not only causes agricultural losses but also reduces income, job opportunity and inputs and investment in agricultural sector (Habiba et al., ۲۰۱۲). On the other hand, the fact that drought expands over a larger geographical area implies that it also has indirect effects. So, crop prices will increase and households become net buyers of crops. In contrast, livestock prices decline when the drought is severe as people are forced to sell animals to buy food. This leads to a livestock value loss (Holden and Shiferaw, ۲۰۰٤).

Generally speaking, dried crops, abandoned farmland, and withered pastureland are the typical signs of drought. Also, prolonged soil moisture deficits due to drought cause damage to crops and pastures. Drought-induced production losses cause negative supply shocks, but the amount of incurred economic impacts and distribution of losses depends on the market. Another important issue is that drought causes long-term lagged effects on perennial crops and livestock productions which probably remain for several years (Wilhite and Glantz, ۱۹۸٥).

From economic perspective, even environmental and social impacts can intensify economic consequences. In other words, any welfare changes experienced by human beings should be counted into the measures of drought economic impacts. For example, if drought causes damages to the habitat of endangered species, then the welfare of people who care about these species would be harmed and therefore should be counted as part of drought incurred losses. Similarly, if drought causes health problems, like stress and anxiety to people, their lost welfare should also be counted as part of drought incurred losses (Ding et al., ۲۰۱۰).

In recent years, many countries have experienced high socio-economic costs of drought. For examples, during۱۹۹۹–۲۰۰۰, up to ٦۰ million people in Central and Southwest Asia were affected by a large-scale persistent drought (IRI, ۲۰۰۱),with Iran, Afghanistan, Western Pakistan, Tajikistan, Uzbekistan and Turkmenistan experiencing the most severe impacts. Drought has been a frequent natural hazard in Iran and only in the last ٤۰ years,۲۷ drought events have occurred (Amirkhani and Chizari, ۲۰۱۰).Also worthy to note, climate change and global warming in the long run will negatively affect the frequency, severity, and territory of these droughts (Golestani and Mortazavizadeh, ۲۰۰۹). In Iran, the average annual rainfall is ۲۲٤-۲۷٥ mm per year (Annual Statistics, ۲۰۰٥). About ۱۰٪ of the arable lands receive more than rainfall of ٥۰۰mm per year and thereby are not dependent on irrigation water while ۹۰٪ of agricultural lands require irrigation (Mazaheri and Majnoon Hoseini, ۲۰۰۱). Certainly, this phenomenon in drought stricken areas including arid and semi-arid regions will expose risks and uncertainty to agriculture which in turn, impact the quality and quantity of agricultural and food production. This has attracted the attention of policy makers and thereby has necessitated the assessment of drought effects at different scales. Although difficult, understanding the economic impacts of drought is important for developing effective relief and mitigation strategies (Ding et al., ۲۰۱۰).

Therefore, in order to design beneficial programs, the economic impacts of drought need to be fully recognized. For this to be achieved, this study first attempted to identify these impacts through a broad literature review. Based on respondents' viewpoints, prioritization of the economic effects is carried out. Factor analysis helped reduce the number of these effects and regression analysis helped recognize influencing factors on farmers' economic vulnerability to drought.

Tarom-e Olia County is located in Zanjan Province, Iran. Most of the people here are engaged in agricultural activities. Active population in agriculture sector accounts for about ٦۹,٥٪ which is comparable to the active farming community of Zanjan province (۳۸٪) and active farming community of Iran (۲۳,٤٪). This implies that the economy of Tarom-e Olia County is highly reliant on agriculture. More to this, industrial activities are more focused on agricultural and food-processing industries (Tarom-e Olia Agricultural Development Outlook, ۲۰۰۷). Reports on rainfall in Tarom-e Olia County in twenty years reveal that this area is facing the threat of drought and is suffering from deficiency of water resources. This implies that, the agriculture sector is facing more risks than ever before due to interplay of limiting factors (Management and planning organization of Zanjan, ۲۰۰۲). The consequences of drought would be shocking in the area, for example, rise in price of crop and livestock and decrease in the number of local residents, decline in food production occurs, and increased demand for low-interest loans, can all lead to exacerbation of socio-economic conditions.

Materials and methods

The survey was carried out in Tarom-e Olia County, Zanjan Province, Iran. The statistical population consists of ۱۲۰۰۰ farmers and other individuals involved in agriculture sector. Using Cochran's formula and stratified sampling method a total number of ۳۷۵farmers were selected. Based on a broad literature review, a questionnaire was designed. A panel of faculty members and experts revised and confirmed the content validity and face validity of the questionnaire. To check the relevance of questions in the context of local conditions, the questionnaire was pre-tested on ۳۰ farmers. Also, the reliability test produced a Cronbach's alpha which was acceptable (۰,۹۰۸). Data were analyzed applying SPSS. Descriptive statistics were used to determine frequencies. Regression analysis helped identify factors explaining variance in farmers' economic vulnerability. Also, factor analysis was applied to summarize mechanisms in smaller number of factors.

Research results

-Socioeconomic characteristics

Most of the respondents were in the category of ۳۰-۶۰ years of age (with an average of ٤۲). Nearly all (۹۷,۹٪) of them were male. ۹٤,٥٪ of the respondents were married and the average household size was ٤. Also, ۷۱,۲٪ of the respondents have had secondary or lower level education. More than half of them (٥۱,۷٪) were simultaneously active in both farming and horticultural activities. The average land size was ۲,۰۲ ha, and the average size of garden was ۱,۹۷ ha. The average annual income was ۱۳۸,۸۸ million Rials.

-Prioritizing the economic effects of drought

The first step was to identify the economic impacts of drought. This was done by a broad literature review. To arrange the ۲٦ economic impacts in order of priority, respondents were asked to rank each item through a scale. On the basis of elicited opinions via questionnaires and the results of Friedman test, the impacts were prioritized. As shown in Table ۱, "increase in demand for loan", "lower purchasing power", and "scarcity of irrigation water" are at the top of the list. Also, "rise in water price" and "reduced water supplies in qanats and wells" remain high priority in the list of economic impacts of drought. Findings of a study carried out by Beare et al. (۱۹۹۸) support the latter findings as they confirm that in presence of uncertain supply, farmers' valuation of water is higher than would be calculated under certainty conditions.

The first five priorities indicate that respondents have fully recognized the immediate impacts of drought on their living conditions. Meanwhile, broader economic impacts of drought at larger scales remain lower priority implying that respondents are less sensitive to them since they can less be touched. Following this trend in prioritization reveals that impacts on other sectors such as industries, tourism and handicraft remain the lowest priority in the table. One possible explanation is that these effects may be assumed as secondary impacts of drought by respondents. In sum, results reveal that the highest priorities are focused on increases in costs and tangible impacts on living conditions, while the lagged impacts of drought on other sectors are less emphasized.

Table ۱. Prioritizing the economic effects of drought from farmers' viewpoint

Priority	Economic Effect of Drought	Mean Rank	Chi-square	Sig. level
۱	Increase in demand for loan	۱۷,۲۲	۸۲۲,٦٥۲	۰,۰۰۰
۲	Lower purchasing power	۱٦,۸		
۳	Scarcity of irrigation water	۱٦,٥۷		
٤	Rise in water price	۱٦,۱۸		
٥	Reduced water supplies in qanats and wells and scarcity of irrigation water in the region	۱٥,۹۸		
٦	Unwillingness of residents and non-native people to invest	۱٥,٥۳		
۷	Rise in unemployment rates	۱٥,۰٦		
۸	Increased farmer households' living costs	۱٤,۹٤		
۹	Decrease in the number of households' livestock	۱۳,۰٤		
۱۰	Worsened standards of living and harmed welfare	۱٤,۰٤		
۱۱	Higher price of agricultural and livestock products and food	۱٤,۰٤		
۱۲	Less investment in the region	۱۳,۸۷		
۱۳	Low level of food production	۱۳,٥٦		
۱٤	Less income and thereby increase in selling of households' properties	۱۳,٤۸		
۱٥	Legal problems due to delay in repayment of financial aids	۱۳,٤۳		
۱٦	Decrease in price of agricultural lands	۱۳,۱٤		
۱۷	Slow pace of development	۱۲,۸۷		
۱۸	More workload at farm level	۱۲,٦۹		
۱۹	Decreased demand for agricultural inputs (such as seed, fertilizer, poison) and other goods with consumption purposes	۱۲,۲۱		
۲۰	Water pollution due to slow water flow	۱۲,۱۹		
۲۱	Lower weight for livestock	۱۱,۹۳		
۲۲	Land-use change	۱۱,۷		
۲۳	Fade away of agricultural industries	۱۱,٤۹		
۲٤	Reduced handicraft products	۱۰,٤۱		
۲٥	Decline in industrial production due to water scarcity	۱۰,۲۷		
۲٦	Destruction of historical and cultural places and tourism industry	۹,۱٥		

-Relationship between farmers' economic vulnerability to drought and selected variables

Correlation analysis was conducted to determine the strengths and directions of relationships between variables. The relationship between farmers' economic vulnerability to drought and other studied variables are summarized in Table ۲. As results revealed there exist significant and positive correlations between vulnerability and selected variables such as knowledge about strategies to confront drought (r=۰,۳٦۳, p<۰,۰۱), application of practices to confront drought (r=۰,۳۷٤, p<۰,۰۱), and willingness to take part in drought management (r=۰,۱٥۱, p<۰,۰۱). Also, there exist positive and significant relationships between vulnerability and other variables such as taking part in workshops (r=۰,۱۲٦, p<۰,۰٥), and taking part in visits (r=۰,۱۰۹, p<۰,۰٥).

Table ۲. Correlation between farmers' economic vulnerability to drought and selected variables

Variable	Type of correlation coefficient	Correlation coefficient	Sig.
Taking part in workshops	Spearman	۰,۱۲٦*	۰,۰۱٤
Taking part in visits	Spearman	۰,۱۰۹*	۰,۰۳٦
Knowledge about strategies to confront drought	Pearson	۰,۳٦۳**	۰,۰۰۰
Application of practices to confront drought	Pearson	۰,۳۷٤**	۰,۰۰۰
Willingness to take part in drought management	Pearson	۰,۱٥۱**	۰,۰۰۳

*, ** Significance at ٥٪, and ۱٪, respectively

-Comparing different farmer groups regarding economic vulnerability to drought

To compare farmer groups, t-test was used. As shown in Table ۳, significant difference was recorded regarding all studied variables. Respondents differ in terms of tree planting pattern around farming plots implying that those who plant trees around their farms are less vulnerable to drought economic effects. This is not surprising, however, given that trees around plots serve as blocks (/windbreaker) hindering the evaporation of water due to wind and high temperature, thus mitigate the devastating effects of drought.There exists significant difference between compared groups regarding membership in cooperatives. Those who are only members of rural cooperatives are more vulnerable to drought in comparison with those who are members of both rural and olive farmers' production cooperatives. Possibly, members of olive farmers' production cooperatives are the owners of their orchards. Meanwhile, it is widely known that olive tree is resistant against high temperature and dryness. Hence, these farmers prove to be less fragile in drought years.

Table ۳ also demonstrates that those farmers who acknowledged a pumping station in their village are less vulnerable to drought in terms of economic consequences. This is because presence of a permanent water resource plays an important role particularly when facing drought.

Surprisingly, those farmers who do not take advantage of agricultural insurance are less vulnerable to drought. One potential explanation is that insurance does not cover drought losses and even when the imbursements are made in case of drought they are very low in amount compared to the costs. Consequently, farmers consider agricultural insurance only as an extra cost. Another possible reason is that farmers who receive imbursements are less motivated to confront it and thus their costs are more likely to increase.

Table ۳. Comparing economic vulnerability to drought among different farmer groups

Grouping variable	Categories	Freq.	Mean	Std. Dev.	t	Sig.
Tree planting pattern around farming plots	No	۳۳۱	۹۲,۱۳	۱۹,۵۵	۲,۲۳۷*	۰,۰۲۶
	Yes	۳٤	۸۵,۰۲	۲۱,۸		
Membership in cooperatives	Rural cooperative	۳۲۰	۹۲,۲۵	۱۹,۵۱	۲,۲٤۲*	۰,۰۲۵
	Rural cooperative and olive farmers' production cooperative	۵۵	۸۵,۷٦	۲۱.۵۹		
Pumping station in the village	No	۱۱۸	۸۷,٦۹	۲۰,۲۵	۲,۳۹*	۰,۰۱۷
	Yes	۲۵۷	۹۲,۹٦	۱۹,٦		
Agricultural insurance	No	۲۲۵	۸۹,٦۵	۲۰,۵	-۱,۹٦٦*	۰,۰۵
	Yes	۱۵۰	۹۳,۷۷	۱۸,۸۳		

*, ** Significance at ۵٪ and ۱٪, respectively

-Regression analysis

A multiple regression model was developed to examine the relationships between farmland attributes and vulnerability to drought. Findings indicate that these attributes influenced the vulnerability to drought and accounted for about ٤۷٪ of the variance in the dependent variable. The results are summarized in Table ٤ and Table ۵.Overall, interpretation of the regression analysis yields several insights into the variables that affect farmers' vulnerability to drought which are as follows:

"Farmers' vulnerability to environmental effects of drought" had a positive effect on economic vulnerability implying that farmers who are vulnerable to environmental effects of drought might be affected more severely in terms of economic costs. A highly significant relationship between size of mechanized orchards and vulnerability to economic impacts of drought was found implying that farmers who have orchards, particularly mechanized ones, are more fragile when drought occurs. A significant negative relationship between use of under pressure irrigation system and economic vulnerability was found. This finding indicates that farmers who apply this method of irrigation are less vulnerable to economic impacts of drought. Level of participation in agricultural training programs had a surprising positive effect on economic vulnerability which may be interpreted as evidence that more participation in such training programs weakens farmers' ability to handle economic challenges associated with drought. Although such training programs are pivotal to improve

farmers' knowledge about agricultural technical issues but, they do not necessarily empower farmers when drought occurs.

Table ٤.Major determinants of farmers' economic vulnerability to drought

Variable	R	R^2	Coefficient (Adjusted)	R^2 (Adjusted)
Farmers' vulnerability to environmental effects of drought	۰,٦٤٨	۰,٤۲۰	٤۲	۰,٤۱۸
Size of mechanized orchards	۰,٦٦۲	۰,٤۳۸	۱,۸	۰,٤۳٥
Use of under pressure irrigation system	۰,٦٦۸	۰,٤٤٦	۰,۸	۰,٤٤۲
Participation in agricultural training programs	۰,٦۷۷	۰,٤٥۸	۱.۲	۰,٤٥۲
Agricultural insurance	۰,٦۸۲	۰,٤٦٥	۰,۷	۰,٤٥۸

Table ٥. Results of regression analysis

Variable	β	Standardized β	t	Sig.
Constant	۲۸,٦۷۱	۳,٦۱٦	۷,۹۲۹	۰,۰۰۰
Farmers' vulnerability to environmental effects of drought	۰,٦۰۹	۰,۰٤۳	۱٤,۲٦٦	۰,۰۰۰
Size of mechanized orchards	۲,۱٦۱	۰,٦۳۳	۳,٤۱٥	۰,۰۰۱
Use of under pressure irrigation system	- ۲,۰۰۳	۰,٥٦۲	-۳,٥٦۳	۰,۰۰۰
Participation in agricultural training programs	۰,۳۱۳	۰,۱۲٥	۲,٥۰۲	۰,۰۱۳
Agricultural insurance	۱,۳۸۸	۰,٦٤۷	۲,۱٤٦	۰,۰۳۳

The following model is estimated for explaining farmers' economic vulnerability to drought:

$$Y= ۲۷,٦۷۱+ ۰,٦۰۹X_۱+ ۲,۱٦۱X_۲- ۲,۰۰۳X_۳+ ۰,۳۱۳X_٤+ ۱,۳۸۸X_٥ \quad (۱)$$

Where Y is farmers' economic vulnerability to drought, $X_۱$ is farmers' environmental vulnerability to drought, $X_۲$ is size of mechanized orchards, $X_۳$ is use of under pressure irrigation system, $X_٤$ is participation in agricultural training programs, and $X_٥$ is agricultural insurance.

-Factor Analysis

The data were also analyzed through SPPS using factor analysis. This analytic method helped reduce the number of variables and identify the underlying structures of patterns dominating farmers' responses. The program summarized ۲٦ economic impacts in six factors, all of which were significant (eigen value >=۱), and explained altogether ٦۱,۱۷٪ of the variation. They were rotated using VARIMAX rotation. Kaiser's overall measure of sampling adequacy (۰,۹۱٤) and Bartlett's (٤۲۱۷) measures revealed that the data were appropriate for factor analysis. The details of the extracted factors, their factor loading, eigen value, and percentage of variance explained are shown in Table ۳.

Six economic impacts concerning farmer households' livelihoods were loaded on factor ۱. This factor accounted for ۱۲,۸۱٪ of the total variance and was termed *impact on economic status of farmer household* because these variables involve costs and wellbeing.

The second factor is almost important as the first factor, explaining ۱۲,٤٤٪ of the variance. The six items included in this factor were all, in some way, related to the agricultural inputs and outputs. Thus, this factor is labeled as *impact on provision of inputs and outputs*. Factor ۳ accounted for about ۱۰,۱۳٪ of the variance. The four items included in this factor reflect major economic issues concerning *investment and employment*. Fourth factor explaining ۱۰,۱۱٪ of the variance is composed of ٦ items. Because these items focus on production conditions, factor ٤ was entitled *impact on production affairs*. Fifth factor explains ۸,۳٥٪ of the variance and consists of ۳ items and is entitled *impacts on industries and tourism* and finally, the sixth factor labeled as *impact on environmental pollution*, explained ۷,۳٪ of the variance.

Table ٦. Results of factor analysis

Economic Effect of Drought	Factor					
	١ *Impact on economic status of farmer household*	٢ *Impact on provision of inputs and outputs*	٣ *Impact on employment and investment*	٤ *Impact on production affairs*	٥ *Impact on industries and tourism*	٦ *Impact on environmental pollution*
Increase in demand for loan	٠,٦٥٨					
Legal problems due to delay in repayment of financial aids	٠,٦٠٥					
Worsened standards of living and harmed farmers' welfare	٠,٥١٤					
Increase in farmer households' living costs	٠,٤٤١					
Lower purchasing power	٠,٧٤٢					
Lower income and thereby increase in selling of households' properties	٠,٢٠٥					
Low level of water in qanats and agricultural wells and scarcity of irrigation water in the region		٠,٦٣٢				
Scarcity of irrigation water		٠,٦٨٨				
Higher price of agricultural and livestock products and food		٠,٥٣٥				
Low level of food production		٠,٣١٤				
Decrease in the number of households' livestock		٠,١٩٣				
Lower weight for livestock		٠,١٥٧				
Unwillingness of residents and non-native people to invest			٠,١٣٦			
Less investment in the region			٠,٣١٢			
Rise in unemployment rates			٠,٠٦٦			
Slow pace of development			٠,٤٩٥			
Decreased price of agricultural land				٠,٦٦٩		
Decreased demand for agricultural inputs (such as seed, fertilizer, etc.) and other goods for consumption purposes				٠,٦٩٤		
Land-use change				٠,٦٧٩		
Fade away of agricultural industries				٠,٥٧٤		
More workload at farm level				٠,١٢٤		
Rise in water price				٠,٠٧٨		
Destruction of historical and cultural places and tourism industry					٠,٧٧٢	
Decreased industrial production due to water scarcity					٠,٧٣٤	
Reduced handicraft products					٠,٦٢٨	
Water pollution due to slow water flow						٠,١٥٦
Eigenvalue	٣,٣٣١	٣,٢٣٦	٢,٦٣٥	٢,٦٣	٢,١٧٢	١,٩٠٢
Explained Variance	١٢,٨١	١٢,٤٤٥	١٠,١٣٥	١٠,١١٤	٨,٣٥٤	٧,٣١٧

Concluding Remarks

This paper was carried out to address two related objectives concerning (۱) recognition of economic effects of drought (۲) introduction of strategies for drought management. Findings indicate that level of education directly influences vulnerability to economic effects of drought. However, ۷۱٪ of farmers have had secondary or lower than secondary education. Besides low level of literacy, participation in agricultural training programs such as classes, workshops, courses, visits, on-farm demonstration, and sessions aimed at transfer of findings affected vulnerability negatively implying that these programs where not efficiently directed toward reduction of economic vulnerability among farmers. Accordingly, efforts should be made to design beneficial programs in form of exhibitions and demonstrations in order to provide training about principles and techniques of tackling drought.

On the basis of findings, an indirect relationship exists between agricultural insurance and vulnerability. In contrast, results of many studies such as Thomas (۲۰۰۸), Sharafi and Zarafshaini (۲۰۰۹) revealed that agricultural insurance can pay off fluctuations in income gains and thereby act as an advantageous tool to confront drought. Here, however, with regard to the results, agricultural insurance makes farmers more defenseless against drought. One possible reason is that compared to the imbursements, agricultural insurance is so costly for farmers. Additionally, delays in imbursements and in some cases no imbursements leads to farmers' unwillingness to take advantage of this tool as a guarantee in years of drought. More importantly, agricultural insurances offered in Tarom-e Olia County do not cover drought losses. Accordingly, raising awareness among farmers in terms of the benefits of insurance should become more frequent. Also, the amount of imbursements should be harmonious with farmers' losses.

Another identified factor which directly affects farmers' economic vulnerability is membership in cooperatives. Results of a study carried out by Keshavarz and Karami (۲۰۰۷) support this finding. Additionally, Iglesias et al. (۲۰۰۷) maintain that communities with high level of participation are less vulnerable to drought because, apart from gaining experience, they can cooperate through interactions. Membership in formal and informal institutions such as cooperatives and non-governmental organizations may help farmer to benefit from social supports. This participation, as Sengestam (۲۰۰۹) stated, is a subcategory of social capital which paves the way for taking advantage of dissemination of innovations and availability of information. It also helps farmers to build up relationships, reduce transfer/transaction costs, and thereby mitigate vulnerability. In sum, this finding has implications for mass media to raise awareness regarding the benefits of membership in social institutions such as cooperatives.

Type of water resource available in the village is another factor that contributes to farmers' vulnerability to drought. Shokri et al. (۲۰۰۷) agree with this finding as they maintain that type of water resource affects vulnerability. This is because permanent water resource with lower risk of being dried can ensure supply in drought years. Based on a report prepared by Tarom-e Olia office/bureau of water resources management, ۱۶۰۳ private shallow wells are arranged to be installed of which ۱۱۵۸ of them (۷۲,۲٤) are licensed and the rest are not. Bearing this in mind, endeavors should be made to restrict the installation of private wells and use of those without license. Additionally, establishment of pumping stations helps reduce losses imposed by drought.

Another issue which is worthy to note is that farmers mostly rely on on-farm channels to transfer water to their farms. Given that water loss during transfer through furrows in soil is high due to absorption and extended plants' roots, it is recommended that public agricultural organizations implement projects that support farmers to cover these furrows. Also, to increase water efficiency, modern technologies for water management should be promoted. These findings are in agreement with the results of a study conducted by Nabi Afjadi (۲۰۰۸).

Given that, from farmers' perspective, lower purchasing power and scarcity of irrigation water were ranked as the second and the third priorities regarding economic effects of droughts, these issues must be taken into account more seriously. Accordingly, planning should be directed towards watershed management to improve ground water supply. Furthermore, credits should be available to enable

farmers to develop modern irrigation systems. These findings are in line with the results of other studies, e.g. Heidari (۲۰۰٦) and Haghayeghi Moghadam (۲۰۰٥).

Tables and Figures

All of the Tables and Figures must be in the center of the page. Tables and figures should be cited consecutively in the text. Title of the Tables must be in the top left corner of the Table and the title of Figures must be in below of them at center. Before and after the Tables and Figures, an empty line must exist (Times New Roman, ۱۰pt, Normal).

Table ۱. Necessary information to write papers

Subject	Font	Size	Type
Paper Title	Times New Roman	۱٦	Bold
Name and Family of Authors	Times New Roman	۱۲	Bold
Affiliation and Email of Authors	Times New Roman	۱۱	Normal
Sections title	Times New Roman	۱۲	Bold
Sections subtitles	Times New Roman	۱۱	Bold
Abstract text	Times New Roman	۱۲	Normal
Keywords	Times New Roman	۱۲	Normal
Main text	Times New Roman	۱۱	Normal
Footnotes	Times New Roman	۹	Normal
Title of Tables and Figures	Times New Roman	۹	Bold
Text of Tables	Times New Roman	۹	Normal
References	Times New Roman	۱۰	Normal
Page number	Times New Roman	۱۰	Normal

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