

[Research]

## Environmental and socio-economic impacts of drought from the viewpoint of Guilan paddy farmers, north Iran

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### ABSTRACT

A comprehensive assessment of drought environmental and socio-economic impacts provides critical information to rational decisions supporting drought mitigation policies and programs. The objectives of this study were to survey environmental and socio-economic impacts of drought in Guilan Province, and prioritize them from the viewpoint of paddy farmers. This study was a descriptive-correlation study, and a questionnaire was the main tool used. The validity of the questionnaire was determined by a panel of experts. The reliability of the questionnaires using Cronbach's alpha coefficient was 85%. The statistical population was the farmers whose basic profession was production of rice and who faced drought according to the information of Agricultural Organization (Jihad-e-Keshavarzi) in 2009. By using the proportional stratified sample method, 270 of these individuals were chosen to complete the questionnaires. The results indicated that drought, in addition to reducing the white-rice production to 312 kg per hectare, also caused some environmental and socio-economic impacts from the viewpoint of paddy farmers. Prioritizing impacts of drought were economic, environmental and social respectively. Other findings indicated that there were no statistically significant relationships between age and environmental and social impacts and between land ownership type and economic and social impacts. But, there was a statistically significant relationship between age and literacy level and economic impacts, literacy level and social and environmental impacts and between land ownership types and environmental impacts of drought.

**Keywords:** Damage, Guilan, Impact, Rainfall, Rice, Water shortage.

### INTRODUCTION

Drought can occur in any climate of the world (Ding *et al.*, 2010) and can cause harmful impacts on human beings and natural ecosystems (Saadati *et al.*, 2009). Among weather stressors, drought is a slow-onset natural disaster in which climatic events interact with economic, environmental, political, and social factors (Zarafshani *et al.*, 2007). There is no agreed definition of drought. Various definitions point to meteorological (problematic weather patterns), hydrological (lack of rain), agricultural (low commodity production) and socio-economic (low incomes and social consequences) explanations; that it is drought's impact on people and their activities (Alston & Kent, 2004). Drought is one of the most important natural disasters which could be defined as: less than average annual rainfall and

discordant distribution of rainfall in the region. With lack of rainfall for a long period of time; farms, gardens, pastures, and forests whose required water resources are provided by rainfall, are damaged directly (Karbassi, 2001). Growing public awareness of global climate change has raised enormous concerns regarding its potential impacts and consequences. Although there are inconclusive findings on the specific impacts of climate change on regional water resources, many scientists have suggested that climate change is likely to increase the frequency and intensity of extreme climate events such as drought (Parry *et al.*, 2007). Drought is - based on frequency of occurrence, severity, affected area, economic damages, environmental and social affects and severe long term impacts- very important and dangerous that is always compared to other disasters

(Nosrati & Kazemi, 2011). Iran is among the dry regions in the world with an average rainfall of about 252 mm per year. Low rainfall, irregular distribution of rainfall, and climate warming are known to cause economic, environmental, political and social crisis in different areas (Alizade, 2001). In recent years, impact of drought was high on water sources, agriculture, livestock production, pastures, migration, rebellion of pests and disease. Drought can also reduce water quality, because lower water flows reduce dilution of pollutants and increase contamination of remaining water sources. Studies indicate that drought has priority to other natural disasters in the frequency of occurrence, duration and extent, loss of life, economic and social impacts and severe effects in the long run (Wilhite, 2000). Damages of drought will affect economic, environmental and social status of communities (Wilhite & Glantz, 1985). Drought includes a set of negative effects which not only affect economic and social activities of farmers and related industries, but also those who are not actually employed in agriculture but are living in agricultural regions (Edwards *et al.* 2008). Bimal (1998) in a study titled "coping mechanism practiced by drought victims (1994-95) in North Bengal, Bangladesh" surveyed the people who were affected by drought. The results indicated that drought is a reversible phenomenon in Bangladesh, affecting plant growth and leading to loss of crop production, food shortage, and, for many people, starvation. Peter (2008) has studied the impacts of drought on the social well-being of rural communities and farm families. The results of his studies indicated that drought has significant impacts on individuals in Victoria, particularly in rural and regional areas. The economic impact of drought includes reducing agricultural production and exports. In fact it decreases activities of each individual and provides basis for their migration. Horridge *et al.* (2005) in a research on the impacts of the 2002-2003 droughts in Australia concluded that the effect of drought on some statistical divisions is extreme, with 20% decrease in income. Despite the relatively small share of agriculture in Australian GDP, the drought has reduced GDP by 1.6%, and has contributed to a decline in unemployment and to a worsening of the balance of trade.

Britton and Ford (2001) studied the effects of drought and flood on water laws and concluded that drought has affected the legislative process and law makers' decisions. Shokri (2005) surveyed environmental, economic and social effects of drought and the effects of solutions applied in order to reduce its effects in Sistan Province (Iran) and concluded that between the effects of drought (environmental, economic and socio-psychology) the economic effects were more than the others, followed by environmental effects, and last of all the least effects were socio-psychological. Rezayi *et al.* (2011) surveyed economic, social, environmental, and ecological impacts of drought in Zanjan province and concluded that these impacts were economic, environmental, social, and ecological.. Nuri and Bazrafshan (1996-2004) investigated the direct and indirect impacts of drought on the rural economy of Sistan and stated that the direct impacts include damage to crops, horticulture, and animal husbandry; and indirect impacts include an increase in the population covered by the support relief organizations, an increase in migration from rural regions, reducing price of agricultural lands and orchards, and also changing rural economic structuring. In the northern provinces of Iran the time mismatch of rainfalls with the cultivation season has caused waste of river water and their flowing into the sea which results in a tremendous amount of problems that has overshadowed agricultural problems of these areas (Dargahi, 2007). Guilan is one of the northern provinces that in recent years has been faced with drought and water shortage. This problem has created many limitations and negative impacts for farmers. Considering that most of the land in the province is under rice cultivation which needs two to three times more amount of water, compared with other cereals, to produce 1 kilogram grains of rice, (Toung *et al.*, 2005), drought and water shortage have more effects on this region. Reliable statistics indicate that Guilan Province will face severe water shortage and drought in the future and these problems, more than anything, would affect rice production (Abrshahr, 2008). The main purpose of this study was to survey environmental and socio-economic impacts of drought from the viewpoint of paddy

farmers in Guilan; north of Iran which follows the specific objectives below:

- 1- Describing personal-agricultural characteristics of paddy farmers.
- 2- Studying environmental and socio-economic impacts of drought.
- 3- Prioritizing environmental, economic and social impacts of drought.
- 4- Studying relationship between paddy farmers characteristics and impacts of drought.

## MATERIALS AND METHODS

The present study was of the descriptive-correlation type in which its information gathered by using the survey method and designed questionnaire. The validity of questionnaires was determined a panel of experts including faculty members of Rural Development Department of Guilan University and researchers in the Rice Research Center. The reliability of questionnaires was 85% using of Cronbach's alpha coefficient. The statistical population of this research was the farmers whose basic career was production of rice and who faced drought and water shortages according to the information of Agricultural Organization (Jihad-e-Keshavarzi) in 2009, while in the previous year (2008) they had safe water for cultivation. This population consists of 100,000 paddy farmers' households. Sample size was 270 using Cochran formula and these individuals were selected by using the proportional

stratified sample method to complete the questionnaires.

$$n = \frac{\frac{t^2 pq}{d^2}}{1 + \frac{1}{N} \left( \frac{t^2 pq}{d^2} - 1 \right)} \quad (1)$$

Where  $n$  is the sample size,  $t$  is the significance level (1.96),  $p$  and  $q$  are the highest dispersion (0.5),  $d$  is the percentage of error (0.06), and  $N$  is the statistical population size (100,000). First, three cities of the province were selected (Talesh, Lahijan and Rudsar). Then from each city three villages and next, samples were randomly selected in proportion to population of each village (fig. 1). Data analysis fulfilled in two descriptive and inferential parts by using SPSS software version 16. Independent variables were age, literacy level and land ownership type and dependent variables were economic, social and environmental impacts. In order to prioritize the effects of drought, for each of the environmental, social, and economic impacts, were identified 10 variables and then these variables with using mean and standard deviation were prioritized from the viewpoint of paddy farmers. In descriptive analysis frequency, percentage, minimum, maximum, mean, and standard deviation were used as variables. In inferential statistics Spearman's, Pearson's and Eta's correlation coefficients were used to evaluate relationships between independent and dependent variables.

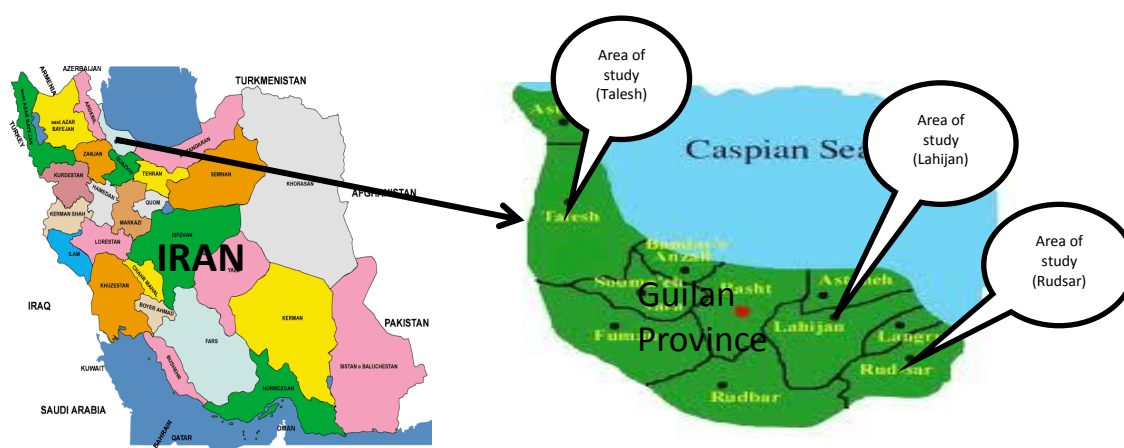


Figure 1: Site of study

## RESULTS

The results were analyzed in two parts, descriptive and inferential, using the SPSS software. The average agricultural experience of paddy farmers was 35.8 years and their average age was 52 years, showing that the community is going to get old. 61% of paddy farmers were illiterate or

have elementary educations, which indicate low levels of literacy among the paddy farmers. The land ownership type indicated that most frequency related to personal ownership. Table 1 shows more information about personal-agricultural characteristics of paddy farmers including: age, literacy level, and land ownership type.

**Table 1.** Personal characteristics of paddy farmers

		Frequency	Percent	
Age	< 40	53	19.6	
	41-50	76	28.1	Mean=52
	51-60	76	28.1	minimum=23
	>60	65	24.2	maximum=81
	Total	270	100	
Literacy level	illiterate	77	28.5	
	elementary	88	32.6	
	Pre-high school	55	20.4	-
	diploma and upper	50	18.5	
	Total	270	100	
Land ownership	Personal	234	86.6	
	Rental	24	8.9	-
	Partnership	12	4.5	
	Total	270	100	

In the year of study, in which paddy farmers were faced with a water shortage, their average area under cultivation reduced by 1% compared with that of the previous year (average area under cultivation was 1.5 ha in 2008, and 1.4 ha in 2009); In other words, due to drought and water shortage, a number of paddy farmers didn't cultivate part of their farms. Also, results indicated that the average yield reduced from 2623 kg/ha in 2008 to 2311 kg/ha in 2009. So yield reduced by

312kg/ha, which directly reduces the income of rice farmers.

In order to prioritize the impact of drought, mean and standard deviations were used. The results indicated that among the effects of drought (environmental, economic and social), economic effects were the most pronounced, followed by environmental impacts, while social impacts were the least. Table 2 prioritizes the economic, environmental, and social impacts of drought in Guilan province.

**Table 2.** Prioritizing impacts of drought

Priority	Impacts	Mean
1	Economic	3.16
2	Environmental	2.95
3	Social	2.79

For each of these effects (economic, environmental and social), 10 variables were identified and then investigated using the Likret scale from the view point of paddy farmers. Then these effects were prioritized by using their means and standard deviations. Table 3 prioritizes the

economic, environmental, and social impacts caused by drought and water shortage in Guilan province. So, drought in addition to decreasing the yield and profit of paddy farmers, resulted in some direct and indirect impacts in this province.

**Table 3.** Prioritizing the economic, environmental, and social impacts of drought

Impacts	Priorit y	Variables	Mean	SD
Economic	1	Increase in costs labor and eradicating weeds	4.60	0.65
	2	Increase in costs for water supply	4.21	0.87
	3	Decrease in purchasing power	4.04	0.84
	4	Decrease in savings	3.98	0.84
	5	Non-payment of bank loans and obligations	3.13	1.58
	6	Increase in the false financial relationship	2.99	1.46
	7	Decrease in Price of crops due to reduction of quality	2.94	1.02
	8	Decrease in income due to reduction of cultivation	2.13	1.65
	9	Decrease in land price	1.92	1.03
	10	Decrease in income from side jobs, sericulture, fishing etc	1.69	1.17
Environmental	1	Decrease in rivers flow, groundwater levels	4.50	0.60
	2	Decrease in surface water reservoirs and ponds	3.77	0.80
	3	Increase in weeds growing in fields	3.63	0.79
	4	Increase in mortality of fish and other aquatic in ponds	3.37	0.76
	5	Decrease in water quality	3.22	1.35
	6	Increase in pest attack	3.08	1.06
	7	Increase in plant diseases	2.95	1.50
	8	Increase in soil erosion	2.35	1.30
	9	Increase in amount and intensity of fires	1.40	0.95
	10	Decrease in diversity of plant species	1.25	0.89
Social	1	Increase in frustration, anxiety and emotional problems	4.23	0.85
	2	Feeling of poverty and decrease in life level	3.57	1.05
	3	Decrease in recreational activities	3.52	1.11
	4	Increase in local divisions to supply water	3.48	1.24
	5	Weakened position of institutions and cooperative unions	3.16	1.53
	6	Weakened traditions of cooperation	2.91	1.16
	7	Increase in tend to migrate	2.77	1.40
	8	Decrease in social ceremonies	1.77	1.30
	9	Decrease in the level of education in children and juveniles	1.29	0.84
	10	Disintegrate of consistency and continuity in family system	1.27	0.45

To study the relationship between the independent variables (age, literacy level and land ownership type) and the dependent variables (economic, social and environmental impacts) Spearman's, Pearson's, and Eta's correlation coefficients were used. The results of Pearson's correlation coefficient indicated that there was a positive and significant relationship between the age of paddy farmers and the economic impacts of drought ( $P=0.157$ ,  $r=0.001$ ) at 99% level of confidence. In other words, with an increase in the age of paddy farmers, the economic impacts of drought also increased. Also the results of this test indicated that there was no significant relationship between age and social impacts ( $P=0.104$ ,  $r=0.088$ ) and between age and environmental impacts of drought ( $P=0.115$ ,  $r=0.093$ ) and that these two variables have no effect on each other. The results of Spearman's correlation indicated a negative and significant relationship between the

literacy levels of paddy farmers and economic impacts ( $S=-0.147$ ,  $r=0.003$ ), literacy level and social impacts ( $S=-0.131$ ,  $r=0.003$ ), and between literacy level and the environmental impacts of drought ( $S=-.125$ ,  $r=0.004$ ) at 99% level of confidence. In other words, the increasing literacy level of paddy farmers reduced the economic, social, and economic impacts of drought. On the basis of Eta's correlation coefficient there was no significant relationship between land ownership status of paddy farmers and economic impacts (Eta= 0.132,  $r=0.035$ ) and between land ownership status and social impacts of drought (Eta=0.138,  $r=0.025$ ); however there was a statistically significant relationship between land ownership status and environmental impacts (Eta=0.102,  $r=0.003$ ) at 95% level of confidence. Comparison of means indicated that, paddy farmers who owned land reported higher environmental impacts of drought than paddy farmers who had partnership lands,

while paddy farmers who had rental lands reported the least environmental impacts of drought. Table 4 shows the results of

correlation coefficients between independent and dependent variables.

**Table 4.** Results of correlation coefficients between variables

Independent variable	Dependent variable	Type of test	Correlation coefficient	Significant level	Significant relationship
Age	Economic impacts	Pearson	0.157**	0.001	Yes
Literacy level	Economic impacts	Spearman	-0.147*	0.003	Yes
Land ownership	Economic impacts	Eta	0.132	0.035	No
Age	Social impacts	Pearson	0.104	0.088	No
Literacy level	Social impacts	Spearman	-0.131*	0.003	Yes
Land ownership	Social impacts	Eta	0.138	0.025	No
Age	Environmental impacts	Pearson	0.115	0.093	No
Literacy level	Environmental impacts	Spearman	-0.125*	0.004	Yes
Land ownership	Environmental impacts	Eta	0.102*	0.003	Yes

\* Correlation is significant at the 0.05 level (2-tailed).

\*\* Correlation is significant at the 0.01 level (2-tailed).

## DISCUSSION AND CONCLUSION

Drought is one of the most important natural disaster which affect economic, environmental, and social conditions of communities. Also it might occur even in all humid and semi-humid areas, although the details and rates can be different from one region to another. Guilan is one of the Northern Provinces of Iran with high rainfall that was faced to drought and water shortage in recent years. This problem, in addition to reducing yield of rice in this province, led to other direct and indirect environmental and socio-economic problems for paddy farmers. The results of this research indicated that the economic effects of drought were the greatest followed by environmental impacts, while its social impacts being the lowest. This result is consistent with the findings of Shokri (2005) and Rezayi *et al* (2011). From the viewpoint of paddy farmers, the economic impacts of drought led to increase in labor costs of eradicating weeds, increase in costs for water supply, decrease in purchasing power, decrease in savings, failing to pay bank loans and obligations, increase in false financial relationships, decrease in price of crops due to reduced quality, decrease in income due to reduced cultivation, decrease in land price, and also in income from side jobs. Environmental impacts of drought included decrease in river flow and groundwater levels, decrease

in surface water reservoirs and ponds, increase in weeds growing in fields, increase in mortality of fish and other aquatics in ponds, decrease in water quality, increase in pest attacks, increase in plant diseases, increase in soil erosion, increase in amount and intensity of fires, and decrease in diversity of plant species. The social impacts of drought brought about an increase in frustration, anxiety and emotional problems, feeling of poverty and decrease in life expectancy, decrease in recreational activities, increase in local divisions of supply water, weakened position of institutions and cooperative unions, weakened traditions of cooperation, increased tendency to migrate, decrease in social ceremonies, decrease in the level of education in children and juveniles, as well as disintegration of consistency and continuity in family systems. Survey of drought impacts indicated that drought had negative impacts on environmental, economic and social factors in Guilan province. These results are consistent with the findings of Wilhite & Glantz (1985), Bimal (1998), Horidg *et al* (2005), Shokri (2005), Peter (2008), and Rezayi *et al* (2011) who stated that drought has several environmental and socio-economic impacts. Noteworthy, these dimensions (environmental, economic and social impacts) cannot be considered separately from each other, but drought is a set of

complex dimensions intertwined together, leading to the synergistic impacts of drought in the area. Due to the nature of economic and environmental impacts, the farmers feel these impacts quickly, while the nature of social impacts is such that their risk is higher in long term. Other findings of this study indicated that, with an increase in the literacy level of paddy farmers, due to the high awareness and knowledge and because of the use of new methods to deal with natural disasters, the economic, environmental and social impacts of drought are reduced. Also with increase in the age of paddy farmers, due to reduced ability and low education level of paddy farmers, the economic impacts of drought increase. Regarding land ownership status, paddy farmers who had rental ownership, sustained the lowest level of environmental impacts due to indifferences to environmental factors of land. According to results of this study it is recommended to; first reduce the negative economic impacts of drought in the region, by adopting strategies such as providing low-interest loans, paying attention to crop insurance, supporting diversity and development of employment taking into priority programs and actions relevant to the organization, and creating new job positions based on capacities of each region. Second, to reduce the environmental impacts of drought, the identification and extension of resistant cultivars appropriate with the region's environmental conditions is necessary. Providing infrastructure of sustainable development of water resources, creation of reservoir dams, dredging of water channels and helping farmers to deal with special pests and diseases of drought period, should also be considered. Third, in order to prevent social impacts, judicial and legal organizations should resolve internal disputes and conflicts in the use of water and pasture, introduce counseling programs for reducing stress and concern, and provide sustainable solutions to support families from drought damages. Also training courses should be held in order to increase paddy farmers' knowledge and awareness to deal with drought.

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## تأثیرات محیطی و اجتماعی - اقتصادی خشکسالی از نقطه نظر شالیکاران گیلانی، شمال ایران

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### چکیده

یک ارزیابی جامع از اثرات زیست محیطی و اقتصادی-اجتماعی خشکسالی، اطلاعات شاخصی را برای برنامه ها و سیاست گذاری های منطقی در خصوص کاهش تأثیرات خشکسالی فراهم می آورد. هدف این مطالعه بررسی اثرات اجتماعی-اقتصادی و زیست محیطی خشکسالی در استان گیلان و اولویت بندی آنها با توجه به دیدگاه کشاورزان شالیکار است. این مطالعه از نوع همبستگی توصیفی است. پرسشنامه ابزار اصلی این مطالعه است. اعتبار این پرسشنامه بر اساس نظرات کارشناسان هیئت داوری تخمین زده می شود. قابلیت اعتبار پرسشنامه با استفاده از ضریب تاثیر Cronbach's alpha، ۰/۸۵ بود. جمعیت آماری کشاورزانی بودند که تخصص اصلی شان کشت برنج بود و مطابق با اطلاعات سازمان کشاورزی (جهاد کشاورزی) در سال ۲۰۰۹ با خشکسالی مواجه شده بودند. با استفاده از روش نمونه برداری طبقه طبقه مناسب، ۲۷۰ فرد انتخاب شدند و پرسشنامه ها را پر کردند. نتایج نشان می دهد که خشکسالی، علاوه بر کاهش تولید برنج سفید برای ۳۱۲ کیلوگرم در هر هکتار، سبب اثرات زیست محیطی و اجتماعی-اقتصادی بر اساس دیدگاه کشاورزان شالیکار شده بود. اولویت بندی اثرات ناشی از خشکسالی به ترتیب شامل اثرات اقتصادی، زیست محیطی و اجتماعی بود. دیگر یافته ها بیانگر این است که رابطه معنی دار آماری میان سن و اثرات زیست محیطی و اجتماعی و همچنین میان نوع مالکیت زمین و اثرات اقتصادی و اجتماعی وجود ندارد. ولی ارتباط معنی دار آماری میان سن و سطح سواد با اثرات اقتصادی، و میان سطح سواد با اثرات زیست محیطی و اجتماعی و میان نوع مالکیت زمین با اثرات زیست محیطی ناشی از خشکسالی وجود دارد.

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