



Nomadic Pastoralists and Drought in the Rangelands of Gonbad-e Kavous, Iran

ARTICLE INFO

Article Type

Original Research

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How to cite this article

Behmanesh B, Shahraki M.R, Sherafatmandrad M, Mahdavi S.Kh. Nomadic Pastoralists and Drought in the Rangelands of Gonbad-e Kavous, Iran. ECOPERSIA. 2021;9(3):207-214.

ABSTRACT

Aim Most parts of the pastoralist's livelihood depend on income from livestock in the rangelands, but drought in rangelands has negative impacts on the ecosystem, cycle of nomadic pastoralists, livestock production, and their family's living. Recognizing the signs of drought effects in the nomadic environment can play a significant role in rangeland management. The present study was conducted to identify and investigate drought signs in Gonbad-e Kavous County, Golestan Province, Iran.

Materials & Methods The study's statistical population consisted of 183 nomadic pastoralists in 10 customary systems, 100 of them were sampled and classified by random method. The data gathering tool was a researcher-made questionnaire. Drought signs were investigated in three dimensions: vegetation, soil, livestock, and herd. In order to ensure the validity of the questionnaire, the views of the experts of the Natural Resources Bureau and Cronbach's alpha method were used for more reliability with an average of 0.717.

Findings The results showed that nomadic pastoralists assessed three factors forage quality degradation, increasing bare land, and livestock production as the most important indicators of drought effects in pastureland. Findings indicate a positive and significant relationship between the pastoralist's viewpoints about the signs of drought effect in the pasture with the variable of the people who depend on them. The results showed a significant difference between respondents' views on gender and education level in the context of drought effects.

Conclusion According to the results of the research, it is suggested that future policies of rangelands can be used in plans for identifying drought signs.

Keywords Nomadic Pastoralist; Drought; Rangelands; Gonbad-e Kavous

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Article History

Received: April 23, 2020

Accepted: November 09, 2020

ePublished: May 25, 2021

CITATION LINKS

[1] Increasing flexibility in rangeland management ... [2] Drought monitoring based on the ... [3] Regional climate change in tropical and ... [4] Protecting livestock, protecting livelihoods: The ... [5] Drought, change and resilience in South ... [6] Rangelands, pastoralists and governments ... [7] Goals and values of ... [8] Cattle population dynamics in the Southern ... [9] Which household tolerates droughts ... [10] Contrasting income shocks with asset shocks ... [11] Uncertainty and sustainability in the ... [12] Investing in pastoralism: Sustainable natural ... [13] Adaptation strategies for reducing vulnerability ... [14] Impacts of global change on the hydrological ... [15] Livelihood security and mobility in the ... [16] Drought insurance for agricultural ... [17] Rangeland management and drought ... [18] Synecology of Semi-Steppe vegetation ... [19] Local perceptions of risk to livelihood ... [20] Farmers' perception of drought impacts ... [21] A conceptual model of arid rangeland ... [22] Rangelands at equilibrium and non ... [23] Alternative states and positive feedbacks ... [24] Effects of the 1990/91 drought on rangeland ... [25] A fence-line contrast reveals effects of heavy ... [26] Changes in population biology of two ... [27] Effect of stocking rate and rainfall on ... [28] Ranching and multiyear droughts in Utah ... [29] On non-equilibrium in arid and semi-arid grazing ... [30] The effects of drought on plant communities ... [31] Viewpoint: The role of drought in range ... [32] Participatory selection process for indicators ... [33] Environmental change and pastoral perceptions ... [34] Assessments of landscape level degradation ... [35] Drought and desertification management ...

Introduction

An arid and semi-arid pastoral ecosystem in the world, which includes a significant part of Iran, is fragile and susceptible to biological systems. It is at risk against various factors such as climatic changes, rainfall, and temperature. So that one of these results could be a drought that affects rangeland and can trigger undesirable ecological changes in rangelands, reduce livestock production and provision of ecosystem services, and threaten ranching livelihoods [1]. Drought is a natural and recurrent climatic phenomenon that has not been properly assessed due to the complexity of nature [2]. Paeth *et al.* [3] acknowledge that droughts are not only related to the shortage of rainfall periods but may be due to a shortage of water for successive farming, which results in a growing deficit of plants. Therefore, drought signs will appear when the demand for utilization of natural resources is higher than its supply due to lack of rainfall [4]. In natural resources, the effects of drought are mainly due to the sharp decrease in the amount of atmospheric precipitation and the increase in temperature relative to the annual average, and the effects of this phenomenon are intensified when, on the one hand, they continue for several years and on the other hand, coincide with the activity inappropriate and unprofessional use of these resources [1-5].

Considering that keeping livestock in the arid and semi-arid pasture is the most important source of income for pastoralists in environmental-social systems [6] so the living of nomadic pastoralists are largely dependent on livestock rearing income in pasture [7], and directly droughts can have very negative effects on pastoral product and livestock production [8]. For this reason [9], argue that repeating droughts are a serious threat to pastoralist's livelihood. Scholars (such as [10, 11] described the drought phenomenon as a major threat to the economy and security of pastoralist's livelihood. Pratt *et al.* [12] argue that pastoralists understand the consequences of the drought phenomenon and the extent of pasture degradation. Some pastoralists also believe that one of the effects of drought on pasture is forcing livestock for long-distance to graze [13, 14]; also, [15] reported lower income from livestock, and [16] described the use of supplemental forage to feed livestock from drought effects. McPeak [10] has also cited the decline in livestock milk as one of the signs of drought. In a research conducted in Zimbabwe,

[17] concluded that reduction in the herd size of livestock increases daily livestock grazing, the long movement for grazing, increased livestock supplementation, decreased vegetation, soil erosion, and reduction of water resources in rangelands are indicative of drought incidence. Analysis [18] suggests a relatively high correspondence between vegetation and environmental factors that explain 93% of the total variance in the data set. Quinn *et al.* [19], in a study in Tanzania, stated that drought affects environmental factors, also affects human and social capital. In their view, increase livestock diseases, increase livestock starvation, and problems related to water resources are another sign of drought in the pasture. Udmale *et al.* [20], in a study in India, declined some factors such as reduce the amount of forage production, reduction in pastoralist's incomes, and shortage of drinking water, and dwindling water quality. Milton *et al.* [21] and Vettr [22] stated in a study in South Africa that droughts could change the type of vegetation, reduces perennial vegetation, and cause a lack of proper distribution of livestock in pastureland. On the other hand, they believe that drought can cause the deaths of palatine plants, increase toxic and non-toxic plants, increase bare ground, soil erosion, increase dust in the pasture, and reduce the efficiency of rain use. In addition to the above [22], another study has reported reducing plant diversity and pastoral production from drought in the pasture.

Other studies in other parts of the world also included indicators as main signs of drought: prolonged regeneration time, reduction of plant deposition, reduction of plant leaf size, reduction of plant size, reduction of non-chewed plants, and decrease palatable plants and increase dried plants [23-27]. Coppock [28]; Sullivan and Rohde [29], also in their studies, mentioned some signs of drought: unwanted sale of livestock by pastoralists, increase livestock death in the herd, reduction of pastoral production, reduce water resources, as well as reduction of forage in pasturelands.

Gamoun and Zammouri [30], according to a study in Tunisia, have stated that one of the most important effects of drought signs on pasture is the change in plant diversity. Thurow and Taylor [31] also investigated drought signs: the reduction of vegetation cover, increase the potential for post-drought, soil erosion, reduction of soil depth and soil structure changes, decrease permeability, and soil water

storage capacity. Due to the pastoralist's high tension in some cases and unsatisfactory use of pasture, it is necessary to identify and analyze the signs of drought. Therefore, the present study was conducted to investigate and evaluate drought signs in rangelands among Gonbad-e Kavus County nomadic pastoralists, Golestan Province.

Materials and Methods

Study area

The present study is aimed at the rangelands of Gonbad-e Kavous County, Golestan Province. The area of the mentioned city is 5071/32 km² and is geographically located between 54° 31' 7" to 55° 39' 1" East and 37° 3' 6" to 37° 6' 3" North (Figure 1). In general, there are 68 pasturelands with an area of about 228682 ha, located in the geographical range of 37° 15' 34" to 38° 6' 18" in the northern latitude and at 55° 44' 11" to 55° 53' 37" eastward. The average study area is 300 meters above sea level. The average annual rainfall is 250mm; the climate is dry and semi-arid. This area is dominated and covered with perennial grasses, annual grasses, and Artemisia. Most parts of the pasture vegetation are medium to poor. Dominant plants of the area are Poa, Bulbosa, Halocnemum, Andropon, Artemisia and Medicago. Gonbad-e Kavus pasture has 68 ranches that Khorasan nomadic pastoralists (Kormanj) are settled. The total range of ranches is 19550 hectares, which holds 44985 livestock heads.



Figure 1) Geographical location of the study area in the Golestan Province in Iran

Sampling & Analysing method

The research was used the descriptive-survey method. Analysis unit In this study is the

nomadic pastoralists residing in 10 ranches (Koki Chopanjeq with 16 pastoralists, QachghSheikh with 14 pastoralists, Aghband Koor with 12 pastoralists, Samboli Goqche with 20 pastoralists, Hal Dordi with 21 pastoralists, Qoucheh with 20 pastoralists, Chelqorb Chatt with 4 pastoralists, Chopanjoq with 15 pastoralists, Ahmadcheh Parsiman with 19 pastoralists and Molamousa Akhundabad with 37 pastoralists). Morgan table was used to determine the sample size. From 183 pastoralists, 118 were selected as the sample size. Therefore 18 questionnaires were not used due to misidentification. After determining the number of samples needed in each region using a suitable allocation method, a simple random sampling method was used to select the users. The data collection was used a researcher-made questionnaire designed according to the review of the notes. Three major dimensions were used to study the effects of drought in the pastures of the study area [32]. These dimensions are vegetation (17 items), soil (3 items), and livestock and herd (16 items). The drought effect index with 36 items was studied. Each item was Measured basis on the five-item Likert method, including very high (numerical value 5), high (numerical value 4), average (numerical value 3), low (numerical value 2), and very low (numerical value 1). The validity of the questionnaire was confirmed through expert opinions of natural resources. The reliability of the questionnaire was also evaluated by calculating the Cronbach's alpha coefficient; the results are presented in Table 1. After completing the questionnaires with the samples, the data were analyzed by SPSS software.

Table 1) Cronbach's Alpha Coefficient with Different Dimensions of Drought Effects in rangelands

Dimension	The number of items	Cronbach's alpha coefficient
Vegetation cover	17	0.873
Soil	3	0.649
Livestock and cattle	16	0.687
Overall Index	36	0.717

Findings

The results presented in Table 2 show that 74% of the respondents were male, and 57% of the respondents were under the age of 45 years, while the average age was 46.68 years. 35% of the subjects were illiterate, and 28% had literacy at an elementary level. Findings indicate that 48% of the respondents had between 3 and 4 family members. On the other hand, 6% of the

respondents were single. As the results show, the average respondents had about 223 heads of cattle, while 39% (with the highest frequency) had fewer than 100 heads. The survey results on the importance and prioritization of drought signs in the pastures of nomadic pastoralists are presented in Table 3. The first to third places are allocated to the quality, production, and palatability of plants. The average vegetation, reducing forage quality, death, and loss of palatable plants in order 4.71, 4.56, 4.49 is located first to third. In other words, the pastoralists believe that the above variables are the first signs of drought on pasture vegetation. In this regard, the reduction of perennial vegetation with an average of 3.95 and increase wheat growth compared to the bushes was 2.62 in the last priority.

According to nomadic pastoralists, the results presented in Table 4 indicate that increasing bare lands and increasing dust in the pasture, respectively, with the average of 4.68 and 4.47, are the most important landmarks of drought. Table 5 also shows the effects of drought on livestock and herds of nomadic pastoralists. Nomad's people mentioned the rate of pastoral production, reducing the income from pastoral products and raising livestock costs, with an average of 4.88, 4.88, and 4.86, respectively, among the most important drought signs concerning livestock and herd. The next priorities are decreasing water resources in the pasture with an average of 2.97, and the livestock movement to very far distances in search of pasture with an average of 2.68.

Table 2) Individual characteristics of respondents

Type of Variable	Groups	Percent
Sex	Female	26
	Male	74
Age (years) Average = 46.68	Less than 35	29
	35-45	28
	46-55	16
	More than 55	27
Education	Illiterate	35
	Primary	28
	Elementary	22
	Secondary	15
Family members (N) Average = 3.28	Does not have	6
	1-2	26
	3-4	48
	More than 4	20
Number of livestock (head) Average = 222.99	Does not have	4
	Less than 100	39
	100-200	26
	201-300	11
	More than 300	20

Table 3) Pastoralist's comments on the effects of drought on vegetation

Signs	Mean	S.D.	Rank
Reduce forage quality	4.71	0.48	1
Reduced forage production	4.56	0.50	2
Destroying (reducing) palatable plants	4.49	0.67	3
Poor vegetation	4.47	0.50	4
Decrease plant size	4.45	0.54	5
Reduce leaves of plants	4.44	0.54	6
Increase dried plants	4.40	0.50	7
Plant density reduction	4.40	0.51	8
Decrease canopy cover of plants	4.31	0.53	9
Change vegetation type	4.24	0.62	10
Increase toxic and non-palatable plants	4.23	0.76	11
Change plant vegetation	4.21	0.52	12
Longer duration of plant renewal	4.08	0.63	13
Decrease seeding plants	4.07	0.62	14
Increase use of farm post-harvest	4.06	0.53	15
Decrease perennial vegetation	3.95	0.58	16
Increase wheat germ to bushes	2.62	0.92	17

Table 4) Pastoralist's Comments about the effect of drought on soil

Effect	Mean	S.D.	Rank
Increase bare (without any plant) land	4.68	0.47	1
Increase dust in pasture (soil particles on plants)	4.47	0.50	2
Increase soil erosion (soil cracks and crevices)	4.26	0.73	3

Table 5) Pastoralists Comments about effects of drought signs on livestock and herd

Signs	Mean	S.D.	Rank
Reduction of pastoral products	4.88	0.32	1
Increase costs for livestock	4.86	0.35	2
Increase the hunger among herds	4.66	0.48	3
Falling birth rate	4.53	0.50	4
The use of additional fodder to feed livestock	4.39	0.51	5
Forced sale of livestock	4.30	0.80	6
Reduction in the size of the herd in ranchers	4.29	0.54	7
Weight loss	4.28	0.60	8
Distribution of livestock	4.18	0.63	9
Low quality of drinking water for animals	3.77	1.02	10
Loss of cattle	3.72	0.78	11
Livestock movement to far distances	2.68	0.92	12
Increase animal diseases	3.62	0.91	13
Continuous grazing	3.01	3.18	14
Reduction of water supply in rangelands	2.97	0.86	15
Lower income of pastoral products	4.88	0.33	16

This study correlation test was used to investigate the relationship between individual characteristics of respondents and their viewpoints on the effects of drought on livestock and pasture. The results of this study are presented in Table 6. The findings indicate a positive and significant relationship between the family members and the viewpoints of the pastoralists about the signs of drought effects on vegetation and soil conditions at 99% level. Also, there was a positive and significant relationship between the number of pastoral producers and pastoralist's viewpoints on the effects of drought on vegetation; there is a negative and significant relationship between the effects of drought on soil in the pasture. In general, there is a positive and meaningful relationship between pastoralist's views on the effects of drought on rangelands with the variable number of dependents. This means that people with more family members are more likely to deal with

drought effects in rangelands. The Mann-Whitney test was used to compare the viewpoints of male and female pastoralists on the effects of drought on pastures. The results in Table 7 show that the views of men and women regarding the effects of drought on vegetation have a significant difference, and men evaluate drought effect on pasture vegetation to a higher degree. Kruskal-Wallis statistical test was used to compare the pastoralist's viewpoints with the signs of drought effects among different educational groups. The results obtained in Table 8 show the comparison between education level and the cited drought signs. The relation between education levels and livestock (cattle and sheep) sign was significant, and especially the pastoralists with secondary school level have evaluated the impact of drought on livestock and herds more than the others.

Table 6) Correlation between variables of characteristics of pastoralist and their perspectives on the signs of drought effects in the rangeland

Drought variables	Age	Education	Family members	Number of livestock
Vegetation	0.107*	0.851	0.000	0.003
	0.162**	-0.019	0.342	0.294
Soil	0.804	0.594	0.000	0.087
	-0.025	0.054	0.387	-0.172
Cattle and sheep	0.791	0.046	0.231	0.036
	0.027	0.455	0.121	-0.210
Total	0.326	0.991	0.000	0.636
	0.099	-0.001	0.343	-0.048

*Level of significance of variables; ** Correlation coefficient of variables

Table 7) Comparison of male and female pastoralist's perceptions of drought effects in rangeland

Indicator type	Average Gender Grouping		U value Man Whitney	Amount of Z	The significance level
	Female	Male			
Vegetation	35.33	55.83	567.500	-3.118	0.002
Soil	42.62	53.27	757.000	-1.660	0.097
Cattle and sheep	48.81	51.09	918.000	-0.347	0.729
Total	42.71	53.24	759.500	-1.594	0.111

Table 8) Comparison of pastoralist's viewpoints on the effects of drought on rangeland according to their educational level.

Type Indicator	Posts Category Education				Chi-Square	Level of Significance
	Illiterate	Elementary	Secondary school	High school		
Vegetation	51.41	48.50	54.30	46.53	0.834	0.841
Soil	50.19	47.73	50.48	54.43	0.941	0.816
Cattle and sheep	48.40	44.57	66.98	42.30	6.694	0.021
Total	51.71	43.71	63.20	41.70	7.219	0.065

Discussion

Drought is one of the major dangers and threats to the environment. This has led to the continued pastoralist's livelihood in a state of flexibility and change [9-11]. Because of the subsequent droughts, the destruction of vegetation and subsequently soil erosion have been reduced and, in some cases, destroyed. This will cause livestock weight loss and compulsory sale by the pastoralists and cause deaths from livestock and flocks. In other words, drought has a potential role in the sustainable management of pastures [33], and because of the dependence of nomadic pastoralists on rangelands, they play a significant role in their sustainable livelihoods. Oba and Kotile [34]; Msangi [35], in their research, believe that pastoralists, due to their high interaction with their surroundings, shepherds have a high ability to identify drought-related symptoms and rangeland degradation. This study was carried out to identify and analyze drought signs in rangelands from a nomadic pastoralist's perspective in Gonbad-e- Kavous County, Golestan province. According to the results, pastoralists classified drought signs in pastures in three groups: vegetation, soil, and livestock. In their research, Reed and Dougill [32] have described three vegetation, soil, and animal species as important indicators of rangeland degradation. The findings indicate that decreased forage quality decreased forage production, and decreased palatable plants are among the most important signs of vegetation about drought. This finding is consistent with the findings of [20] So that they confirm the decline in fodder production during drought. Suding *et al.* [23]; Riginos and Hoffman [26]; Fynn and O'Connor [27] have also expressed significant drought signs in their studies, increase unhealthy plants, reduction of palatable plants, and increase dried plants. Pastoralists have evaluated the decline of perennial vegetation cover and increasing the ratio of wheat compared to bushes in the last priorities.

In addition, the results of [21] have suggested the decline of perennial crops in South Africa, including the main drought signs in rangelands. Concerning the fact that the pastoralists put down the reduction of plant diversity in the last priority, but [22] in his research has described the reduction of plant diversity as one of the main drought signs in pastures. Gamoun and Zammouri [30] in Tunisia concluded that

changing plant diversity is one of the most important effects of drought signs on rangelands. As the results showed, nomadic pastoralists in the studied area indicate that increasing the bare land and increasing dust in the pasture are the most important landmarks during the drought. Milton *et al.* [21] also confirmed this finding in their research. Because pastoralists evaluated the soil variable erosion among the soil variables in the last priority, but [17] in research in Zimbabwe consist that soil erosion is one of the most important soil factors during the drought. Because nomadic pastoralists have reported increasing bare land, dust and soil erosion are including drought signs in the pasture.

In addition, [31] also investigated soil depth reduction and soil pattern changes, reduced permeability, water storage capacity in the soil, and drought signs. The findings indicate that reducing pastoral production, lowering the income from pastoral products, and raising pastoral costs among pastoral varieties are the priority. This finding has the same opinion as the research results by [15-17, 22]. On the other hand, nomadic pastoralists put the variables of reducing the sources of animal drinking in pastures and passing long distances for grazing at the lowest level. In addition, in their research results, [13, 14] indicate that passing long distances in pastures for finding food is drought sign. As the results show, the effects of drought on pasture with the variable have a positive and significant relationship. This means that people who have more members in the family are more likely to recognize the effects of drought in rangelands. This is due to the double tension of the drought in the livelihood of these pastoralists' households. Also, the findings indicated that there was a significant difference between the vegetation factor categories concerning the effects of drought on rangelands between male and female society. It seems that due to the high number of male pastoralists to women in pastures, men's groups have more knowledge about the effects of drought on rangelands. On the other hand, pastoralists who are educated are more likely to evaluate the drought signs among livestock and herds.

Conclusion

According to the research results, it is suggested that the effects of drought in these areas can be identified and analyzed to ensure sustainable

management and proper utilization of the pasture so that these indicators can be used in policy and planning in the future management of rangeland.

Acknowledgments: None Declared by Authors

Ethical Permissions: None Declared by Authors

Conflicts of Interests: None Declared by Authors

Authors' Contribution: Nehmanesh B. (First author), Methodologist/Main Researcher (40%); Shahraki M.R. (Second author), Statistical Analyst (40%); Sherafatmand M. (Third author), Discussion Writer (10%); Mahdavi S.Kh. (Fourth author), Introduction Writer (10%)

Funding/Sources: None Declared by Authors.

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