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Assessment of Rangeland Degradation Indicators using Exploiters' View between Authorized and Unauthorized Exploiters (Case Study: Saryqmish Winter Rangelands, Golestan Province, Iran)

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Abstract

In recent years, large rangeland areas have been destroyed for various reasons, so that its negative impacts on local people's income and sustainable livelihood are become significant. Due to the fact that signs of negative or downward trends in the rangelands condition are being revealed prior to the complete degradation, a study was done to identify these sings and evaluate their importance in Saryqmish rangelands, Marave Tape County, Golestan Province, Iran. Data were gathered using direct and participant observations. Based on rangeland degradation indicators extracted from literature and interviews, a questionnaire was drawn up under which the respondents were asked to rate the importance of rangeland degradation indicators in two different scales: 5-point Likert-type scale and a 20-point scale. The results showed that "vegetation" with 68.9% and 53.3%, and "climate" with 48.9% and 77.8% are known as the indicators with medium and high importance in rangeland degradation, respectively. In other words, exploiters known climate and vegetation more important than other indicators in rangeland degradation. The results indicated that exploiters consider "reducing production plants" and "reduce the number of annual plants and grass" as the first priorities for assessing rangeland degradation Statistical comparison of the rangeland degradation indicators between authorized and unauthorized users pointed out that there were no significant differences between these two groups in assessed rangelands degradation indicators.

Keywords: Rangelands; Degradation Indicators; Authorized Exploiters; Unauthorized Exploiters; Saryqmish

1. Introduction

In recent decades, increase in human population and its livestock, change in traditional management and rangelands conversion to croplands are contributed to the decline in rangelands areas (Desta and Coppock, 2002; Tefera *et al*., 2007). Iran rangelands with more than 84 million hectares (FRW, 2016) are the bed of sustainable development and life continuation but extension of productive activities including agriculture and other economical sections in one hand and clutter of traditional management systems and lack of their suitable alternative on the other hand, has generated unappropriated

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condition in the rangelands (Rahimi Sooreh and Sadeghi, 2005). Several factors can cause negative changes in the quality and quantity of natural resources that lead to the decline and retrogression of soil and vegetation and finally rangelands degradation. In this sense, rangelands degradation can be tracked in the vegetation changes induced by soil erosion, leaching and changes in the soil physical properties (Zake *et al*., 1997). Rangelands degradation indicators differ from region to region and are mostly in common in cases such as loss of preferred species, vegetation, biodiversity and forage production, and soil erosion and runoff increment (Ahmad et al., 2012). Destruction of natural resources caused by the unsustainable exploitation of villagers and local people in different ways, such as fuel wood, livestock overgrazing, and change in forest and rangeland land uses (Nasreen *et al*., 2006; Agudelo *et al*., 2003).

In contrast, increase in plants production and higher average dry weight of plants per area unit as well as increasing average regional rainfall are signs of rangelands condition improvement (Rahimi Sooreh and Sadeghi, 2005). Human-induced degradation can intensified by removing plants that control erosion (Sharifinia and Mahdavi, 2011). Consequently, many rare and palatable species will disappear in favor of unpalatable and invasive species (Rajabi *et al*., 2010). Actually, severe and unplanned grazing is the main reason of the disappearance of desired and palatable species and the dominance of unpleasant and noxious species (Hamadeh, 2002). When rangelands forage resources are utilized without appropriate plan, there will be a downward trend in vegetation and subsequently, reduction in litter amount, so that it leads raindrops to directly hit bare soil that will intensify erosion (Jafari *et al*., 2009). Severe utilization of forage and fuel of rangelands have a deteriorating impact on them (Sinha et al., 1997). One of the most serious threats to the rangeland condition is fire (Roques *et al*., 2001; Augustine and Naughton, 2004). Amount of soil erosion is one of the main factors in the rangeland condition (Ahmadi Iikhchi *et al*., 2003). In other word, rangeland degradation can speed up soil erosion not only through destruction of vegetation but also through decline of soil quality. Low vegetation cover, appearance of bare soil and low number of shrubs are the sings of rangeland degradation (Oba and Kotile, 2001; Angassa and Oba, 2008). Other factors such as high and low temperatures, variable rainfall regimes, low density vegetation, and soil fragility and dispersion have been known to be effective on downward trend of rangelands (Kisamba-Mugerwa, 2001). Rangeland degradation indicators such as reduction in vegetation, loss of plant litter, soil erosion, loss of seed banks, changes in species composition and reduction of forage production have reported in some researches (Ahmad *et al*., 2012). Decreasing forage plants primary production, reducing plant canopy cover, changes in the plant composition and increasing non-palatable and poisonous plants are the main signs of the early stages of degradation (Yan *et al*., 2005; Milton *et al*., 1994). Based on indigenous ecological knowledge of pastoralists, decreasing forage plants and plants primary production, and changing soil color are the main sings of the rangeland degradation (Zhou *et al*., 2005).

In many developing countries where rangelands are a dominant land type and critically important in livelihoods of a significant portion of the population, severe rangeland degradation can create significant social, economic, and environmental problems (Bedunah and Angerer, 2012). Part of the degradation can be related to unauthorized grazing. It is assumed that Pastoral communities' indigenous ecological knowledge and its outcomes can make an important contribution to the development of local policies (Oba, 2012). Therefore, identifying rangeland degradation indicators and the exploiters perception of them are among the parameters that could be important in the management of the country rangeland resources. Nevertheless, there is no information on the indigenous knowledge about rangeland degradation across pastoral communities in different regions of Iran. So current study was done to identify and prioritize rangeland degradation indicators based on the pastoral communities' indigenous ecological knowledge and to see how authorized and unauthorized exploiters differ in rangeland degradation indicators identification.

2. Materials and Methods

2.1. Study area

The field research is Saryqmish rangelands located in 15 km West of Marave Tape city and the southern edge of Atrek river in Golestan Province in north-east of Iran. The region area is

about 1950 hectares. According to modified De Martonne climatic classification (De Martonne, 1926), region climate is semi-arid. The study site receives about 353 mm of annual precipitation and dry season is about 6 months. The annual mean temperature is 18ºC. The soil texture is silt loam. The vegetation plants in the area belonged to Poaceae, Papilionaceae, Chenopodiaceae, Rutaceae and Lamiaceae families. There are 40 authorized exploiters in the area with 1890 animal units (mainly sheep) that use rangelands in common. All exploiters are Turkmen and settled in Saryqmish village. The region rangelands are winter rangelands and are used from December to March by 4 months.

Table 1. Indices of rangeland degradation used in different literature.

Indicator	Source
Loss of palatable plant frequency	Ahmad *et al.*, 2012; Rajabi *et al*., 2010; Hamadeh, 2006; Zhou *et al*., 2005; Roba and Oba, 2009; Saad *et al*., 2011
Appearance of unpalatable and poisonous plants	Rajabi *et al*., 2010; Hamadeh, 2006; Yan *et al*., 2005; Milton *et al*., 1994
Loss of vegetation	Ahmadi Iikhchi *et al*., 2003; Oba and Kotile, 2001; Angassa and Oba, 2008; Kisamba-Mugerwa, 2001; Ahmad *et al*., 2012; Yan *et al*., 2005; Milton *et al*., 1994;
Loss of biodiversity	Ahmad *et al*., 2012; Flather and Sieg, 2000;
The decline in forage production	Ahmad *et al*., 2012; Rahimi Sooreh and Sadeghi, 2005; Yan *et al*., 2005; Milton *et al*., 1994; Zhou *et al*., 2005
Increasing soil erosion and runoff	Ahmad *et al*., 2012; Ahmadi Iikhchi *et al*., 2003; Jafari *et al*., 2009; Moges and Holden, 2007; Okoba and Sterk, 2006
Increasing dry matter	Rahimi Sooreh and Sadeghi, 2005
Changes in average rainfall	Rahimi Sooreh and Sadeghi, 2005; Kisamba-Mugerwa, 2001
Loss of litter	Ahmad *et al*., 2012; Jafari *et al*., 2009
The ground without coverage (bare soil)	Oba and Kotile, 2001; Angassa and Oba, 2008; Darwish and Faour, 2008
The decline in plants density	Oba and Kotile, 2001; Angassa and Oba, 2008; Macharia, 2004
Reduction in soil depth	Darwish and Faour, 2008
High and low temperatures	Kisamba-Mugerwa, 2001
Soil fragility and depression	Kisamba-Mugerwa, 2001
Loss of seed bank	Ahmad *et al*., 2012
Change in vegetation composition	Ahmad *et al*., 2012; Yan *et al*., 2005; Milton *et al*., 1994;
Soil salination	Hubert, 2003
Soil infiltration rate reduction	Reed, 2005
Change in soil color	Zhou *et al*., 2005

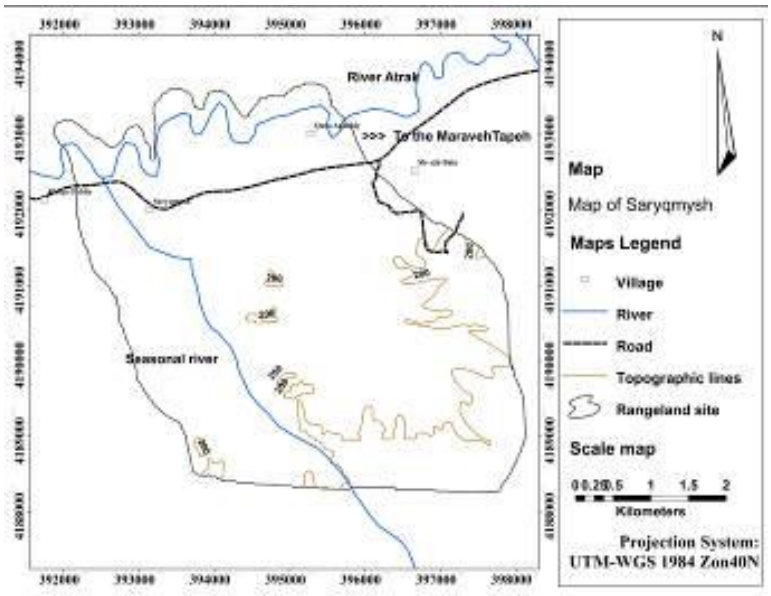

Fig. 1. The study area in North of Iran

2.2. Data collection

A descriptive research method was used to assess rangeland degradation indicators from exploiters view. Data were gathered using direct and participant observations and three 1-hour non-structured interviews with five experienced authorized (with grazing license) and unauthorized (without grazing license) exploiters. Therefore, 15 interviews were conducted. Using the initial results of interviews as well as literature review in the field of rangeland degradation indicators (Table 1), a questionnaire was drawn up under which the respondents were asked to rate the importance of rangeland degradation indicators in two different scales: 5-point Likert-type scale (Unimportant =1, Of Little Importance =2, Moderately Important =3, Important =4, Very Important = 5) and a 20-point scale (1 to least important and 20 to most important). Two scales were used to compare them and determine the best scale. Our statistical population were fifty pastoralists (35 authorized and 15 unauthorized) of Saryqmish rangelands. Using the Krejsi-Morgan table, 30 (authorized) and 15 (unauthorized) pastoralists were randomly selected for sampling and filling questionnaires.

2.3. Data analyses

To assess the importance of each indicator in the rangelands degradation, total score of the respondents were summed for each indicator in each category. The obtained scores were divided into five and classes interval was calculated as fallow:

$$i = \frac{\mathrm{R}}{n} \quad (1)$$

where, *i* is classes interval, *R* is range (the difference between maximum and minimum of the variable that is going to be classified) and *n* is the number of classes of interest.

Mann-Whitney test was used to compare rangeland degradation indicators between the two authorized and unauthorized exploiters communities based on Likert and 20-point scales. The statistical software package, SPSS V. 21 was used for data statistical analysis (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.).

3. Results

3.1. General characteristics of the respondents

The results show that about 85% of the respondents are illiterate or with primary level education. More than half of them, i.e. 64 percent, were between 50 and 60 years old and the average age was 48.5 years. Beside animal husbandry, most respondents in this area were engaged in agricultural works, so that their income comes from agriculture and animal husbandry jointly. The results also showed that studding population has averagely around 35 years of experience in animal husbandry and 215 animal units, including sheep, goats, cows and camels.

3.2. Rangeland degradation Indicators from the authorized exploiters view

The results of assessing authorized exploiters viewpoints are shown in Table 2. As shown, indicators "reduction of plants production" and "reduction of annual plants and forbs" are rated as the first priorities in both 5-point Likert scale and the 20-point scale. Therefore, 50 percent of respondents ranked these indicators more than 4 in 5-point Likert scale and more than 5 in 20-point scale. This show the importance of "reduction of plants production" and "reduction of annual plants and forbs" between indicators of vegetation category. In contrast, indicators "loss of litter", "reduction of shrubs" and "increase the number of non-palatable and poisonous plants" are rated as the last priorities indicating their less importance than other indicators in assessing rangeland degradation. The results of soil indicators suggest that their priorities on both scales are almost identical, so that the indicators "clayey soil" and "soil salination were the first priorities. "Reduction of rainfall" and "increased risk of pest damage (such as rats and grasshoppers)" had the first priorities in climatic and other indicators respectively. The results of comparison of two scales in used indicators are shown in Table 3. "Climate", "vegetation" and "soil" criteria were rated as important categories in both scales respectively.

Table 2. Rank of rangeland degradation indices from authorized exploiters viewpoint

Median	Indices	Median	
		5-point Likert scale	20-point scale
Vegetation	Reduction of plant production	4	5
	Loss of biodiversity	3	4
	Loss of palatable plants	3	5
	Increasing the number of non-palatable and poisonous plants	3	4
	Reduction of shrubs and perennials	3	4
	Reduction of annual plants and forbs	4	5
	Reduction of vegetation cover	3	4
	Increasing of plants intervals	3	5
	Loss of litter	3	4
Soil	Soil dispersion	3	4
	Soil salination	3	5
	Reduction of soil infiltration	3	4
	Increase of bare soil	3	4
	Clayey soil	4	5
	Loss of soil darkness	2	4
	The sandiness of the soil	2	4
Climate	Reduction of rainfall	3	5
	High and low temperatures	3	4
Others	Reduction of water resources	3	4
	Increase of water resources spacing	3	5
	Increased risk of wildfires	2	4
	Increased risk of pest damage (such as rats and grasshoppers)	4	5

Table 3. Rank of rangeland degradation criteria from authorized exploiters viewpoint

Criteria	5-point Likert scale			20-point scale		
	Unweighted Linear Combination*	SD	Rank	Unweighted Linear Combination**	SD	Rank
Vegetation	3.19	2.89	2	4.40	2.97	2
Soil	3.04	3.15	3	4.33	2.73	4
Climate	3.32	1.31	1	4.56	0.96	1

*= range 1-5

**= numbers first classified to 5-point scale (range 1-5) and their Unweighted Linear Combination were then calculated

3.3. Rangeland degradation indicators from the unauthorized exploiters view

As shown in Table 4, “loss of biodiversity”, “reduction of annual plants and forbs”, “reduction of shrubs” and “perennials and reduction of plant production” were ranked as important in rangeland degradation assessment by unauthorized exploiters in both scales. Indicators of the three other criteria were considered to play almost identical role in rangeland degradation assessment. “Clayey soil”, “reduction of rainfall”, and “increased risk of pest damage (such as rats and grasshoppers)” were ranked as the first priorities. It can conferred that unauthorized exploiters the same as authorized exploiters considered vegetation indicators more important than other in rangeland degradation assessment.

The importance of indicators among the all exploiters (authorized and unauthorized) is presented in Table 6. Based on the results, the respondents ranked the "vegetation" criterion with 68.9 and 53.3 percent and "climate" criterion with 48.9 and 77.8 percent as moderately important in both scales.

The results of Mann-Whitney test are presented in Table 7 and 8. There were no significant differences between the two authorized and unauthorized exploiters communities in rangeland degradation indicators ($\alpha \leq 0.05$). In other words, authorized and unauthorized exploiters had the same ideas about rangeland degradation indicators and having or not having an exploitation license had no influence on their viewpoints.

Table 4. Comparison and rank of rangeland degradation indices from unauthorized exploiters viewpoint

Criteria	Indices	median	
		5-point Likert scale	20-point scale
Vegetation	Reduction of plant production	3	5
	Loss of biodiversity	4	5
	Loss of palatable plants	3	4
	Increasing the number of non-palatable and poisonous plants	3	5
	Reduction of shrubs and perennials	3	4
	Reduction of annual plants and forbs	4	5
	Reduction of vegetation cover	3	5
	Increasing of plants intervals	3	4
Soil	Loss of litter	3	4
	Soil dispersion	3	4
	Soil salination	3	4
	Reduction of soil infiltration	3	4
	Increase of bare soil	3	4
	Clayey soil	3	5
	Loss of soil darkness	2	4
	The sandiness of the soil	3	4
Climate	Reduction of rainfall	3	4
	High and low temperatures	3	5
Others	Reduction of water resources	3	4
	Increase of water resources spacing	3	4
	Increased risk of wildfires	3	4
	Increased risk of pest damage (such as rats and grasshoppers)	4	5

Table 5. Comparison and rank of rangeland degradation criteria from unauthorized exploiters viewpoint

Criteria	5-point Likert scale			20-point scale		
	Unweighted Linear Combination*	SD	Rank	Unweighted Linear Combination**	SD	Rank
Vegetation	3.23	2.38	1	4.43	2.81	2
Soil	3.07	2.64	3	4.40	2.20	4
Climate	3.05	1.10	4	4.55	0.57	1
Others	3.15	1.78	2	4.42	1.64	3

*= range 1-5

**= numbers first classified to 5-point scale (range 1-5) and their Unweighted Linear Combination were then calculated

Table 6. The importance of rangeland degradation criteria among the all exploiters (authorized and unauthorized)

Criteria	The importance of rangeland degradation criteria					
	5-point Likert scale			20-point scale		
	High	Moderate	Low	High	Moderate	Low
Vegetation	22.2	68.9	8.9	33.3	53.3	13.3
Soil	35.6	51.1	13.3	66.7	31.1	2.2
Climate	48.9	46.7	4.4	77.8	20	2.2
Others	13.3	62.2	24.4	51.1	42.2	6.7

4. Discussion

Pastoralists and herders often have different perceptions on the rangelands degradation problems compared to the scholars and the experts (Dejene *et al*., 1997, Reed and Dougill, 2002). This leads to restrictions on the successful implementation of range management plans (Mapinduzi *et al*., 2003). It is recommended that sustainable range management systems be based on a combination of indigenous ecological knowledge of local communities and scientific knowledge to prevent degradation of rangelands (Khwarae, 2006). Due to a long history and experience, pastoralists have a comprehensive and accurate body of knowledge about their own pastoral systems and rangelands condition (Reed and Dougill, 2002). In this regard, current study aimed to identify and evaluate indigenous ecological knowledge of pastoralists of rangeland degradation signs. The results indicated that authorized exploiters consider "reducing production plants" and "reduce the number of annual plants and grass" as the first priorities for assessing rangeland degradation. Ahmad *et al* (2012) also confirmed these findings, so they argue that the rangeland degradation indicators vary from region to region, but reduction of plants production is one of the main symptoms of rangeland degradation. Rahimi Sooreh and Sadeghi (2005) reported increase of plants production and dry matter per hectare in rangelands as signs of range condition improvement. The findings also suggest that

indicators "loss of litter", "reduction of shrubs and perennials" and "invasion of non-palatable and poisonous plants" are ranked as the last priority by the respondents to assess rangeland degradation. Jafari *et al* (2009) expressed in their research that unsystematic use of rangeland forage causes regression of vegetation, which will reduce the amount of litter. Macharia (2004) findings in Kenya also show that loss of woody vegetation (bushes and shrubs) is a sign of rangeland degradation. Reduction of shrubs is also reported as the sign of rangeland degradation (Oba and Kotile, 2001; Angassa and Oba, 2008). The reduction of palatable species due to rangeland degradation can replace native plants and dominate unpalatable species in the rangeland (Rajabi *et al*., 2010; Hamadeh, 2006). The results of this study suggest that the soil indicators "clayey soil" and "soil salination", climatic index "low and high temperatures" and among other criterion “increased risk of pest damage” were ranked as the first priorities to assess rangeland condition. Therefore, villagers put more importance on climate and vegetation than soil and others criteria in rangelands degradation assessment. These results are in accordance with the results of other authors (Hubert, 2003; Kisamba-Mugerwa, 2001). According to unauthorized exploiters viewpoints, index "reduced plant diversity" of vegetation criterion, "clayey soil" of soil criterion, "reduction of rainfall" of climate criterion and “increased risk of pest damage" of other criterion had the higher degree of importance than other indicators. Ahmad *et al*. (2012) and Flather and Sieg (2000) have been considered loss of biodiversity of rangelands as a sign of regression. The results obtained from all exploiters (authorized and unauthorized) indicate that they know climate and vegetation more important than other criteria in the rangeland degradation assessment. The results of the indicators comparison between authorized and unauthorized exploiters indicate that there is no significant difference between them in relation to the signs of rangeland degradation. Based on the research results and comparison of 20-point and Likert scales, it can be suggested that the 20-point scale shows the results more than reality as well as low understandability for the respondents and time-consuming. So by using Likert scale, besides saving time, the respondents and interviewees do not feel confused and select the desired option in short time as possible. In addition, the results of Likert scale is closer to reality based on the researcher's views and field works. So it is recommended that Likert scale get used in the researches required questionnaires in the field of natural resources, to saving time and better understandability for interviewees.

5. Conclusions

The traditional knowledge of local pastoralists in the both study sites is useful and important in the management of rangeland resources. Pastoralists have a wealth of interests for emphasizing on their own indices to be more practical for the rangeland assessments. Therefore documenting indigenous ecological knowledge on their land condition can provide useful information for the restoration, development, sustainable utilization and conservation of the rangelands (Turner et al., 2000; Abate et al., 2010). Our results indicate that pastoralists have a broad knowledge base covering materials from rangelands vegetation to soil and climate changes. Involvement of pastoralists and documenting their knowledge on rangelands can provide useful bases for the sustainable utilization and conservation of natural rangelands. Therefore, this indigenous ecological knowledge may represent a powerful tool to evaluate rangeland degradation and develop new plans and strategies for restoring degraded rangelands. It can be said that such plans that are based on indigenous knowledge can be easily accepted by local people.

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