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Investigation on effects of range management plans, property size and number of land unit owners on rangelands (case study: Saveh Rangelands)

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Abstract

This study was conducted in a summer rangeland of Saveh region at Markazi province. Firstly, property of rural rangelands including private, and collective management were selected as three area levels of small (less than 700 hectares), medium (700-2200 ha) and large (greater than 2500 hectares) were studied based upon Range Management Plans (RMP). A property without plan was also selected as control treatment. After determining the number and size of the quadrats in each vegetation community, a reference area was selected for data collection and rangeland characteristics were investigated. Afterwards, collected data were analyzed by nest design analysis using SAS software. The results showed that the rangelands with RMP had a better range condition than those without RMP. Also rangelands under private management showed a better condition in comparison with collective management. Meanwhile, range condition of large area property was better than that of other property sizes. According to the results, range management based on private RMP in a large property was identified as the best management case.

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Introduction

In today's world, the value and status of natural resources, especially rangelands are obvious to all. Nowadays, rangelands are not considered just for forage production anymore but other services such as soil and water conservation, oxygen production, preventing global warming, carbon sequestration, plant and animal gene banks, ecotourism values, industrial and medicinal plants, reducing air pollution, diversity of flora and fauna, wildlife refuge and so forth are considered more important than forage production. Forage production of rangelands forms just 10 to 20 percent of rangeland ecosystem values (Khalilian and Shams al-Din, 2000), (Forest, Rangeland and Watershed Organization, 2009). The area of rangelands in Iran has been reported about 86 million hectares (Range Technical Office, 2004). Iran is an arid and semi-arid country with an average annual rainfall of 240 mm. Therefore, important role of the rangelands in rainfall storage is simply understood from considering the vast area of the rangelands (Khajodin and Basiri, 1994). In Iran, rangelands can meet the requirements of only 37 million animal units for a period of 7 seven months while 83 million animal units rely on the rangelands (Forest, Rangeland and Watershed Organization, 2009). Both range managers and range experts believe that rangelands of the world are being degraded due to overgrazing, hence a balance between livestock and rangeland is essential in range management (Kellner and Bosch, 1992), (Norton, 1998).

Rohde *et al* stated that long-term sustainable management not only needs the authority to establish the rules to resolve the problems and conflicts, but also designing and performing the procedures are very crucial (Rohde *et al.*, 2006). Range Management Plans (RMP) in Iran also has been known as a suitable way to reduce the grazing pressure and to practice effective management on rangelands since 1968. RMP have been prepared for about 25 million hectares by rangeland technical office in Forests, Rangelands and Watershed

Organization (Eskandari *et al.*, 2007). A RMP is defined as a compiled program through which soil and water resources are preserved and sustainability of the production is guaranteed with regard to the potential of the region.

In fact, all measurements applied for range management, range improvement and suitable utilization in certain areas of the rangelands are considered in a RMP allocated to the stakeholders for a period of 30 years (Eskandari *et al.*, 2007). Walker had a study on rangelands of North West Argentina and stated that sustainable management of rangelands needs a database on annual forage production, species composition and population of grazing livestock based on a RMP so that the balance of livestock and grazing capacity could always be monitored (Walker, 1993). RMP lead to change in sustainability indicators of rangelands. Unfortunately, in some of the ongoing RMP, grazing capacity (balance between forage production and livestock population), grazing season and period, are not clearly observed while range condition and grazing capacity of the rangelands in which technical principles of the RMP are considered have been improved (Alizadeh *et al.*, 2001). Dehdari made a comparison between rangelands with and without RMP at Semirrom region and concluded that range management plans had positive effects on rangelands. The results showed that the effectiveness of these plans would increase in rangelands with owners fewer than five as well as an area more than 800 ha (Dehdari, 2012). Borhani studied the effect of area on canopy cover and range condition of Semirrom region and showed that rangelands with larger areas had a better vegetation and range condition. He stated that this result could be due to the effectiveness of management actions including controlled grazing and better implementation of range improvement projects (Borhani, 2013). Sardari studied the rangelands of Chahar Mahal and Bakhtiari province and stated that under the conditions that no supervision was made, no significant differences were found between the

rangelands with or without RMP and this was because of the excess livestock population in both conditions (Sardari, 1999). Hassan Zadeh stated that increased population of pastoralist households will raise rangeland degradation index and it is decreased with increase of the land area per household (Hassanzadeh, 2001). Kepe *et al* concluded from economic and ecological observations that relationship between sustainable development and large lands is stronger than other important factors (Kepe *et al.*, 2005). Laurent *et al* in an economic research conducted in South Africa showed that the land area of many farmers was so limited as a result of dividing the land between the children and increasing of the pastoralist population. He concluded that for sustainable utilization of natural resources and fighting poverty, dividing large properties to small ones should be avoided (Laurent *et al.*, 1998). Continuity and being large rangelands are considered as two main factors for successful management by many scientists (Bailey *et al.*, 1996), (Senft *et al.*, 1985), (Stulth, 1991).

World Bank introduces six important and fundamental factors as the causes of poverty in rural communities including small property size and low productivity (World bank, 1990). The main objective of the current research was to determine the best

range management and rangeland dedication considering different management in terms of property size, population of pastoralist, and RMP. There are many studies in this field while the effects of the mentioned factors have been considered separately. Comprehensive investigation with regard to the property size, population of pastoralist and RMP which carried out simultaneously can be considered as the main difference between the current study and other researches.

The hypotheses of the research were that vegetation cover, density, litter and forage production of RMP rangelands with private management and large area would be higher than those of the without RMP rangelands, collective management and medium and small areas.

Material and Methods

Similar rangelands were selected to do the research from Nobaran district of Saveh city as a semi-steppe region at Markazi province, with maximum similarity with climate, topography and vegetation. Two kinds of management (private and collective) and three sizes of land area (to 700, 700-2200, and more than 2200 ha) were considered in a RMP and without RMP rangelands (table 1.).

Table 1. Characteristics of the rangelands in Saveh under different managements.

	Size Class	Management Type		
		Collective RMP	Without RMP	Private RMP
Summer Rangeland	Small	1- Baykhan	1- Meymeh	1-Dagh Kandy 2
		2- Zanbar1	2- Jafar Abad	2-Hesar Chay
		3- Zanbar2	3- Dokhan	3- Folad Baghi
	Medium	1- Harighan	1- Baghche Ghaz	1- Ghoch Belagi 1
		2- Darband	2- Tohidlo	2- Ghoch Belagi 2
		3- Michak	3- Sangag	3- Dagh Kandy 4
	Large	1- Ardmin	1- Kaleh Gosh	
		2- Saman	2- Tajareh	
		3-Chahar Had	3- Gozal Dareh	

In each location (site), a reference area was identified and number of quadrats was established based on statistical method. The quadrat size of 1 m² was applied based on vegetative form of the plants. Data of vegetation cover, forage production and

plant density were recorded for each site at a certain time which coincided with the range readiness. In each vegetation type, four transects of 200 m length along or perpendicular to the slope (depending on topographic conditions and vegetation changes) was

established on which 15 quadrats of 1 m² were used. All the measurements were made within total of 60 quadrats for each vegetation community. Plant species were categorized into three palatability classes of I, II and III, based on the Code book of Forest and Rangeland Organization of Iran (Forest and Rangeland Organization, 1971) and considering indigenous knowledge. Vegetative forms were also identified. Canopy cover percentage of each species was estimated within the quadrats. Double sampling method suggested by Arzani and King was applied for forage yield estimation. In this method, forage production of 15 quadrats was measured using clipping and weighing method. In the remaining 45 quadrats, forage production was calculated based on the correlation between data of canopy cover and forage production (Arzani and King, 1994). Density was estimated by recording the number of individual

plants of each species within the quadrats along transects. Data were analyzed in a nested design using SAS software.

Results

According to the results, there were significant differences among the most factors in rangelands with or without RMP, private and collective management, and finally among rangelands with different surface areas (property sizes). But no significant differences were observed between private and collective rangelands with regard to some variables like, total production, production of class II and class III plant species (table 2.).

Table 2. Results of statistical data analysis in a nested design using SAS software.

	DF	Total vegetation Cover %	vegetation Cover of Class I %	vegetation Cover of Class II %	Vegetation Cover of Class III %	Shrub Cover %	Forb Cover %	Grass Cover %	Total density	Density of class I
Type of rangeland	1	**42084	**7756	**1370	**23686	**10856	**967	**5241	*472	**691
Type of management	2	**1242	**1022	**208	**1480	**5877	**5820	**425	**86	**89
Type of area	7	**1396	**940	**901	**1541	**1728	**405	**700	**74	**76
Error	1475	148	19.4	32.4	137.9	137.4	49.2	21.1	6.1	1.5

Continue table 2. Results of statistical data analysis in a nested design using SAS software.

	DF	Density of class II	Density of class III	Total production [kg]	Production of class I [kg]	Production of class II [kg]	Production of class III [kg]	litter %	Bare soil %
Type of rangeland	1	**84	*19	**436145	**49125	*4100	**252811	**53	**101178
Type of management	2	**49	*15	ns 6245	**5867	ns 698	ns 5863	*14	**2120
Types of area	7	**30	**37	**12892	**6364	**4860	**11402	**53	**3255
Error	1475	1.3	4	3128	366	663.2	2907	3.9	124.5

Ns: No significant difference. *: Significant difference at 5 percent. ** Significant difference at 1 percent

Type of rangeland (with and without RMP), Type of management (private and collective), Type of area (small, medium and large)

Discussion

According to the results, there were significant differences among the most studied factors in rangelands with or without RMP, private and collective management, and finally among property sizes. However some exceptions were also observed. With regard to some variables including total vegetation cover, production and density and also vegetation cover, production and density of desirable species (class I), in large and private rangelands with RMP were significantly higher than those of medium or small collective rangelands without RMP.

But the same situation was observed for non-desirable species (class III) in rangelands with single owner and rangelands with RMP. In the other words, vegetation cover, production and density of class non-desirable species in rangelands with RMP and also in private rangelands were higher than those of rangelands without RMP and collective ones. This indicates that range seeding with native palatable species seems to be necessary for implementation of Range Plans and a better range management when range condition is poor especially where condition trend range is negative. Because palatable species and soil of these rangelands are degraded due to the over grazing in the past. So without improvement, desirable plants cannot compete with unpalatable and class III species.

In rangelands with a large property size, desirable species are more than that of medium or small property sizes. Also, non-desirable species in these rangelands are less compared to that of medium or small area rangelands. Probably, it indicates that property size could be considered as the most important economical factor for improvement of palatable species and reduction of unpalatable species. With regard to the life form types, it is noteworthy to state that implementation of range plans, private management and large property size showed a positive effect on increase of all life forms (forbs, grasses and shrubs) due to the relatively favorable rainfall and adequate soil moisture. For

this reason, there is no need to rainfall storage practices due to adequate soil moisture. No significant differences were observed between private and collective rangelands in terms of forage production. It is noteworthy that although no significant differences were observed between private and collective rangelands in terms of total forage production and production of class III and class II species, class I species showed significant differences. This indicates that private management has led to strengthen palatable plants and class I species but the difference has not been so great, so that makes total forage production significant. Litter was also higher in RMP, private and large properties compared with no RMP, collective, medium and small ones (Dehdari, 2012), (Borhani, 2013) and (Harrington *et al.*, 1984).

According to the results, it is concluded that a better range condition could be obtained from rangelands with RMP compared with rangelands without RMP. The results are in agreement with the findings of (Asrari, 2000), (Abbasi, 1996), (Khalilian and Shams al-Din, 2000), (Azarnivand, 2004), (Savory, 1987), (Walker, 1993) and (Teague and Dowhower, 2002). In the other words, range management based on RMP would be more appropriate. For instance, Mousavinejad studied 18 rangelands with or without range management plans (RMP) of Semnan province and concluded that canopy cover, yield and range condition of the rangelands with RMP were better than those of rangelands without RMP (Mosavinejad, 1997).

Range condition of private management is also better than that of collective ones because in private, the owner has a sense of ownership and responsibility to conserve rangeland and usually will try to increase the income through appropriate management like management of grazing season, balance between grazing capacity and population of livestock. But in collective management, there is no sense of ownership and each owner just tries to have more utilization over the grazing capacity and that is

why range management principals are less considered in such case of management. Our results are in agreement with the results of studies done by (Abdollah Poor, 1994), (Azkya, 1995), (Ghandaly, 2001), (Ramezani, 1998), (Azarnivand, 2001& 2004), (Hardin, 1998) and (Antje Burke, 2004). Almost, all researchers have the same view and believe that range condition of private management is better compared with collective ones. For example, Antje Burke studied arid rangelands of Namibia for 11 years and stated that grazing intensity in private management was less than that of collective ones and private management were more economically efficient for the owner (Antje Burke, 2004). Arzani *et al* studied arid rangelands of Semnan province and stated the similar result (Arzani *et al*, 1997).

Ghandaly compared forage utilization methods and their effects on natural resources in Semnan province. He stated that range condition of the rangelands in which less pastoralists are existent is better compared with rangelands with more pastoralists (Ghandaly, 2001). Azarnivand also believed that private RMP was more effective than common RMP and they should be assigned to the pastoralists individually if possible (Azarnivand, 2001).

Finally, it is realized that large properties size have a better range condition than medium and small ones, since forage production is higher in large properties which let the pastoralists enter more livestock to earn higher income. This issue affects the range condition from two aspects: the first is that the rancher has more economical ability for investment in the rangeland and the second is that no surplus livestock are entered by the rancher to earn more money since he can meet the costs of living and he knows the consequences of destruction of the rangeland that his or her livelihood depends on it.

However, in small properties firstly the rancher has a low income without any investment ability and

secondly he will try to enter more livestock to earn more money and to meet the living costs in short term. In the short term, plant composition is changed and forage quality is decreased while no changes occur to the forage quantity. In this situation, despite forage feeding, the livestock lose weight due to the decrease of forage energy content. If this trend continues, forage quantity will also be decreased as far as range become poor with negative trend and landholder will have no attention to the range condition and range improvement anymore because of the low forage quality and production, low economic potential and small area of the rangeland.

These results are in agreement with those reported by (Abedini, 2001), (Ramezani, 1998), (Laurent *et al.*, 1998), (Kepe *et al.*, 2005), (Teague and Dowhower, 2002), (Bailey *et al.*, 1996), (Stulth, 1991), (Boon and Coughenour, 2001) (Calvin and Thorenton, 2001) and (World bank, 1990). For example, Teague & Dowhower studied the effect of different types of rangeland management on range condition and concluded that size of the rangeland had impacts on range condition as the larger properties had the better range condition and believed that range management based on RMP was better than those without RMP (Teague and Dowhower, 2002). Abedini examined the social factors affecting rancher's participation in RMP and concluded that rangeland area and the ownership had an important role in the participation of indigenous people which should be taken into consideration by government administrators (Abedini, 2001). Arzani and Sanjari concluded that degradation was higher in land units with none optimal economic size in their study area (Arzani and Sanjari, 1999). Ramezani also evaluated privatization of rangelands in RMP of Fars province and concluded that rangeland area assigned to each household should be sufficient to meet household expenses and assignment to fewer owners was the best assignment (Ramezani, 1998). Calvin & Thornton found that in regions where the share of each household for range and agricultural lands was higher as well as the number of livestock units per

household member and with diversity in utilization, food security and shepherd welfare could be created easier and normative utilization of rangelands and natural resources would be possible (Calvin and Thorenton, 2001).

Conclusions

Generally RMP is the best way for of promoting range condition and making balance between animal and forage. However its performance is much better when it applied in large properties with single owner. So it is necessary RMP be provided for all rangeland also encourage people to sell small properties to owners with medium or large size properties. Large properties would be economic and it is possible to run correct grazing management based on economic and social condition of each country. It is important to say that if population of the livestock does not correspond with grazing capacity, RMP will not function as expected.

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