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## Rangeland Condition and the Appropriate Rangeland Management Methods

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### ABSTRACT

Improvement, development and proper exploitation of current rangelands conditions and selecting a range management method (balanced, natural and, artificial) to be implemented in the form of a range management plan (RMP). Data was collected from the rangelands of Haraz River watershed. Information including the total percentage of vegetation and each of the increasing species, rangeland condition and production were studied in 2016. To determine the best range management method, the analysis of variance was used. To compare the quantitative characteristics measured before and after the implementation, a two-sample independent t-test was used. Mann-Whitney U test was used to

compare qualitative characteristics. Results showed that the vegetation percentage of palatable species composition did not increase, the balanced and natural methods were the best methods in good and fair rangeland condition. The reason for the lack of increase in the number of palatable species was the unsuccessful implementation of planned programs in RMPs. The artificial method was performed in the RMPs with poor vegetation types, the implementation of these plans had no significant effect on the rangeland condition of the study rangelands due to the high livestock population. Rangeland plans will be more effective when there is a balance between grazing capacity and livestock population.

Keywords: Rangeland condition, Rangeland, management methods, Rangeland trend

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## 1. Introduction

In the middle of the last century, due to the socio-economic problems of beneficiaries, the exploitation, and management of rangelands have changed a lot. In the past, there were no problems in the rangeland management due to the conventional rules and the appropriate proportion of the number of beneficiaries and the number of livestock. However, nowadays, due to the management difficulties of rangelands, a large number of beneficiaries and high population of livestock and ranchers with poor economic status, the investment and rangeland development have been challenged (Kamrani 2004). Therefore, in the current situation, the most basic steps to prevent rangeland degradation and improve the rangeland condition are the provision and utilization of range management plans in the form of a compiled program.

In the last few decades, hundreds of rangeland management projects have been developed and implemented with the aim of developing basic utilization. These projects have played a positive role in improving rangeland conditions (Arzani et al 2011).

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Safari et al (2016) believe that by selecting the correct range management method and appropriate rangeland and improvement practices, the rangeland condition, livestock grazing management, watershed condition, and wildlife habitat can be improved.

Borhani et al (2014), through the technical and ecological evaluations of range management plans in Isfahan province, showed that the implementation of range management plans greatly influenced the increase of desirable species. This also improved the rangeland condition and reduced the uniformity of the rangelands, where RMPs were implemented. However, in some range management plans, the grazing capacity, time, and duration of range utilization are not well-respected. The reason is that these are not cost-effective (Arzani et al 2011). However, the capacity and capability of rangeland production are significantly increased in the projects where technical principles are well observed. Savory (1987), Walker (1993), and Teague & Dowhower (2002) argued that if the utilization of rangelands is designed and planned, the exploitation will be more sustainable.

There are three methods for range management, including Balanced, Natural, and Artificial methods, which can be chosen in the range management plan based on vegetation community condition. Balanced is used when the range is good and the land is covered with grass. However, the amount of plants needs to have high palatability, and the duration of growth and reproduction should be good. The objective of the balanced policy is to maintain the current desired condition of rangelands that are in good condition. Natural is used when the condition of the range is not so good and the plants have a little palatability, but there is hope for their reproduction and growth, and it is enough to rest them. In the natural policy, the objective is to improve vegetation condition by providing enough time for natural regeneration. This policy is used in the rangelands where the condition is fair and the vegetation cover, regeneration, and palatable species composition in the total vegetation cover are low. Artificial is used when none of the first and second modes are available, the erodible rangelands, the palatable plants are very low or absent, the range is weak, and there is no natural regeneration or the recovery requires a long time. Management in poor rangelands is seeking improvement and reclamation of vegetation using the artificial policy and implementing methods such as seeding, pit seeding and etc. (Arzani et al 2011).

Since rangeland beneficiaries, especially in private rangelands are thinking of exploiting more in the short-term, they are ignoring the range grazing capacity. Therefore, the range management principles such as the balance of livestock in these rangelands are less observed. Researchers such as Hardin (1998), Qandali (2001), and Antje (2004), have also this issue. Continuing this trend will result in reduced rangeland production, forage quality and livestock production (Houston & Woodward 1966, Launchbaugh 1967; Shoop & McIlvain 1971). This problem can be solved by selecting the right grazing system and applying the appropriate rangeland management method under different rangeland conditions, as it both causes the proper distribution of livestock in the rangeland and improves the range trend. Among these methods, the artificial policy could be conducted only in case of government funding, since it is associated with the implementation of improved practices and cost spending.

Since the government intervention in improving the rangeland condition is common in Iran, among these methods, the artificial method, which is accompanied with costly reclamation and improvement practices, could be implemented in the low-area rangelands in case of government financial assistance. Therefore, not much attention is paid to this method by the rangeland beneficiaries. (Arzani et al 2011). It is clear that the range management costs vary depending on the range condition. Regardless of this fact, sometimes the experts make a mistake in preparing the range management plans and selecting the right range management method. Due to the little data published on this issue, the present study was carried out to investigate the role of rangeland condition in selecting the best rangeland management method in the form of a range management plan in a vegetation community. It should be noted that this is the first study in the rangelands of the central Alborz region with a fixed and mobile rural livestock and a dominant combination of sheep and goats (85% sheep).

## 2. Material and Methods

### 2.1. Study site

The research was conducted in the Gazanak rangelands with an area of 18416 hectares in the south of Amol city and in the Larijan district, north of Iran. It is located between 59° 45' 90" and 61° 54' 50" eastern longitudes and 39° 63' 900" and 39° 25' 800" northern latitudes, including nine range allotments with rangeland management plans. These plans had been started in the 1990s. The average rainfall of the region is 602.3 mm annually, with the highest and lowest rainfall of 89.9 mm in March, and 12.6 mm in August. The species are mostly and belong to the *Poaceae* family. The dominant species are *Festuca ovina*, *Bromus tomentellus*, and *Onobrychis cornuta*.

## 2.2. Measurements of range management plans

Out of the range management plans implemented in the 1990s, three plans of each range management type and a total of nine plans were randomly selected. The characteristics of each plan included the range management method for livestock grazing (the rangeland type, number of livestock and proposed grazing system), vegetation percentage, production, and rangeland condition and trend, recorded in Excel software (Table 1). The required number of plots was calculated based on Eq.  $N = \frac{t^2 S^2}{p^2 \bar{x}^2} (1 + 2/n)$  (Mesdaghli 2007). Therefore, 80 plots of 1 square meter (totally 240 plots for all three methods) were applied in each of the areas that Rangeland management methods were implemented. Systematic random sampling was used to establish the plots along four 50-meter transects. The vegetation characteristics were then re-measured as the percentage of total canopy cover, vegetation percentage, and composition of important rangeland species (desirable and undesirable to the grazing livestock) in 2016. Clipping and weighing method was used to measure rangeland production. In order to determine the rangeland condition in each vegetation community, the 4-factor method suggested by Parker & Harris (1951) was used. To compare quantitative characteristics, the two-sample independent t-test was used at significant levels of 1% and 5%. The Mann-Whitney U test was used in order to compare qualitative characteristics.

**Table 1- Comparison of the range condition and range trend in 1990 and 2016**

Range allotment	Rangeland type	Proposed grazing system in 1991	The start year of RMP	Rangeland condition in 1991	Rangeland trend in 1991	Rangeland condition in 2016	Rangeland trend in 2016	Animal Unit (AU)
Rinekoh	Br.to- Fe.ov-As.sp	Rotation	1997	good	positive	good	positive	3579
Raiskoh	Fe.ov-Br.to-On.co	Delayed rotation	1999	fair	constant	fair	constant	2897
Malarkoh	Fe.ov-Br.to-On.co	Rotation	2005	good	positive	good	positive	1120
Gazanak	Fe.ov-Br.to-On.co	Delayed rotation	1993	fair	constant	poor	constant	1295
Asklat	Fe.ov-Br.to	Rotation	2005	good	positive	good	positive	1839
Anji	Fe.ov-As.sp-Ar.au	Rest rotation	1999	fair	constant	fair	constant	2090
Amlaira	Fe.ov-Br.to-On.co	Delayed rotation	1997	fair	constant	fair	constant	237
Abgarm	Fe.ov-Br.to-On.co	Rest rotation	1997	good	positive	good	positive	909
Ghazimaz raeask	Fe.ov-Br.to-On.co	Rotation	2009	good	positive	fair	constant	2035

## 3. Results and Discussion

### 3.1. Measurements of range management plans

Comparison of differences in the mean values of canopy cover and production in various range management policies showed a difference between the various management policies for these variables (Figures 1 and 2). In other words, the implementation of Rangeland management methods is effective on the percentage of canopy cover and rangeland production, and consequently, on the rangeland condition. The rangelands selected for the implementation of balanced rangeland management method had a good rangeland condition, the highest mean production (390.06 kg ha<sup>-1</sup> Dry Forage), and the highest mean canopy cover percentage (71.64%). However, the lowest mean production (345.67 kg ha<sup>-1</sup> Dry Forage) and the lowest mean percentage of canopy cover (50.16%) were obtained for the poor condition rangelands, where the artificial method was implemented.

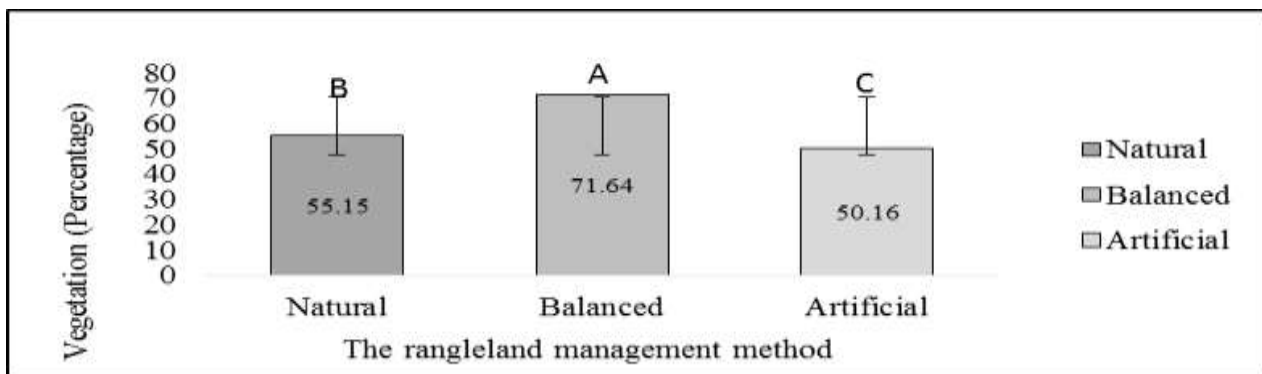


Figure 1- Vegetation percentage of each rangeland management method (2016)

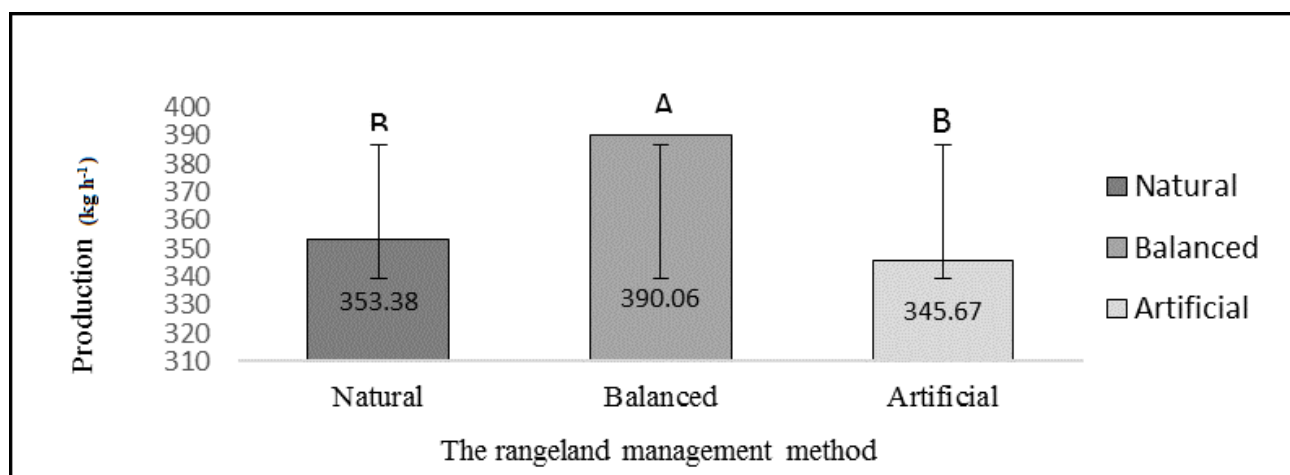


Figure 2 - Production of each rangeland management method at the time of the study (2016)

### 3.2. The study of changes in rangeland condition and trend

The study of vegetation percentage analysis showed that the balanced policy with an average of 71.64% was the best rangeland management method for the good rangeland condition in the study area. Moreover, the results of production proved that the artificial and natural policies with an average production of 345.67 and 353.38 kg ha<sup>-1</sup> Dry Forage had no significant difference, and the balanced policy was determined as the best. The rangelands selected for the implementation of balanced range management- that were in more than a good condition- had the highest mean production (384.3 and 448.2 kg ha<sup>-1</sup> Dry Forage) and that of the artificial range management had the lowest average production (257.6 and 317.3 kg ha<sup>-1</sup> Dry Forage). In addition, the assessment of the significance of condition changes (very good, good, fair, poor, and very poor) and condition trend (positive, negative and constant) was conducted in 2016 using the non-parametric Mann-Whitney U test (Zare Chahuki, 2012). These studies showed that changes in the rangeland condition and trend between the two assessment periods were not significant in any of the Rangeland management methods.

The vegetation composition in terms of percentage of palatable and increasing species was investigated and compared. This showed that the palatable species like alfalfa (*Medicago sativa* L.), white clover (*Trifolium repens* L.), and sheep fescue L. (*Festuca ovina*) did not increase compared to the year of preparation of range management plan (the 70s). However, the increasing species, such as bulbous meadow grass (*Poa bulbosa*) and common mullein (*Verbascum thapsus*) were increased.

The study of changes in plant composition and production of desirable species in the 1990s and 2016 showed that a significant difference was found between these values as well as among the range management policies. In other words, implementing the range management plans showed a positive effect on the production of rangeland species. Arzani et al (2011) conducted a study on the effects of rangeland management plans on the condition and capacity of rangelands in

both arid and semi-arid regions. According to the final report of the study, the effectiveness of range management plans could be increased by economizing rangelands' area, prioritizing the private rangelands when planning RMPs, proper selection of measuring methods, determining the capacity, controlling livestock, and paying attention to the socio-economic issues. The changes in rangeland condition and trend were insignificant in all the rangeland management policies in 2016. Furthermore, no positive changes were observed in the degree of rangeland condition and/or trend, as a result of the implementation of the rangeland management plan. This suggests that the mere planning is not enough, but monitoring, controlling the number of livestock, and executing the program are also very important. In this regard, Arzani (1994) and Valentine (2001) believe that determining a regional production index and ultimately long-term grazing capacity, as well as the correct selection of livestock number, are the most important options to improve the vegetation, livestock production, and economic returns. They also concluded that the sustainable utilization of rangelands requires a management program, correct estimation of grazing capacity, and a balance between the number of livestock and rangeland production.

It should be noted that the results obtained from this research are inconsistent with the results of Mazaheri et al (2009) conducted in the Khorasan Razavi Province, Eftekhari et al (2016) in Markazi Province, and Ariapoor et al (2016) in the Hamedan Province. All the studies showed that the implementation of rangeland management plans had an effect on increasing the vegetation cover, production, and improvement of vegetation composition in favor of palatable species. The main reasons for the differences between the findings of this research and the results of the above-mentioned researchers are the lack of adequate supervision, lack of credit and facilities, and finally the lack of enough knowledge of rangeland beneficiaries about the benefits of implementing range management plans. A study was conducted on the changes in the percentage of vegetation of palatable (Class I) and increasing species after implementation of rangeland management plans. It showed that species such as *Medicago sativa* (alfalfa), *Trifolium repens* (clover), and *Festuca ovina* (grass) had no significant change as a result of the implementation of natural and balanced rangeland management plans. However, the rangeland beneficiaries tried to increase the percentage of palatable species using rangeland improvement methods such as water resources improvement and development (installation of watering place, spring repair and water transfer) as well as seeding projects with species of *Medicago sativa*, *Trifolium repens*, and *Poa bulbosa*. The implementation of these practices is not only costly but also requires a lot of time to achieve the results. While the rangeland beneficiaries with the guidance of natural resources experts could achieve this goal appropriately by applying the grazing systems and appropriate Rangeland management methods at the least cost. Thus, it is important to choose the correct management method in each vegetation community. In practice, the vegetation percentage of *Poa bulbosa* increased by 49.43%, but alfalfa (59.6%) and clover (58%) were significantly reduced. Undoubtedly, the reason is the proper establishment of *Poa bulbosa* seeds and livestock preference in the rangelands of the region to graze on alfalfa and clover. In contrast, as a result of the implementation of natural and balanced rangeland management methods, the two increasing species of the Alborz summer rangelands, *Poa bulbosa*, and *Verbascum thapsus*, had no significant change; however, the implementation of artificial policy in 2016 resulted in a significant increase for the two species, as compared to the 1990s. Therefore, the percentage of vegetation was significantly increased in *Festuca ovina* (73.25%) and *V. thapsus* (45.76%). The reason for this is related to the excessive livestock grazing, the lack of proper implementation of livestock grazing management, and the lack of complete implementation of reclamation practices due to the lack of funds and facilities, which have weakened the rangelands. In addition, in the natural rangeland management method, *Festuca* and Alfalfa increased by 6.8% and 5%, respectively. The vegetation percentage of white clover was reduced by 20%, with no significant change. These insignificant changes in the invasive species were associated with a reduction in the vegetation percentage of *Festuca* and *Verbascum thapsus*. In the balanced rangeland management method, the canopy of *Festuca* and Alfalfa increased by 8.74% and decreased by 8.13%, respectively, and the vegetation percentage of white clover reduced by 15.21% with no significant change. No significant changes were observed in the invasive species studied except for a slight reduction in *Festuca* species and an increase in *Verbascum thapsus* (Table 2). These changes occur due to increased grazing pressure. However, considering the good and fair rangeland condition of the study area, the selection of artificial rangeland management method imposes many costs, such as the supply and purchase of inputs, building materials, and the labor and expertise cost in implementing improvement and reclamation projects (seeding, construction of water storage, water reservoir and so on). In other words, the artificial rangeland management method only affected the total vegetation percentage without increasing the percentage of desirable species. It is in conflict with the main purpose of Rangeland management methods, which is to increase the percentage of palatable and desirable species for livestock. In contrast, the balanced range management method as the first option and then the natural range management method regardless of the fact that there are far fewer administrative costs, have better performance and can be easily performed as compared to the artificial policy. Therefore, the rationale is that the cost-effective, simple and quick policies are implemented rather than costly and complex management methods. The results of this study are consistent with the findings of Danckworts & Madam (1991), Holecheck (2002), Hoshino et al (2009), and Moradi and Mofidi (2012). They

showed that the increased grazing pressure caused the reduction of palatable species and an increase in toxic and unpalatable species.

**Table 2- The average percentage of palatable and increasing species in 1990 and 2016**

*The average percentage of vegetation*

Species	Natural policy			Balanced policy			Artificial policy		
	1990	2016	percentage	1990	2016	percentage	1990	2016	percentage
<i>Medicago sativa</i>	6	6.3	5	8.6	7.9	-8.13	2.5	1.01	-59.6
<i>Trifolium repens</i>	4	3.2	-20	4.6	3.9	-15.21	1.5	0.63	-58
<i>Festuca ovina</i>	20	21.36	6.8	20.69	22.5	8.74	8.03	12	49.43
<i>Poa bulbosa</i>	2.6	2	-23.07	0.5	0.45	-10	4	6.93**	73.25
<i>Verbascum thapsus</i>	1.2	10.01	-15.83	0.58	0.69	18.9	2.6	3.79**	45.76

\*\* , The Significant difference at the 1% level

Generally, in the rangelands, where the grazing capacity is taken into consideration and rangeland management plans are carefully implemented with the participation of beneficiaries, the quantity and quality of the plant composition will undoubtedly increase. The effectiveness of rangeland management policies on vegetation factors in the rangelands where the balanced and natural methods are applied indicates that the positive or negative changes in vegetation are not sufficient to change the degree of rangeland condition, and these rangelands mostly have a constant trend. Therefore, it is necessary to increase the effectiveness of the rangeland management plans by more supervision, increasing the income of beneficiaries by multipurpose utilization, the balance between livestock and long-term grazing capacity, and applying grazing systems. The balanced and natural rangeland management policies have a positive and significant effect on the total vegetation in the rangelands with a good and fair condition. However, it did not lead to an increased degree of rangeland condition or a significant increase in vegetation percentage and an increased percentage of palatable species composition. It should be noted that in the fair rangeland condition, the incorrect implementation of the artificial method has had no positive effect on the rangeland condition and trend. It means that despite the increased vegetation percentage of increasing species, the vegetation percentage and production of these rangelands decreased compare to the time of preparation the RMP. Failure to correctly execute programs and the lack of attention to the livestock stocking rate and its related variables as well as collective rangelands and failure to observe the grazing season by beneficiaries are the main reasons for the weakening of these rangelands. It seems that the effectiveness of rangeland management plans will be more when the plans are implemented on rangelands where there is a balanced livestock grazing (Tawafi & Arzani 2012; Gillen & Sims 2006). Therefore, the most important management action in the rangelands of the region is the choice of balanced rangeland management method, since it is easier, more cost-effective, and more feasible. Among nine range allotments studied in this research, the rangeland management method has not been selected correctly in five range allotments, so that in two range allotments, the natural policy was applied instead of the balanced policy. As well, in three range allotments whose rangeland condition was fair, regardless of climate conditions and topography and soil characteristics, the artificial policy was applied along with implementing the projects such as seeding and pit seeding, instead of the natural method within the proper grazing systems (Table 3). Due to the continuous presence of livestock and unsuccessful implementation of grazing management programs, the rangeland production continued to decline (Table 3). Overall, the selection of artificial rangeland method not only has contributed to increasing the amount of vegetation but also has imposed the costs of implementing reclamation and improvement practices on beneficiaries.

**Table 3- Comparison of the range condition and range management method proposed during the 1970s and 2016**

No	Ranch Units	The rangeland condition in 1991	The rangeland management method	The rangeland condition in 2016	The proposed rangeland management method
1	Rinekoh	good	Natural*	good	Balanced
2	Raiskoh	fair	Natural	fair	Natural
3	Malarkoh	good	Balanced	good	Balanced
4	Gazanak	fair	Artificial*	poor	Artificial
5	Asklat	good	Balanced	good	Balanced
6	Anji	fair	Artificial*	fair	Natural
7	Amlaira	fair	Artificial*	fair	Natural
8	Abgarm	good	Natural*	good	Balanced
9	Ghazimazraeask	good	Balanced	fair	Natural

#### 4. Conclusions

Our results clearly showed that it is important to choose a suitable, practical, and not expensive range management method to utilize the rangelands and promote its condition. Rangeland condition is a good criterion to select a suitable policy. Where the rangeland condition is good or fair, the artificial policy is not recommended for range improvement. Considering that the implementation period of 85% of range management plans in the summer rangelands of the study area is finished (over) and needs to be revised, therefore, while observing ecological principles, beneficiaries' economic power and rangeland beneficiaries' views, the revision of range management plans should be put on the agenda by the custodians of natural resources. Accordingly, it is necessary to economize range management and, consequently, improve the livelihoods of beneficiaries through focusing on other rangeland uses including by-products, fattening, apiculture, tourism, and aquaculture in range management plans. Finally, it seems that another similar study in winter rangelands can provide interesting results regarding the effects of range management plans on the rangeland condition.

#### References

- Antje B (2004). Range management systems in arid Namibia. What can livestock numbers tell us?. *Journal of Arid Environments* 59: 387-408
- Ariapour A, Mehrabi H R & Pahlavan D A (2016). Effect of rangeland plans on production, and condition Rangelands: a Case Study in Rangelands in Khazal Area of Nahavand County. *Rangeland Journal* 10: 1-10 (In Persian)
- Arzani H (1994). Some aspects of estimating short and long term rangeland carrying capacity in the Western Division of New South Wales. Ph.D. Thesis, University of New South Wales, Australia, 304
- Arzani H, Eftekhari A, Dehdari S, Borhani M & Kiani R (2011). Final report of the investigating the effect of rangeland plans on the condition and capacity of rangelands in the arid and semiarid climatic zones. University of Tehran, 243 (In Persian)
- Borhani M, Arzani H & Jaber Al-Ansar Z (2014). Assessment of Rangeland management methods and proposed grazing systems in Semiarid. Esfahan Province. *Iranian Journal of Range and Desert Research* 21: 530-540
- Danckworts Y E & Madam K (1991). Dynamic of Rangelands Ecosystems. *Proc. Fourth International Rangelands Congress Mont Palliser France* 3: 1066-1069
- Eftekhari A (2016). Effect of the range management plan on rangeland condition: a case study in Zarandieh region, Markazi province. *Iranian Journal of Range and Desert Research* 23: 218-209
- Gillen R L & Sims P L (2006). Stocking rate and weather impacts on sand sagebrush and grasses: a 20-year record. *Rangeland Ecology and Management* 59: 145-152
- Hardin G (1998). Essay on sciences and society: extensions of "The tragedy of the commons". *Science* 280: 682-683
- Holecheck J L (2002). Do most livestock losses to poisonous plants result from "poor" range management? *Journal of Range Management* 55: 270-276

- Hoshino A (2009). Comparison of vegetation changes along grazing gradients with different numbers of livestock. *Journal of Arid Environment* 73: 687-690
- Houston W R & Woodward R R (1966). Effects of stocking rates on range vegetation and beef cattle production in the northern Great Plains. *Technical Bulletins, USA Agriculture Department* 64
- Kamrani K (2004). The Effect of Economic and Social Factors on Managing Rangelands in Chaharbagh Region of Semnan Province. Master's thesis, Gorgan University of Agricultural Sciences and Natural Resources, Iran. 132 (In Persian)
- Launchbaugh J L (1967). Vegetation relationships associated with the intensity of summer grazing on a clay upland range site in Kansas. *Technical Bulletins, USA* 20-24
- Mazaheri M, Khaksar Astaneh H & Motalebi M (2009). Calculation of the efficiency of rangelands granted in the form of range management plans in Khorasan Razavi province, *Sixth Iranian Agriculture Economics Conference*. Khorasan Razavi, Iran
- Mesdaghi M (2007). *Range management in Iran*. Astane Ghods Razavi Press: Mashhad. 333
- Moradi E & Mofidi M (2012). Effects of grazing enclosure on vegetation in Semi- Steppe rangelands of Semirom in Esfahan: a case study in Hana. *Journal of Rangeland* 3: 272-282
- Parker K W & Harris R W (1958). The 3-Step Method for measuring condition and trend of forest & Ranges: A resume of its History, *Development and Use* 55-69 in *Techniques and Methods of Measuring Understorey Vegetation*. U.S.D.A. Forest Service, Southern Forest Experiment Station and Southeastern Forest Experiment Station, Tifton, Georgia.
- Qandali K (2001). Comparison of the effect of Rangeland management methods on Rangelands in Semnan Province. MSc Thesis, Emam Khomeini University, Iran, 119
- Safari H, Arzani H & Tavili A (2016). Selection of rangeland breeding methods based on environmental conditions: a case study in Middle Taleghan rangelands. *Range and Watershed Management. Iranian Natural Resources Journal* 69: 611-619
- Savory A (1987). A holistic approach to range management using short duration grazing. *Proc. Intn'l. Rangel. Congr* 1: 555-557
- Shoop M C & Mellvain E H (1971). Why some cattlemen overgraze and some don't. *Journal of Range Management* 24: 252-257
- Tawafi S & Arzani H (2012). Evaluation of the sustainability of rangeland exploitation by integrating social, economic, GIS and RS indices: a case study in Chalous Road ranges in the Arengah. Ph.D. Thesis, Islamic Azad University, Iran, 113 (In Persian)
- Teague W R & Dowhower S L (2002). Patch dynamics under rotational and continuous grazing management in large, heterogeneous paddocks. *Journal of Arid Environments* 53: 211-229
- Valentine J F (2001). *Grazing Management*. University of San Francisco: USA. 659
- Walker B (1993). Rangeland ecology: understanding and managing change. *Ambio* 22: 80-87
- Zare Chahuki M A (2016). *Data analysis in natural resources research using SPSS Software*. Jihad Daneshgahi Press: Tehran. 310