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Review Article

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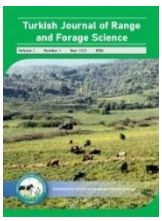

A Review on The Factors Causing Deterioration of Rangelands in Turkey[2]

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A B S T R A C T

In Turkey, the quality and production power of the rangelands have decreased over time by uncontrolled grazing, carelessness and without improvement of rangelands in time because they are medium benefited. Sustainability has not been achieved in rangeland improvement and management projects that implemented by the Turkish Ministry of Agriculture and Forestry for last 20 years. Mistakes concerning to grazing of animals are effective on the basis of both gradual reduction of the current classes of existing vegetations and the lack of improvements in the rehabilitated ones. Attention should be paid to the grazing time and intensity, animal distribution and animal species in order to use the rangelands correctly. Failure to comply with any of these principles causes rangelands to tend to deteriorate. Generally, problems are not to be faced in terms of the selection of the species of animals will be grazed in the rangelands in Turkey. On the other hand, animal distribution would be a problem in the vicinity of the settlement and water resources; otherwise, there is not any major problem in other areas. Heavy grazing appears as an important problem in the rangelands of some settlement areas where the number of animals is high. However, this is not the main factor causing deterioration of the most rangelands. Because approximately 75% of the land is evaluated for grazing the animals in Turkey. In contrast, untimely grazing is one of the most destructive effects on rangelands vegetation. Untimely or yearlong grazing causes serious damage to plants that do not produce enough photosynthesis tissue. On the other hand, it disrupts the soil-water-air-nutrient element balance for a long time by causing deterioration of the soil structure. This causes destructive effects, especially, in good plants and the condition of the rangelands is gradually decreasing. Consequently, firstly, observing the grazing season will solve at least half of the issues related to the deterioration and sustainability in range management

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1. Introduction

Vegetation occur and develop under the influence of grazing along with the influence of prevailing climate and soil factors present already in the environment. Rangeland vegetation with small fluctuations persist, unless there is a significant change in these factors. However, if there is a significant change in any of these factors effective in the formation of vegetation, then the vegetation will react to this and follow the occurred changes. For instance, the dry matter production of the vegetation decreases in first, subsequently, a change towards more resistant species is observed if they have seen the period of droughts for few years. This impact increases or decreases due to the grazing pressure in the rangeland. Similarly, vegetation sparse as a result of improper grazing causes soil losses (Fig. 1). In this way, the fertility of the soil decreases and less rainwater is retained into the soil. The environment of vegetation and soil changes, shrinking root mass and plants take less benefit from soil water.

Generally, there are no extreme changes in environmental factors if putting aside the changes in the global climate for the last half century. That is why, it cannot be said that the effect of climate and soil factors in the change of vegetation is the main factor. On the other hand, improper grazing is the main reason for the deterioration of rangelands all over in the world (Altın et al., 2011). Improper grazing is a kind of grazing that has been done without following the principles of rangeland management. Principles of rangeland management; (a) grazing with the suitable number of animals for the amount of forage that produced in the rangeland, (b) complying with grazing and resting times, (c) steady distribution of animals in the rangeland and (d) grazing with those animal species that make sure the best usage of plant vegetation and land structure in the rangeland. Among these principles, untimely and heavy grazing are the most effective in the deterioration of rangelands. Irregularities in animal distribution are mostly observed in the collection of animals in those rangelands which are close to village. Generally, problem has also not been faced in the selection of animal species. As a matter of fact, the presence of sheep and cattle is mostly located in the Eastern Anatolia Region, the sheep in Central Anatolia and the goats in the Mediterranean belt of Turkey.

Therefore, approximately 85% of Turkish rangelands are either in fair or in poor conditions (Avağ et al., 2012), in other words, the main reason for the presence of good and excellence rangelands at only 15% which is the subject of this review paper.

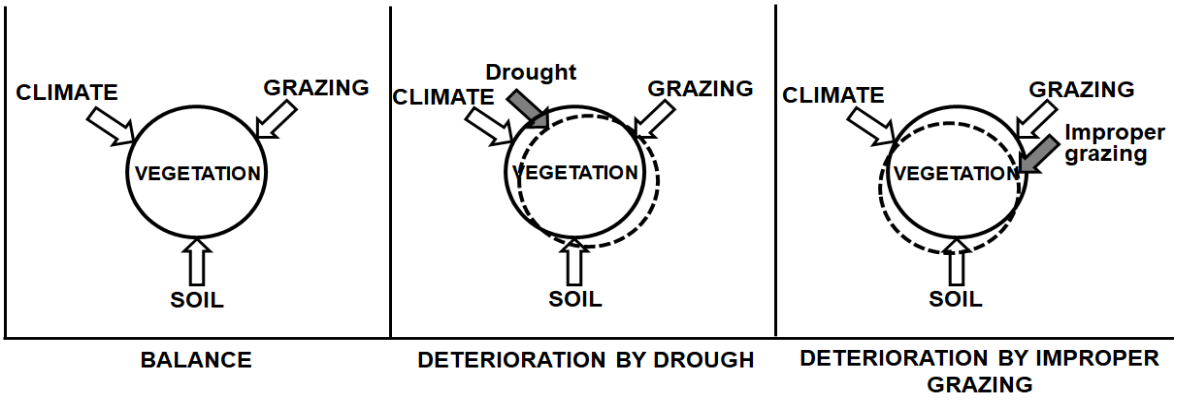

Fig 1. Vegetation balanced under climate, soil and grazing factors, and drought and deterioration caused by improper grazing.

Roughage Sources

Quality roughage sources of animals are the fodder crops sown in the fields along with the hays of rangelands and meadows. In addition, harvest and threshing as well as the factory residues are also offered to animals even if their feeding values are low. Also, in Turkey, a significant portion of the forage consumed by animals is constituted by crop residues (Gökkuş, 1994; Alçiçek et al., 2010). Since the relationship between production and consumption in rangeland livestock raising and its effects on the plants that are producers, and plant residues that can be used in livestock production and fodder crops are not considered in this review article.

Rangeland Presence

According to the data of the Turkish Statistical Institute, natural rangelands with a total area of 13.2 million hectares are concentrated in Eastern and Central Anatolian Regions in Turkey due to their climatic and soil properties. Apart from the Black Sea Region, the southern and western coastal belts are the regions with the least natural rangelands (Table 1).

Table 1. Distribution of rangeland areas by regions*

Regions	Total area (1000 ha)	Rangeland area (1000 ha)	Ratio (%)
Eastern Anatolia	16.355	4.861	29.7
Central Anatolia	19.802	4.704	23.8
Southeast Anatolia	6.175	749	12.1
Black Sea	11.642	1.269	10.9
Mediterranean	9.034	631	7.0
Aegean	7.496	435	6.3
Marmara	7.276	519	7.1
Total	**77.783**	**13.168**	**16.9**

* Calculated from the Turkish Statistical Institute (TÜİK)'s data in 2018.

Animal Presence

According to the livestock statistical data of Turkey for the year 2018, the total presence of animal heads are given as 63.6 million (TÜİK, 2018). Amongst, 46.1 million is composed of small ruminants (72.5%), 17.2 million of them are cattle (27.0%) and the remaining 0.3 million (0.4%) are equids. As a result of the calculation, the current animal presence totals 19.3 million AU. In the distribution of this by animal groups, it has been seen that the small ruminants have 4.4 million AU (23.0%), bovines have 14.6 million AU (75.6%) and the equids have 0.3 million AU (1.4%) shown in Table 2.

Eastern Anatolian Region occupies the first place with 14.4 million animal heads (3.7 million AU) in the distribution of animal presence by geographical regions. Central Anatolian Region ranks second in terms of number of animals (12.5 million head), especially because of the higher number of cultured cattle, but takes the first place in terms of its AU value i.e., 4.1 million AU. Southeast Anatolian Region is in the lower ranks as AU (2.2 million AU) despite of having the high number of animals (11.1 million head), especially, due to its high number of sheep population. The number of animals is less in coastal regions. However, Aegean Region has a significant number as AU due to the high amount of rearing the cultured cattle in large enterprises (Table 3.). But, almost all of these cultured cattle do not take benefit from rangelands.

Table 2. Livestock population of Turkey according to the statistical data of the year 2018.

	Number of animal		AU	
	Head	Percentage (%)	Head	Percentage (%)
Cultured cattle	8.419.204	13.24	8.419.204	43.52
Hybrid cattle	7.030.297	11.05	5.272.723	27.26
Domestic cattle	1.593.005	2.50	796.502	4.12
Buffalo	178.397	0.28	133.798	0.69
Camel	1.708	0.03	1.708	0.01
Total	*17.222.611*	*27.00*	*14.623.935*	*75.60*
Sheep	35.194.882	55.33	3.573.120	18.47
Goat	10.922.427	17.17	873.794	4.52
Total	*46.117.309*	*72.50*	*4.446.914*	*22.99*
Monogastric	273.029	0.43	273.486	1.41
Total	**63.612.949**		**19.344.335**	

Table 3. Distribution of livestock according to different geographical regions in Turkey (1000 head)

	Cattle				Small ruminant		Mono		
	Cultured	Hybrid	Domestic	Other	Sheep	Goat	gastric	Total	AU
Eastern A.	746,1	2.133,8	425,9	26,0	9.495,9	1.488,2	66,8	14.382,6	3.720,8
Central A.	2.080,1	1.326,6	186,2	23,5	7.597,5	1.243,7	39,9	12.497,5	4.109,0
Southeast	437,7	860,5	368,2	20,0	6.600,6	2.746,9	49,0	11.082,8	2.214,3
Blacksea	938,2	1.286,8	310,4	63,9	1.701,1	417,7	34,6	4.752,7	2.342,8
Mediterranean	843,3	469,1	74,8	3,1	2.800,2	2.984,9	19,4	7.194,9	1.776,0
Aegean	2.072,1	478,3	140,6	13,1	3.860,6	1.260,9	41,6	7.867,0	3.041,2
Marmara	1.301,8	475,3	87,0	30,5	3.138,9	780,2	21,8	5.835,6	2.140,2
Total	**8.419,2**	**7.030,3**	**1.593,0**	**156,6**	**35.194,9**	**10.922,4**	**273,0**	**63.612,9**	**19.344,3**

*Calculated from the data of the Turkish Statistical Institute (TÜİK) in 2018

Animal Presence Benefited from Rangeland

In large livestock enterprises, cultured cows are not left to natural rangelands but they are generally raised under a closed system of raising. Productive dairy animals reared by the small enterprises are also only allowed for very limited grazing into the rangelands. Therefore, cultured cattle have not been taken into consideration in calculating the amount of animals benefiting from the rangeland. In contrast, hybrid and domestic cattle are mostly grazed in the rangeland during the grazing season. On the other hand, since the number of equids is very small and not enough flocks can be formed in the rangeland, that is why, it is thought that these animals do not benefit in this extent that they affect the rangeland vegetation. Small ruminants (sheep and goats) are the animals which take most benefit from the rangeland. Even, mostly the grazing season is not taken into consideration when these animals are grazed. Small ruminants are grazed in the rangeland round the year as long as the weather conditions are suitable in winter. However, in regions where the continental climate prevails, snow cover and cold and humid weather in the coastal and passage zones make it difficult to graze in the rangeland. So, depending on the effective cold of winter and snow cover, small ruminants cannot take benefit from the rangelands in Eastern Anatolian Region for 4-5 months, 1-2 months from the rangelands in Central and Southeast Anatolian Regions, 0.5-1 month in Mediterranean and Aegean rangelands, 1 month in Marmara rangelands, 1-1.5 months in rangelands other than highlands in Black Sea Region, and up to 6 months only in the highlands.

In dry agricultural lands, fodder crops cannot be sown in summer since irrigation cannot be done. For this reason, the stubble remaining after the winter crops are harvested in early summer, are important feeding sources for animals. As a matter of fact, in a study conducted by Gökkuş et al., 2017, it has been reported that there was no significant difference between the live weights and body condition values of sheep grazing on wheat stubbles in sorghum-sudangrass pasture. In this regard, in the summer when the grass is decreasing and drying in the natural rangelands, the farm animals, especially the sheep are grazed in the stubble areas approximately for 2-3 months according to the regions. Small ruminants do not go to rangeland in winter, except for grazing season, as long as they graze in summer on stubbles. For this reason, it is accepted in the calculation that the small ruminants stay in the rangeland as long as the grazing season.

Considering the above mentioned issues, the results of the calculation and evaluation made in order to determine the presence of animals grazing in the rangeland are given in Table 4. According to this, it can be said that the areas accepted as rangeland are grazed with animals far above the amount they will carry (approximately more than 2.5 times). However, farm animals also make extensive use of areas (bushes, garbage disposals, roadsides, bumps in the field edges, etc.) outside of the rangeland. It is very difficult to estimate the extent of the contribution of grazing points other than the shrubby areas in animal feeding. Since the shrubby areas (rangelands) are in official records, it is possible to calculate the roughage that the animals can benefit from.

The shrublands, defined as degraded forests and included in the classification of forest, cover an area of 11.5 million hectares (OGM, 2012) and it is totally grazed by domestic small ruminants and partially by the hybrid cattle. Distribution, productions and carrying capacities of these areas according to regions are given in Table 5. In terms of climate characteristics, shrublands are concentrated especially in Aegean, Mediterranean and Black Sea Regions. As a result of the evaluation, the number of animals that could be carried by the shrublands has been calculated as 2.5 million AU. The supply-demand relationship between the number of animals and the actual rangelands, resulting from the grazing capacity, is explained in Fig. 2.

Table 4. Actual presence of animals benefiting from natural rangeland by region in Turkey.

	Grazing capacity (1000 AU)	Amount of animal utilized on rangelands (1000 AU)	Difference
Eastern Anatolia	2.187.5	2.901.3	+713.8
Central Anatolia	1.045.3	1996.7	+951.4
Southeast Anatolia	128.4	1.698.7	+1570.3
Black Sea	507.6	1.163.6	+656.0
Mediterranean	130.9	840.6	+709.7
Aegean	110.7	928.1	+817.4
Marmara	138.4	813.2	+674.8
Total	**4.248.8**	**10.342.2**	**+6.093.4**

Table 5. Amount of produced grazable feed and the number of fed animals in shrublands (degraded forest), (Gökkuş, 2019).

Regions	Area (1000 ha)	Yield* (ton ha^{-1})	Total production (1000 ton)	Grazing capacity (1000 AU)
Eastern Anatolia	1.173	0.8	938.4	205.7
Central Anatolia	1.453	0.8	1.162.4	254.8
Black Sea	1.726	1.2	2.071.2	454.0
Southeast Anatolia	966	0.8	772.8	169.4
Marmara	886	1.2	1.063.2	233.0
Mediterranean	2.049	1.0	2.049.0	449.1
Aegean	3.210	1.0	3.210.0	703.6
Total	11.463		11.267.0	2.469.5

*Amount of grazable dry hay.

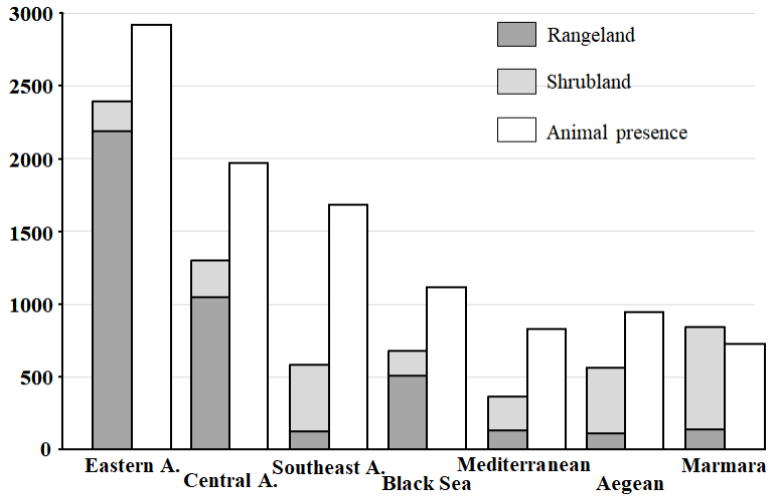

Fig 2. Grazing capacities of rangelands and shrublands and existing animal presence of the regions (1000 x AU). Dark columns indicate the supply and white columns indicate the demand of feed.

Based on this assessment, the obtained production from these natural feed producing areas in regions other than Marmara seems to be very far from meeting the need for roughage for the maintenance of animals in grazing season. Animal feed deficit is particularly high in the Southeast Anatolia Region. Decrease in rangeland yields and decline of shrublands in this region reveal this result. Widespread shrubs in coastal regions provide an important advantage to livestock raising of this region. It is possible to find green forage all around the year will be grazed, especially by small ruminants.

"Other land" represents those parts of the land which are not classified as productive lands (e.g., stony, steep, flooded, barren lands, etc.) having a share of the significant sources of animal roughage in our country. Such lands are among the places where farm animals mostly take benefit from. The area covered by these lands is consisted with 16.6 million hectares excluding agricultural lands, rangelands and forest areas. So, it has more space than rangelands. A part of these areas has already been covered as meadow- rangeland areas with 21.7 million hectares that is mentioned in the book titled 'Land Use in Turkey' (Anonymous, 1978) published in 1978 and also found in the statistical data issued in 1980 by the General Directorate of the Soil and Water. In other words, there is an area of approximately 7 million ha rangeland among other lands are already accepted as meadow- rangeland. It is very difficult to predict how much of the other land is grazed by the animals and what its production power is. However, it can still be said that the animals have been grazed in about half of these places. Livestock animals are grazed in an approximate of 75% of the land in Turkey by considering other lands, stubble and fallow fields, roadsides and forest areas are also used. For this reason, it can be stated that in regions other than the Southeast Anatolia Region, animals do not have any lack of roughage during the grazing season.

According to the statistical data of 2017, there is an acreage of 10.3 million hectares of cool season cereal fodder crops in Turkey. As a result of the calculation done by assuming that approximately ¾ of this area is used and the amount of grass stubbles that the animals can consume, is approximately 100 kg/ha, and an AU should consume 25 kg of stubble per day. Thus, it is concluded that the share of grass stubbles for the animals is equivalent to approximately 1.5 million AU.

Evaluation

By considering all of issues, it has been seen that the number of animals benefiting from the actual natural rangelands, therefore, the grazing pressure on the rangeland is not in a size that will lead to the degradation of vegetation. In that case, what could be the main reason for the existence of the risk of erosion (Koç et. al., 1994), and often being in poor or fair condition of the majority of rangelands in Turkey?

The main factor causing the deterioration of rangeland is the untimely grazing. By means of untimely grazing that the grazing has been carried out without paying attention to the critical periods of spring, summer and autumn, as well as grazing throughout the winter means grazing all around the year. Rangeland plants do not have unlimited power of production. They have sufficient photosynthesis and continue their biomass production when the environmental factors are not restrictive. In this respect, the factors that affect or even threaten the production of plants are grazing and unfavorable environmental factors. Plants should have enough photosynthesis tissues to reproduce after grazing. It is tried to be covered with already reserve nutrients in case the nutrients required for growth cannot be produced by the plant. In this case, plants grow less and use a lot of reserve nutrients. Also, a long period of time is required for the plant to recover itself after grazing since the growth is slow due to reserve nutrients (Altın et al., 2011). If grazing is repeated, there would be a proportional decreasing amount of reserve nutrients each time, and even, it becomes no longer able to fulfil the plant's need at a stage. The death of the plant occurs at this stage. Moreover, reserve nutrients ensure that the plants are physiologically strong, thus resisting against the negative use and environmental factors. Plants face these conditions more frequently in spring caused by untimely grazing. This heavy pressure forces particularly the desirable plants to withdraw from vegetation. Similar conditions are also be faced to the growth of some plants in the regions (coastal belts) where the winter season is cool. The development period, where the plants have small and green leaves, is the period when it is sensitive to grazing. Plants are found in this position in late autumn, cool winters and early spring; and very sensitive to grazing. During these sensitive periods, plants, especially the desirable plants in rangeland are seriously damaged by the implementation of yearlong grazing. Their powers of production fall dawn and they withdraw from the rangeland vegetation over time. As a result, rangeland condition gradually decreases and first, it becomes "fair" and then in "poor" condition. If this pressure continues, the rangeland completely loses its quality and becomes a land that does not produce crops. These periods when plants are sensitive to grazing also coincide with the cool and rainy season. Therefore, the soil is generally saturated with water and there is an excess of water at the bottom, too. Grazing such rangelands seriously disrupts the soil structure as well as the damage to the plants. Soil becomes compacted, its aeration is reduced, surface runoff and associated erosion increase and infiltration of rainy water becomes difficult. Root development weakens, the amount of organic matter in the soil declines, and the productivity

decreases. These negative conditions, besides the direct effect of grazing, decrease the production power of plants and invader species that are resistant to these conditions and mostly have noxious plants, that is, hay yield and low quality are adjusted in the environment. As a result, rangeland deteriorates and goes away from reaching the needs for roughage for animals.

2. Results

As a result of the above mentioned evaluations, in Turkey, the main factor involves in the deterioration of rangelands, contrary to popular belief, has been seen that come forward from the untimely grazing but not from the heavy grazing. The solution for this depends on the proper and correct management of the rangeland, especially the times of grazing and resting. If this can be done in addition, the expected improvement in rangelands can be achieved with the application of a proper and timely rangelands improvement program. Furthermore, in this way, the sustainability problem can be solved, which is still seen as the most important handicap in rangelands improvement and management projects carried out by the Turkish Ministry of Agriculture and Forestry. This is a well-known fact that the proper rangelands management is also an improvement method and that the desired results cannot be obtained if rangelands improvement practices are carried out on rangelands that are not managed properly. Here, besides proper management in the rangelands of Southeast Anatolia Region, focusing on improvement practices and supplement feeds to grazing animals is an important requirement for improving rangelands.

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