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HAZARD EVALUATION OF LIVESTOCK PRESSURE ON NATURAL RANGELANDS OF IRAN

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ABSTRACT

Overgrazing accelerates soil and vegetation degradation in Rangelands. So, Livestock Population Density-i.e. allocated number of sheep per ha- can serve as an index for measuring pressure on range environment. For this purpose, SADRA region has been selected as the study area, where it is located in the upper reaches of MAHARLU basin, Fars Province, Southern Iran. The required data has been extracted from existed records and published reports in ministry of Agriculture, ministry of Energy, Iran Statistics Center and Meteorology Organization. This study is to assess livestock pressure on rangeland in the study area, using Geographic Information System (GIS) tools and a model based procedure. FAO/UNEP Model has been selected for this purpose, which uses a ratio of potential carrying capacity of region to current Livestock Population Density as an Index for livestock Pressure. However, the model has been modified in this study to achieve a better estimation of pressure index according to the actual conditions of the region. Local parameters which have been used to modify this methodology are: annual consumption for livestock unit in the study area, dependency of each livestock to pasture, number of livestock unit for each animal and land use map. Hazard map of pressure of livestock was prepared after overlying and calculating the different parameters in a GIS. According to the results, hazard classes of severe and very severe include about 19% of the study area. Areas, including higher classes of hazard severity have been identified in the eastern part of the region. It is because of low potential of natural rangeland to grow enough forage and also a high number of livestock. Poor soil and harsh climate decrease natural potential of rangeland to grow more forage and to support livestock efficiently.

KEY WORDS : Livestock pressure, livestock unit, potential of forage production, rangelands, FAO/UNEP, GIS

INTRODUCTION

Rangeland ecosystems have been grazed by small ruminants mainly sheep and goats, for more than 5000 years (Noy-Meir and Seligman, 1979; Perevolotsky and Seligman, 1998). Arid and semi-arid grasslands in the Middle East also have been evolved for more than 8000–9000 years (Smith, 1995). Livestock play an important role in human-being livelihood. Nowadays, livestock have been grown generally to satisfy the same ancient demands- e.g. milk, meat, wool and manure. As shown in Fig.1, livestock in the area grew in big herds. Today, It is also as a saving-account for villagers and nomads' family as so they sell livestock at local markets, whenever they are in an urgent need of money.

Apart from key role of livestock in local and national economy, it has always been blamed for its effects on accelerating land degradation. It is while environmental degradation, caused by human pressure and land use changes, has become a major problem worldly-wide (Erlich, 1988; Wilson, 1992). Grazing with heavy stocking has also multiple effects on agro-ecosystems by defoliating plants and consequently influencing their growth, strength and regeneration processes. Besides, it reduces diversity of plant species as well as vegetation crown cover and amount of biomass. By reducing vegetation crown cover, water infiltration rate decreases and wind/water soil erosion also increases (Mwendera and Mohamed Saleem, 1996; Le Houerou, 1996; Asadu and *et al.*, 1999, Taddese, 2001). Compacted soil caused by herd, becomes strong, making it difficult for new shoots both to penetrate roots in and to emerge stems out of the soil. Such a soil is unlikely to drain well and will pond after a moderate rainfall. Soil particles from these zones will be susceptible to erosion carrying particles, organic matter and

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phosphorus to surface waters (Warren *et al.*, 1986).

When a region is affected by heavy stocking grazing, recovery will occur within a long period of time. The consequences are minor and reversible if grazing intensity is either low or moderate. Conversely, they become major and irreversible if it is very high. So it is very important to have a general view about grazing intensity, degradation hazard and the consequences to plan natural rangeland accurately.

The main objective of the study is to evaluate pressure of livestock in the region according to classification of hazard severity, while number and type of livestock has been considered as the key factors to determine the hazard classes. In this research, a model of assessing for livestock pressure has been proposed, using two types of data including thematic maps and attributions which has been stored, processed and analyzed within Arcview GIS environment. All the data obtained from the local offices and checked through intensive field work.

Fig. 1 Goat is one kind of livestock in the study area, grew in big herds.

Study Area

The Study area, SADRA region, is located in the western part of MAHARLU basin, Fars Province, Southern Iran. The region (Fig. 2) is bounded between Latitude 29°,40′ and 29°,56′ N and Longitude 52°,10′ and 52°,24′ E. Fig. 3 indicates the location of the region in the basin and in Iran.

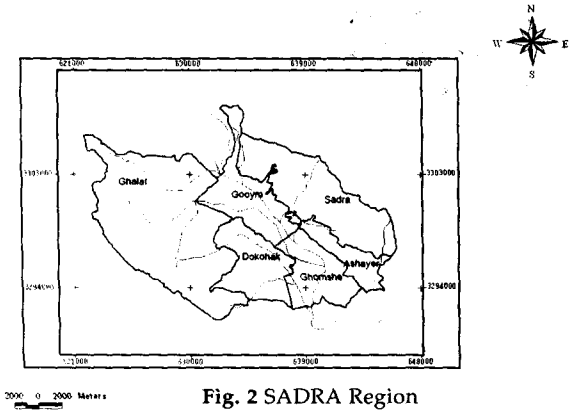

Fig. 2 SADRA Region

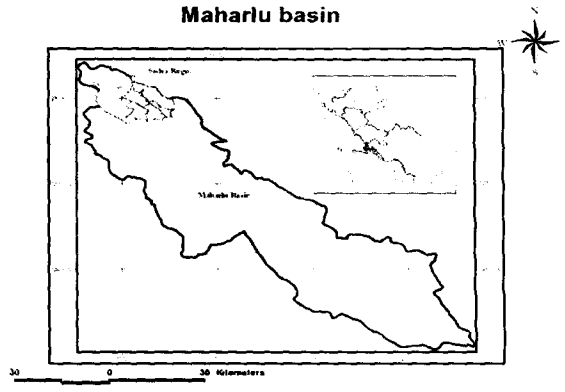

Fig. 3 Location map of Maharlu Basin in Iran.

It covers an area of nearly 25,112 ha, including Ghalat, Dokoohak, Gooyum, Ashayer, and Ghomshe countryside with 35,202 residents in 2006. The region lies in the semi-arid climate and receives only a precipitation less than 500mm, annually.

Method

FAO/UNEP Model of Livestock pressure assessment (FAO/UNEP, 1984) has been recommended the main framework to assess Livestock pressure on the natural Rangeland. The model has been adopted for the current study, considering some modifications to produce a hazard map, presenting a better estimation of pressure index according to the actual conditions of the region. To assess the pressure index of livestock the following steps have been taken:

Estimating Potential Productivity of Rangeland:

Potential productivity has been used as an indicator to classify rangelands. It indicates that how much a rangeland is able to produce forage (dry matter in Kilogram per year in ha) in a given climate condition without considering impact of anthropogenic activity. It has been calculated in following steps:

Assessing Consumable Dry Matter (CDM):

The following equation has been employed to assess consumable dry matter. It is based on amount of annual rainfall (R) for zones with winter rainfall (Le Houerou and Le Hoste, 1977), adopted by FAO/UNEP (FAO/UNEP, 1984).

$$CDM\ (kg / ha) = 2.17 \times R\ (mm) - 103.7$$

Applying the equation the map of the annual rainfall for the region has been turned into CMD map in Arcview GIS software.

Assessing CMD':

The method uses soil conditions to achieve a better

and more probable estimation of CMD than the above equation provides. It emphasizes on the influence of soil conditions- its capability and suitability- to produce biomass and annual dry matter of forage consequently. Hereby, a new value of CDM has been demonstrated by CMD' which is calculated from equations, presented in Table 1, offered by FAO/UNEP (1984) and Kharin (1986). The soil condition of the region has been extracted from existing reports (Jahad-e-Keshavarzi Organization of Fars, 2004). Finally, CDM' map of the region has been produced by overlaying map of land units, including attributes of soil suitability, on the CDM map and applying equations of Table 1 in Arcview GIS.

Assessing Potential of Carrying Capacity (PCC):

To assess this a ratio of CDM' to 440 is used: Potential of Carrying Capacity (PCC) = CDM' ÷ 440 the number 440 is the amount of the dried forage (kg) needed for each livestock unit (sheep) per year (1.2 kg per day; Report, Research Institute of Planning and Agricultural economics, 1998) while the forage need of each livestock unit (cow) per annum is estimated as 2000 kg in FAO/UNEP (1984) method.

So, the PCC indicates number of livestock unit (L.U.), can be supported by a (ha) of a certain rangeland annually. In this study "sheep" has been considered as the livestock unit, however, "cow" is the unit in FAO/UNEP method.

Assessing Actual Density of Livestock (ADL):

To assess ADL, first, equivalent livestock units are defined for various animals (Natural Resources Bureau of Fars Province, 2003). It has been indicated in Table 2 for the animals in the study area. Then animal dependencies on natural rangelands are considered, because farmers use some other complementary food resources such as agricultural debris, to feed their animals. It has been also demonstrated in Table 2 for different animal types of the region. So Active Livestock Unit (ALU), depend on natural rangeland, has been calculated by multiplying the number of the animals in each sub-region by the equivalent animal unit by the corresponding dependency rate. Then, total number of ALU has divided to the area of rangelands in each sub-region to calculate actual density of livestock in the rangelands. The maps of ALU and ADL have been produced for the region, including all sub-regions in Arcview GIS.

Assessing Livestock Pressure (LP):

Comparing the map of potential carrying capacity (PCC) with the actual density of livestock (ADL) presents the difference between natural potential of rangeland to supply forage sustainably and actual demands that there is for. To produce a hazard map of degradation, the maps (the PCC and the ADL) have been overlaid (divide) to present weights of Potential conditions against actual one. Then, the

Table 1. CDM's modified Equations, based on soil suitability for Natural Resources in the land units.

CDM's modified Equations	Soil Suitability for natural resources		Soil Limitations
CDM' = CDM + 0.25 CDM	Good	S1,S2	No limitations
CDM'= CDM - 0.25 CDM	Medium	S3	Medium limitations
CDM'= CDM - 0.50 CDM	Low	S4 ,S5	Severe limitations
CDM'= CDM - 0.75 CDM	Poor, very poor	N1 ,N2	Absolute Non-suitable soils

Table 2. Local Statistics for Livestock in the regions (Jahad-e-Keshavarzi Organization of Fars, 2007)

Sub- region	Rangeland (ha)	Number of livestock units								
		Sheep	Goat	Cattle			Buffalo	Camel	Others (like donkey)	Total
				Endemic	Exotic	Hybrid				
Equivalent Animal Unit		1	0.75	4	6.5	9.5	6.5	5.5	4.5	
Dependencies on Range(%)		60	70	26	20	5	75	90	75	
Ghalat	3523.95	560	117	-	-	85	-	-	194	956
Gooyum	610.72	427	138	-	884	46	-	-	-	1495
Ashayer	1053.21	1065	904	-	-	-	-	-	158	2127
Sadra	2329.29	510	248	-	-	-	-	-	14	772
Dokoohak	176.99	270	89	-	-	52	-	-	9	420
Ghomshe	337.80	362	163	-	-	52	-	-	18	595

final map has been classified by adopted FAO/ UNEP pre-defined categories to produce classified hazard map of the region. The categories, employed in this research, have been demonstrated in Table 3.

Table 3. Severity classes defined for livestock Pressure assessment

Severity Classes of Livestock Pressure*				
None	Slight	Moderate	Severe	Very Severe
≥ 5	1.5 – 5	1.0 – 1.5	0.5 – 1.0	< 0.5

* Livestock Pressure = Potential of Carrying Capacity (PCC) / Actual Density of Livestock (ADL)

RESULTS

The hazard map, shown in Fig.4, presents the livestock pressure in the region and the sub-regions. It reveals "very severe" condition of degradation hazard in the most parts of hillsides in the eastern SADRA region, which is only about 3.17% of total rangeland (Fig. 5). The "Severe" condition of degradation hazard is observed in the rest of the hillsides in the eastern and center part of the Region. It includes 15.9 % of total rangeland. The high pressure in the eastern part is related to the both lower potential of forage production and also numbers of livestock.

The "Moderate" degradation hazard conditions are located in Dokoohak plain and partly in the eastern of the region, like the hillsides of Ashayer sub-region. It covers only small parts of the area, about 0.75% of total rangeland. The hazard map shows most parts of the rangelands (about 80%) belong to the least hazardous condition, which is located in the western and the northern parts.

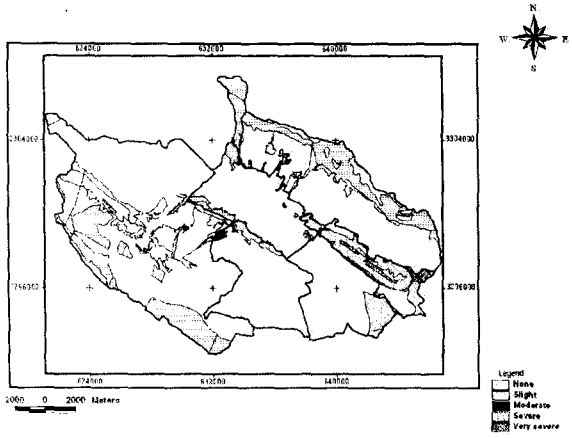

Fig. 4 The haxard classes of livestock presure in the region

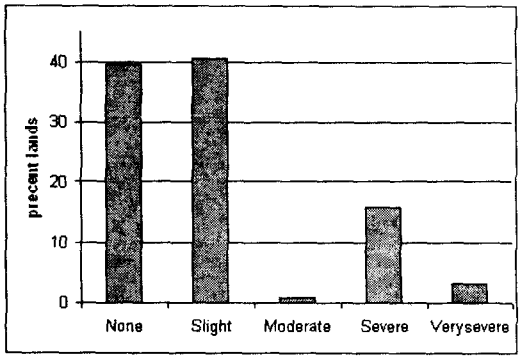

Fig. 5 Percent rangeland under different hazard severity classes of pressure of livestock in the sadra region.

CONCLUSIONS

Hazard analysis of livestock pressure is as a prerequisite of conserving and improving natural rangelands. Conserving and reclaiming rangeland in Southern Iran, highly threatened by overgrazing, is the need of the day. Hazard map using different data in the GIS together gives a far better opportunity to distinguish severity classes of livestock pressure. The study has employed criteria for assessing animal pressure, which are not universal and they have been elaborated on the basis of the local conditions. A ratio and classification of potential carrying capacity to present livestock density by FAO/UNEP (1984) method can be adopted for assessing livestock pressure in this region. However, some modifications, based on the local data, are needed to achieve a better estimate of the pressure. Local parameters, which have been used to modify the method, are: annual consumption dry matter for livestock unit, livestock dependency on natural rangeland and number of livestock unit for each animal. The hazard map shows that the areas under severe and very severe classes cover about 19% of the study area.

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REFERENCES

Asadu, C. L.A., Ike, O.O. and Ugwuoke, B.O. 1999 Cattle grazing and environment in eastern Nigeria: Impact on soil physical properties. Outlook on Agriculture, 28, 103-107.

Erlich, P.R., 1988 The loss of diversity: causes and consequences. In: Wilson, E.O., Peter, F.M. (Eds.), Biodiversity. NationalAcademic Press, Washington, DC, pp. 21–27.

FAO/UNEP 1984 Provisional methodology for assessment and mapping of desertification, Food and Agriculture Organization of the United Nations, Rome, 84p

Jahad-e-Keshavarzi Organization of Fars, 2007 Statistics of Livestock in Fars Province.

Jahad-e-Keshavarzi Organization of Fars 2004 Sadra watershed report.

Kharin, N.G. 1986 Desertification assessment and mapping: a case study of Turkmenistan, USSR. Annals of Arid Zone, 25, 1-17.

Le Houerou, H. N. 1996 Climate change, drought and desertification, Journal of Arid Environments, 34, 133-185.

Le Houerou, H. N. and Hoste, C. H. 1977 Rangeland production and annual rainfall relations in the Mediterranean Basin and in the African Sahelo- Sudanian zone, Jr. of Range Management, 30, 181-189.

Mwendra, E. J. and Mohammad Saleem, M.A. 1996 Infiltration rates surface runoff and soil loss as influenced by grazing pressure in the Ethiopian highlands, Soil Use and Management, 13, 29-35.

Natural Resources Bureau of Fars Province 2003 *Livestock report*, Ministry of Agriculture, Iran

Noy-Meir and Seligman, 1979. Management of semi-arid ecosystems in Israel. In: Walker, B.H. (Ed.), *Management of Semi-arid Ecosystems*. Elsevier, Amsterdam, pp. 113–160

Perevolotsky, A., Seligman, N.G., 1998. Role of grazing in Mediterranean rangeland ecosystems. BioScience 48, 1007–1017.

Research Institute of Planning and Agricultural economics (1998) complete studies for rehabilitation and development of agriculture and natural resource in the basins of rivers of Kor and Sivand, Shapur and Dalaki, Mond and Saheli of Persian Gulf: Livestock report, Ministry of Agriculture, Iran

Smith, B.D., 1995. The Emergence of Agriculture. Scientific American Library, New York, NY. Snyman, H.A., 1999. Short-term effect of soil-water, defoliation and rangeland condition on productivity of a semi-arid rangeland in South Africa. *Journal of Arid Environments* 43, 47–62.

Taddese, Y. (2001) Land degradation: A challenge to Ethiopia, *Environmental Management*. 27, 815-824.

Warren, S.D., Thurow, T.L., Blackburn, W.H. and Garza, N.E. 1986 *Journal of Range Management* 39, 491-495.

Wilson, E.O., 1992. *The Diversity of Life*. Belknap Press, Cambridge, MA, USA.