Model of extensive cattle grazing for sustainable use in rangelands

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Abstract: To design a model for sustainable utilization of rangeland suitability to cattle grazing, based on geographic information system (GIS) was considered. The framework of the study was based on FAO method for land evaluation (1991). The most important and feasible factors affect in rangeland suitability for grazing was investigated. From which three sub models including water accessibility, forage production and soil erosion sensitivity were developed. Suitable areas in four levels of (high suitable (S1), moderately suitable (S2), marginally suitable (S3), and not suitable (N)) were calculated in Sorkh-abad watershed. In general, slope and sensitivity of soil to erosion, were major limitation of range suitability in this region. Also, it was pointed out that none of the vegetation factors, was limiting factor, but some areas were recognized as S3 class due to the effect of erodible class as limiting factor and reduced production suitability class. High slope was caused reduction of suitability for cattle grazing due to difficulty of accessibility to watering points. Also, the results shows that 34.94% of rangeland is classified as moderate suitability (S2) and 6% and 59.60% are arranged as low suitability (S3) and non-suitable (N).

Keywords: range suitability, land-use, extensive grazing, sustainable, land evaluation.

Introduction

Combining land and land use in a land evaluation procedure gives land suitability, defined as the fitness of a land unit for a land use type which is assessed by comparing land use requirements of each land utilization type with land (FAO, 1991). F.A.O framework was created by focusing on rangeland topographical and ecological indicator that affect in livestock utilization. In this frame work the ability of types of livestock is considered. The ability of cattel to cover a long distance and sleep to reach a water source is lower than ability of other livestock. The criteria for rangeland suitability assumed for livestock grazing are classification into 3 sub-models of forage production, water sources and soil erosion sensitivity. Also, GIS is a useful tool in such a study of suitability evaluation [1].

This study is about to define influential factors on rangeland suitability for extensive grazing of cattle, proposing a model, and classifying rangelands suitability and finally define declining and limiting factors for cattle grazing.

Materials and Methods

In this research, Sorkh-Abad basin in Mazandaran province is located north of Iran was selected. This region extends from 52° 52´ to 52° 57´ east in longitude and from 35° 55´ to 35° 59´ north in latitude, covering about 2400 ha area. In terms of forage production suitability, proper use factor was determined based on class of soil erodibility, range condition degree and range condition trend classes. Then production suitability was determined based on available forage to animal. Water quantity, quality and distance were integrated to determine water suitability. For determination of soil erodibility suitability the EPM model was applied. Sub models of soil, forage and water formed final suitability model. Cattel are the most common type of large domesticated in Sorkh-abad rangeland. Suitability for cattle grazing was rated as illustrated by table 1.

Table 1: Factor rating of land characteristics

No	Rates	Meaning
1	S1	Highly suitable
2	S2	Moderately suitable
3	S3	Marginally suitable
4	N	Not suitable

In the present study, the limiting condition assessment was considered. Each land requirement factor that takes the lowest suitability was determined and, on the basis of this factor, class of suitability was defined.

1. **SOIL EROSION MODEL**

In the EPM model factors of erosion, land use, geology sensitive to erosion, and topography were evaluated.

2. **WATER ACCESSIBILITY MODEL**

Water resources consists of 3 sub-models including Water resources distance, water quality and water quantity. In this study, location, quantity, quality and distance of water resources in each property boundary was determined.

3. **FORAGE PRODUCTION MODEL**

The grazing capacity and the suitability of the forage production in vegetation types were first determined. The production of entire plant varieties edible to cattle were separately determined by cutting and weighing of samples in each plot at the end of the active growth period.

Vegetation species were evaluated to determine palatability them to cattle. Combining range condition, trend and erosion state in each vegetation type resulted in forage allowable use coefficient. Then available forage in each vegetation type was calculated.

Finally comparing the available forage with required forage level yielded the forage production suitability.
Combination of three sub models of soil erodibility, water and forage formed suitability model of cattle grazing in rangelands (fig. 1), ArcGIS 9.3 was used to produce suitability maps.
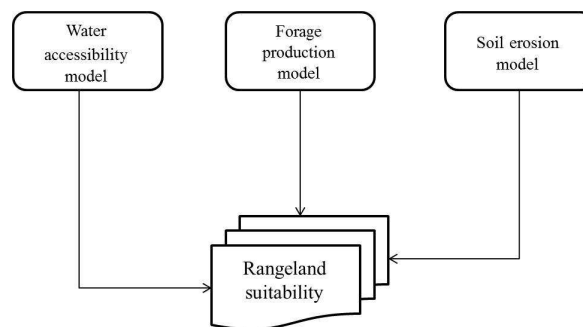
Figure 1: Final suitability model for cattle

Results and discussion

Results of integrating three sub-models are summarized by table 2.

Table 2: Suitability results in Sorkh-abad rangelands

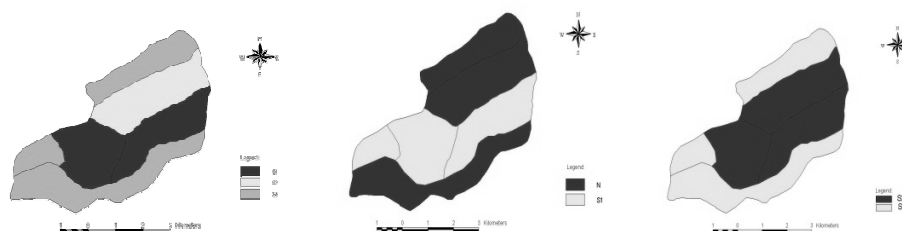| Suitability class	Sorkh-abad (Hectares)
Livestock	Cattle
S1	-
S2	838.3(34.9%)
S3	144.01(6%)
N	1418.06(59.06%)
Total	2400(100%)

Figure 2: three sub-models of water resources, erosion and forage suitability

The results showed the potential of the Sorkh-abad rangelands for extensive cattle grazing. The only limitation in forage productivity was early grazing finding for the region [1]. There was no limitation in terms of water quantity and quality in the area. All water resources were in the suitability class of S1. The only limitation of water resources was accessibility limitation in steep areas. Similar problem was reported in central areas of Alborz [4]. In this region the most pertinent limiting factor for erosion vulnerability was slope, converting rangelands into dry farming and presence of geologic formations sensitive to erosion. Most suitable areas are classified as S2. So cattle grazing limitation is not serious in the region. Grazing management could be practiced to control early grazing in the area. Also appropriate grazing systems should be applied to reduce undesirable species in vegetation composition [3].

In this area physical factors were more effective than vegetation factors. None of the vegetation types were unsuitable; however, in some cases range suitability were S3 class. In these cases, soil vulnerability to erosion is the limiting factor. Soil erosion is the most important driving force for the degradation of upland and mountainous ecosystems. Suitable water distribution, forage production and land cover were among advantages of the area. However, with regard to water accessibility model, slope was a declining factor [5].

Land cover changes and concomitantly runoff incretion resulted in more severe erosion which decreases the suitability grazing. Forage availability ratio to total production could be promoted by ecological management policies regarding range grazing capacity, range readiness for grazing, proper grazing distribution and retrieving desirable plant species [7].

Conclusions

In this study different limitations and opportunities for extensive cattle grazing were examined. Our finding shows that, a cattle grazing is one of the uses readily available for Sorkh-abad rangelands. This should be understood, rangelands' utilizations comprise certain qualities and criteria that the model prepared to assess suitability, must consider.

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