Introducing the GIS-Based Ecological Carrying Capacity Model of Nutrition Resources

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Introduction

The GIS- based Ecological Carrying Capacity Model of Nutrition Resources (ECCNR-GIS) software is a new approach based on rangeland assessment and the estimated energy content of forage. This software is derived from Badjian (2005) following studies on the ecological capacity model of livestock feed resources in Bakkan plain area, Southern Iran. ECCNR-GIS software is designed to calculate the regional ecological carrying capacity based on available forage resources and considers the energy metabolism (ME) requirements in relation to livestock management to estimate the animal needs. ECCNR-GIS software is written in Visual Basic, as a set of mathematical equations that represent a system of relations between production subsystems. The software is based on conceptual models and measurements taken from rangeland, agricultural fields and animal herds of Joobkhale region in Southern Iran. These subsystems include rangeland production as the main forage resource of the region together with farm byproducts that also play a significant role in the area. The current status of the rangelands does not meet the needs of the animal and hence the need to incorporate agricultural crops and residues. The model estimates the amount of energy produced from agricultural residues to determine overall nutritional supplies and carrying capacity.

Method

The production data from rangelands used in ECCNR-GIS software was estimated from plant species derived from digital plots and maps of slope, soil, pasture, palatability class status and trends at a plot level, with digital point location using GPS. Digital plots showed distribution of species in vegetation types. These were used as input information in the GIS environment. After weighing the dried samples, the amount of energy based on dry matter digestibility (DMD) was determined. Available forage AF, ME, DMD, and the production rate (P) of species were also estimated. A mathematical relationship between the amount of DMD and ADF (Acid Detergent Fiber) in ECCNR-GIS was established. In the laboratory, samples were dried and ground, and ADF value was measured to estimate the amount of DMD.

The software estimated the total energy produced compared with the amount of energy needed for the livestock subsystem in the area. Hand feeding systems of the animals was taken into account for by including rangeland and farm by-products through the calculation of the amount of energy. The software consists of all the relationships of herd type and composition of the herd as well as the relationship between grazing and rangeland, ranging from topography, class, slope class, soil rating palatability of the status. The trends in the pasture with the loss of energy are also given in the mathematical equation.

Results

Introduction of ECCNR-GIS features and its abilities can be described in following outputs:

I. Vegetation layer accompanied with ecological rangeland assessment is based on evaluated digital plots including the type of plant species in each vegetation type, slope, soil, pasture conditions, trends, range and class of palatability. Clearly the greater the number of digital points, the more accurate the result in a model.
II. Measuring the vegetation-types area is based on the species canopy in plots. A digital vegetation-type area layer is produced in GIS.
III. Based on topography of the region, soil classes can be determined. Compliance with the layer level of the digital environment, GIS, soil surface of each class can be obtained. The digital domain not only shows the location and condition of species on soil, but also in other parts of the region. In other words, the user can determine the state of the soil in the region.
IV. Based on topography of the region, steep class types can be determined. These levels are defined in terms of the classification model. As before, the user can recognize the entire class gradient in the study area that would assist in planning.
V. Domain combination of rangeland condition and trend in digital is defined in ECCNR-GIS. This combination would be compared in determination of the PUF (Proper Use Factor) coefficient. This factor helps the user to determine the combination level of grazing management in the region.
VI. Palatability as a factor in determining the amount of reducing multiple PUF is defined in the placement of digital surface in ECCNR-GIS. This map would help the user to make the necessary decisions for grazing management in the region.
VII. Range of plant-level production based on the differ-

ent types of digital harvested forage production levels is defined in ECCNR-GIS. Certainly, compared to the levels obtained in the previous steps, this factor would be an important rangeland grazing management decision-making factor.

VIII. Rangeland trending and condition, vegetation class, steep, slope and soil classes are factors that affect palatability and animal preference or PUF in ECCNR-GIS. Domain information would help the user for the aforementioned factors and optimal management to apply.

IX. Available forage (AF) of the rangeland related to PUF can be obtained in ECCNR-GIS. AF level helps the user to generate an optimal utilization (a maximum of 50% forage production).

X. Determination of metabolic energy (ME) of digitally located species in vegetation types that is based on DMD.

XI. Determination of DMD layout and levels in ECCNR-GIS, can be estimated by the ME.

XII. The final ECCNR-GIS output is ME level in digital vegetation map of the region. This map shows the ecological factors that impinge on sustainable ME production with consideration of the region's livestock. This map shows the ecological balance between livestock and rangeland.

Conclusion

Work with ECCNR-GIS software is easy and with a little education, most experts familiar with GIS can benefit from it. Changing the input data to the ECCNR-GIS, it can predict, on the basis of a herd of productive resources, provision of productive resources based on vegetation change in circumstances such as drought and subsequent ecological capacity of livestock feed resources in different conditions.

References

Badjian, Gh.R. (2005). Effect of Ecological Rangeland Management on Livestock Production of Settled Nomads in the Bakkan Region of Southern Iran. PhD thesis. Universiti Putra Malaysia (UPM). Malaysia.