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Prediction model for herbaceous vegetation production in a semi-arid environment: embedding fuzzy logic in GI

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Herbaceous vegetation annual production plays a key role in understanding ecosystem functioning. In semi-arid environments this production responds significantly to spatial and temporal changes in rainfall amounts to soil moisture distribution. Therefore, semi-arid regions are characterized by patchy pattern that was not yet fully explained in the detailed scale. The main reason for our limited understanding is the focus of scientific effort in polarized scales - small plot and large regions rather then in a detailed study of the intermediate scale (slope and watershed).

In the current research we present spatially and temporally explicit model to predict the potential of herbaceous vegetation production in both ends of a semi-arid region. The predictive model is GIS-based and the hypotheses are formulated using fuzzy logic.

The model seeks to simulate the hypothesized soil water requirements for potential herbaceous production through formulating spatial and temporal variation in four indirect variables: rock cover, radiation, runoff (TOPMODEL) and soil sub-slope units. In addition, we add to the model two climatic variables: temperature and rainfall amount. The radiation, sub-slope units and runoff were predicted using digital elevation data with 25X25m cell resolution, while soil characteristics, extracted from field survey, were also combined in the runoff model. Rock coverage was classified from air photo with 1.25 x 1.25m pixel resolution and the climate data is from standard meteorological stations.

The fuzzy logic production model allows prediction of two processes in the life span of the herbaceous plant: 1) germination - modeled in daily iterations until the conditions are satisfied; 2) primary production - modeled on a weekly basis. Finally, seasonal for herbaceous vegetation maximal production conditions in every cell were predicted.