TEMPORAL AND SPATIAL VARIATIONS IN THE SAHELIAN RANGELANDS: REMOTE SENSING TECHNIQUES FOR RESOURCE MONITORING IN NIGER

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ABSTRACT

Almost two decades of below normal precipitation receipts have had a pronounced impact on the environment and people of the Sahel zone in Africa. The degree of desertification that has occurred varies from year-to-year and from place-to-place due to the highly variable nature of Sahelian thunderstorm rainfall. As a result, a significant need exists annually for accurate and timely information on the current status of the environment. One cost-effective method for providing resource managers with some of the information they need is through digital image processing of NOAA AVHRR satellite data. This paper identifies the techniques currently being used by Projet Gestion de Ressources Fourragères to estimate the standing crop of annual grasses at the end of each summer rainy season.

An operational system exists within the Ministry of Agriculture and Animal Resources of the Government of Niger to produce summary statistics and maps of biomass production based on satellite data analysis each October. To-date, four years (1986-89) have been monitored and this resource assessment will continue. Estimates of biomass production are prepared using both remote sensing and GIS technologies combined with extensive ground truth data collection from over 30 sites across the Sahelian zone in Niger. The NOAA AVHRR data is converted into the Normalized Difference Vegetation Index (NDVI) and used in simple linear regression analyses to relate the satellite data to surface observations. Coefficients of determination for the four different years have ranged from over .90 to near .60. Inverse regression analysis is used to predict biomass for all areas of the grassland zone. The combination of image processing and GIS hardware and software are used to produce maps and summary statistics for individual resource management units within Niger.

Results obtained to-date highlight the strong temporal and spatial variability that exists. Included within the four years that have been analyzed are a year of extreme drought (1987) and a year of above normal rainfall (1988). Due to the spotty nature of each annual rainfall pattern, the best and worst years of grass production at many sites do not correspond with regional averages. A few sites had good production in 1987 whereas others had localized drought conditions in 1988. Examination of the four years of data provide several insights concerning both the time frame necessary and the quality of information that must be collected for global monitoring of environmental changes.