A DIGITAL GEO-REFERENCING SYSTEM FOR MONITORING GROUND COVER IN DRY LAND ECOSYSTEMS

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Rationale

Rangelands are the most widespread land use type in the dry areas, and are home to most of its poorest inhabitants. Having low productivity and potential, the people they support remain largely marginalized. Over-grazing and the transformation to cropland are major causes of productivity loss, leading to widespread land degradation and desertification, compounded by climate change. The first step in any rangeland rehabilitation/restoration intervention should be to assess rangeland condition. Given the dynamic nature of plant community responses to climate fluctuations and man-made disturbances, there is a need for both short and long-term monitoring of rangelands.

Until recently, rangeland assessments have been more subjective than objective. Ground cover is a key indicator of rangeland condition and influences rangeland management decisions. Cover parameters are typically recorded by field personnel using field sampling techniques. Monitoring requires repeated observations, which are stretched over vast areas of land, requiring a lot of resources. Due to the cost and subjectivity, the result is a reduction in the frequency and confidence of traditional monitoring. Fortunately, with the advances in geo-spatial and electronic technologies new opportunities for vegetation and ecosystem monitoring have been created.

Methods used and partnership set up

Ground-level photography has been used for many years to document rangeland condition. However its broader application was limited without knowing exactly where photos were taken. The integration of GPS into digital cameras has expanded the possibilities for rangeland monitoring. Scientists at the International Center for Agricultural Research in the Dry Areas and in collaboration with Oregon State University have been developing digital tools and protocols for monitoring rangeland vegetation in dry areas.

The technique called digital vegetation charting technique employs an automated classification of digital images using VegMeasure®. VegMeasure® is a non-commercial software that allows accurate analysis of vegetative ground cover (Louhaichi et al., 2010). Field-based images can be taken using a digital camera with built in GPS mounted on a stand. Images can be batch processed rapidly. This approach is less labor intensive, less biased, provides a permanent record for future scrutiny, is non-destructive, more efficient, and is repeatable (Booth et al., 2005; Louhaichi et al., 2010). The digital camera with built in GPS capability must be held at a fixed height above the ground, pointing vertically downward in the same direction.

Results

This method reduces the time, cost, and subjectivity of traditional monitoring. Previously, hand charting of vegetation in quadrats, a very time consuming and tedious method, was used to collect cover estimates in the field. VegMeasure speeds-up this process and provides long term datasets than can be revisited. Furthermore, the protocol standardizes the measurement process so that results are more uniform and reflective of the condition of vegetation growing on a site. We compared technician estimates of plant cover (green leaf, litter, bare ground) between technicians and against the VegMeasure classified image. Result indicates that there was a high amount of variation between technicians in traditional monitoring, due to the fact that estimation of cover is highly subjective, VegMeasure reduces the variance between technicians. Monitored areas can be revisited each season or year to assess the spatial and temporal effect of natural and human induced factors. The images become a valuable data set that records and characterizes the condition of the range at a specific locations and time to document change and range trend.

Easily generated detailed time series maps are needed to measure the impact of management and policy decisions as well as contribute to agricultural information systems. Current methods of assessing change and differences in range trend and rangeland health rely heavily on professional interpretation. The addition of data quantification provides an important tool as land management agencies transition from collecting data primarily as a guide for internal management decisions to data sets that address both management and litigation concerns. This method is a continual work in process to achieve these ends. VegMeasure can also detect pant stress such as the deficiency of phosphate or herbicide application (Preuss *et al.*, 2012; Louhaichi et al., 2013).

Outcomes

More detailed rangeland condition maps help land managers, development projects, and migratory pastoralists monitor, assess and manage their natural resources in arid and semi-arid rangelands in an improved manner. The suggested protocols and tools provide valuable information for assessing the impact of climate change, livestock/wildlife grazing, spread of degradation/desertification rates and thus, improve rural community livelihoods. More detailed maps on greenness are just the first step. This method can be coupled with further field measurements that can provide detailed maps of biomass and palatability. This information is essential to inform carbon markets, livestock insurance schemes, and to assist pastoralists in their decision making.

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