Quantification of land degradation and productivity of agro-ecosystems under changing climate and land use

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Abstract
Agro-ecosystems in dry areas are sensitive to changes in climate and land use. The gross and net primary productivities of these agro-ecosystems are highly variable in both spatial and temporal scales. Accurate and up-to-date information on grasslands and croplands along with extreme events are important for understanding the food security and sustainability of socio-ecological systems. In this research, we provide an overview of satellite and in-situ based observations and modeling of land use dynamics, coupled with edaphic and climatic factors in dryland production systems. Our efforts highlight recent advances in satellite-based mapping and in monitoring of croplands (cropping intensity, cropping calendar, crop types, crop rotation, water use, etc.) and grasslands (vegetation phenology and density) using time-series vegetation indices such as Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI) and Land Surface Water Index (LSWI). Secondly, the satellite-based Vegetation Photosynthesis Model (VPM) was used to estimate gross and net primary production of croplands, grasslands and tree-based systems. Thirdly, we introduce new methods in satellite-based mapping of grassland degradation and desertification from farm to landscape scales to identify prioritization hotspots for intervention and the design of improved adaptation strategy across the scales. Finally, paper discusses the role of community remote sensing and citizen science in the participatory monitoring of dry area grasslands and croplands. This is ongoing study, and initial results show the annual dynamics of the vegetation flux across the study region in response to climate and extreme events. The vegetation trend analysis seems to be a clear predictor of the productivity in response to degree of land degradation and LWSI is much more sensitive to productivity and droughts than does NDVI and EVI. We showcase the data products at the open access web portals (e.g., http://geoagro.icarda.org/) including smartphone apps, visualization kits and tools. The resultant data products are also adopted for the design of spatial decision support systems for rural advisory and policy analysis towards climate-smart villages and agriculture.

Keywords: remote sensing, grassland, drought, MODIS, NDVI, LSWI

Keywords: remote sensing, grasslands, croplands, agro-ecosystems, climate change, land degradation, productivity

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