

Scientific Summary

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Trends of Greenness in Addis Ababa and its Surrounding (2000-2017)

NDVI (Normalized Difference Vegetation Index) was introduced in 1974. Despite its limitations, it has been under use for monitoring bio-physical and cultural landscapes from satellite. The present study employed MODIS based NDVI to examine trends of greenness and its link with LULC (land use/land cover) change and rainfall in Addis Ababa and its surrounding (covering 1,217 sq km) over a period of 17 years (2000-2016). Supervised classification of LANDSAT was carried out to identify four thematic classes. Land use land cover change was detected using post classification comparison method. Yearly aggregates of mean, standard deviations (SD), minimum and maximum values of NDVI were generated from MODIS time-series images (n=387) and spatially mapped. The aggregated yearly NDVI and rainfall values were standardized to z-scores and statistically correlated. The change no-change classes were found to be 427(35%) and 790 (65%) square kilometers respectively. The study revealed an overwhelming increase in built-up area by 183%. Agriculture and vegetation were reduced by 34% and 29% respectively. A general decline in NDVI implying net-loss in greenness was revealed in the study area. Spatio-temporal variation was observed in the onset (start), green up (peak), senescence (decline) and end (dormancy) dates of NDVI. Spatially, three classes of NDVI were identified: low NDVI zone (the center with homogeneous built-up area), medium NDVI zone (the transitional zone with mixed LULC) and high NDVI zone (the periphery with a relatively better vegetation cover). Major land cover change classes were found to be predominantly located in the transitional NDVI zones and slightly in the peripheral zones. NDVI was found to be positively correlated with rainfall data ($R^2=0.25$, Addis Ababa station) and ($R^2=0.2$, Bole station). Nevertheless; the correlation between maximum NDVI and rainfall values has shown a decreasing trend over the years (highly declined after 2010). NDVI decline was found to be earlier (2008/09) in the time-series compared to rainfall (2010/11). The study concludes that decline in NDVI between 2000 and 2016 in the study area is more explained by net-loss in vegetation and agricultural land than decline in rainfall. Ultimately, the study recommends the integration of field based bio-physical and anthropogenic variables with fine spatial resolution remote sensing data for further research.

Key Words: Physical Geography and Ecosystem Science, NDVI, Addis Ababa, MODIS, Time-series, Greenness, LULC.

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Master degree project 30 credits in Geo-Information Science and Earth Observation for Environmental Modeling and Management (GEM) , 2017

Department of Physical Geography and Ecosystem Science, Lund University. Student thesis series **nr 24**

Monitoring trends of greenness and LULC (land use/land cover) change in Addis Ababa and its surrounding using MODIS Time-series and LANDSAT Data