A joint MSc Thesis Topic between Center for Remote Sensing of Land Surfaces (ZFL), Geography Institute and International Institute of Tropical Agriculture (IITA)

Introduction of Africa RISING Program

The goal of the Africa Research in Sustainable Intensification for the Next Generation (Africa RISING - https://africa-rising.net/) program is to create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems. Africa RISING endeavours to improve food, nutrition and income security, while conserving the natural resource base. The program undertakes integrated research on sustainable agricultural intensification (SAI) technologies to enhance crop productivity while reducing negative environmental impacts in small holder farming systems in Five African countries. SAI comprise of proven best-bet agronomic technologies such as improved varieties, good agronomic practices and soil and water conservation measures.

SAI technological options are suited for specific biophysical and socio-economic context. To improve spatial targeting of technologies, Africa RISING program use geospatial tools and methods to characterize the biophysical and socio-economic systems in which validated bundles of SAI technologies can be extrapolated with least risk of failure. Therefore geospatial analysis is utilized as a decision support tool that ensures that the research outputs are in sync with the socio-economic, ecological and policy dimensions in the target regions. Below is an outline of MSc. topics planned for 2019.

1. **Spatial assessment of land degradation in semi-arid zone of central Tanzania**.

Abstract:

Land degradation that is reflected in decline in vegetation cover and depletion of soil fertility ia a major biophysical constraint to agricultural productivity in semi-arid zone of Tanzania. The situation is aggravated by low and unreliable rainfall, frequent famine, overgrazing and increased cultivation of marginal areas. Design and implementation of site specific rehabilitation programs are hindered by limited availability of reliable information on magnitude of degradation at particular location. Ground assessments are laborious and only cover limited areal extent. Earth observation satellites provide repetitive monitoring of earth resources over extensive land mass and therefore could provide timely proxy for monitoring the extent and magnitude of changes in ecosystem health. The main aim of the proposed study is to develop a spatially explicit land degradation index (LDI) for Kongwa and Kiteto Districts of Tanzania. The LDI map is expected to guide spatial targeting of land rehabilitation programs using agroforestry and other soil and water conservation practices.

A short description of methodology.

The proposed study will utilize time series earth observation data on vegetation productivity indices, weather (precipitation, Tmin and Tmax, runoff, etc), topography, and soils chemical and physical characteristics. These will be complimented by field measurements of degradation using land degradation surveillance framework (LDSF). Gridded time series data for vegetation productivity indices and climate data will be utilised to investigate long term spatial-temporal trends. The

influence of climate change signal and anthropogenic factors in driving the vegetation trends will be quantified. The input factors and generated vegetation and climatic trends will be subjected to a spatial multi-criteria analysis to generate a map of land degradation index (LDI). Vegetation productivity and climatic trends will be correlated to assess the strength of climate change and anthropogenic signals in driving vegetation trends. Maps will be validated by correlation with field observed soil erosion severity index. Appropriate land rehabilitation practices will be recommended based on LDI values.

Study area.

Kongwa and Kiteto districts are located in the Dodoma region, central Tanzania. The area is characterised by undulating to rolling plains and plateaux with elevation ranging from 500 to 1200 meters above sea level. Rainfall is unimodal to weakly bimodal with precipitation ranging from 500 to 800 mm per year but exhibit wide spatial variability. Soil moisture is the most influential factor affecting crop production and this is mainly caused by inadequate and erratic rainfall distribution. Similarly, continuous cropping of cereal-based systems has led to severe land degradation resulting from soil erosion, which in turn results in loss of ecosystem benefits. Poor farming practices, particularly in areas with soil pan, may result in 30% to 66% loss of rainwater in semi-arid areas. Main crops grown include sorghum, pear millet, and maize but yields are very low (1 - 1.5 t/ha for maize compared to a potential yield of 4.5 t/ha).

We offer:

The proposed study will be conducted at ZFL, University of Bonn in cooperation with the Geospatial unit of IITA - Africa RISING program. There will be a need for a fieldwork hosted by IITA in Tanzania (research costs such as local transport and accommodation during field data collection in Tanzania will be covered by host).

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