Using soil-vegetation-atmosphere models and downscaled global climate scenarios to assess the impact of climate change in Morogoro region, Tanzania

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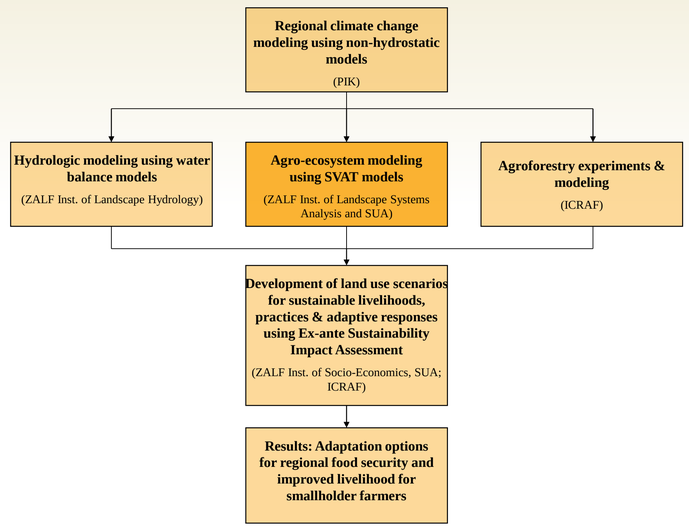
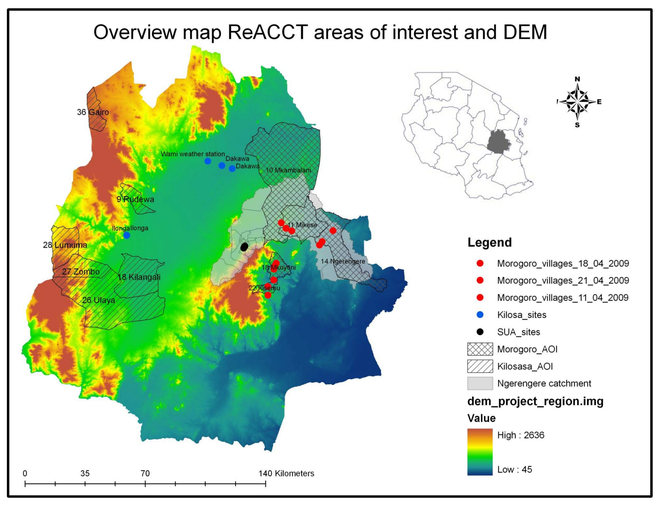
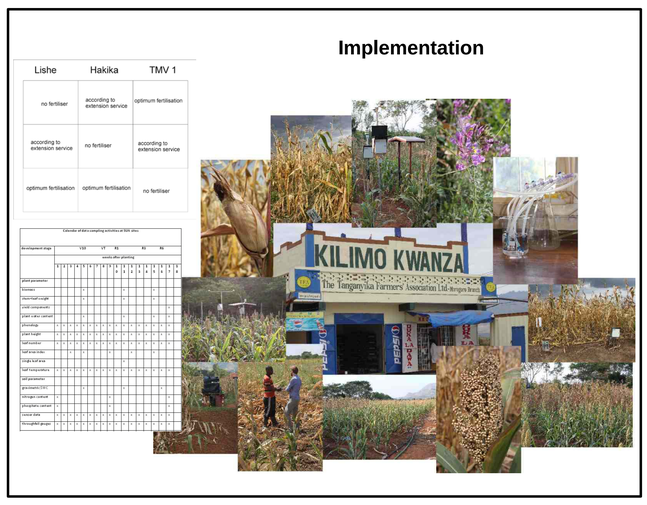
Project Background and Objectives

Climate change is a recognized risk to peoples' livelihoods in Tanzania. The projected impacts include: variability in temperature,rainfall, flooding and drought. This affects different sectors namely agriculture, water resources & ecosystem services among others. Final effects are being felt in reduced agricultural production,diminishing river flow & possibly ground water. This will be coupled with increasing demand for food due to increase in human pressure.
ReACCT (Resilient Agro-landscapes to Climate Change in Tanzania) aims at assessing the regional impacts of climate change on agriculture and environment in the Morogoro region of Tanzania and at designing adaptation strategies and practices for small-scale agriculture and land use. The sub-project crop-soil modelling concentrates on model based estimations of climate change impacts on current land use systems and practices. At three research sites, distributed over the project region and with distinct climates, field trials are conducted to assess the yield potential of widely-used maize and sorghum varieties. The data obtained from the study are used to calibrate multiple soil-vegetation-atmosphere models ranging from rather simple to process-oriented models, which are able to simulate the bio-geophysical interactions between climate, soil and vegetation. These models are sensitive to changes concerning soil hydrology, nutrient cycling, and crop response to assess combined climate change and management effects on crop production, water resources and soil fertility. Combined with downscaled global climate scenarios, these models evaluate the best management practices for future climatic conditions. In another approach tested at sites at the Sokoine University in Morogoro the effects of including trees into the farming systems are investigated. Here the maize and sorghum varieties taken into account are cultivated at one site under standard conditions, whereas at the second site the plants are shaded by native Acacia trees. The effects of the shading on growth and development are measured *in situ* as well as the water use of trees and crops to quantify water competition between the plants. The interrelationship of these processes is modelled using the Water, Nutrient and Light Capture in Agroforestry Systems (WaNuLCAS) model, which has been developed at the World Agroforestry Centre.



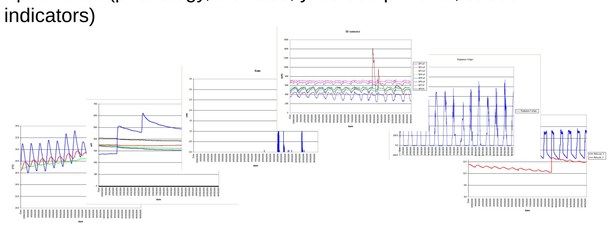
Location and Implementation





Data collected at trial sites

- weather data (radiation, rainfall, air temperature, humidity, soil temperature)
- soil data (physical and chemical parameter, soil water content)
- plant data (phenology, biomass, yield components, stress indicators)



Crop Modeling Objectives

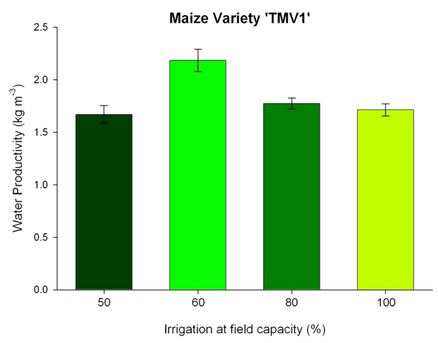
- to test the yield performance of commonly used hybrid varieties (maize, sorghum) in field trials at 3 locations in Morogoro region
- to test the performance of different treatment levels (water, fertilizer)
- to measure water use of crops to quantify water use efficiency
- to calibrate crop growth models for regional conditions and varieties
- development of scenarios of future yield performance based on the combination of crop modeling with climate change scenarios
- to identify suitable models for research at SUA and offer capacity building
- comparison of performance of local versus improved maize/sorghum varieties in cooperation with Norwegian scientists (University of Oslo)
- generation of detailed land use maps of the project region based on LandSat data from 3-4 decades

Crop Models to be tested

CropWat FAO
AquaCrop FAO
Parched Thirst SUA
DSSAT ICASA
Hermes ZALF
Monica ZALF

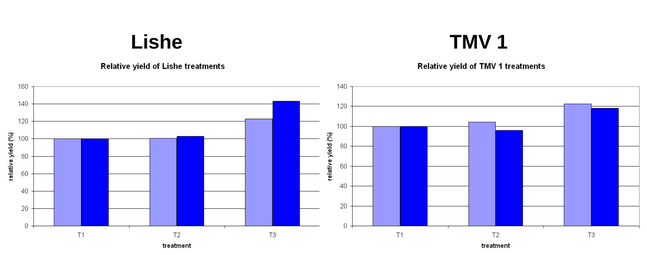
Preliminary Results

Results master thesis Richard Festo



Water productivity (kg/m3) of maize variety TMV1 under different irrigation treatments (T1= 50% field capacity (fc), T2 = 60% fc, T3 = 80% fc, T4 = 100% fc)

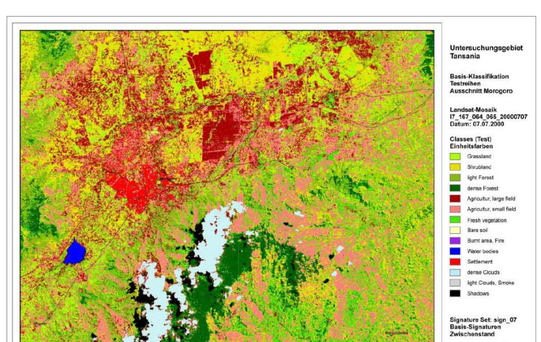
Preliminary results of field trials at SUA Masika 2010



light blue = whole plant
dark blue = cobs

T1 = no fertilization
T2 = according to extension service
T3 = optimum fertilisation

Preliminary results of land use classification



Outlook

- crop models will be calibrated with obtained trial data sets
- based on the generated landuse and soil maps crop modeling results will be upscaled to the regional level
- results of crop modeling will be linked to climatological, socio-economic and hydrological sub-projects
- scenarios of future performance of tested varieties will be developed
- paths of rural development will be analysed based on combined project data

- further field trials in the ongoing/upcoming dry and rainy seasons are needed to improve the data base
- in cooperation with Ola Westengen additional local varieties are tested in field trials
- seed market for local and improved varieties will be investigated

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