

## Landuse and Land cover Mapping of the Simiyu Catchment (Tanzania) using Remote Sensing Techniques

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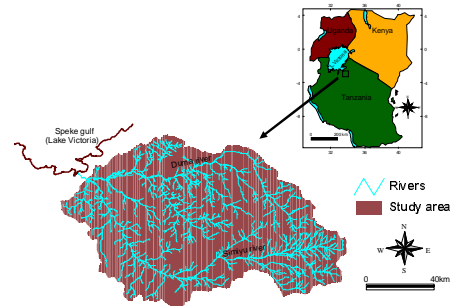
## Introduction

- **Lake Victoria**
  - Largest Lake - Freshwater (Africa)
  - Share resources (Tanzania, Uganda, Kenya)
- **Water quality (declining)**
  - Non-point sources & Point sources
- **Non-point sources (Agricultural fields)**
  - Fertilizer (P) and pesticides
  - Others: sediments, etc.
- **LVEMP, 1997** (Tanzania, Uganda, Kenya)
  - Rehabilitation, Monitoring, Control (water quality of the Lake)

## Fate/Transport and Objectives

- Trends of increasing contaminant (phosphorous and pesticides) concentrations in the Simiyu river originate from agricultural fields
- **Transport:** dissolved form or associated with sediments  
**Study:** to predict the transport of pesticides and phosphates in the Simiyu catchment, **baseline data** are prerequisite.  
i.e. "Land use/Land cover map"
- **Problem:** do not focus on pollution issues, old & cover big area
- **Objective:** Integrating remote sensing techniques and field data to reasonably map landuse and land cover in the Simiyu catchment, which provides recent and reliable information for water quality and quantity simulations

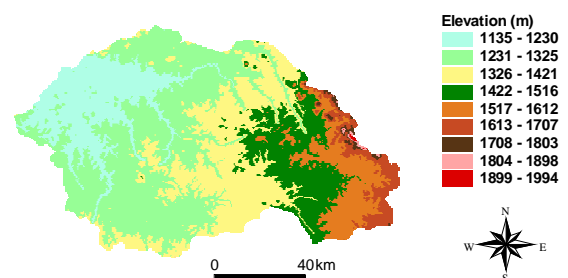
## Study area -Simiyu catchment



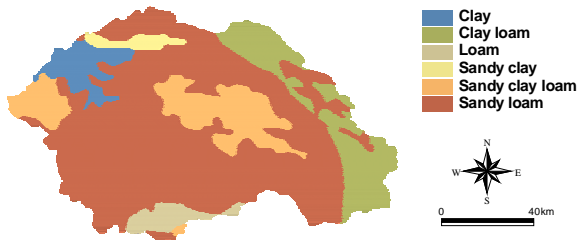
## Catchment Characteristics

Area	10800 km <sup>2</sup>
Topography	1140 - 1640 m
Soil type	Sandy loam (60%)
Landuse	Cultivated, Grassland, Bushland
Climate	Annual rainfall: 700 - 1000 mm
	Temperature: Average 23 <sup>o</sup> C
	Annual evaporation: 1973 mm
Hydrology	Discharge: 0 - 208 m <sup>3</sup> /s

## Topography



## Soil map



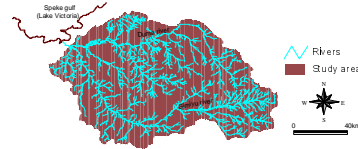
## Landuse and Land cover Mapping

### Steps involved

Purchasing satellite images, satellite images preprocessing (Idrisi32 release 2) & interpretation, field data acquisition (supervised classification), images classification

### Satellite images data acquisition

LANDSAT7 ETM+, 170/062 of 3/4/2001 and 169/062 of 12/5/2001, each 8 bands, USGS, GEOTIFF format, resolution band 1-5 and 7 (28.5 m)



## Landuse and Land cover Mapping *cont.*

### Image registration

Images were registered using GCPs topographical maps scale 1:50,000, **criteria** at most RMS 0.5 pixel = 14.25 m

### Images processing (enhancement + interpretation)

Differences among 2 scenes (different dates), colour composite band 345 (insignificant differences), scenes mosaicked and processed single images (Fig.)

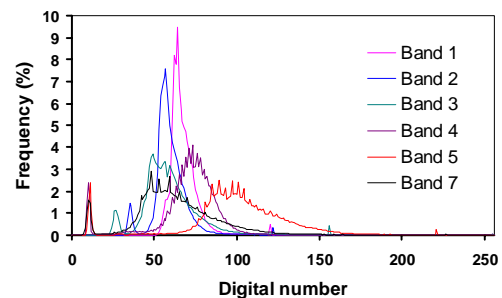
### Results:

Not all land use and land cover identified

### Alter. solution:

Use field data for supervised classification to classify satellite images, land-use & land cover in the Simiyu catchment

## Landuse and Land cover Mapping *cont.*



## Landuse and Land cover Mapping *cont.*

### Field data acquisition

**Prior field campaign:** collection of all possible land-use & land cover categories, using frequency histograms of six bands, color composite images, principal component images, and general prior knowledge of land-use; 11 dominant categories were identified

**Training sites selection:** 11 dominant categories in images 3, 4, and 5, principal component. Criteria: large coverage, uniformity and accessibility

### Training sites data collection

Extensively 2002 and 2003, sites visited tallying image acquiring dates & digitized and stored in LT computer

**Note:** Crops individually not identified (mixed)

## Landuse and Land cover Mapping *cont.*

### Classification (Idrisi32, Supervised & Maximum likelihood)

#### Step 1: Training sites and signature development

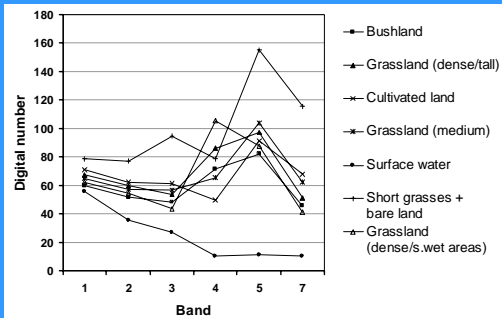
Training sites were digitized (band 345), **uniformity**, **avoiding mixed pixels**, ensuring **at least 100 pixels** & evenly distributed over study area

**Signature development (MAKESIG), evaluation (SIGCOMP)**, similar and overlapping signatures detected using box plots & HISTO

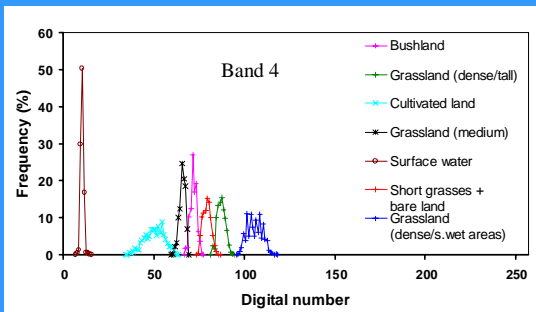
**Condition** - maximum likelihood method: means of signatures be **significantly separable** and **uniformity** of training sites maintained

**Step 2: Classification**, using maximum likelihood algorithm was performed to developed signatures

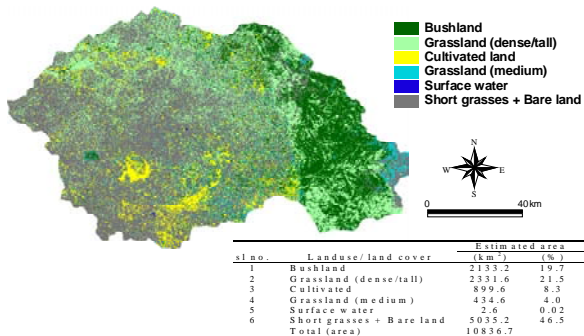
## Landuse and Land cover Mapping *cont.*



## Landuse and Land cover Mapping *cont.*



## Landuse and Land cover Mapping (Classification Results) *cont.*



## Conclusions

- Combining remote sensing, Idrisi32 image processing software, GIS and extensive/detailed ground information to reasonably map landuse and land cover of the Simiyu catchment has been achieved. Landuse and land cover is extremely valuable especially for water quantity/quality predictions, and assessing hydrological effects of landuse changes.
- The use of frequency histograms of the bands, general prior knowledge of landuse, together with colour composite images features existing in the Simiyu catchment could be predefined and mapped.
- Using well defined training sites, better separability and uniformity, supervised classification procedures and maximum likelihood classifier prove to be useful in the classification of satellite images.
- The Simiyu catchment is by far dominated by mixed short grasses and open land (46.5%), suggesting that the Simiyu catchment is highly subjected to erosion.

## Recommendation

- Possible improvement and subject for future work: The use of various sets of satellite images covering all seasons, to discriminate crop types from cultivated land or if existing from mixed short grasses and open land.

