

# **LONG TERM MONITORING AND ASSESSMENT OF NATURAL RESOURCES: REMOTE SENSING AS A COMPONENT OF AN INTEGRATED APPROACH – THE CASE STUDY OF THE LAKE VICTORIA BASIN IN KENYA**

**By**

- 1. Ambrose Oroda**
  - 2. Stephen Anyango**
  - 3. Charles Situma**  
and
  - 4. Anne Branthomme**
- 1 INRA National Consultant – Remote Sensing and Mapping**
  - 2 INRA Overall National Consultant – Kenyatta University**
  - 3 INRA National Project Coordinator – Department of  
Resource Surveys and Remote Sensing (DRSRS)**
  - 4 INRA-Kenya Project Manager – FAO, Rome**

# INTRODUCTION

- Human well-being and progress are vitally dependent upon the ecosystems goods and services:
  - Food
  - Freshwater
  - wood-fuel
  - Fibre
  - Medicines
  - Meeting man's spiritual, recreational and educational needs
  - Stabilizing soils
  - Stabilizing climate.

# INTRODUCTION Cont.

- Population pressure has resulted in increased demand for ecosystem goods and services:
  - This has resulted in over-exploitation and altering of the ecosystems negatively
  - It has resulted in changes in the ecosystems structures
  - It alters ecosystem functioning
  - Modifying the basic physical properties of the ecosystem
  - Disrupting the complex interactions that typified the original ecosystems.

# THE KENYAN SITUATION

- The Kenyan economy is principally natural resources based
- The main sources of livelihoods for the majority of Kenyans are agriculture, livestock production, exploitation of forest resources and tourism
- Land and the resources thereon are, therefore, very critical for Kenya, and constitute the basis for survival

# THE KENYAN SITUATION Cont.

- The ecosystems resources in Kenya are threatened by degradation arising from
  - accelerated deforestation
  - Desertification
  - soil degradation
  - increasing industrial pollution
  - decrease in biodiversity
  - increase in invasive non-palatable species
  - decrease in the quality and quantity of water
  - depletion of mineral and wildlife resources

# THE KENYAN SITUATION Cont.

## DEGRADATION

- Threatens the economic, social, political and the physical well-being of the country
- Affects resources integrity
- Diminishes the population's ability to obtain their basic needs and results into increased levels of poverty and food insecurity

# ECOLOGICAL/ECOSYSTEM RESOURCES MANAGEMENT

- Availability of current and accurate information is very important for the development of sound policies
- There is still limited knowledge, understanding and awareness on the severity of environmental challenges in Kenya at both the local and national levels

# ECOLOGICAL/ECOSYSTEM RESOURCES MANAGEMENT Cont.

- Periodic spatial land cover and land use assessments are important:
  - generate information on the state of environment
  - Assess conditions and trends of the natural resources
  - Provide information on environmental hotspots resulting from unsustainable utilisation of the natural resources. The hotspots could be due to:
    - deforestation
    - degraded wildlife habitats
    - diminishing biodiversity
    - loss of wetlands
    - water degradation sites
    - Etc.

# ECOLOGICAL/ECOSYSTEM RESOURCES MANAGEMENT Cont.

- The various components and resources in an ecosystem are closely interrelated hence the need to manage and assess them in an integrated and holistic manner
- For example, there is need to enhance understanding the interactions between land use management practices and the natural resources and ecosystems functions and services
- In Kenya, the assessments of the ecosystem resources have been mainly sector based or driven by limited information needs by policy makers or institutions targeting one particular aspect or a particular resource

# INTEGRATED NATURAL RESOURCES ASSESSMENT (INRA)

- Because of the narrow approach to resources assessment in Kenya, a programme known as INRA was conceptualised.
- It is an ecosystems based approach by FAO (of the UN) and GoK under FNPP and GoK funding.
- Aim – to establish a monitoring system that can generate information on the state of and changes in the environment and natural resources for:
  - policy formulation
  - land use planning
  - conservation and sustainable use of the resources

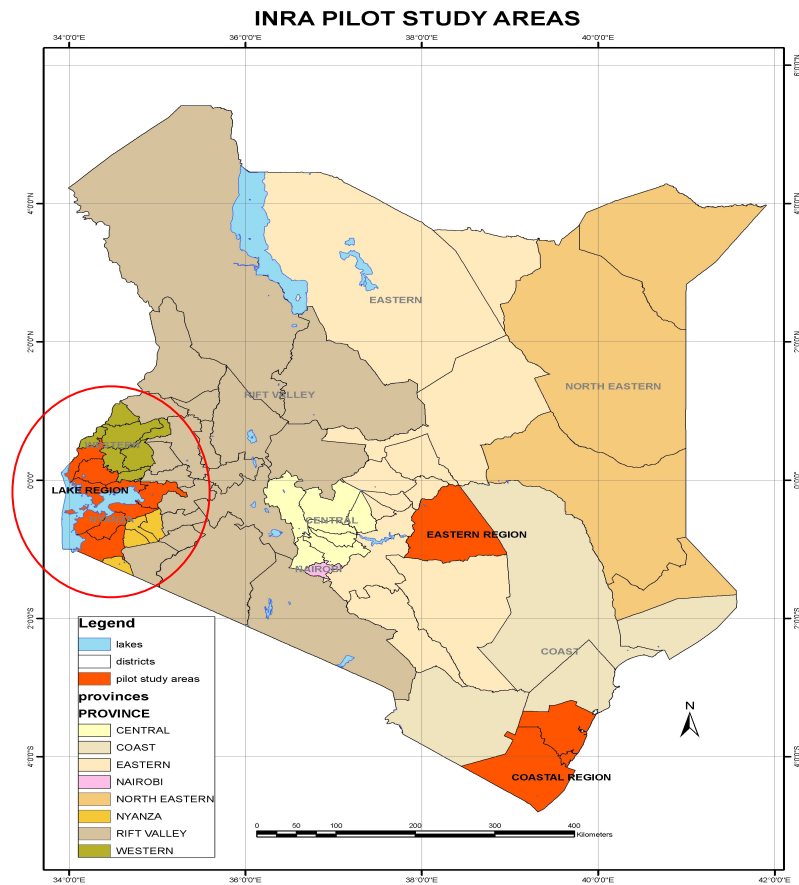
# REMOTE SENSING AND MAPPING COMPONENT

- RS – is an efficient tool to track and monitor both spatial and temporal transformations on landscape thro' LCLU mapping.
- Combined with in *situ* assessments, other biophysical data and socio-economic data, RS makes assessments integrative and holistic.
- The integration and manipulation of the RS spatial data into Geographical Information System (GIS) makes analyses and understanding of land use change processes much easier.

# THE STUDY AREA

- The Lake Victoria basin in Kenya
- Approx. 38,900 sq. km or 22% of the entire LVB.
- One of the most densely populated areas of the world, about 300 persons per sq. km in Kenya
- One of the poorest rural populations in the world - over 55% poverty rate.
- Major basic livelihoods
  - crop farming
  - livestock production
  - fishing
- Majority are small scale peasant farmers, many practising subsistence farming
- The area is vulnerable to many environmental changes

# STUDY AREA Cont.



16<sup>th</sup> – 20<sup>th</sup> June 2009

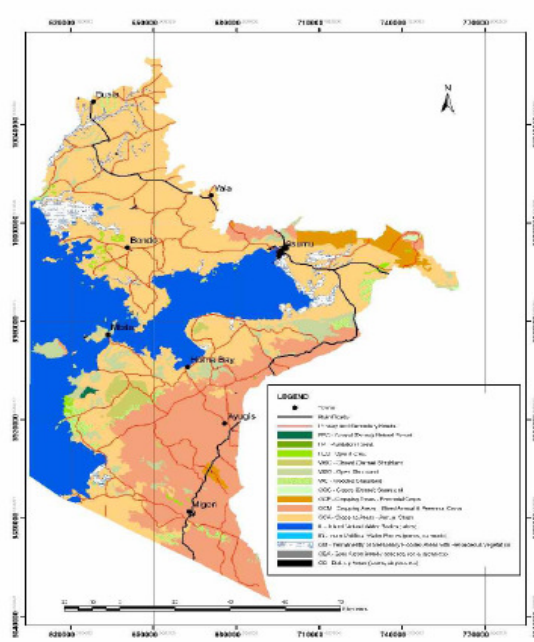
Ambrose Oroda, P. O. Box 61361 – 00200, NAIROBI,  
Kenya  
Cellphone: +254725632597  
Email: ambrose\_oroda@yahoo.com

# MATERIALS AND METHODS

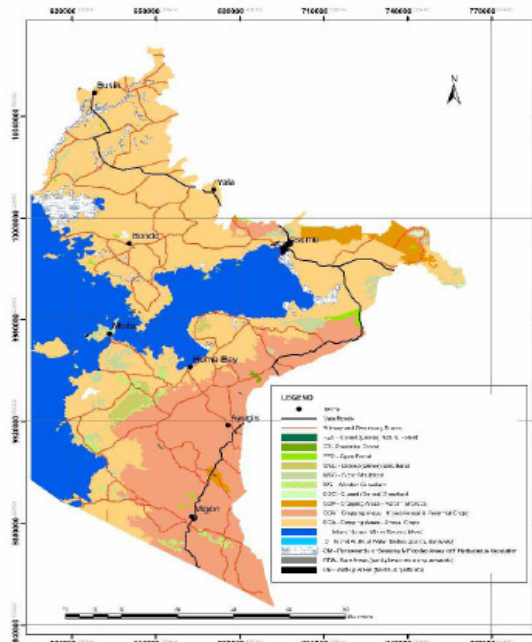
- Remote Sensing
  - Two sets of medium spatial resolution images (Landsat images of 2000 & Landsat and ASTER images of 2008) acquired, processed and analysed
- Classification scheme was developed based on the modification of FAO-AFRICOVER LCCS into the INRA one (see the INRA classification scheme).
- Detailed inter-class and intra-class change detection
  - Visual interpretation using GeoVIS
  - Swipe using ERDAS Imagine
  - Classification using LCCS

# RESULTS – Land cover/use Maps

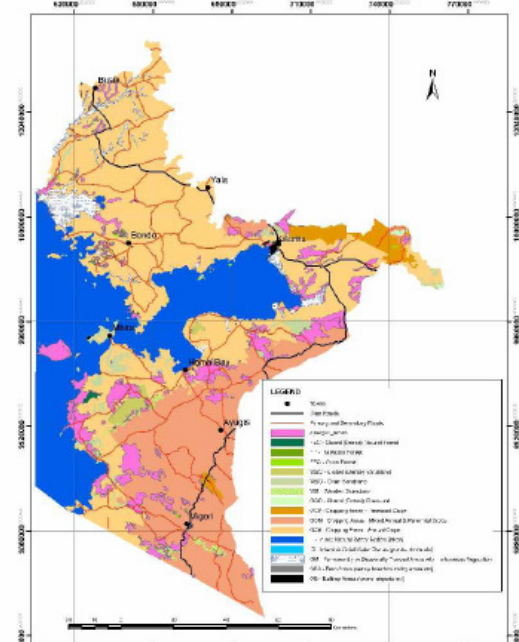
- Land cover and Land Use Maps



LCLU 2000,



2008



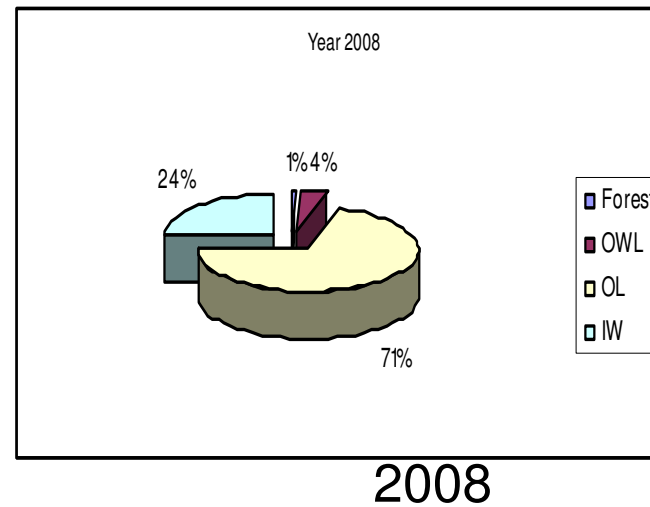
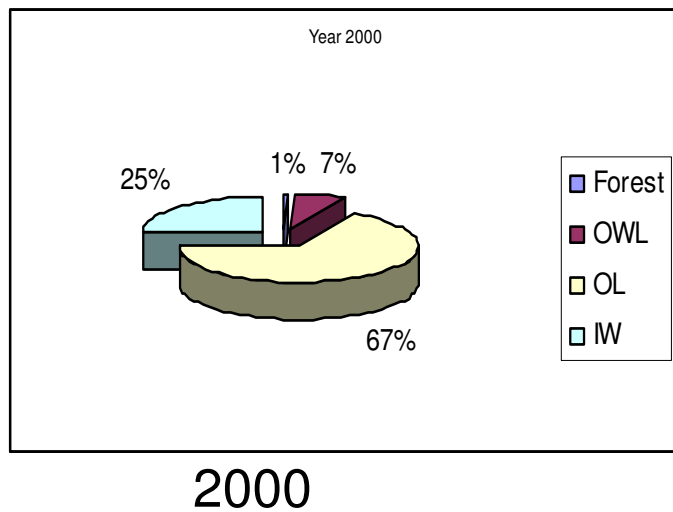
change map

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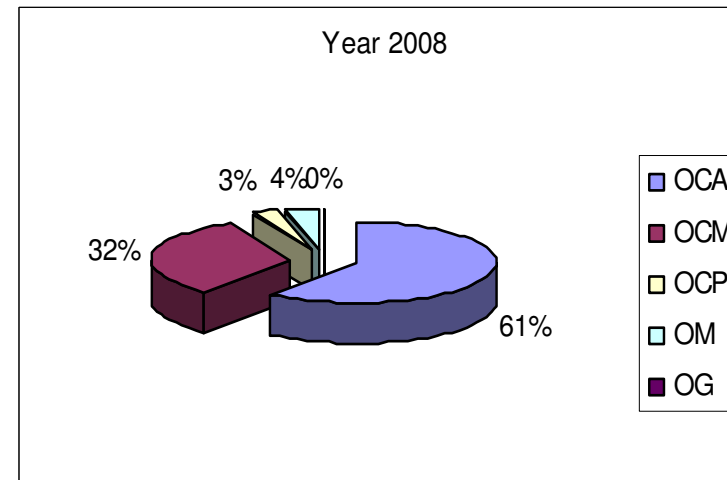
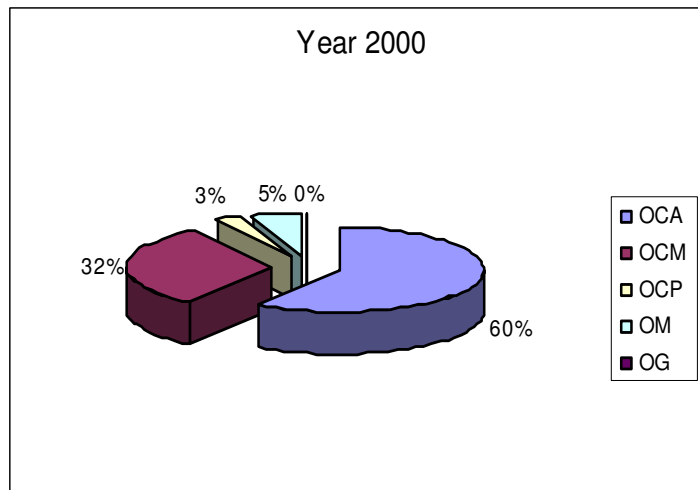
# RESULTS – Major L/C Classes

- Major land cover classes



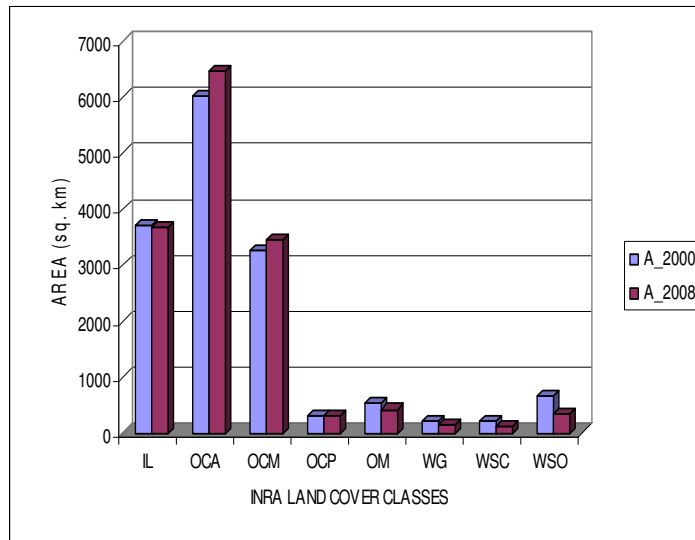
# RESULTS – Major L/U classes

- Major Land Use Classes

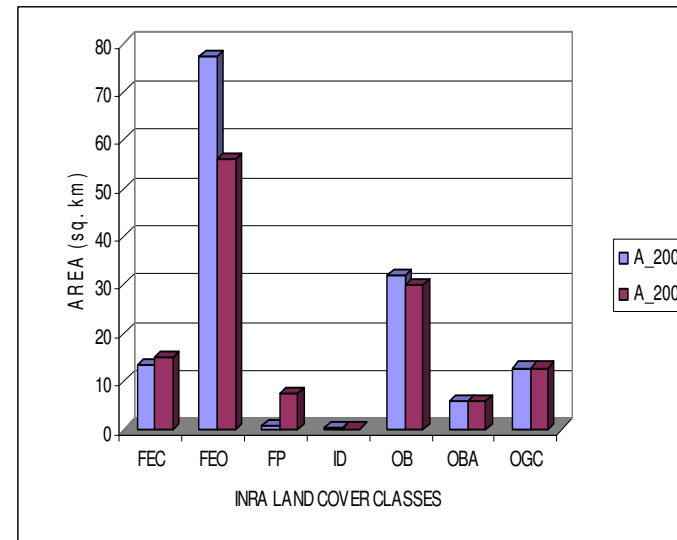


# RESULTS – Changes in land cover classes

- Figures showing land cover and land use changes

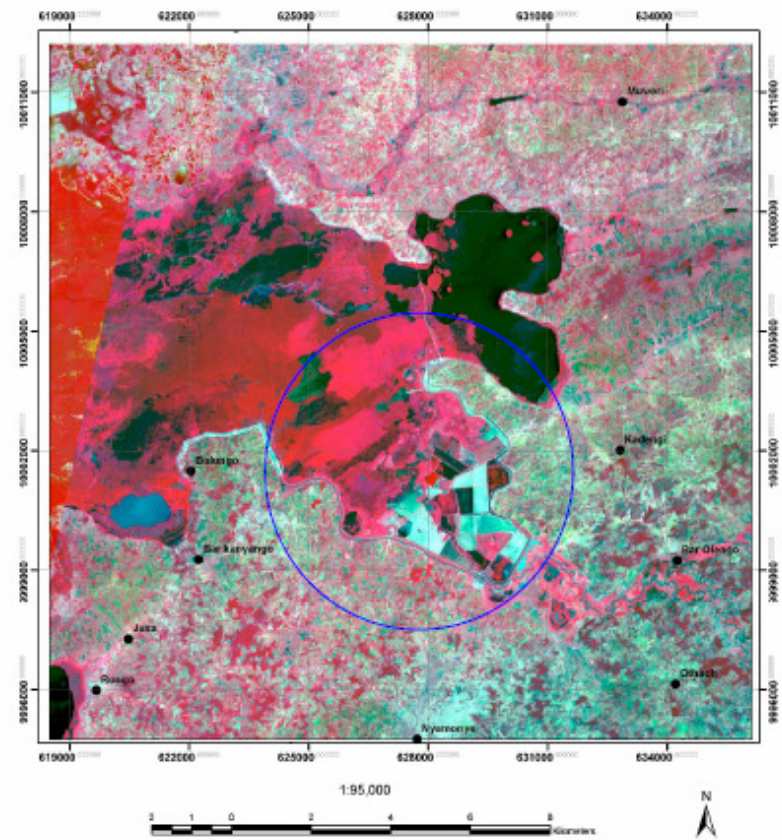
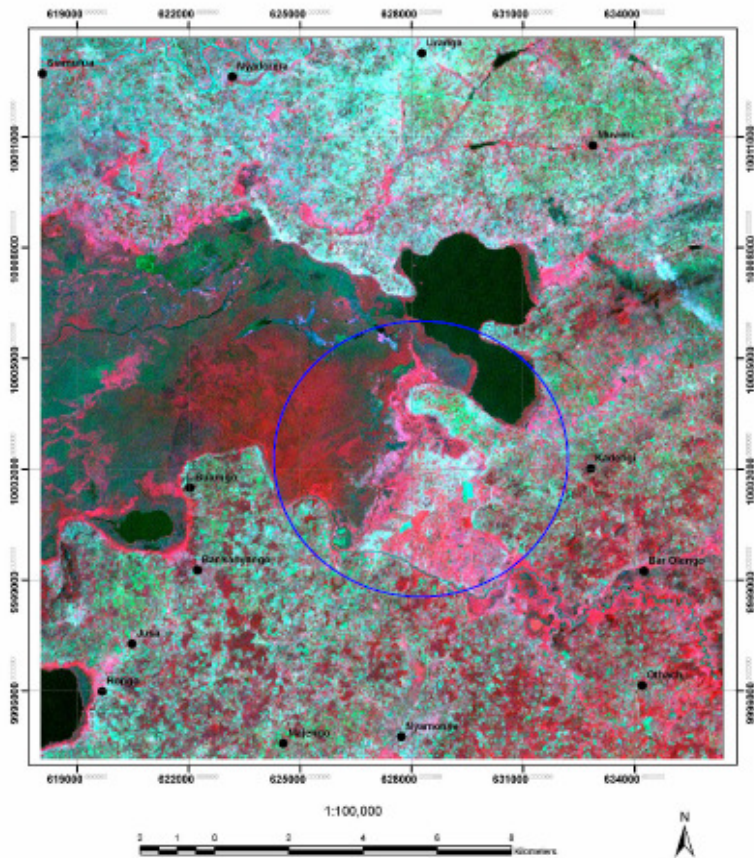


Major classes



Minor classes

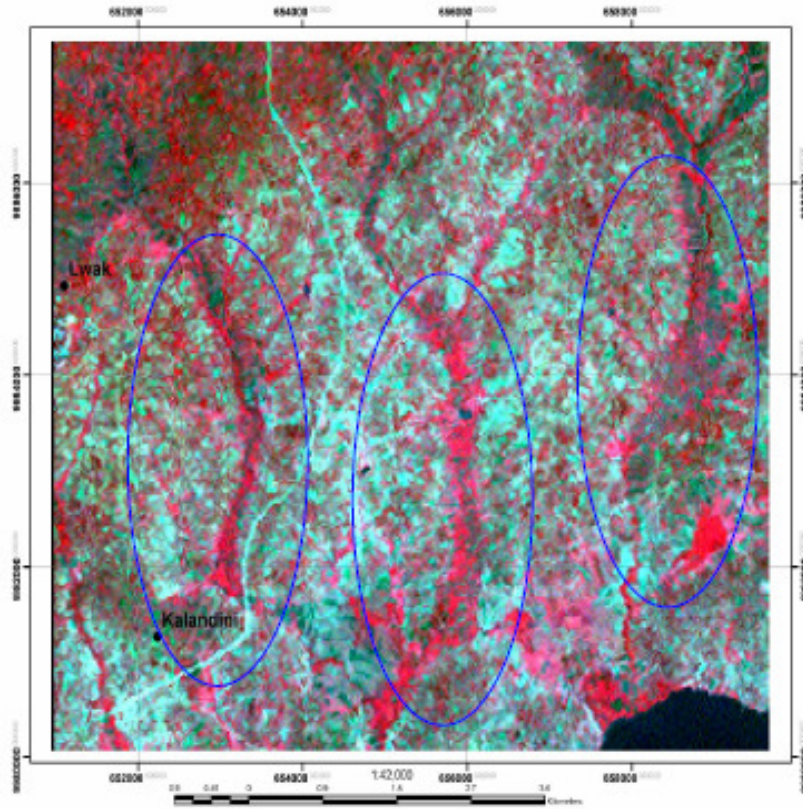
# RESULTS – Detailed inter- and intra-class changes



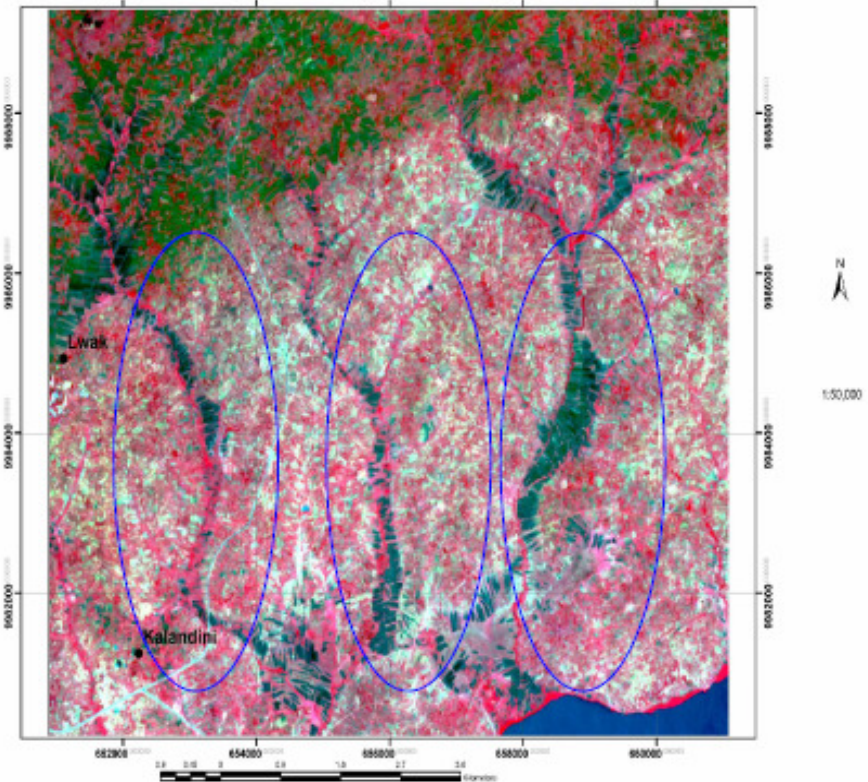
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# RESULTS – Detailed inter- and intra-class changes



Landsat 2000



Aster 2008

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# NOTE

- The lake basin is experiencing many environmental challenges
  - Land degradation
  - Increased agricultural activities – consequences???
  - Deforestation, more so in areas outside the basin but with negative impacts felt within the basin
  - Impacts on fish breeding grounds???
  - Increased flooding – upstream deforestation
  - Irregular rainfall patterns – climate change???

# CONCLUSIONS AND RECOMMENDATIONS

- **Conclusions**

- the area is predominantly agricultural
- Agriculture is mainly subsistence farming
- Woody vegetation greatly decreasing – agriculture
- Wetlands also greatly decreased
- Remote Sensing technique and methodology and the subsequent integration of the resultant databases into a GIS are very important in rapid assessment, monitoring and mapping of natural resources through land cover and land use assessments.

# CONCLUSIONS AND RECOMMENDATIONS

- Recommendations
  - Decrease in woody vegetation is a big challenge – need to encourage on-farm tree planting
  - Further studies be carried out on the impacts of increased agricultural activities, particularly on land degradation
  - Further studies on linkages between area under agriculture and land productivity
  - Studies on possibilities of pollution due to possible increase in the use of inorganic fertilizers due to increased agricultural activities.
  - Studies to find out the impact of changes in land cover and land use on biodiversity, both floral and faunal
  - Greater integration of remote sensing information with field data in order to produce more precise thematic maps necessary for decision making and long term planning

THANK

YOU

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Ambrose Oroda, P. O. Box 61361 – 00200, NAIROBI,  
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Cellphone: +254725632597  
Email: [ambrose\\_oroda@yahoo.com](mailto:ambrose_oroda@yahoo.com)