



Workshop on participatory assessment of land degradation and sustainable land management in grassland and pastoral systems

Monitoring land cover at global, regional and national levels and its contribution to the assessment of grassland and pastoral areas

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Land and Water Division (NRL)

FAO HQ - January 2015

Content

- *FAO Global Land Cover Network*
- *FAO Land Cover Mapping Toolbox*
- *National land cover databases*
- *Global Land Cover SHARE database*
- *Relevant products*
- *Operational Monitoring systems*
- *Conclusions*

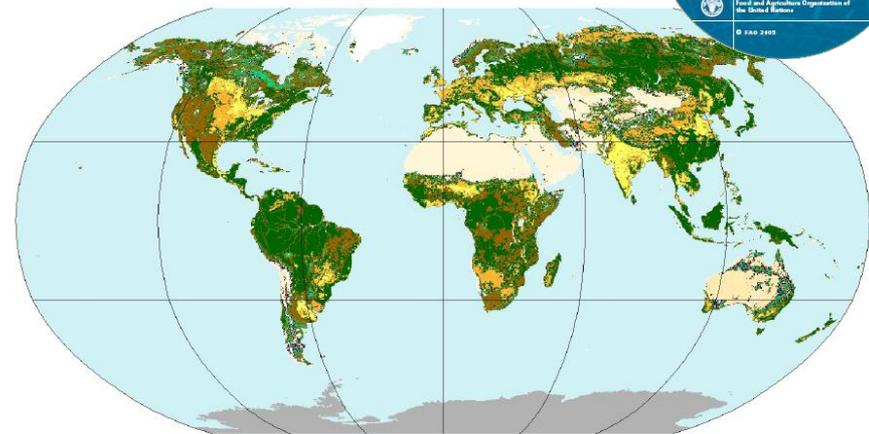
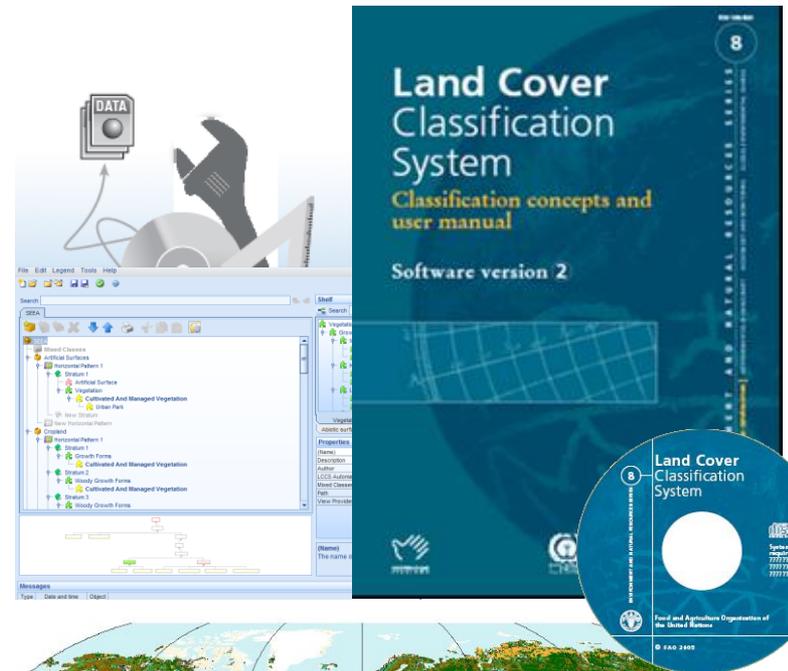


Figure 3 – Distribution of dominant GLC-SHARE Land Cover Database.

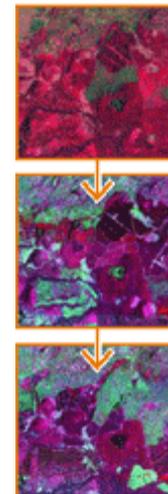
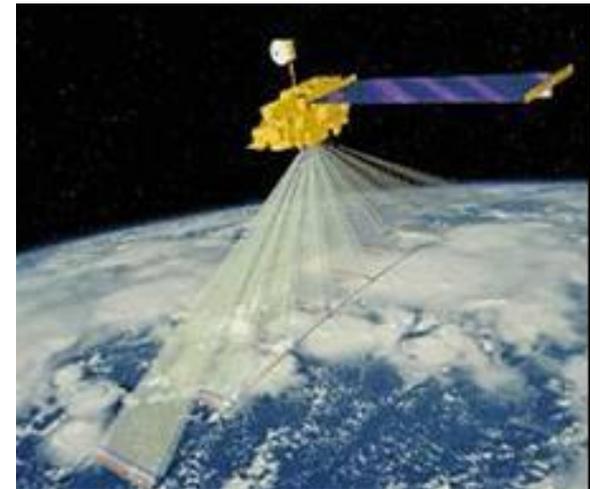
■ 01 Artificial Surfaces	■ 04 Tree Covered Area	■ 07 Mangroves	■ 10 Snow and Glaciers + Antarctica
■ 02 Cropland	■ 05 Shrubs Covered Area	■ 08 Sparse Vegetation	■ 11 Water bodies
■ 03 Grassland	■ 06 Herbaceous Vegetation	■ 09 Barren soil	■ Antarctica



FAO Global Land Cover Network (GLCN)

Main Objectives:

- To **improve linkages** between global, regional and national studies on land cover and the environment
- To improve **standardization, homogenization, compatibility** and efficiency of information provided by different applications
- To provide information that improves design and efficiency of sampling for **validation of land cover** products at global, regional and national levels.
- To increase **use and sharing of remote sensing data** and its derived datasets
- To provide **comparable products** at global, regional, and national and lower levels
- To undertake **capacity development and institution strengthening** to maximize benefits for developing countries
- To support **operational development and use** by national stakeholders of products emanating from the programme





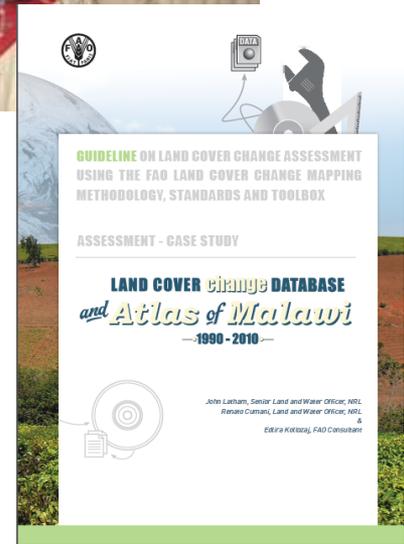
FAO GLCN Core activities

- Establish global network
- Develop Land cover mapping methodology
- Standards development (LCCS/LCML)
- Land Cover Mapping Toolbox (LCCS/MadCat/ADG)
- Technical assistance to national experts for land cover mapping activities
- Preparation of guidelines, manuals, templates, workshops, technical papers, metadata
- Capacity building
- Awareness raising workshops, training resources and sessions
- Dissemination and outreach (FAO GeoNetwork and FAO GLCN website)
- Enable use of the land cover information

Sudan

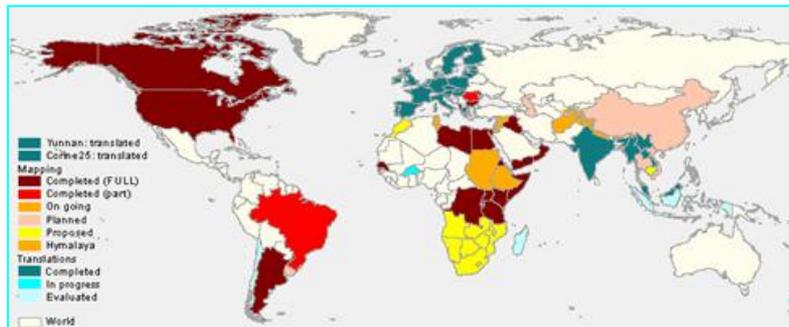
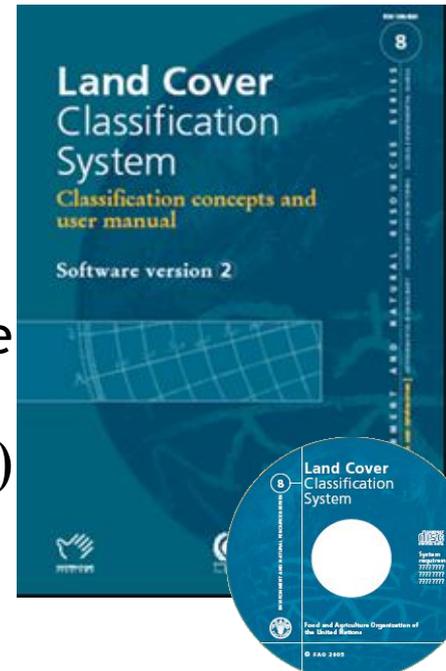


•Nepal



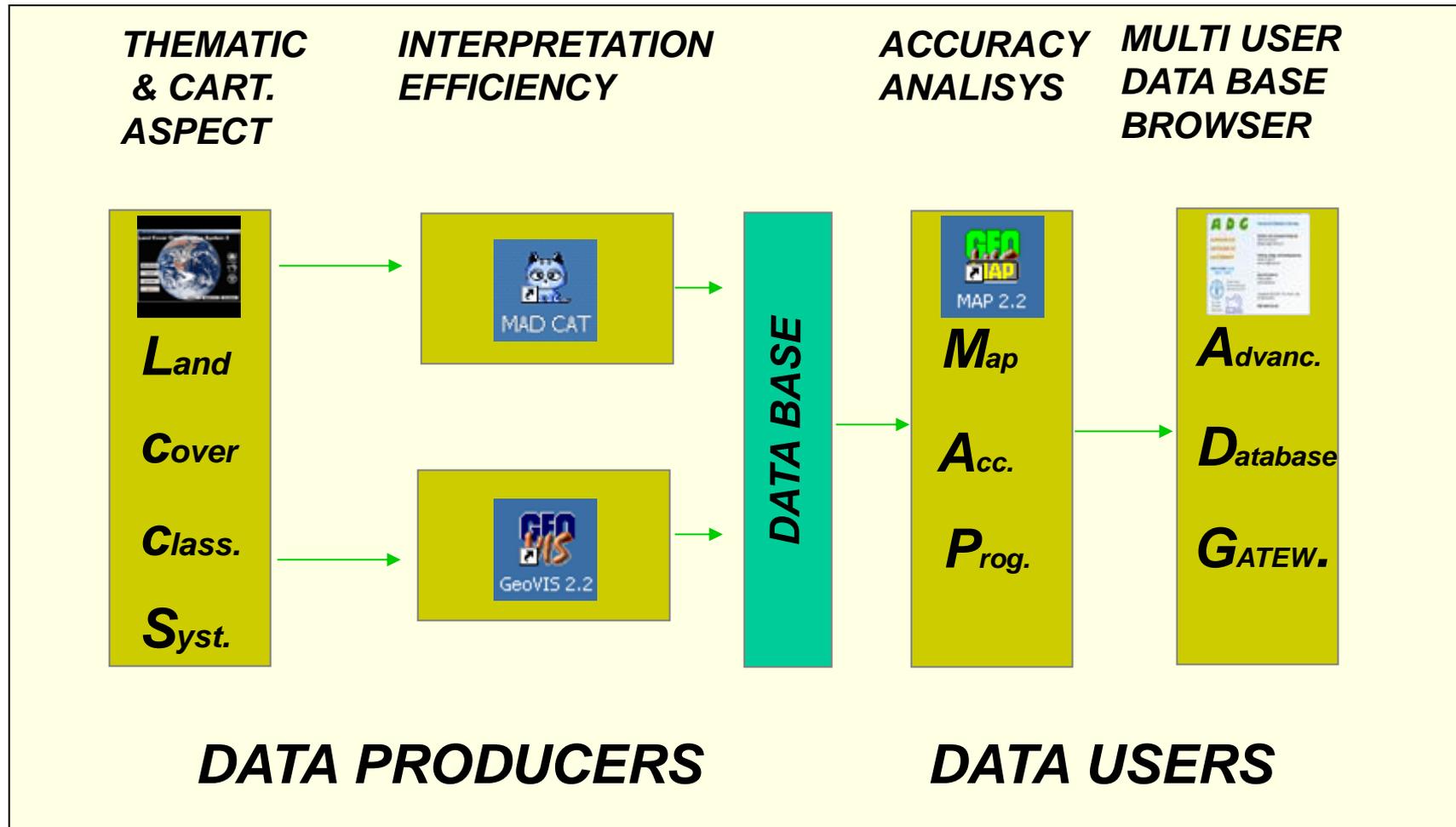
Standards and Classification System LCCS / LCML / ISO 19144-2:2012

- LCCS: Comprehensive methodology for description, characterization, classification and comparison of most land cover features identified anywhere in the world, at any scale or level of detail: basis for comparative classification. (6 UN official languages)
- Created in response to a need for a harmonized and standardized collection and reporting on the status and trends of land cover



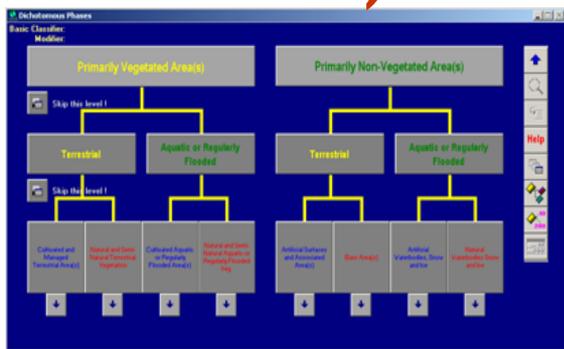


FAO Land Cover Mapping Toolbox

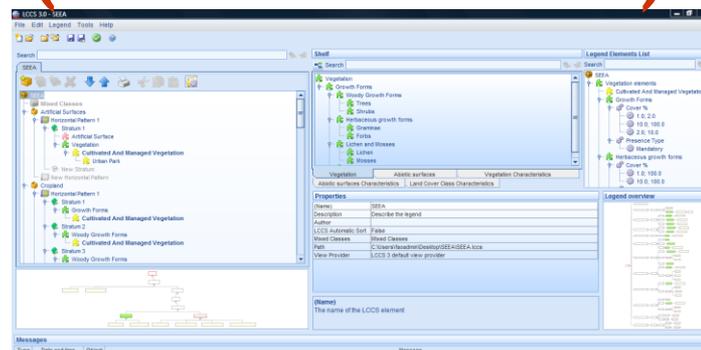




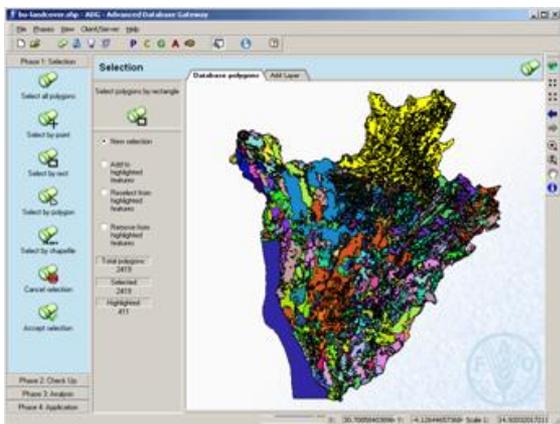
LCCS 2: 2001 (use LCCS)



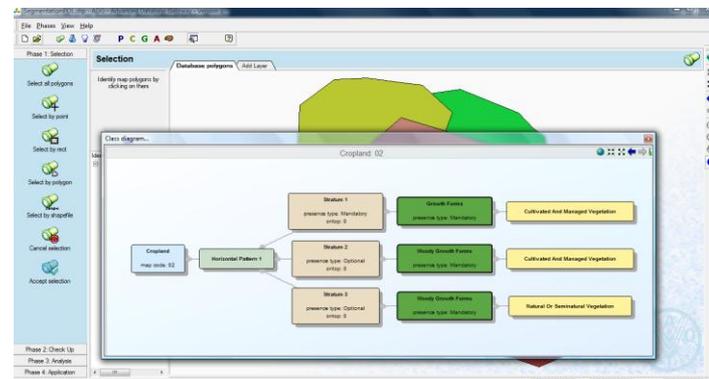
LCCS 3: 2013 (use LCML/UML)



ADG 2: 2003



ADG 3: 2013



ADG 3 for ArcGIS 10.x: 2013



Mapping Device - Change Analysis Tools (MADCAT)

- Application designed by FAO
- Uses object-base classification
- Current version – Release June 2013
- Wizard driven installation
- Implemented using .Net Framework
- Coding with LCCS2 and LCCS3
- Requires Windows XP / Vista / 7 /8 (32 and 64 bit)
- Free to use for FAO programmes
- One time activation needed:
 - Institution, User Name, Address, PC CODE
 - send request by email





GLCN MadCat - Mapping DeviceChange Analysis Tool (SYSTEM) : kenya

File Edit View Tools ?

Application info
Coding attribute : Y2008CODE
Legend type : LCCS SINGLE

Project management

- New project...
- Open project...
- Save project
- Save project as...
- Raster manager...
- Load segmentation...
- Load training areas...
- Load extra layer...
- Reference manager...
- Open LCCS3 / LCCS2 legend...
- Edit LCCS2 legend...
- Close LCCS3 / LCCS2 legend

Raster tools

- Cursor / Region of interest
- Segmentation
- Training areas
- Extra layer
- Reference layers
- Edit polygons
- Automatic clustering
- Change detection by polygon
- Interactive coding tools
- Reports and exporting data

Segmentation

HELP

SYNCRONIZE MULTIPLE WINDOWS...
Open a dialog box to set the synchronization between all additional windows (1, 2 and 3) and the Main window.

p169r061_2000_0127_432_WM

1HLM

1HLM

Last action: SYNCRONIZE MULTIPLE WINDOWS...

4,009,386.896 , -75,503.708 1:290395



GLCN ModCat - Mapping DeviceChange Analysis Tool (SYSTEM) : Kenya : Kenya

File Edit View Tools ?

Application info
Coding attribute: Y2008CODE
Legend type: LCCS SINGLE

Project management

- New project...
- Open project...
- Save project
- Save project as...

Raster manager...

- Load segmentation...
- Load training areas...
- Load extra layer...
- Reference manager...

Open LCCS3 / LCCS2 legend...

- Create LCCS2 legend...
- Edit LCCS2 legend...
- Close LCCS3 / LCCS2 legend

Raster tools

- Cursor / Region of interest
- Segmentation
- Training areas
- Extra layer
- Reference layers
- Edit polygons
- Automatic clustering
- Change detection by polygon
- Interactive coding tools
- Reports and exporting data

Segmentation

ZOOM & WINDOW/OUT:
Zoom window out.

Last action: ZOOM WINDOW/OUT

Coding legend

Show labels

- Cultivated and Managed Terrestrial Area(s)
 - 1GH
 - 1HS+2TS
 - 1HLM
 - 1HLMi
 - 1HLMi_su
 - 1HLM-is
 - 1HS
 - 1HSi
 - 1HS-is
 - 1HSY
 - 1HSY-is
 - 1SLM

Recent classes | Class details | Customize

Code: 10637

Classifiers: A3B1B5C1D1

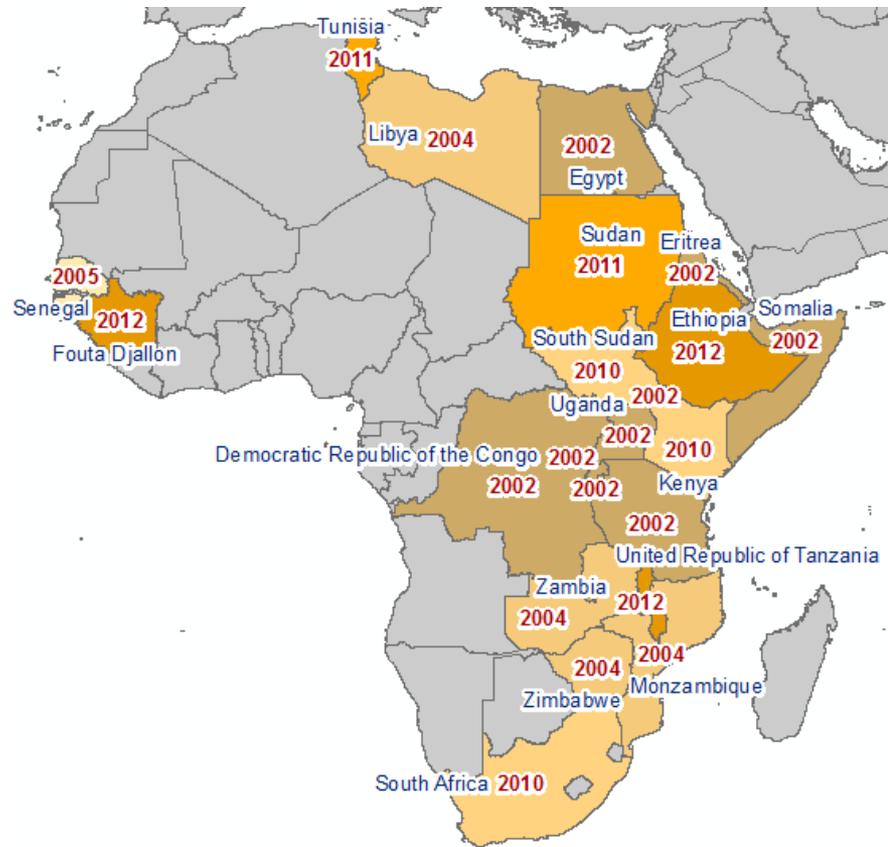
User name: Rainfed Herbaceous Crop(s)

User description: Large to medium (>2ha) rainfed herbaceous crops

FAO's Land Cover Mapping in Africa

Country scale (30m or better resolution)

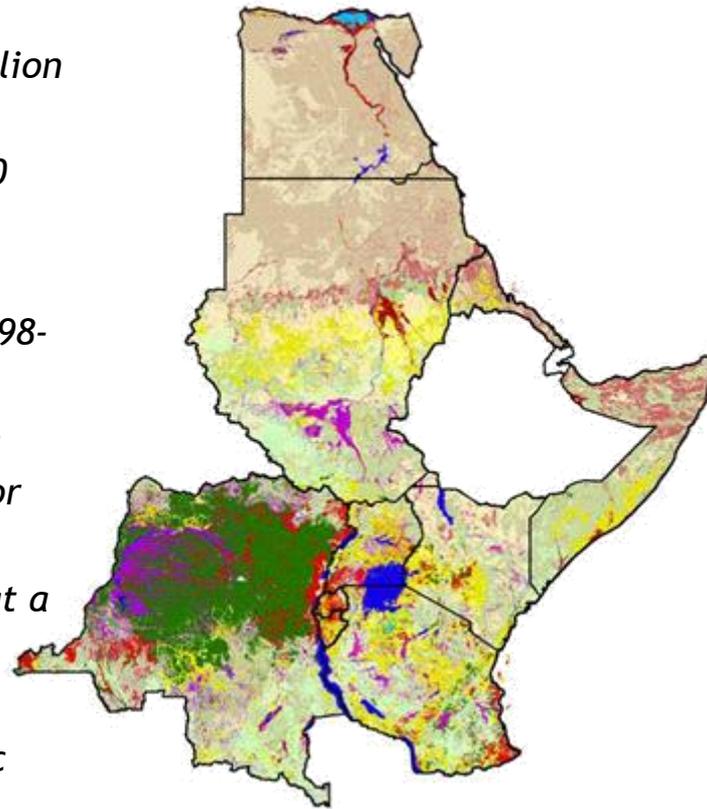
- on going ECUNET
Ethiopia
- 2012 Fouta Djallon
Highlands
Malawi
- 2011 Sudan
- 2010 South Sudan
Tunisia
Kenya Update
- 2007 Somalia
- 2006 Kenya LCC
- 2005 Senegal
- 2004 Libya
- 1998- 2002 AFRICOVER



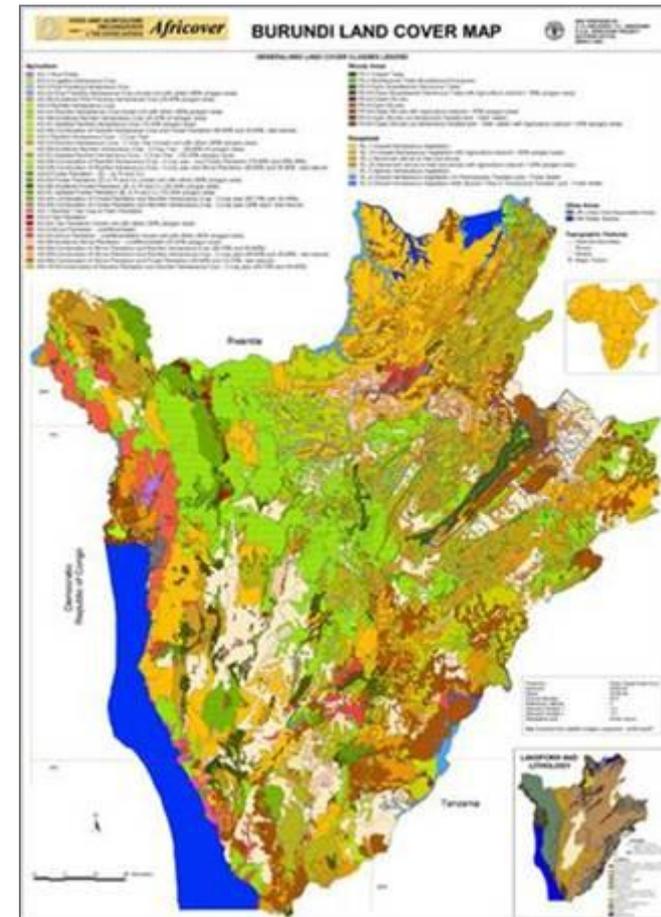
GLCN/AFRICOVER: East Africa Module

Development of a regional database and regional aggregation

- **Project facts:**
- **Mapped area:** 8.5 million Km²
- **Countries covered:** 10
- **Landsat Scenes used:** more than 400
- **Period of activity:** 1998-2004
- **Result:** **Multipurpose** Africover Database for the Environmental Resources produced at a 1:200,000 scale (1:100,000 for small countries and specific areas)



Burundi, DR Congo, Egypt, Eritrea, Kenya, Rwanda, Somalia, Sudan, Tanzania and Uganda.





GLC-SHARE approach

- FAO System of Environmental Economic Accounts (SEEA) London Group process
- Global Consultations, interviews, comments, questions, recommendation
- A significant step in improving the information accuracy of global land cover database
- It integrates the best land cover data available (at sub-national, national, regional and global level) into one single harmonized database
- It uses international standards: ISO TC 211 - 19144-2:2013 LMCL

UN Home | Department of Economic and Social Affairs | Statistics Division



Home | Statistical Databases | Publications | Methods & Classifications | Meetings & Events | Technical Newsletters

You are here: SEEA >> SEEA Revision >> Issues - Central Framework

Home

SEEA

SEEA Revision

Energy

Water

Land and Ecosystems

SEEA Briefing Notes

Publications

Land cover classification

Outcome paper:  [English](#)

Cover note:  [English](#)

Comment template:  [English](#)

Global consultation status: Open

Deadline for comments: 17/01/2011

Number of comments: 24

Comme

▪ Recommendation 19b.1: That the Land Cover Classification System (LCCS 3) developed by FAO should be adopted as the land cover classification system in the revised SEEA and that the LCML (ISO 19144-2) should be adopted at the methodology for linking to external sources of land cover data described in other land cover systems.

GLC-SHARE: fact-sheet

- Uses the FAO SEEA LCML(*) legend
- 30 arc-second pixel resolution
- 11+1 layers indicating the % share of each class
- Dominant land cover layer and quality score
- Overall class accuracy ~80%
- Designed as a platform to facilitate crowd-sourcing
- Compatible with FAOSTAT classification
- Designed to be used for GAEZ 2010 update

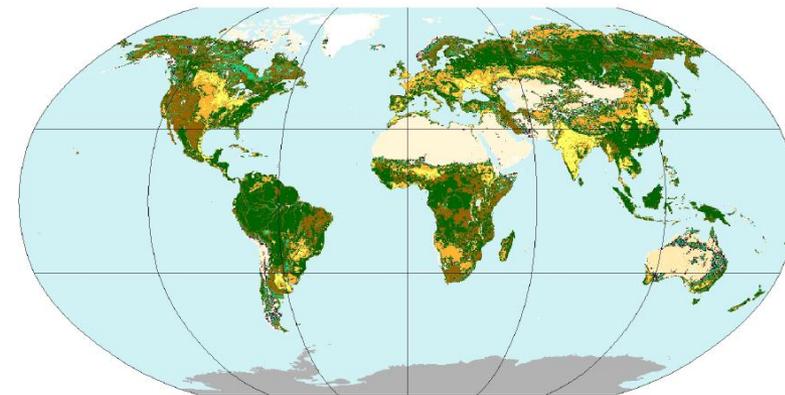
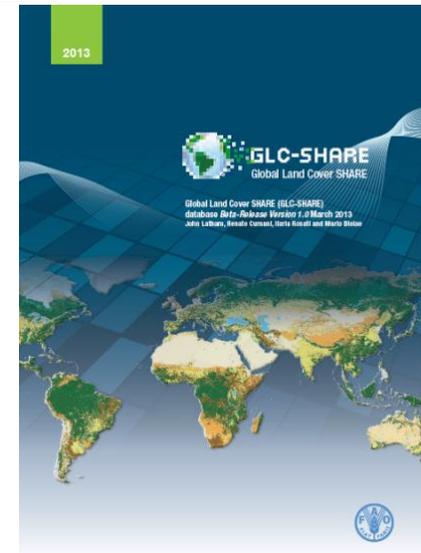


Figure 3 – Distribution of dominant GLC-SHARE Land Cover Database.

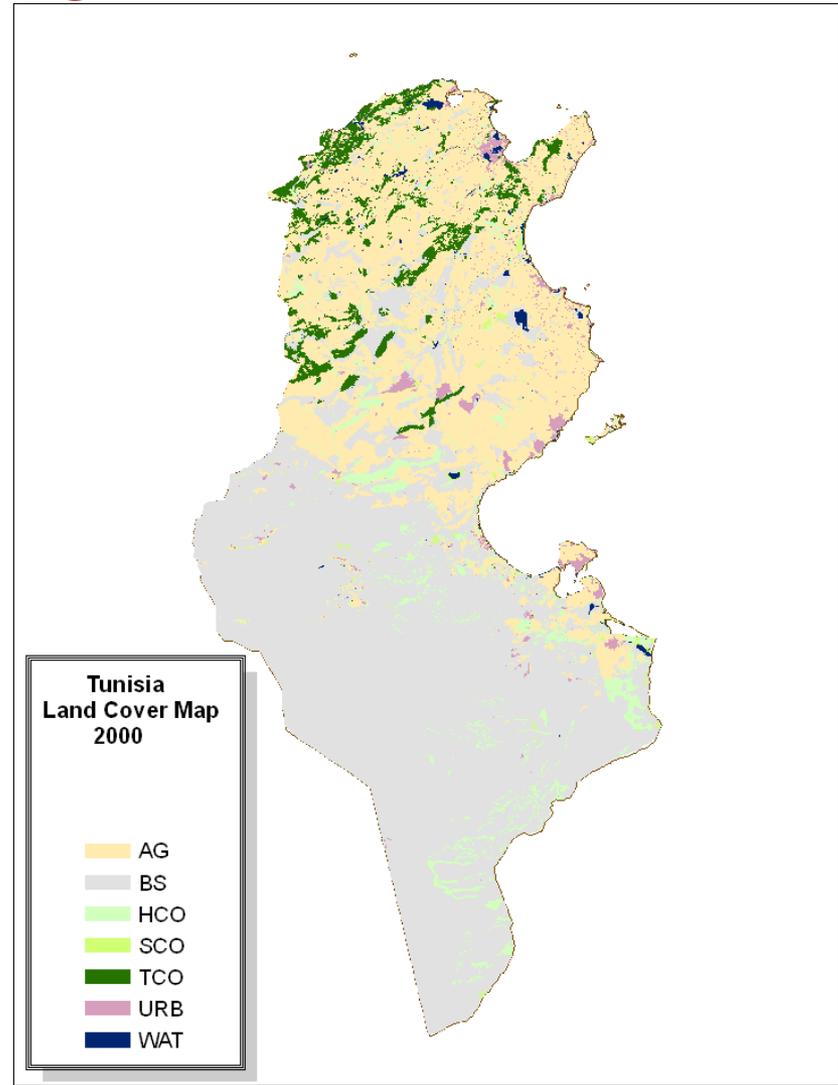
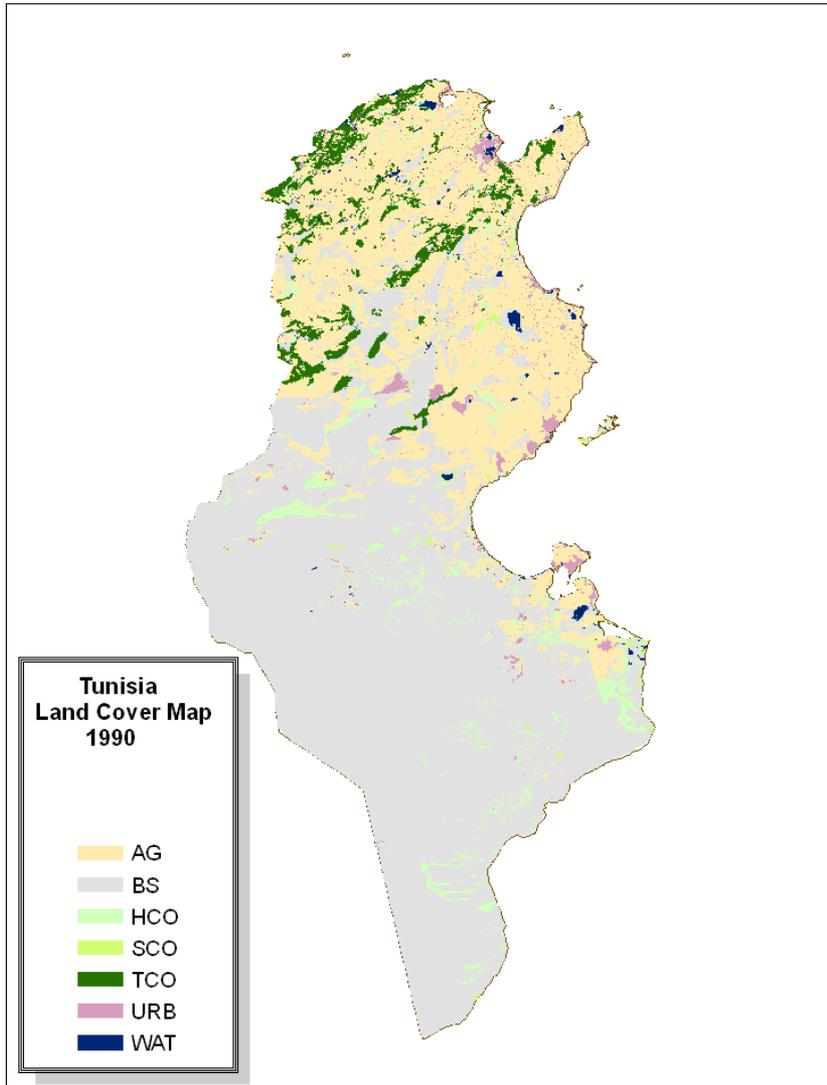


Methodology and datasets published in 2014



Tunisia land cover change 1990 - 2000

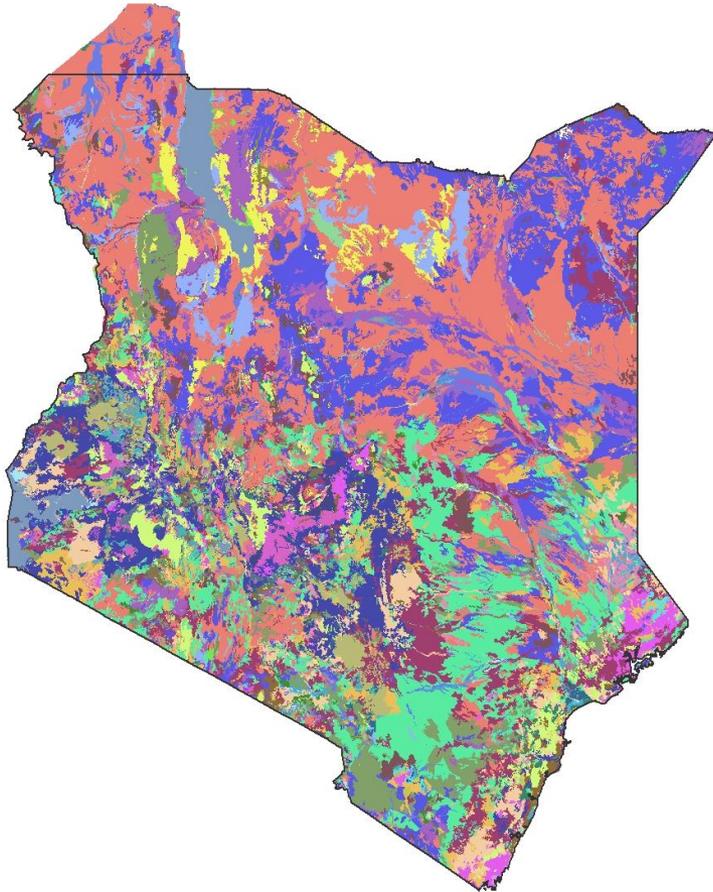
NATURAL RESOURCES DEPARTMENT (NR)



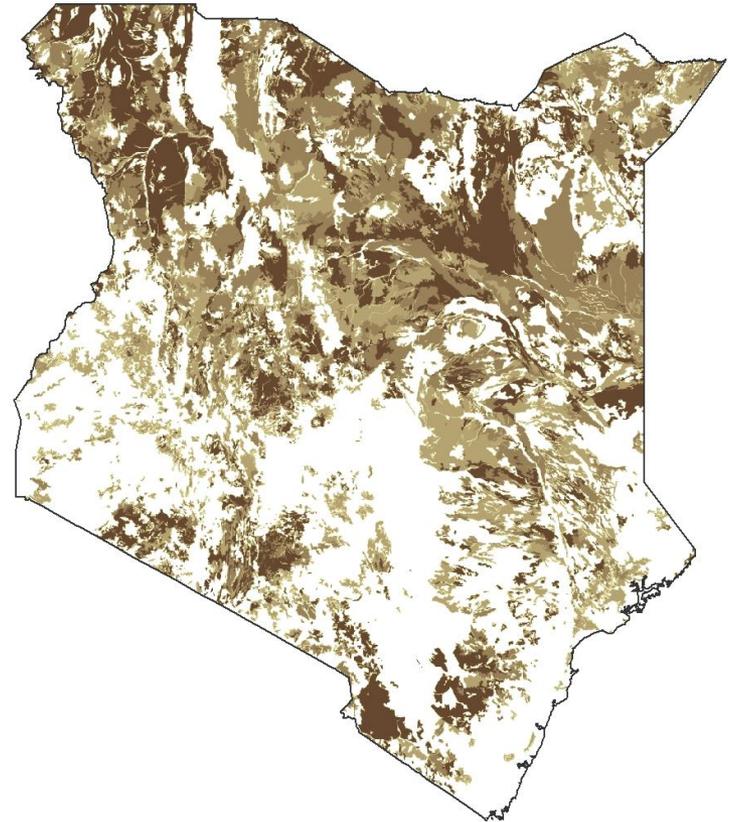


GLC-SHARE derived: Grassland %

Kenya land cover

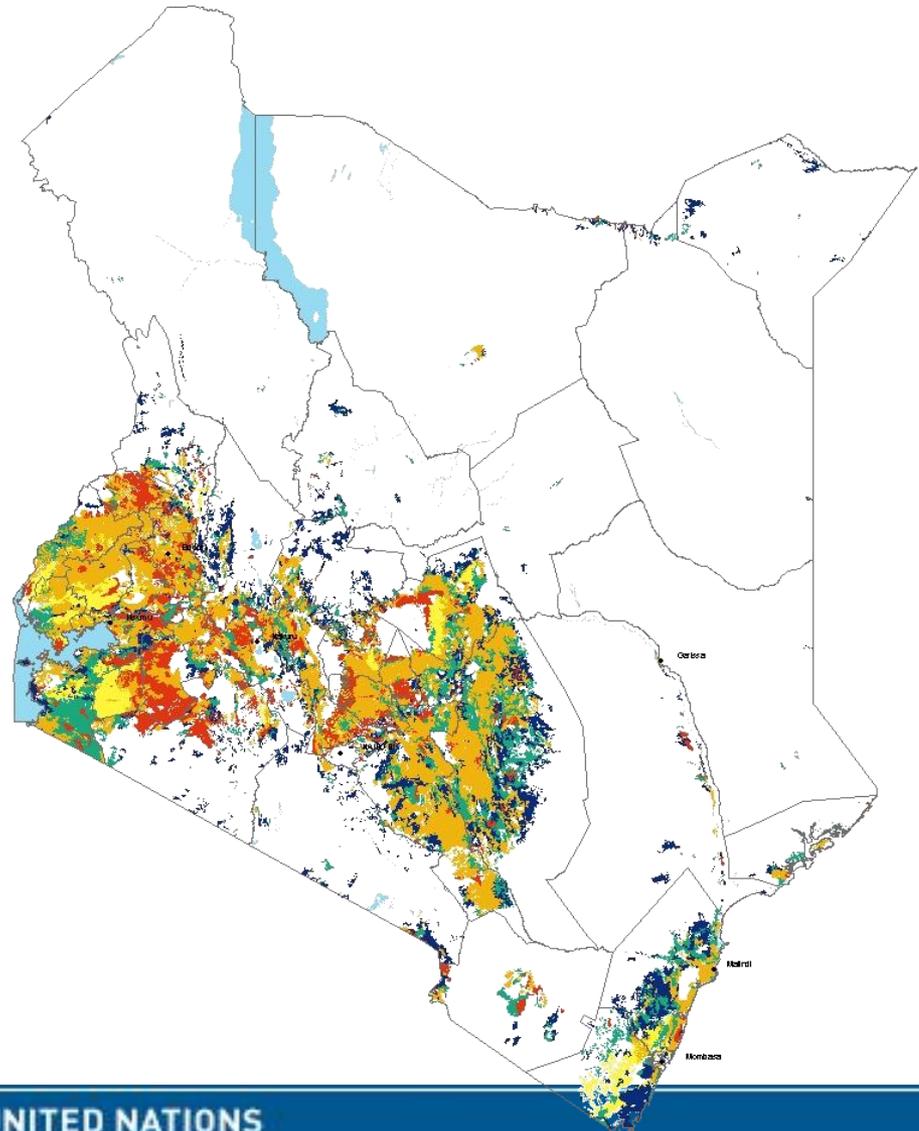
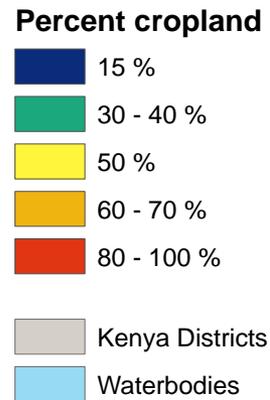


GLC Share Land Cover 2014: Grassland





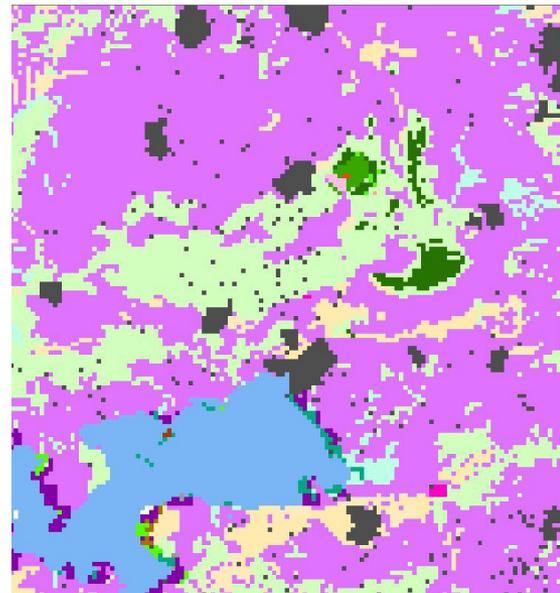
GLC-SHARE derived: Cropland Intensity



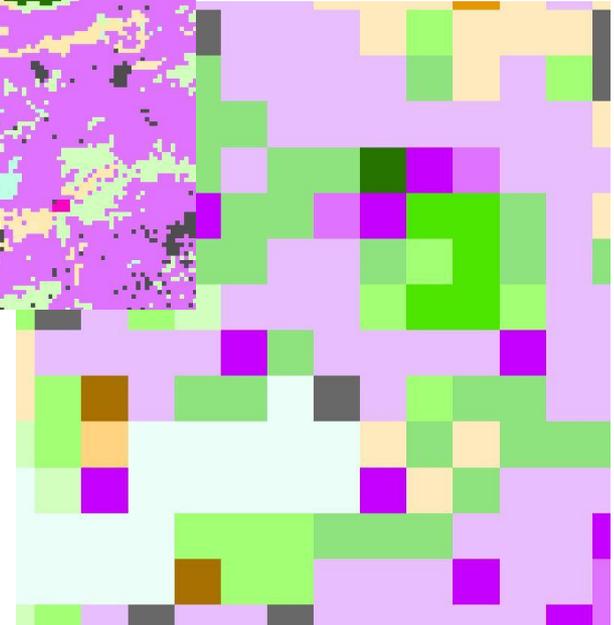


GLC-SHARE derived: Land Use Systems

30'' - GLC-SHARE



5' - LADA

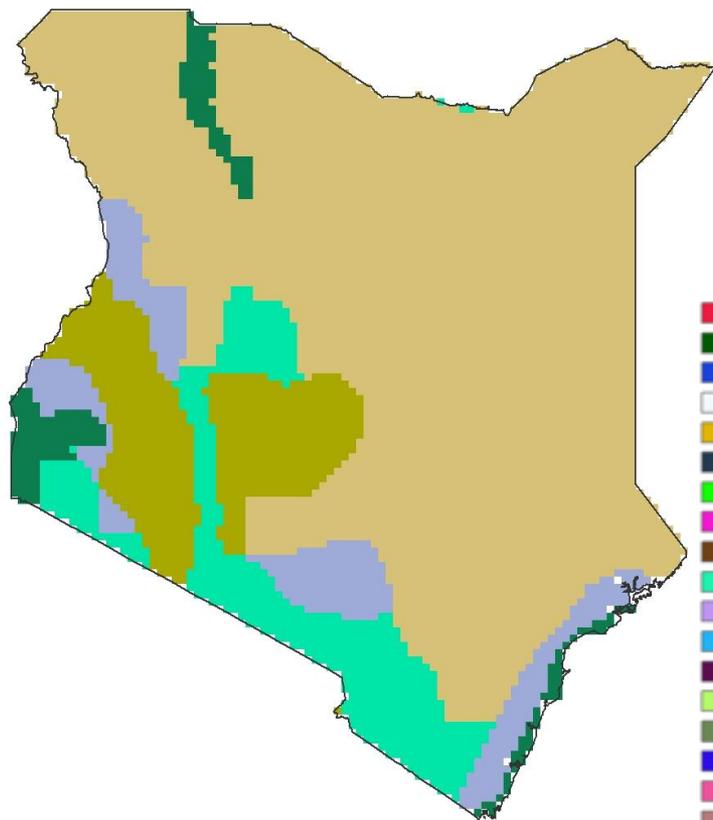


- Land Use System
- 0
 - 1 Forestry - no use / not managed (Natural)
 - 2 Forestry - Protected areas
 - 4 Forestry - Pastoralism moderate or higher
 - 5 Forestry - Pastoralism moderate or higher with scattered plantations
 - 6 Forestry - Scattered plantations
 - 7 Herbaceous - no use / not managed (Natural)
 - 8 Herbaceous - Protected areas
 - 9 Herbaceous - Extensive pastoralism
 - 10 Herbaceous - Mod. Intensive pastoralism
 - 11 Herbaceous - Intensive pastoralism
 - 13 Rainfed Agriculture (Subsistence / commercial)
 - 14 Agro-pastoralism Mod. Intensive
 - 15 Agro-pastoralism Intensive
 - 16 Agro-pastoralism mod. intensive or higher with Large scale irrigation
 - 17 Agriculture - Large scale irrigation (> 25% pixel size)
 - 18 Agriculture - Protected areas
 - 19 Urban areas
 - 20 Wetlands - no use / not managed (Natural)
 - 21 Wetlands - Protected areas
 - 22 Wetlands - Mangroves
 - 23 Wetlands - Agro-pastoralism
 - 24 Bare areas - no use / not managed (Natural)
 - 25 Bare areas - Protected areas
 - 26 Bare areas - Extensive pastoralism
 - 27 Bare areas - Mod. Intensive pastoralism or higher
 - 28 Water - Coastal or no use / not managed (Natural)
 - 29 Water - Protected areas
 - 30 Water - Inland Fisheries
 - 100 Undefined

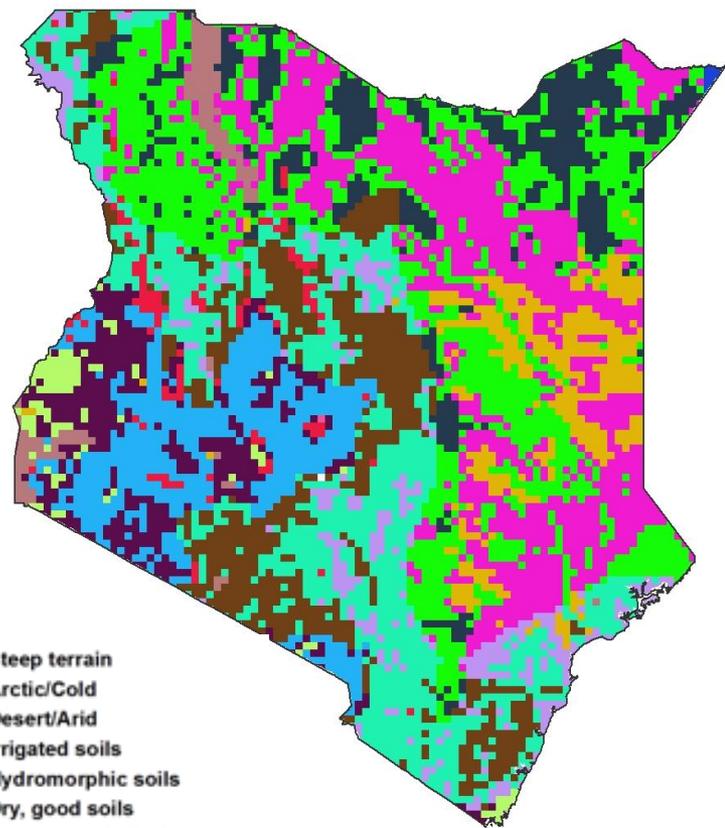


Farming Systems and AEZ

Farming System



- Irrigated
- Humid lowland tree
- Forest based
- Highland perennial
- Highland mixed
- Root and tuber cro
- Cereal-root crop m
- Maize mixed
- Agro-pastoral
- Pastoral
- Arid pastoral-oase
- Artisanal fishing
- Perennial mixed



AEZ zonation

- Steep terrain
- Arctic/Cold
- Desert/Arid
- Irrigated soils
- Hydromorphic soils
- Dry, good soils
- Dry, moderate soils
- Dry, poor soils
- Moist, good soils
- Moist, moderate soils
- Moist, poor soils
- Sub-humid, good soils
- Sub-humid, moderate soils
- Sub-humid, poor soils
- Humid, good soils
- Humid, moderate soils
- Humid, poor soils
- Water



Natural Landscapes and protected areas

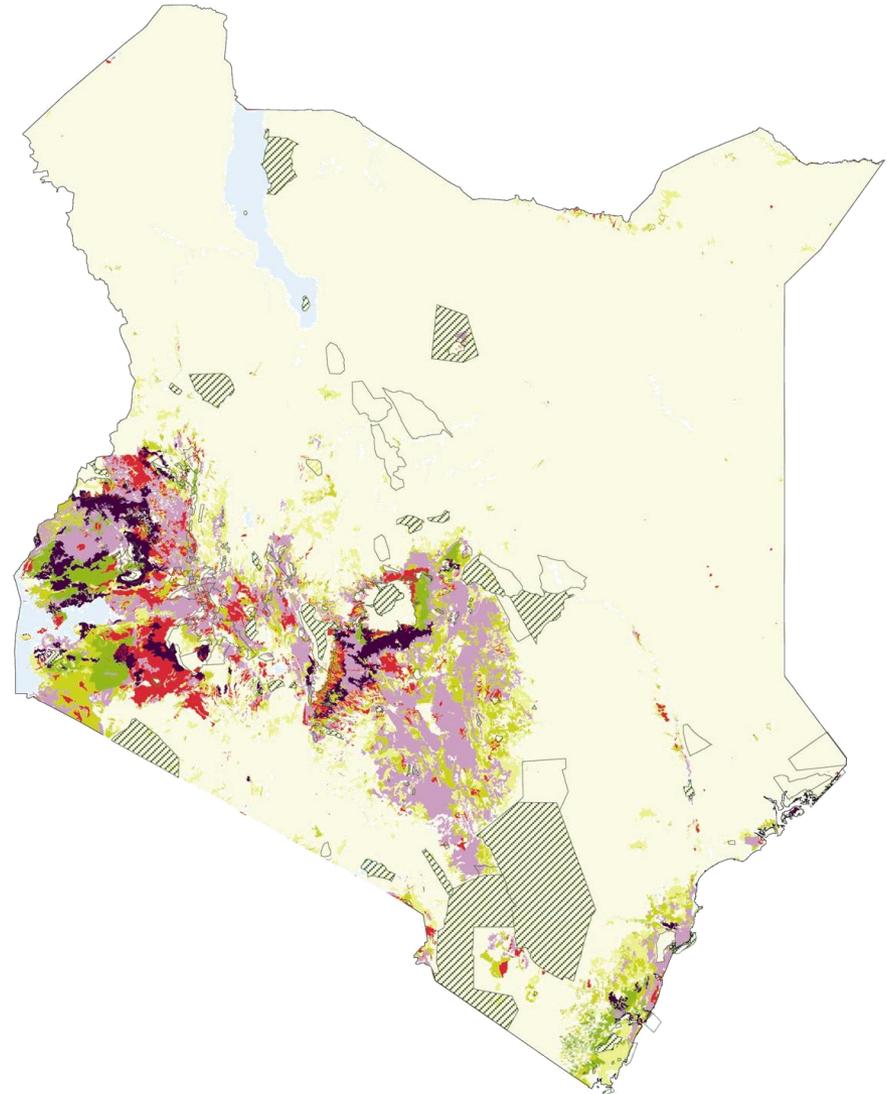
Sources: *Africover – Food and Agriculture Organization of the United Nations, Kenya National Environment Management Authority, and World Conservation Monitoring Centre.*

Protected Areas

-  IUCN I-IV
-  Other

Natural Landscapes

-  > 80 %
-  80 %
-  70 %
-  60 %
-  50 %
-  40 %
-  30 %
-  < 30 % (Urban and agricultural areas)
-  Waterbodies





National Land Resources Evaluation

LRIMS: Land Resources Information Management System



- *Designed and developed based on FAO guidelines for sustainable management of natural resources*
- *Implements an integrated and interactive approach to land use planning enabling assessment and modeling of land suitability and responses to potential agricultural production*
- *Integrates various functionalities and methodologies into one processing environment*
- *Built on modular approach (extendable and replicable)*

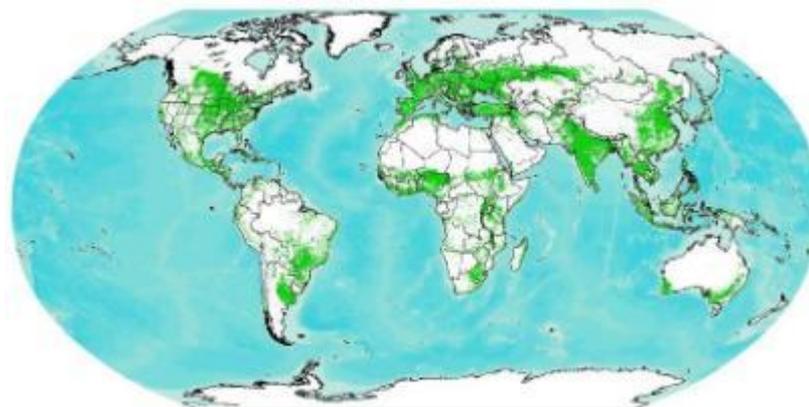




Earth Observations and Monitoring

- Earth Observations contribute to monitor agriculture, forestry, grasslands, vegetation, pastoral systems effectively and timely:
 - monitoring of vegetation condition, and productivity,
 - global or regional climate modeling and prediction (e.g. drought),
 - environmental modeling and prediction (e.g forest fires, etc.).
- Effective use of Earth observation information, in combination with data gathered in the field, provide tools that enhance the collection, storage, analysis and dissemination of food security information

GLC-SHARE Cropland Distribution



EOs and Global Monitoring

- NRL is also involved in programmes on global, regional and national systems to monitor and assess production as an important decision making tool:
 - provide timely information on crop production and yield in a standardized and regular fashion at the regional to global level.
 - provide estimates as early as possible during the growing season(s) and update the estimates periodically through the season until harvest.
- Examples are **GEOGLAM** and **SIGMA** (*Stimulating innovation for Global Monitoring of Agriculture*) combining in-situ information, weather and satellite data in a convergence of evidence approach to estimate production and yield.



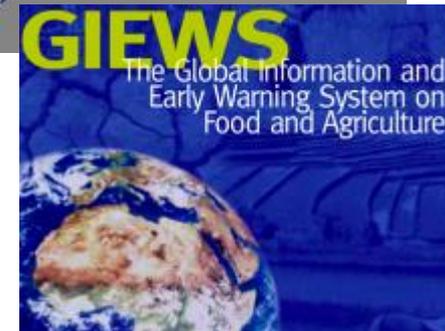
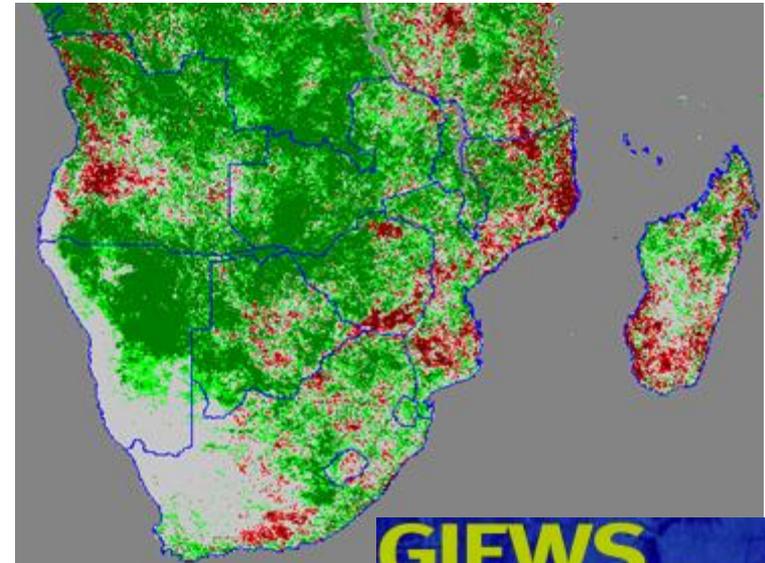
Geospatial Applications in FAO: early warning

Global Monitoring for GIEWS: NDVI and RFE

1. Monitor the state of vegetation in cultivated and rangeland areas
2. Monitor the rainy season and identify areas which are likely to have suffered from or might be affected by, drought or excessive rainfall.
 - Interpolated Estimated Rainfall IER or RFE from FAO/ARTEMIS from CPC of NOAA,
3. Estimate/Forecast yields of major crops
4. Estimate the extent of cultivated land:
 - Satellite images at different time, reference period, planting dates

Normalized Difference Vegetation Index (SPOT-4)

Difference between Current Dekad and Average
FAO - ARTEMIS



Global Active Fires Monitoring

GFIMS: satellite based near real time fires monitoring

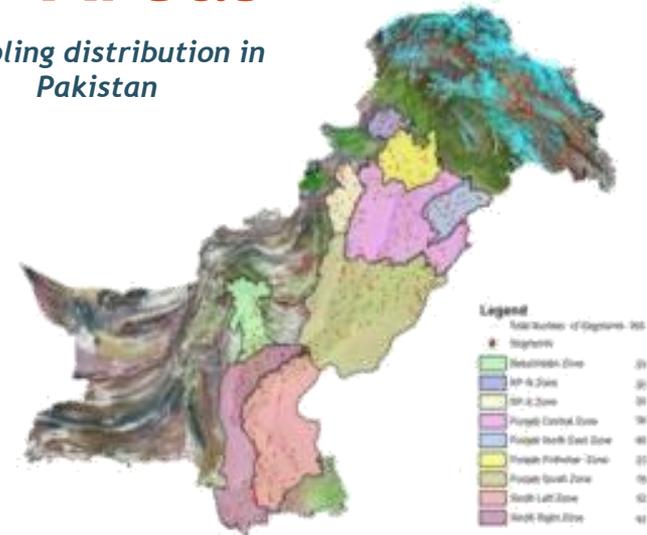
image MODIS Terra, California, 26th Oct 2003



EOs and Monitoring of Crop Areas

1. Area frames (AF) is a statistical method used for crop acreage and yield estimation.
2. Good quality land cover data improves stratification, reduces sample size and allocation and produces more accurate estimates.
3. NRL is collaborating in various projects world-wide to produce high quality national LC databases and **enhance sampling strategy** in national implementation of AF methodology.

Sampling distribution in Pakistan



Sampling unit from satellite



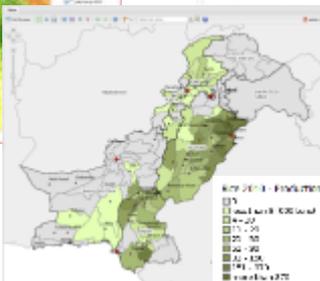
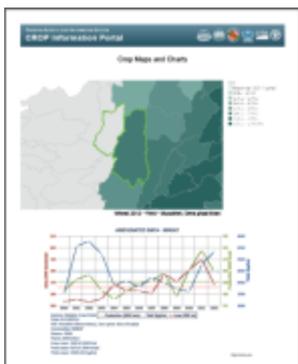
Punjab South Zone broken down into sampling units (red)



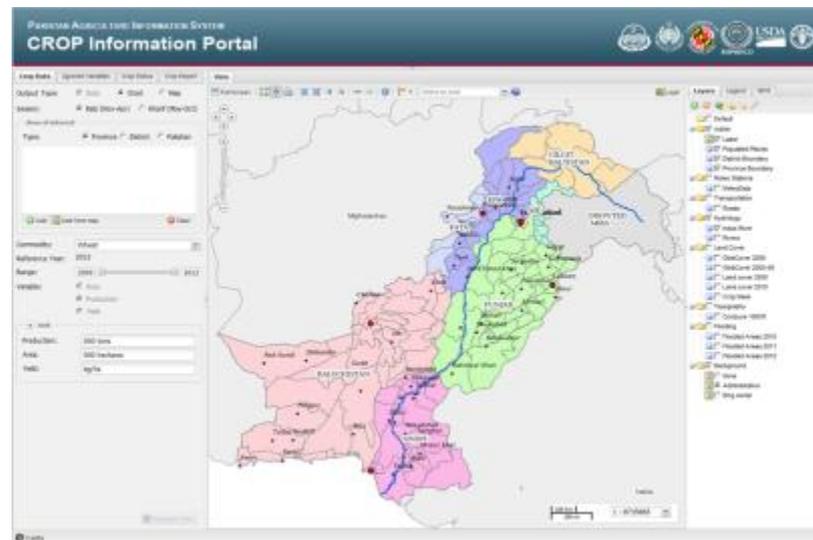
EOs and Crop Monitoring in Pakistan

Tools:

- GLAM
- Crop Information Portal
- Smart phone application (MAGIS)
- Area Frame Sampling System (AFSS)



Crop Information Portal



- Web based, open source platform for data and information dissemination on Pakistan's major crops (wheat, maize, rice, cotton and sugarcane) and agrometeorological conditions affecting crop growth. It is fully integrated with satellite based information into a GIS like environment.



Key elements for a sound monitoring system

- Stakeholder engagement and governance
- Desirable vs. feasible vs. sustainable (cost-benefit analysis)
- Data management models (data collection, validation, exchange protocols and standards), scale, use, resolution spatial and temporal, variables, indicators, metrics
- Initial set of indicators that can be measured and monitored by remote sensing:
 - Definitions and classification system
 - Grassland extent
 - Grasslands productivity
 - Management intensity and input use
 - Grazing responses
 - Vegetation condition, state and dynamics, bare soils
 - Ecosystem functioning



Key elements for a sound monitoring system

- Synthetic aggregated indicators for decision support
- Direct measurements by in-situ, social, local, households surveys, protocols designed, developed and accepted
- Measurements derived by remote sensing, national wall-to-wall assessments and/or sampling for monitoring, land cover change
- Integration of the datasets into information systems
- Capacity building nationally accepted and owned
- Information, dissemination and decision support systems (reporting and verification)



Towards establishment of a monitoring system

- Stakeholder needs assessment
- Development of framework and metrics
- Selection of pilot sites based on criteria for selection of target areas for monitoring
- Evaluate metrics on pilot sites
- Define technical requirements for a monitoring system
- Define minimum set of indicators for decision support based on the measurements, analysis, decision support needs
- Develop sustainable land management plans considering systems that are resilient to climate change and variability
- Support sustainable transformation and change
- Monitoring and evaluation
- Users acceptance and testing



Thank you

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FAO

Links:

www.fao.org

www.fao.org/nr/gaez

www.fao.org/geonetwork

www.glcnet.org