



WORLD  
RESOURCES  
INSTITUTE

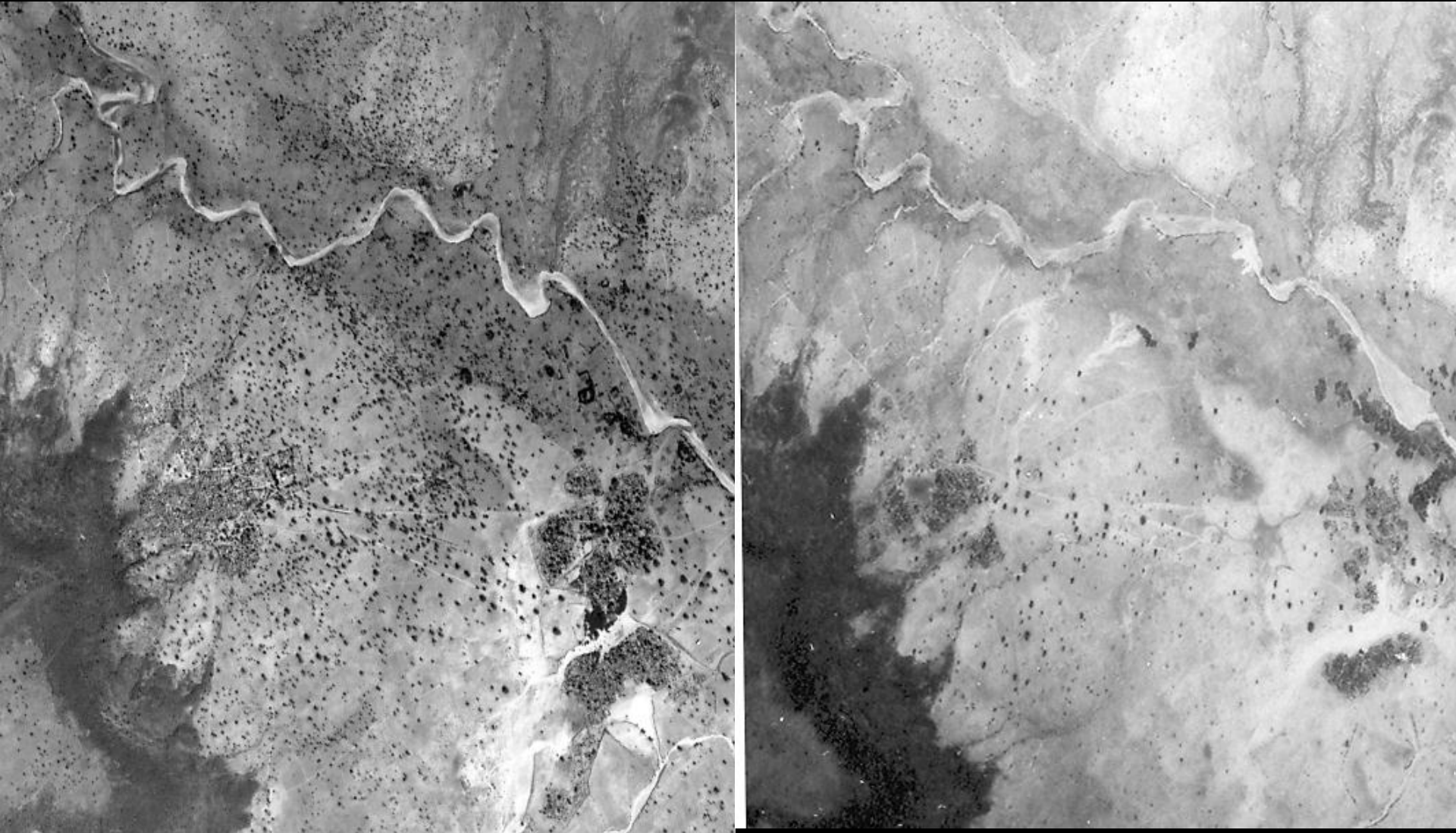
# WHERE EACH TREE MAKES A DIFFERENCE: HOPES AND OPPORTUNITIES FOR DRYLANDS

*Lars Laestadius*

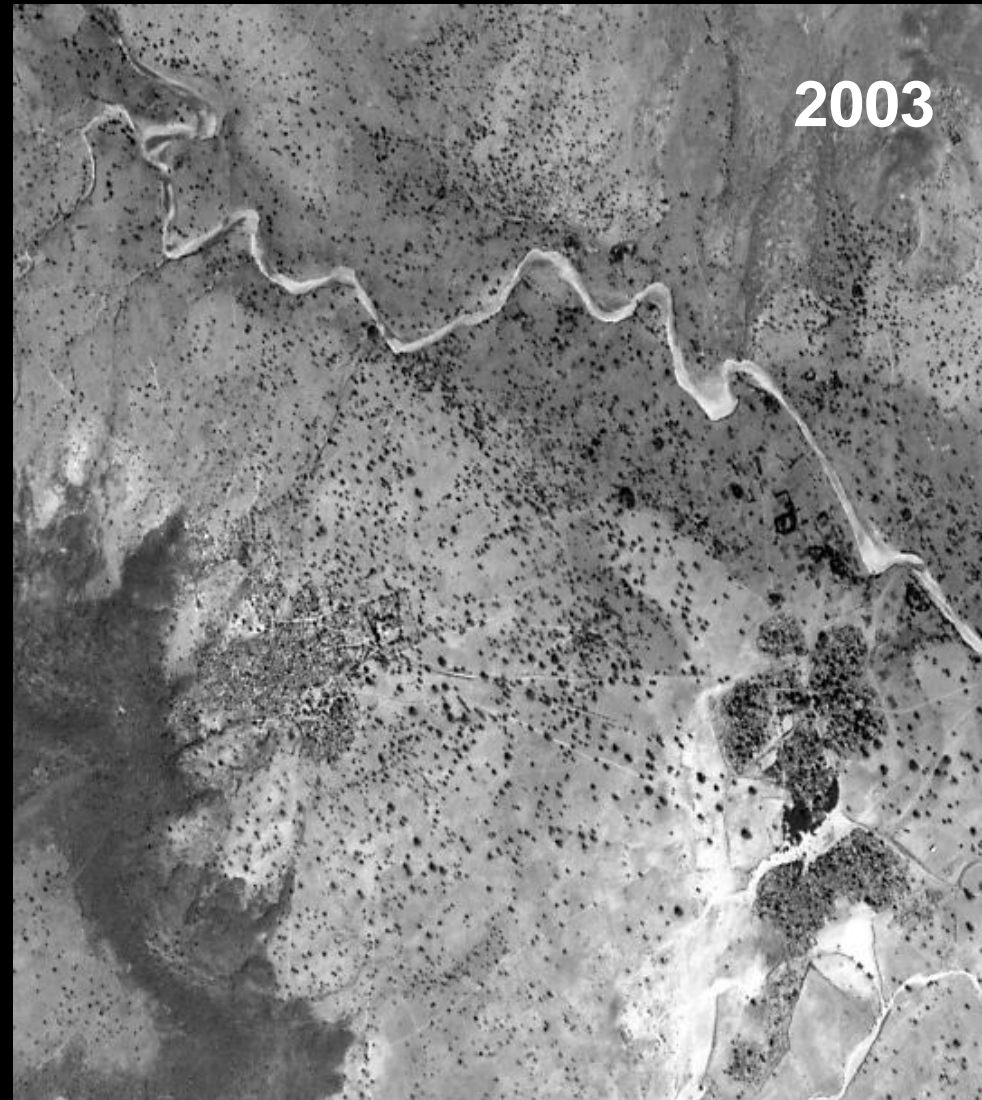
*FAO, 25 June 2014*

*[larsl@wri.org](mailto:larsl@wri.org)*

# Vegetation in Galma in 1975 and 2003



# Vegetation in Galma in 1975 and 2003



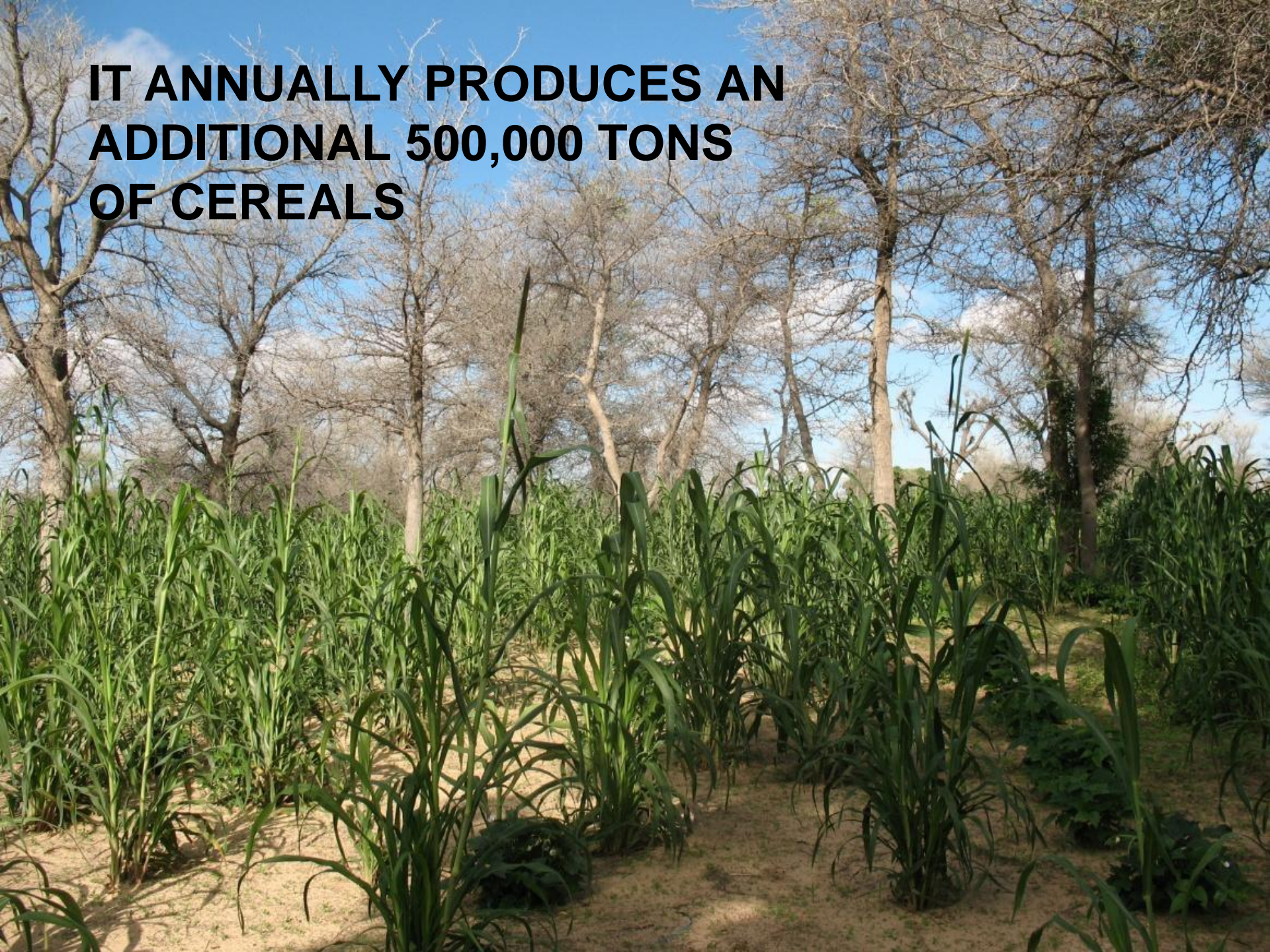


# **NIGER: 5 million ha new agroforestry parkland in Maradi and Zinder Regions**





**IT ANNUALLY PRODUCES AN  
ADDITIONAL 500,000 TONS  
OF CEREALS**





**FOOD DEFICIT IN NIGER IN 2011 -2012:**

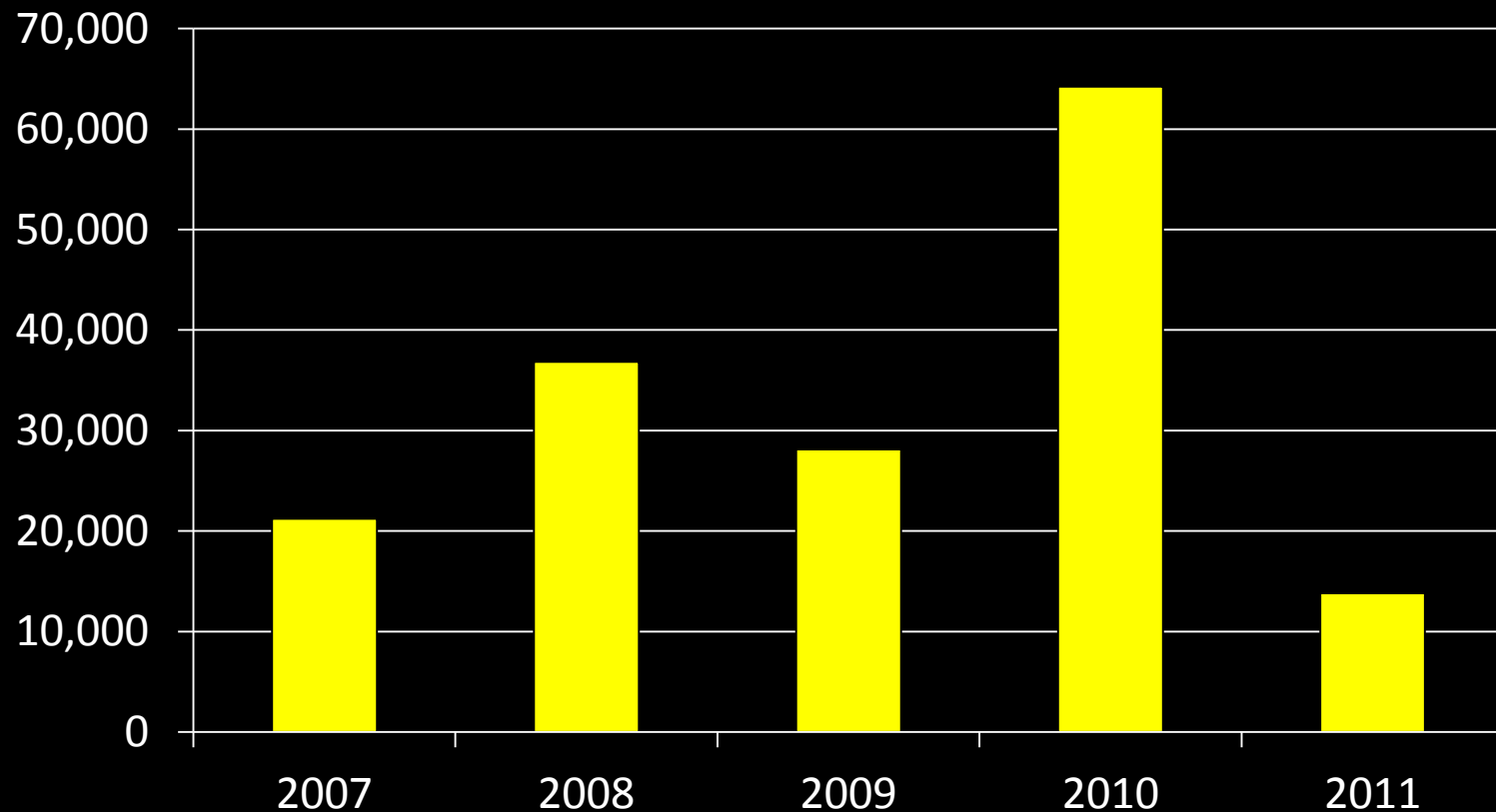
**600,000 TONS**



# Benefits of agroforestry: Grain surpluses (Niger)

Annual grain surplus in Kantché department (Zinder, Niger)

*Metric tons*

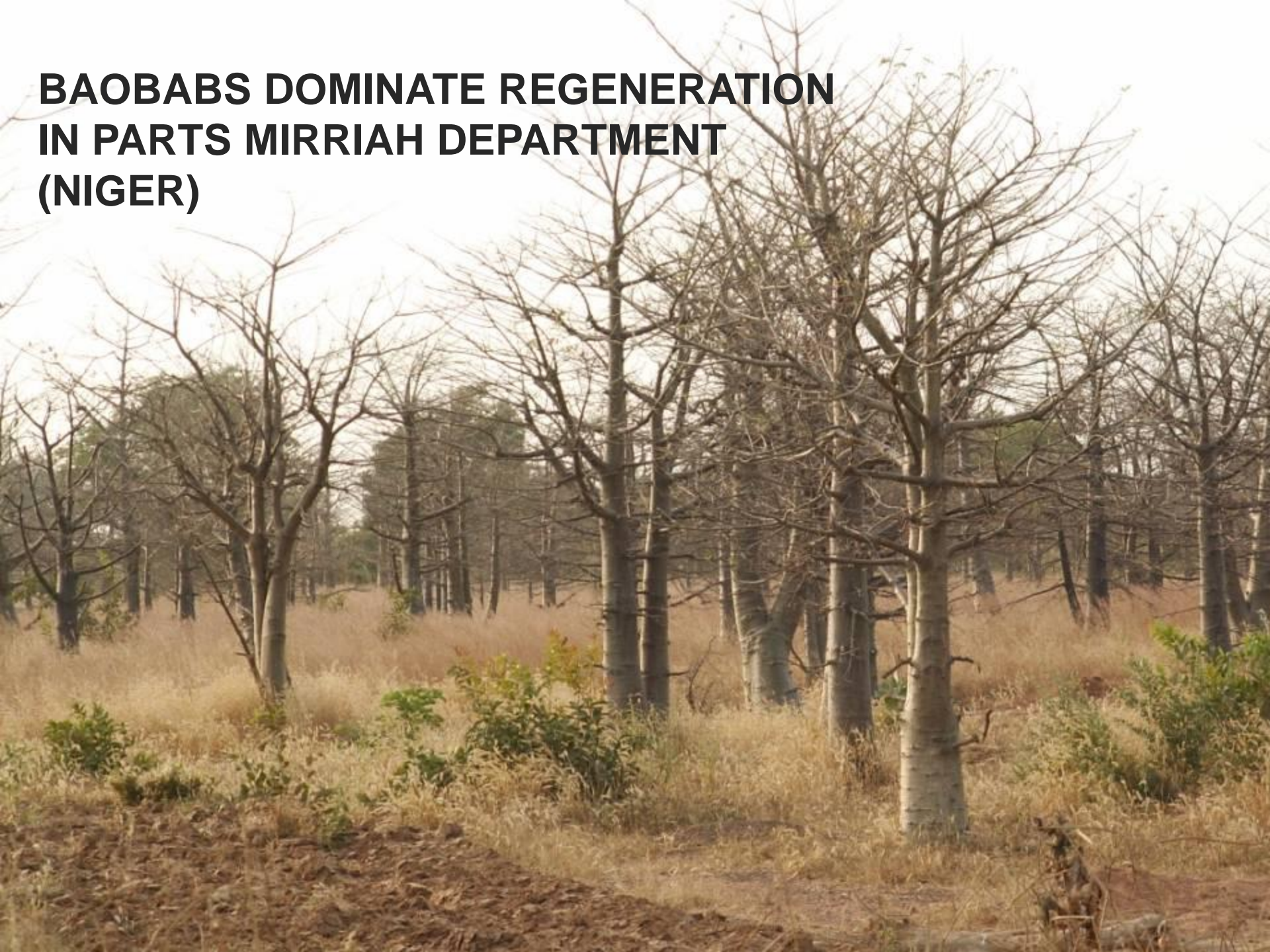




**LIVESTOCK DEPENDS  
ON TREES 6 MO/YR.**



# **BAOBABS DOMINATE REGENERATION IN PARTS MIRRIAH DEPARTMENT (NIGER)**



## **FOOD SECURITY IS MORE THAN GRAIN**

**Leaves of one mature baobab tree is worth  
34 \$ to 70 \$ per year**

**This allows farmers in Niger to buy 70 – 175 kg  
of grain at current market prices**

**Source: Yamba and Sambo (2012)**



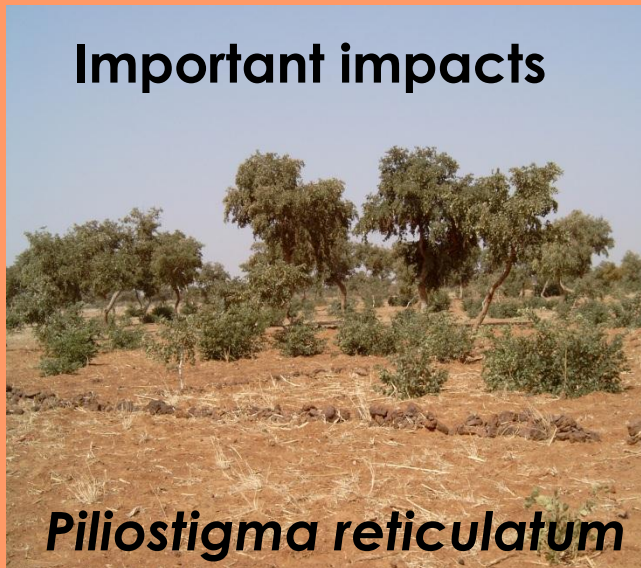
# WATER HARVESTING AND AGROFORESTRY



Zai

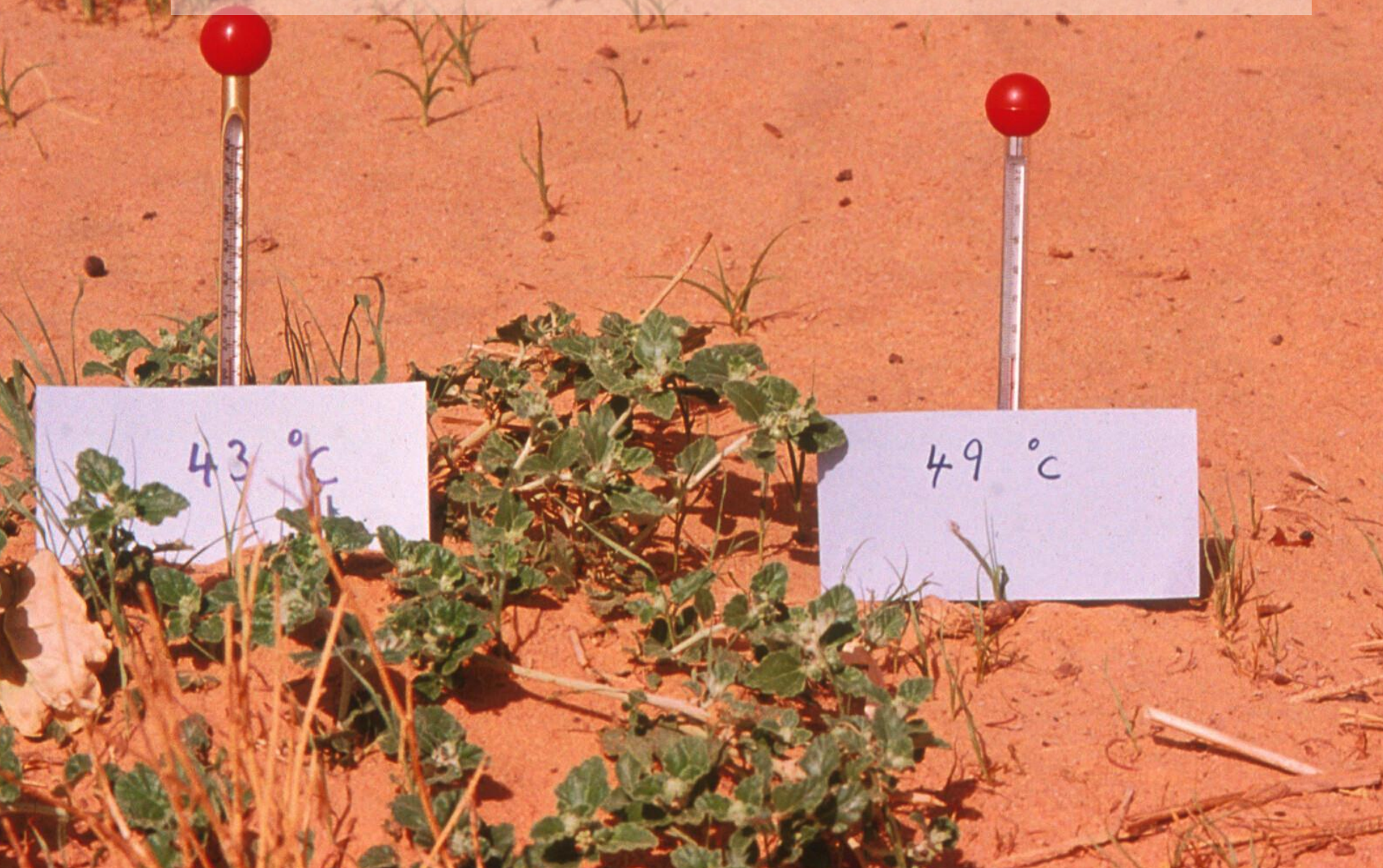


Half moons





# VEGETATION TURNS DOWN THE HEAT





# Shinyanga, Tanzania- then





# Shinyanga, Tanzania- now





# Humbo, Ethiopia



**Before: 2000**



**After: 2007**



WORLD RESOURCES INSTITUTE



**MANY RESTORATION/REGREENING SUCCESSES IN  
THE DRYLANDS CAN BE SCALED UP.....  
WE KNOW WHAT TO DO AND HOW TO DO IT**





Dryland forests and trees are important

But ... we treat them as being inferior

If we don't measure it, we can't manage it

But ... we have no good baseline and  
no good monitoring system



**The regreening of Southern Niger flew  
« under the radar » for 20 years**

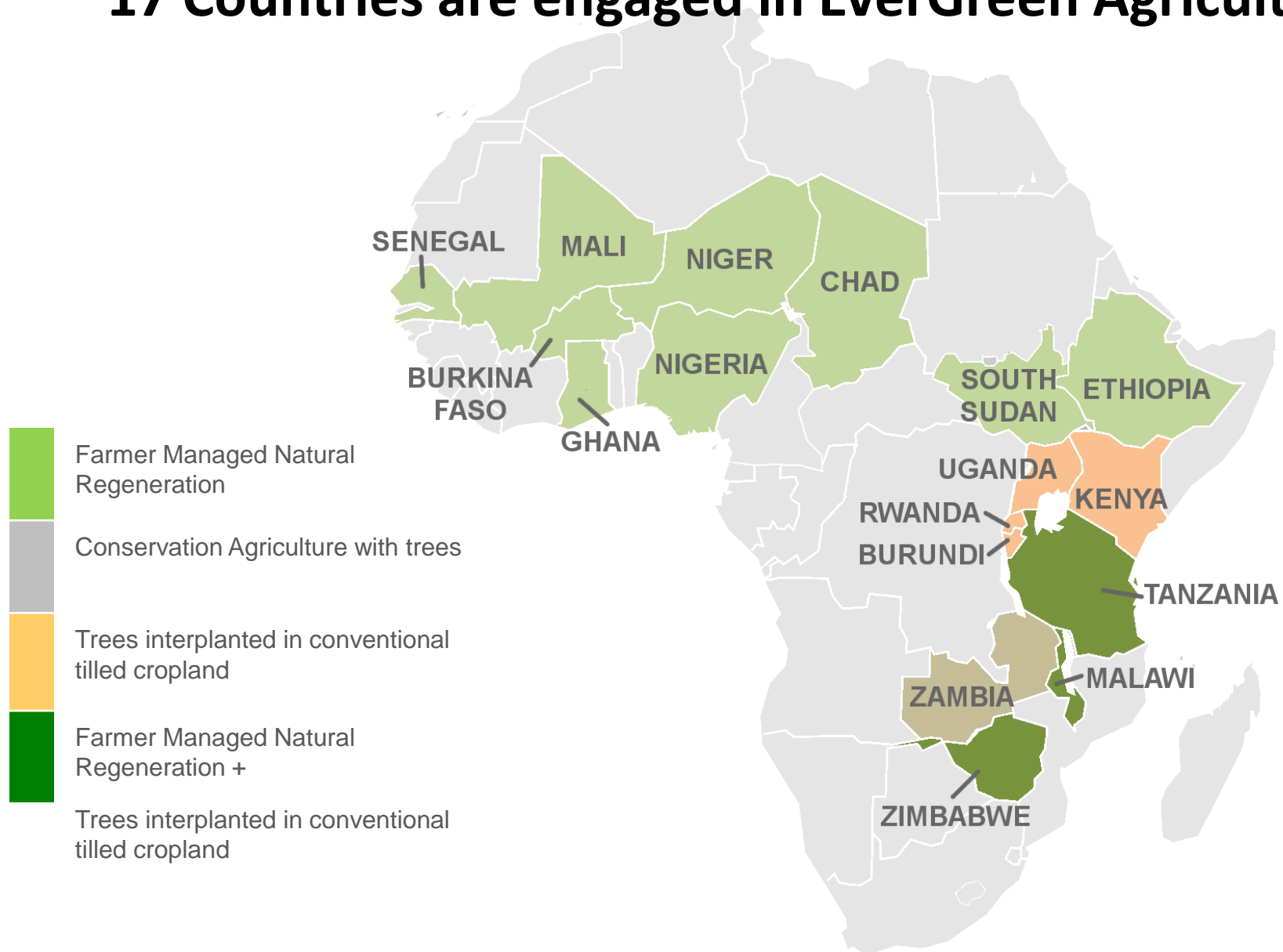




New initiatives and investments  
are coming to the drylands



# 17 Countries are engaged in EverGreen Agriculture





# Great Green Wall for the Sahara and the Sahel initiative

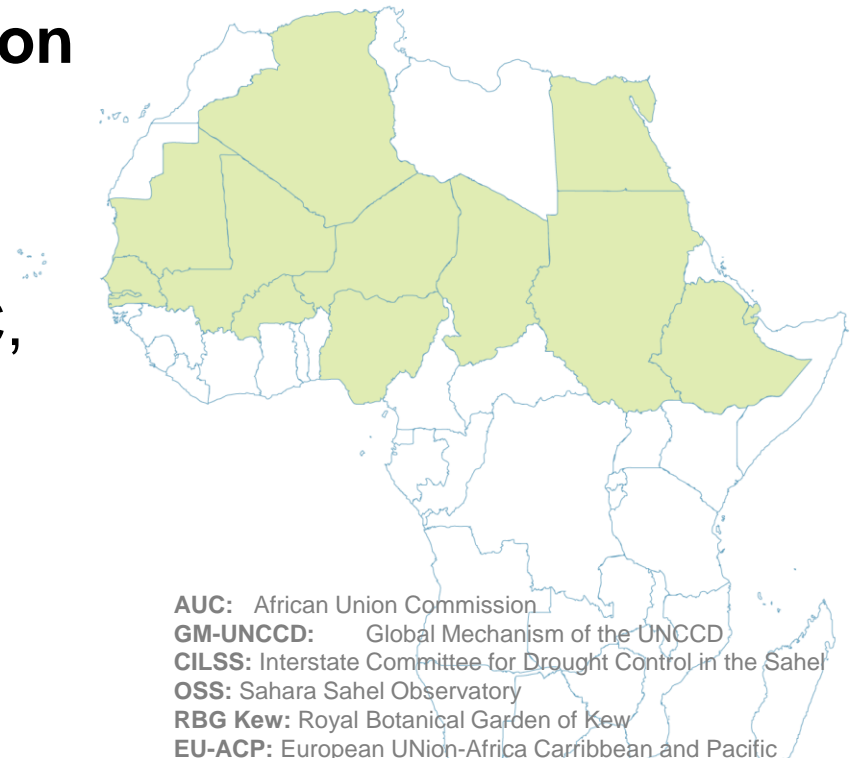


FAO support to the **African Union Commission** and **13 partner countries**

**Implemented** by FAO with AUC, EU, GM-UNCCD, CILSS, OSS, RBG Kew and other partners

**EU-AU strategic partnership**  
(theme on climate change)

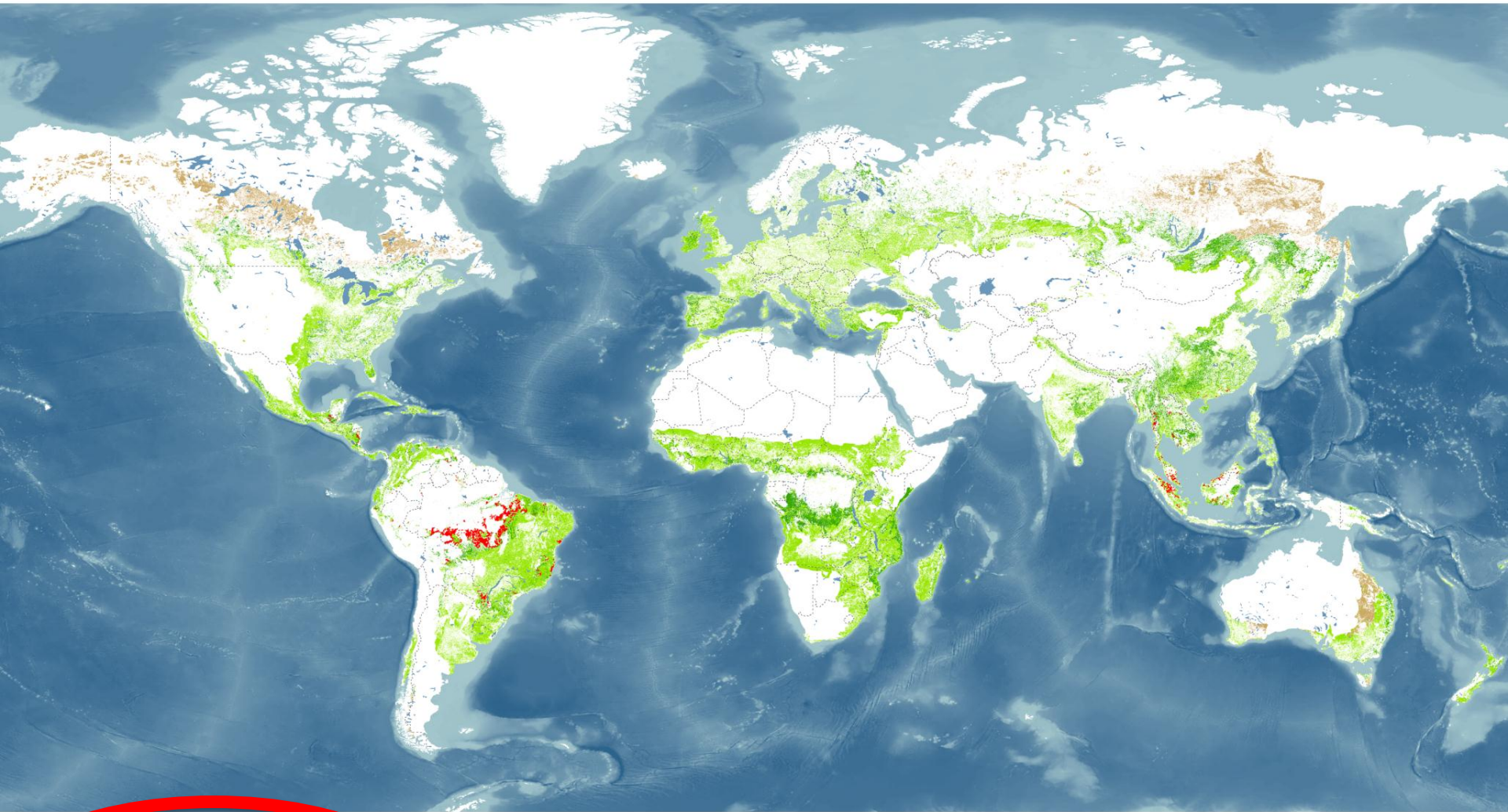
In coordination with GEF-WB  
**SAWAP/BRICKs**



**AUC:** African Union Commission  
**GM-UNCCD:** Global Mechanism of the UNCCD  
**CILSS:** Interstate Committee for Drought Control in the Sahel  
**OSS:** Sahara Sahel Observatory  
**RBG Kew:** Royal Botanical Garden of Kew  
**EU-ACP:** European Union-Africa Caribbean and Pacific  
**SAWAP/BRICKs:** Sahel and West Africa Programme in support to the great green wall that is implemented in 12 countries funded by GEF and World Bank. The Bricks is the regional project that aiming to support services to the 12 countries of the SAWAP. BRICKs stands for Building Resilience through Innovation, Communication and Knowledge Services



# A World of Opportunity for Forest and Landscape Restoration



## FOREST AND LANDSCAPE RESTORATION OPPORTUNITIES

- Wide-scale restoration
- Mosaic restoration
- Remote restoration

## OTHER AREAS

- Recent tropical deforestation

How will we (and they) know how it goes?

A better system for mapping and monitoring  
of forests and trees across drylands  
is needed

But ... how ???



# *Data limitations*



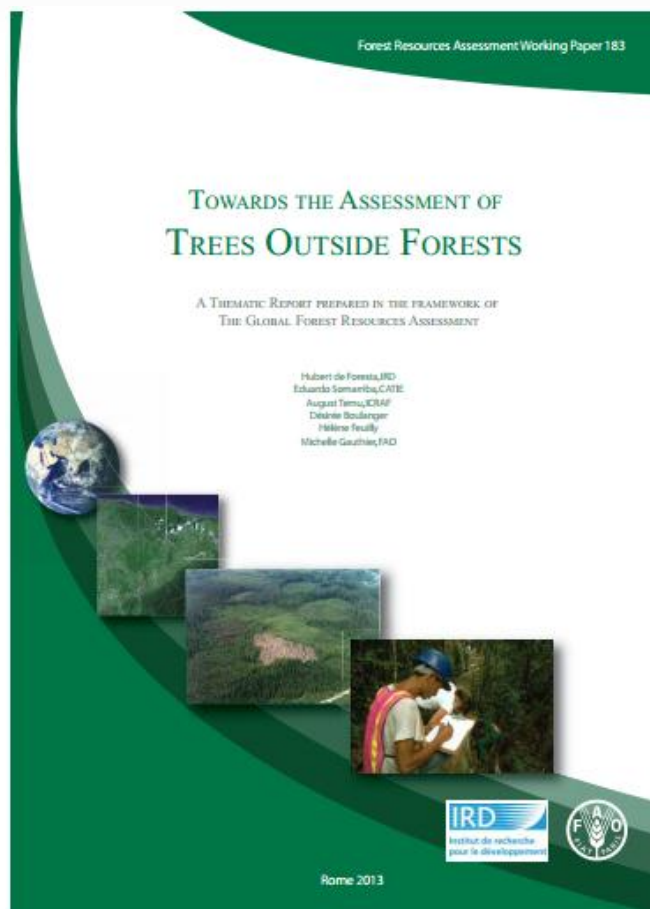
*Landsat 2012 composite*

*spatial resolution:  
30m*



*High resolution imagery  
(from Google Earth)*

*spatial resolution:  
<1m*



de Foresta H, Somarriba E, Temu A, Boulanger D, Feuilly H and Gauthier M. 2013.

## **Towards the Assessment of Trees Outside Forests.**

FRA Working Paper 183. FAO Rome.

Free available at:<http://www.fao.org/docrep/017/aq071e/aq071e00.pdf>





# Collect Earth

Visual interpretation tool for land  
use/cover classification



**OPEN FORIS INICIATIVE**

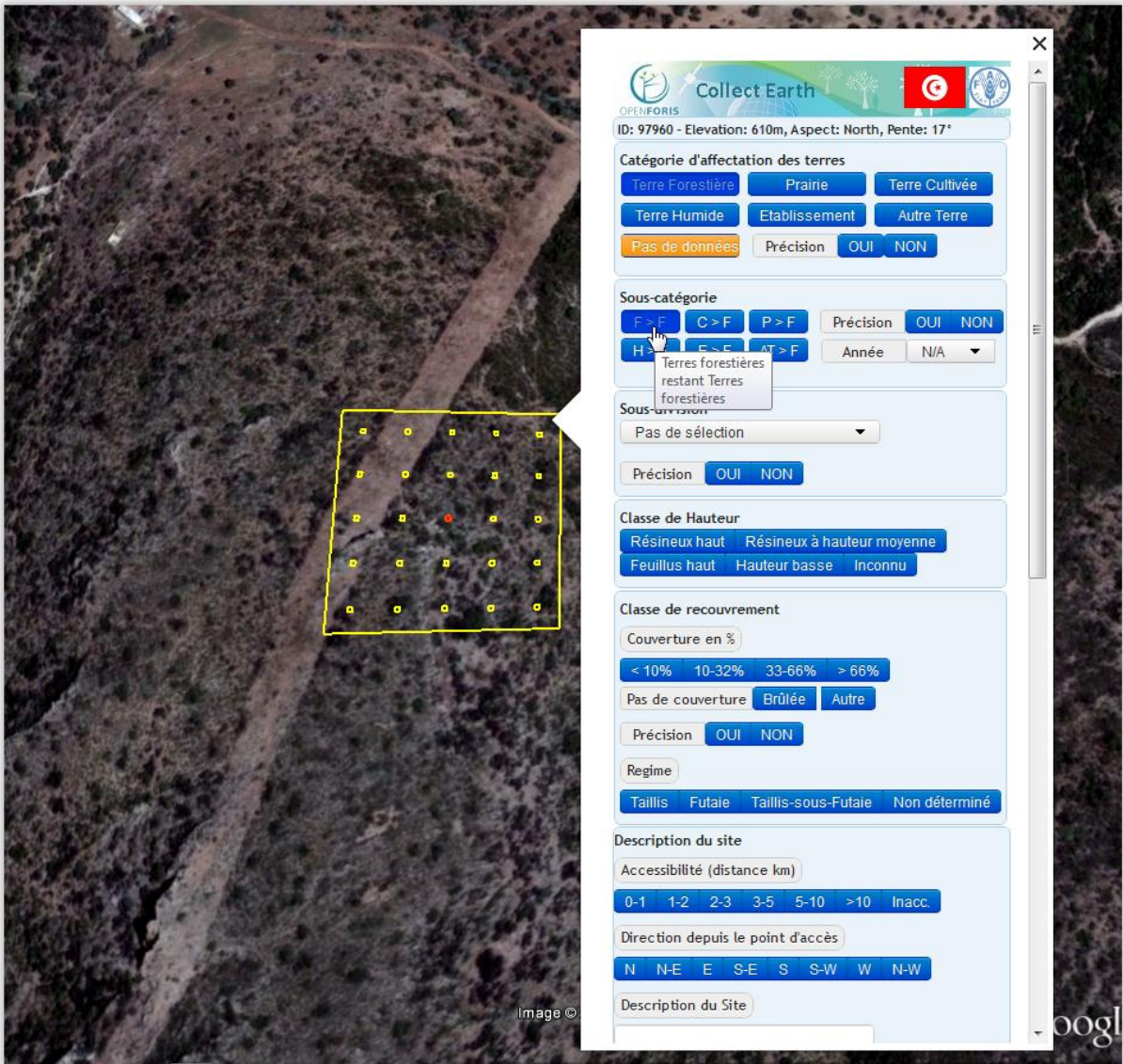
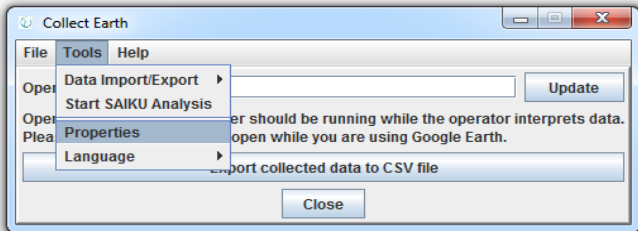
<http://www.fao.org/forestry/fma/openforis/en/>

## COLLECT EARTH TOOL





# COLLECT EARTH TOOL



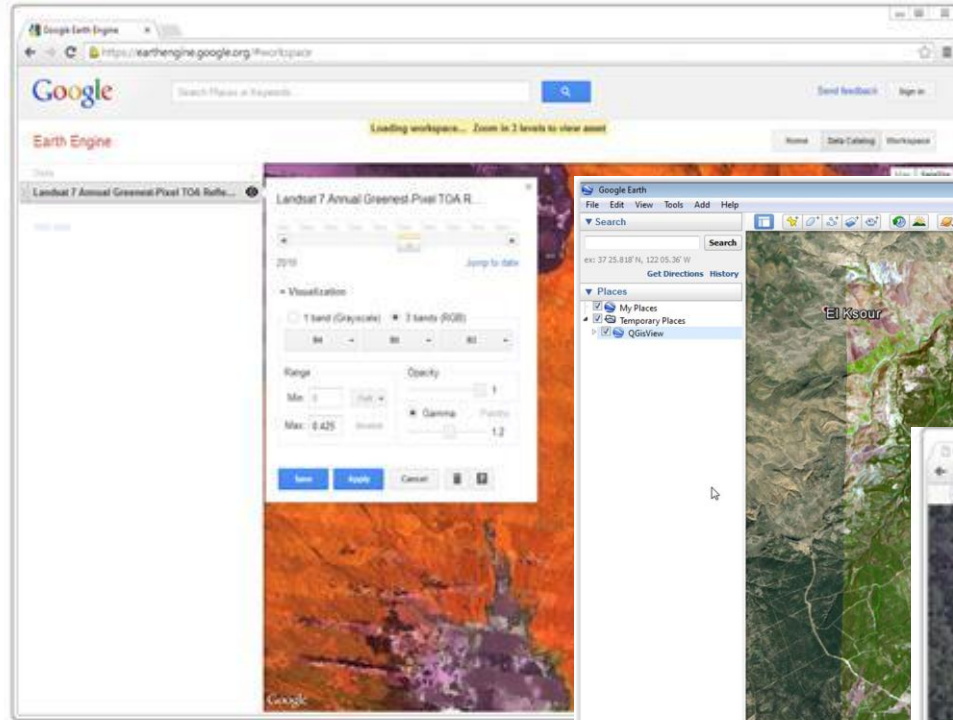
# Collect Earth : using many sources of information



Medium  
resolution  
time series

Very high  
resolution

Bing, GE +  
... any other  
available!







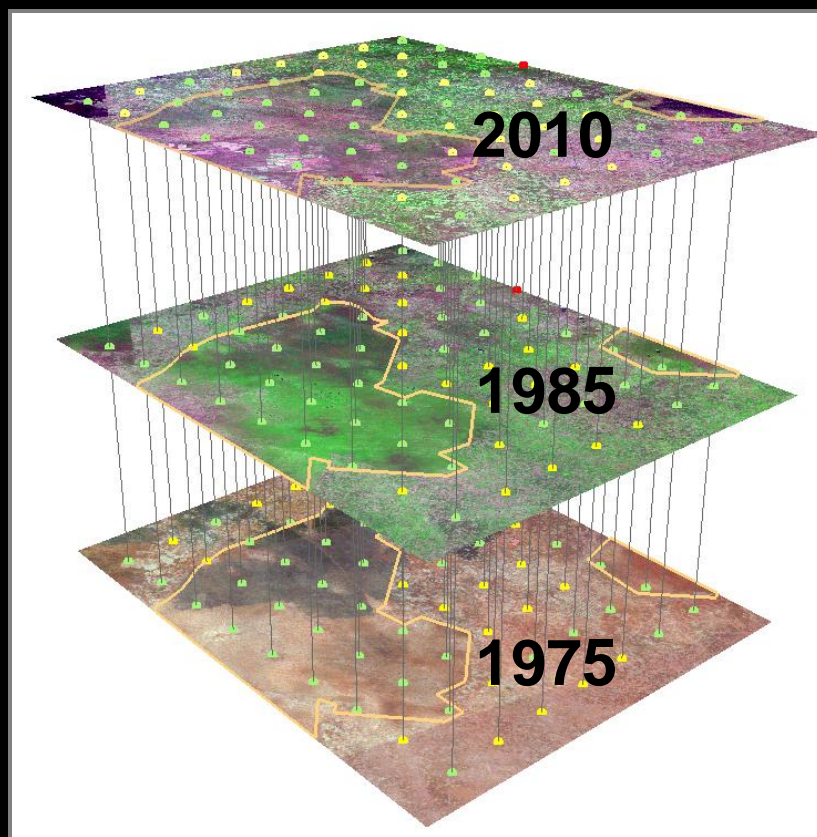
## How can I get it?

- Future version fully customizable by user.
  - Ready by September-October 2014
- Currently support to set up the APP is needed for new surveys.
  - More information:

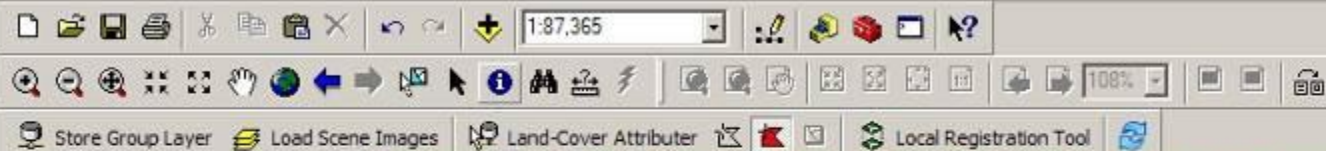
<http://www.fao.org/forestry/fma/openforis/en/>

# Rapid Land Cover Mapper

The RLCM tool is designed to facilitate time-series mapping and trends analysis of land use and land cover. We built and implemented it for large area mapping in West Africa







**Land-Cover Attributing**

- ☐ lc\_points
- ☐ wrs2000
- ☐ lc\_points5 - lc\_points5
  - Forêt (Forest)
  - Savane
  - Prairie marécageuse (Wetland)
  - Steppe
  - Plantation
  - Mangrove
  - Zone de Culture (Agriculture)
  - Plans d'eau (Water Bodies)
  - Surface Sableuse (Sandy)
  - Terrains Rocheux (Rocky)
  - Sols Dénudés (Bare Soil)
  - Habitation (Settlements)
  - Zone de Culture Irriguée
  - Forêt galerie (Gallery Forest)
- ☒ Scene p205r050
  - ☐ p205r050\_5t19841017\_t RGB
    - Red: Layer\_1
    - Green: Layer\_2
    - Blue: Layer\_3
  - ☒ p205r050\_7t19991104\_t RGB
    - Red: Layer\_1
    - Green: Layer\_2
    - Blue: Layer\_3

Display Source Selection Catalog



**LCMapper**

Land-Cover Type

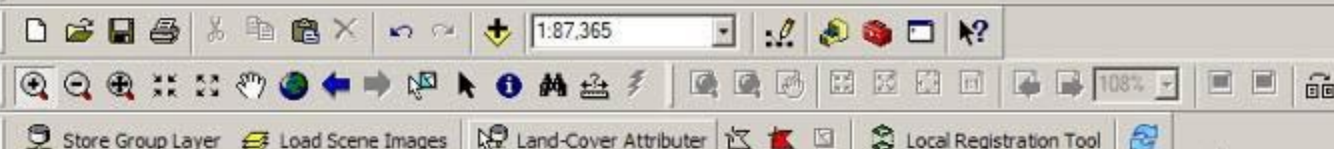
- ☐ Forêt
- ☐ Savane
- ☒ Prairie marécageuse -
- ☐ Steppe
- ☐ Oasis
- ☐ Plantation
- ☐ Mangrove
- ☐ Zone de Culture
- ☐ Zone de Irrigué Culture
- ☐ Plans d'eau
- ☐ Surfaces Sableuse
- ☐ Terrains Rocheux
- ☐ Sols Dénudé
- ☒ Habitation
- ☐ Nuage
- ☐ Ombre de nuage
- ☐ Forêt galerie/formation

Time Period

2000(Circa)

☐ ☒ ☐ ☐ ☐

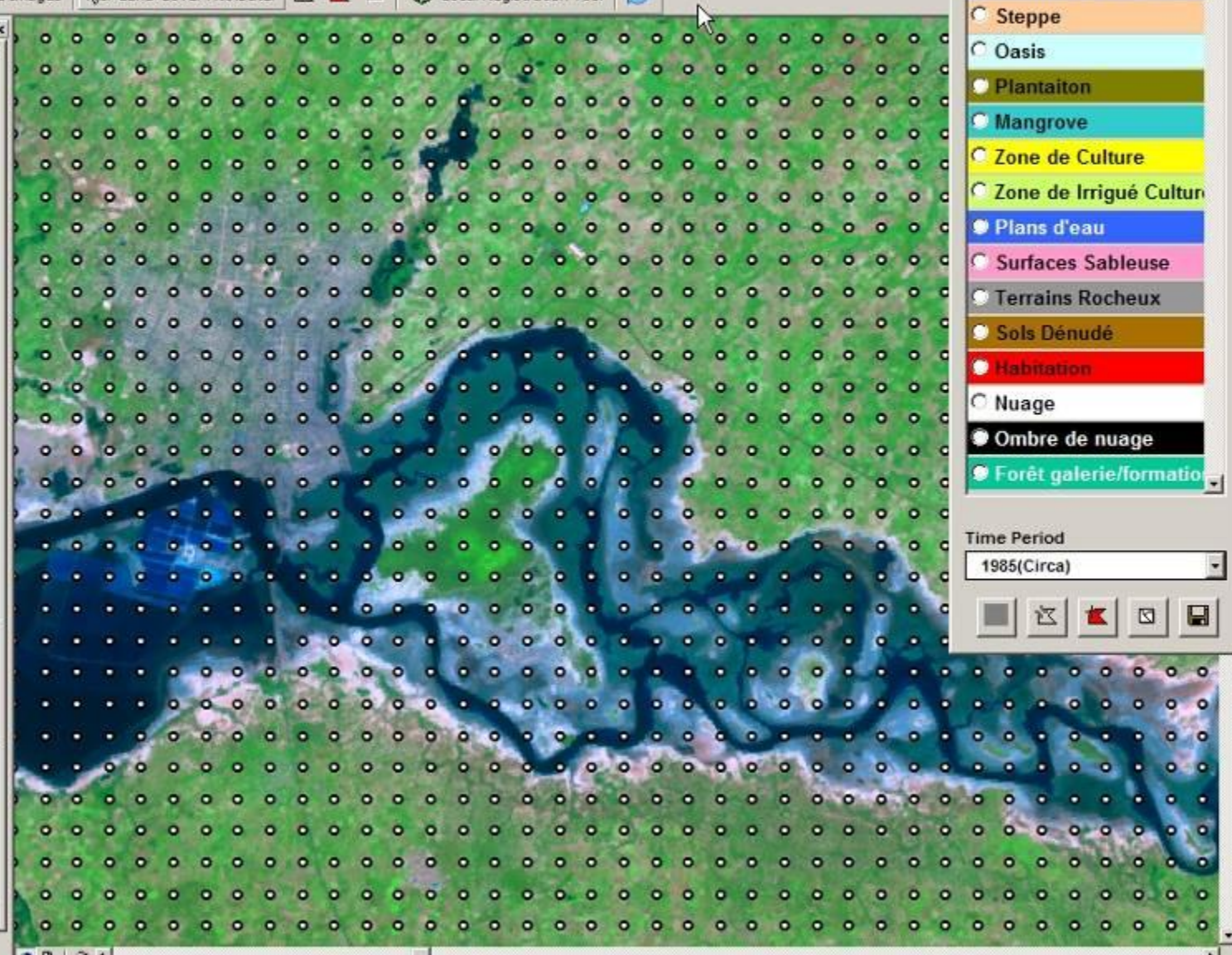




**Land-Cover Attributing**

- ☒ **lc\_points**
  - <all other values>
  - Land-Cover Landsat 7
    - Forêt galerie
    - Zone de Culture (A)
    - Zone de Culture irriguée
    - Nuage / ombre de nuage
    - Forêt (VF)
    - Savanes (VS)
    - Prairie marécageuse (VP)
    - Steppes (VSt)
    - Oasis (VO)
    - Plantations (PVI)
    - Mangroves (VM)
    - Plans d'eau (E)
    - Surfaces Sableuses (SS)
    - Terrains Rocheux (SR)
    - Sols Dénudés (SD)
    - Habitations (H)
- ☐ wrs2000
- ☐ lc\_points5 - lc\_points5
- ☒ Scene p205r050
  - ☐ p205r050\_5t19841017\_t RGB
    - Red: Layer\_1
    - Green: Layer\_2
    - Blue: Layer\_3
  - ☒ p205r050\_7t19991104\_t RGB
    - Red: Layer\_1
    - Green: Layer\_2
    - Blue: Layer\_3

Display Source Selection Catalog



**LCMapper**

Land-Cover Type

- ☐ Forêt
- ☐ Savane
- ☒ Prairie marécageuse
- ☐ Steppe
- ☐ Oasis
- ☐ Plantaiton
- ☐ Mangrove
- ☐ Zone de Culture
- ☐ Zone de Irrigué Cultun
- ☐ Plans d'eau
- ☐ Surfaces Sableuse
- ☐ Terrains Rocheux
- ☐ Sols Dénudé
- ☐ Habitation
- ☐ Nuage
- ☐ Ombre de nuage
- ☐ Forêt galerie/formatio

Time Period

1985(Circa)

Legend icons: Gray, Red, Blue, Green, Black.





## Land-Cover Attributing

- ☒ lc\_points
  - ☐ <all other values>
  - Land-Cover Landsat 7
    - Forêt galerie
    - Zone de Culture (A)
    - Zone de Culture irriguée
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- ☐ lc\_points5 - lc\_points5
- ☒ Scene p205r050
  - ☐ p205r050\_5t19841017\_t  
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RGB
    - Red: Layer\_1
    - Green: Layer\_2
    - Blue: Layer\_3

## Land-Cover Type

- ☒ Forêt
- ☐ Savane
- ☒ Prairie marécageuse -
- ☐ Steppe
- ☐ Oasis
- ☐ Plantation
- ☐ Mangrove
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- ☐ Zone de Irrigué Culture
- ☐ Plans d'eau
- ☐ Surfaces Sableuse
- ☐ Terrains Rocheux
- ☐ Sols Dénudé
- ☒ Habitation
- ☐ Nuage
- ☐ Ombre de nuage
- ☐ Forêt galerie/formation

## Time Period

1985(Circa)



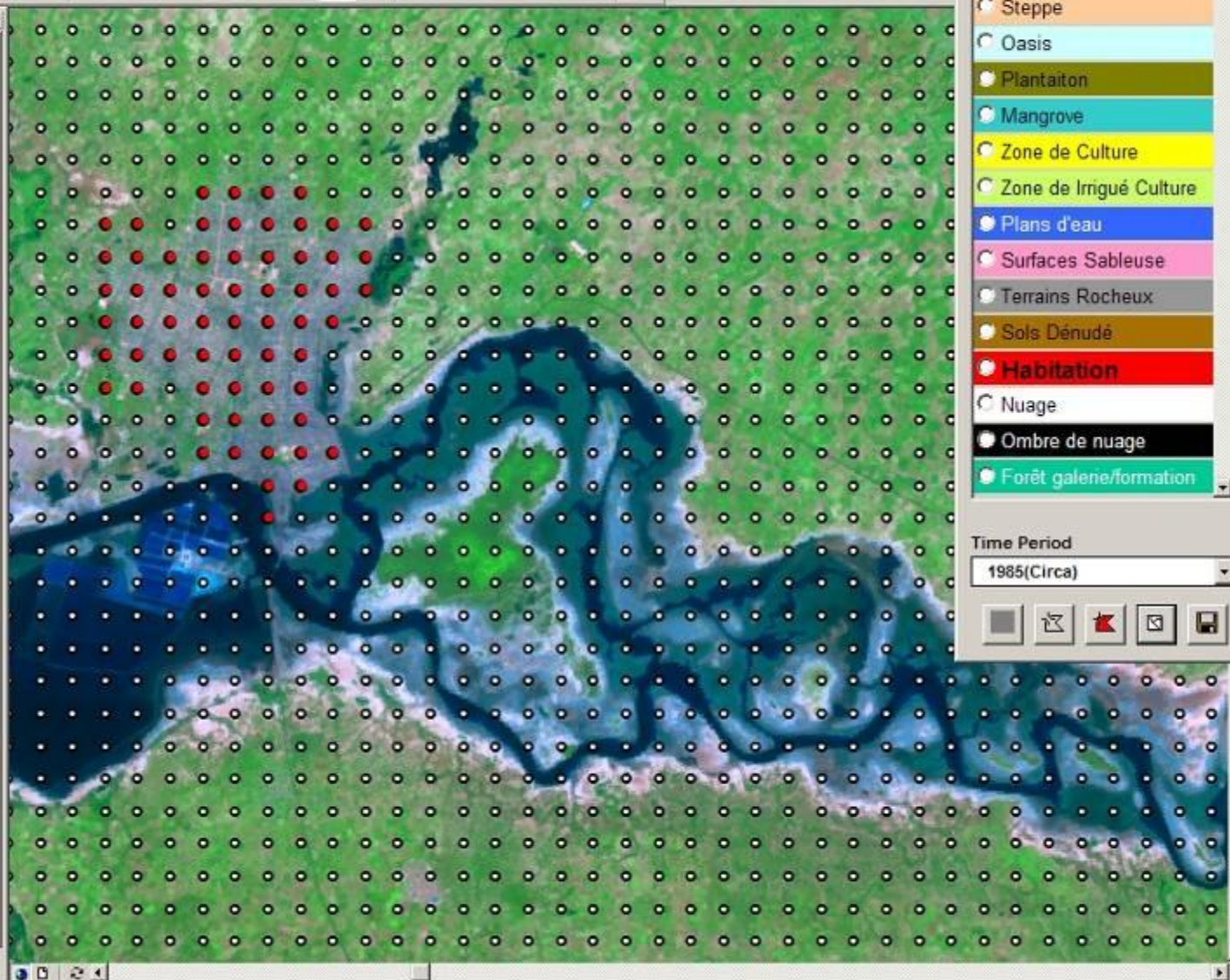




**Land-Cover Attributing**

- ☒ **lc\_points**
  - ☐ <all other values>
  - Land-Cover Landsat 7
    - Forêt galerie
    - Zone de Culture (A)
    - Zone de Culture irriguée
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- ☐ wrs2000
- ☐ lc\_points5 - lc\_points5
- ☒ Scene p205r050
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RGB
    - Red: Layer\_1
    - Green: Layer\_2
    - Blue: Layer\_3
  - ☒ p205r050\_7t19991104\_t  
RGB
    - Red: Layer\_1
    - Green: Layer\_2
    - Blue: Layer\_3

Display Source Selection Catalog



- ☒ Forêt
- ☐ Savane
- ☒ Prairie marécageuse -
- ☐ Steppe
- ☐ Oasis
- ☐ Plantation
- ☐ Mangrove
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- ☐ Plans d'eau
- ☐ Surfaces Sableuse
- ☐ Terrains Rocheux
- ☐ Sols Dénudé
- ☒ Habitation
- ☐ Nuage
- ☐ Ombre de nuage
- ☐ Forêt galene/formation

1985(Circa)



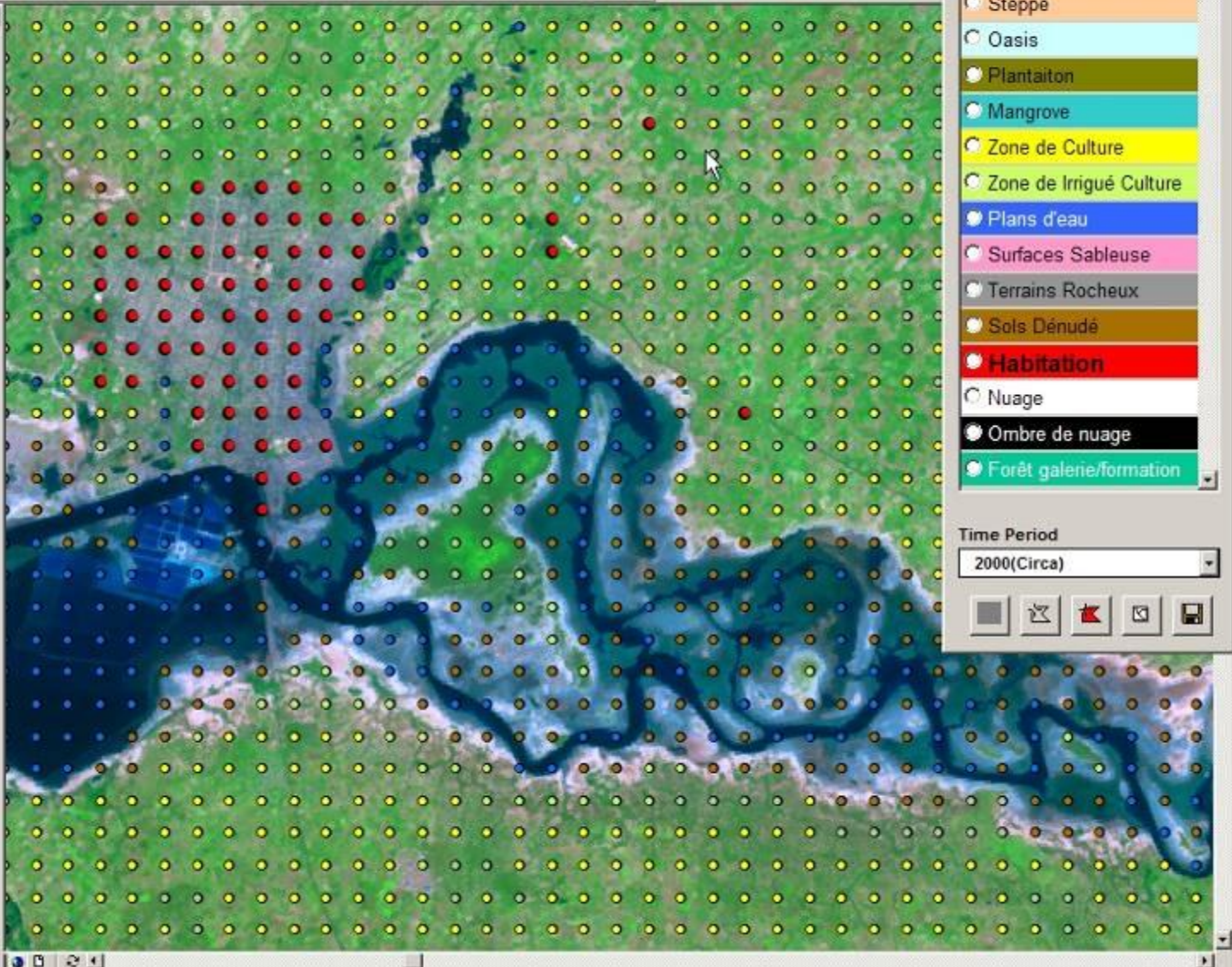




**Land-Cover Attributing**

- ☒ **lc\_points**
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  - Land-Cover Landsat 7
    - Forêt galerie
    - Zone de Culture (A)
    - Zone de Culture irriguée
    - ☒ Nuage / ombre de nuage
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- ☐ wrs2000
- ☐ lc\_points5 - lc\_points5
- ☒ Scene p205r050
  - ☐ p205r050\_5t19841017\_t  
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    - Blue: Layer\_3
  - ☒ p205r050\_7t19991104\_t  
RGB
    - Red: Layer\_1
    - Green: Layer\_2
    - Blue: Layer\_3

Display Source Selection Catalog



**LCMapper**

Land-Cover Type

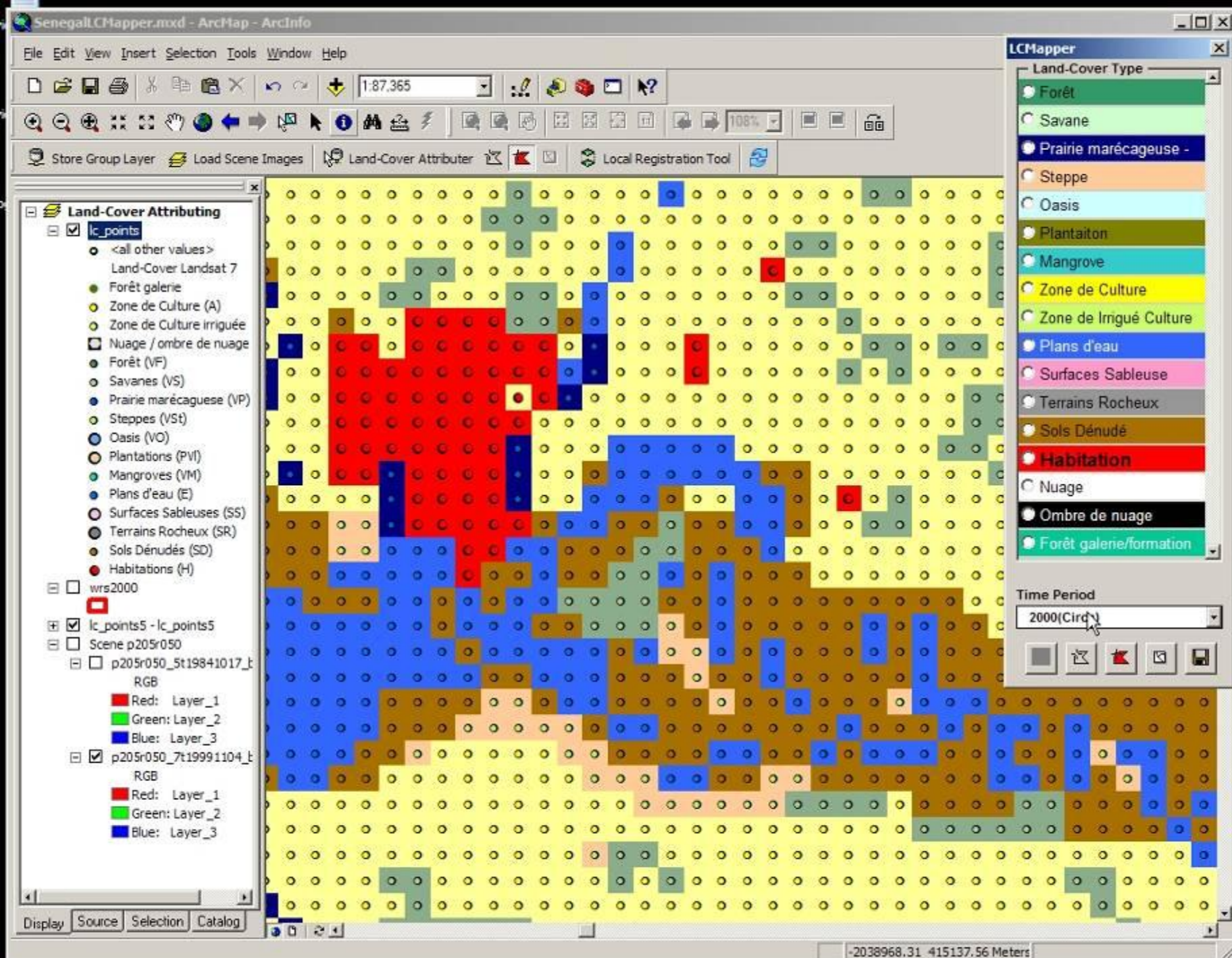
- ☐ Forêt
- ☐ Savane
- ☒ Prairie marécageuse -
- ☐ Steppe
- ☐ Oasis
- ☐ Plantation
- ☐ Mangrove
- ☐ Zone de Culture
- ☐ Zone de Irrigué Culture
- ☐ Plans d'eau
- ☐ Surfaces Sableuse
- ☐ Terrains Rocheux
- ☐ Sols Dénudé
- ☒ Habitation
- ☐ Nuage
- ☐ Ombre de nuage
- ☐ Forêt galerie/formation

Time Period

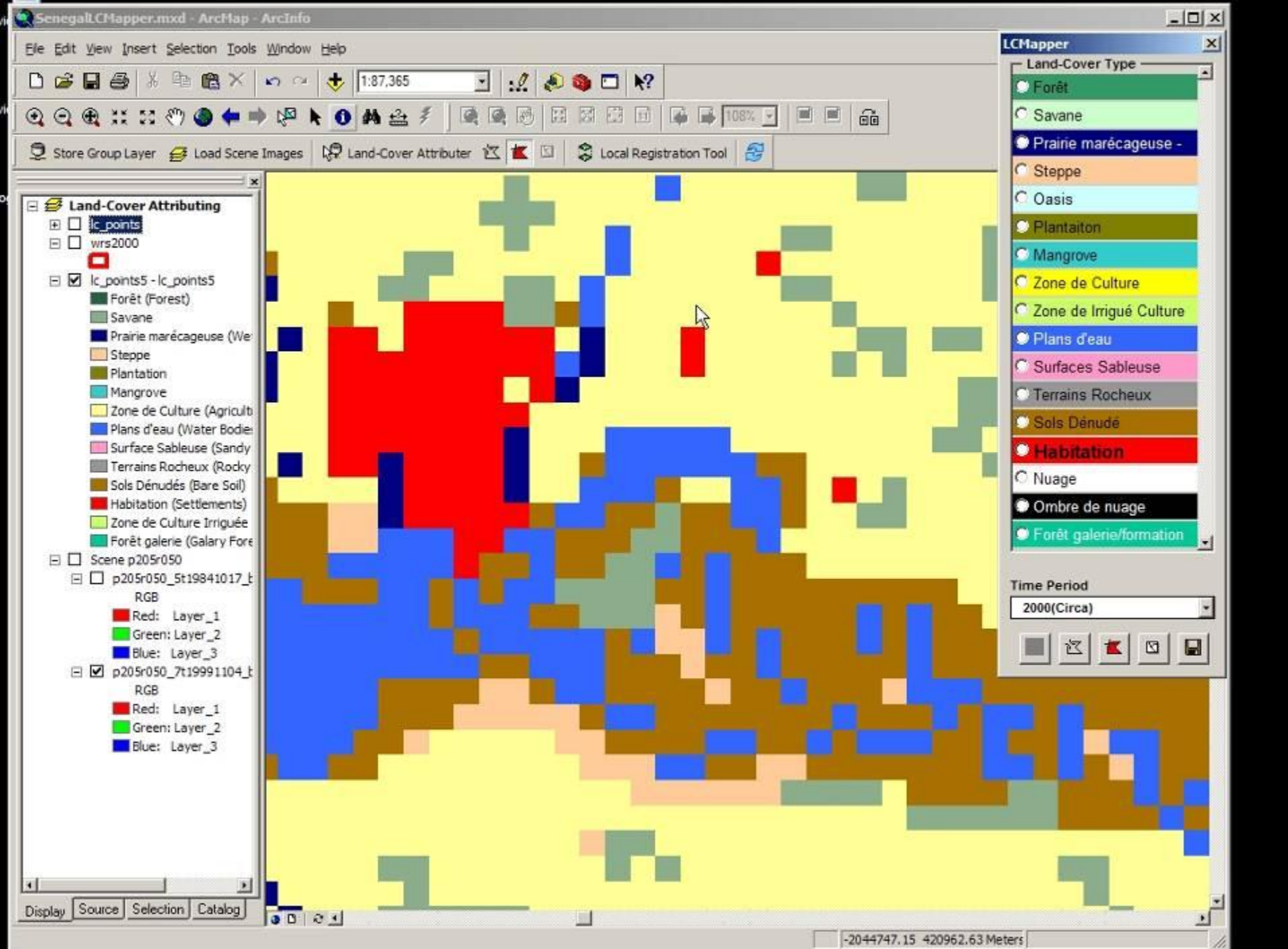
2000(Circa)

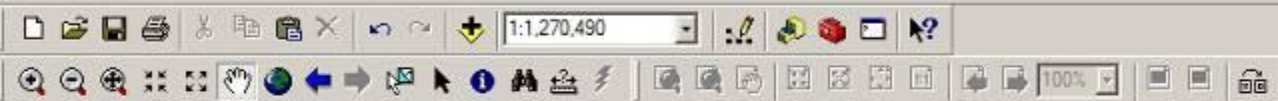
☐ ☒ ☐ ☐ ☐





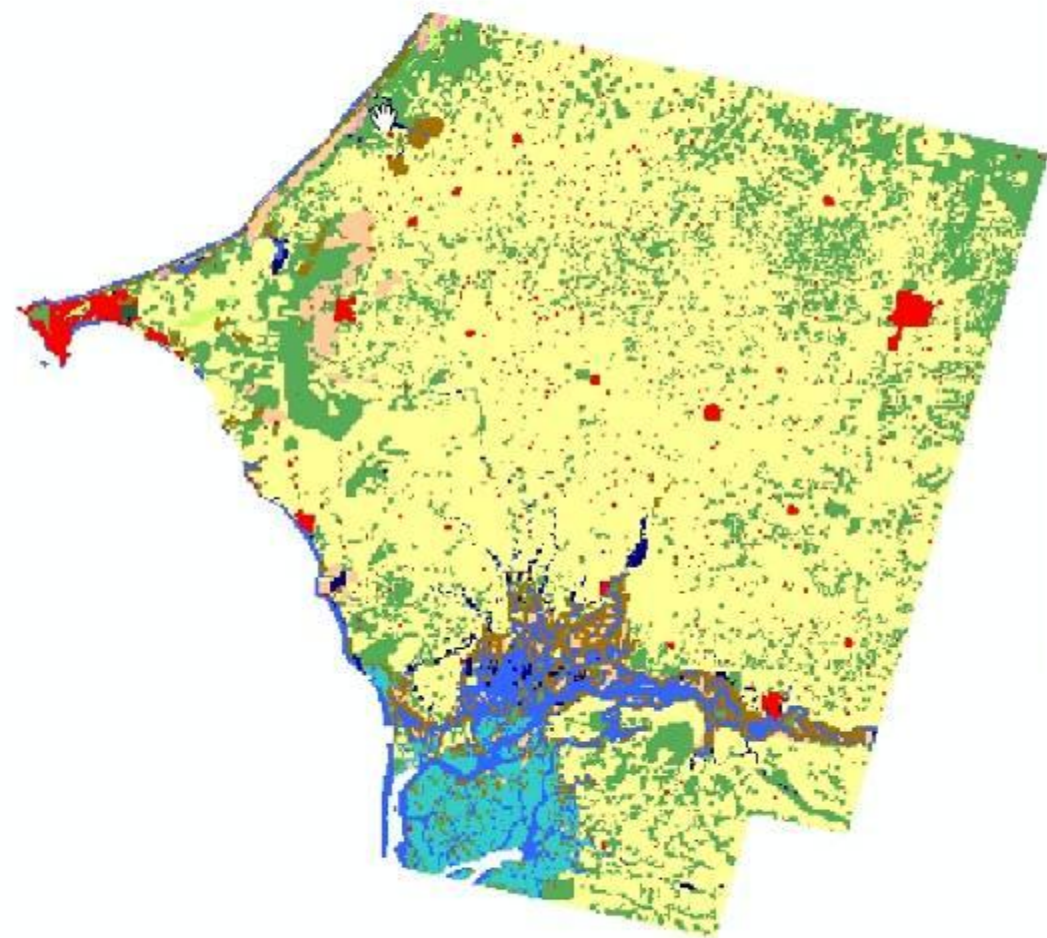






**Land-Cover Attributing**

- ☐ lc\_points
- ☐ wrs2000
- ☒ lc\_points5 - lc\_points5
  - Forêt (Forest)
  - Savane
  - Prairie marécageuse (Wetland)
  - Steppe
  - Plantation
  - Mangrove
  - Zone de Culture (Agriculture)
  - Plans d'eau (Water Bodies)
  - Surface Sableuse (Sandy)
  - Terrains Rocheux (Rocky)
  - Sols Dénudés (Bare Soil)
  - Habitation (Settlements)
  - Zone de Culture Irriguée
  - Forêt galerie (Gallery Forest)
- ☐ Scene p205r050
  - ☐ p205r050\_5t19841017\_t RGB
    - Red: Layer\_1
    - Green: Layer\_2
    - Blue: Layer\_3
  - ☒ p205r050\_7t19991104\_t RGB
    - Red: Layer\_1
    - Green: Layer\_2
    - Blue: Layer\_3



**LCMapper**

Land-Cover Type

- ☐ Forêt
- ☐ Savane
- ☒ Prairie marécageuse
- ☐ Steppe
- ☐ Oasis
- ☐ Plantation
- ☐ Mangrove
- ☐ Zone de Culture
- ☐ Zone de Irrigué Cultures
- ☐ Plans d'eau
- ☐ Surfaces Sableuse
- ☐ Terrains Rocheux
- ☐ Sols Dénudé
- ☐ Habitation
- ☐ Nuage
- ☐ Ombre de nuage
- ☐ Forêt galerie/formation

Time Period

2000(Circa)

[Legend icons: grayscale, red, blue, green, yellow]

















# Land Use/Land Cover of Western Senegal

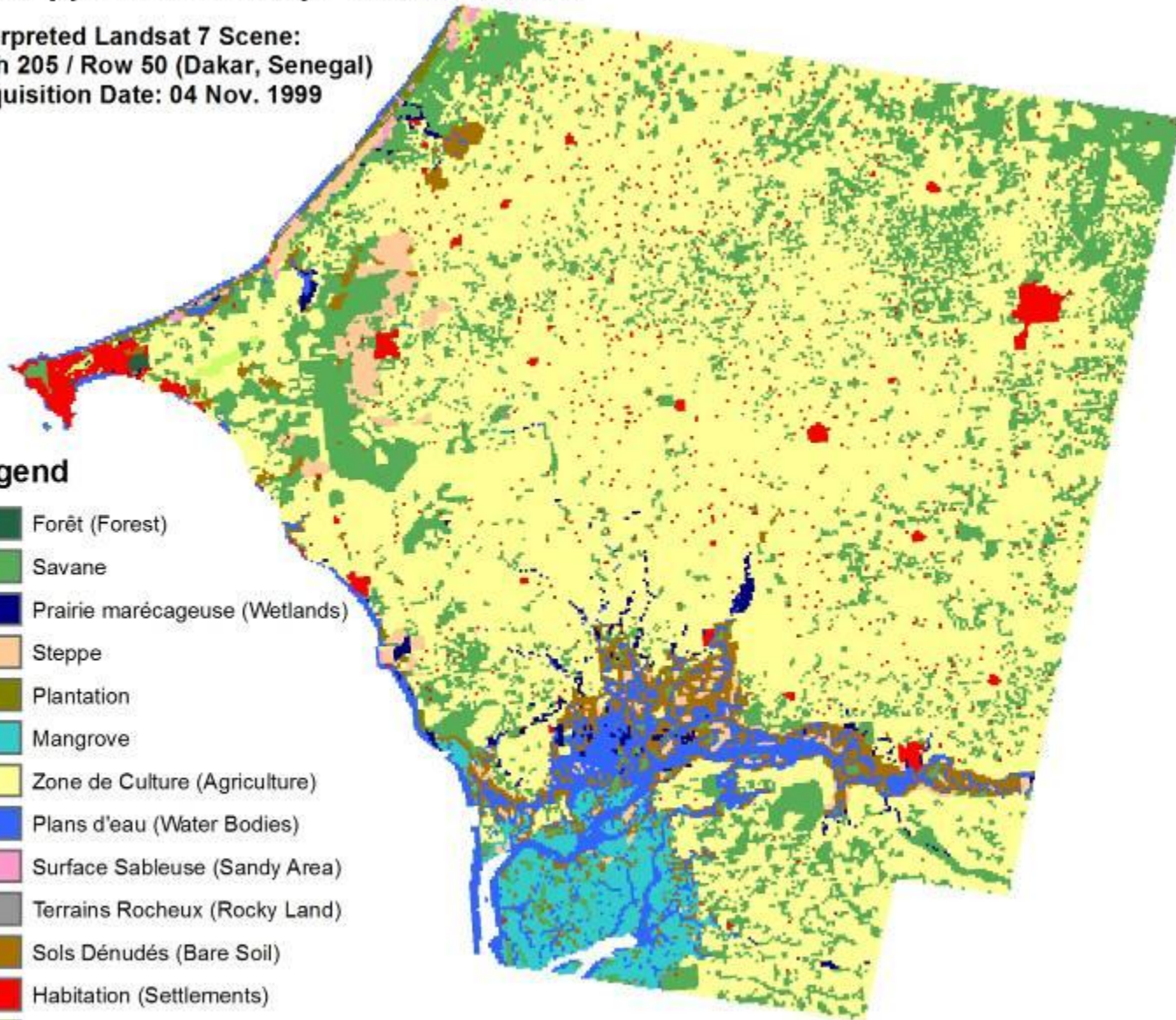
## LCMapper Preliminary Product Results

Interpreted Landsat 7 Scene:  
Path 205 / Row 50 (Dakar, Senegal)  
Acquisition Date: 04 Nov. 1999

### Legend

-  Forêt (Forest)
-  Savane
-  Prairie marécageuse (Wetlands)
-  Steppe
-  Plantation
-  Mangrove
-  Zone de Culture (Agriculture)
-  Plans d'eau (Water Bodies)
-  Surface Sableuse (Sandy Area)
-  Terrains Rocheux (Rocky Land)
-  Sols Dénudés (Bare Soil)
-  Habitation (Settlements)
-  Zone de Culture Irriguée (Irrigated Agriculture)
-  Forêt galerie (Galary Forest)

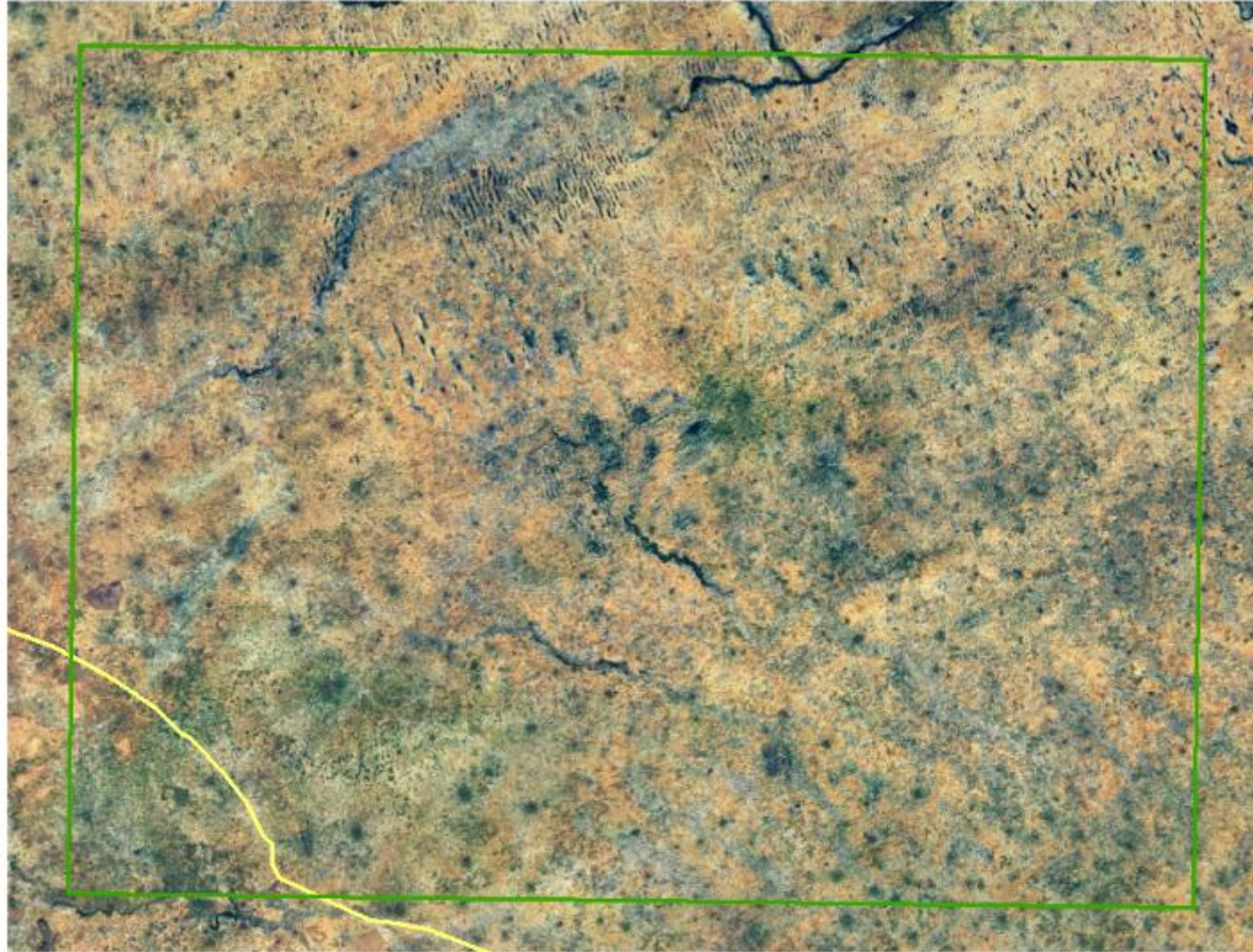
Map Produced: 08 July 2005





# Study Area 1 –Tree cover mapping

## Google Earth image (2014)

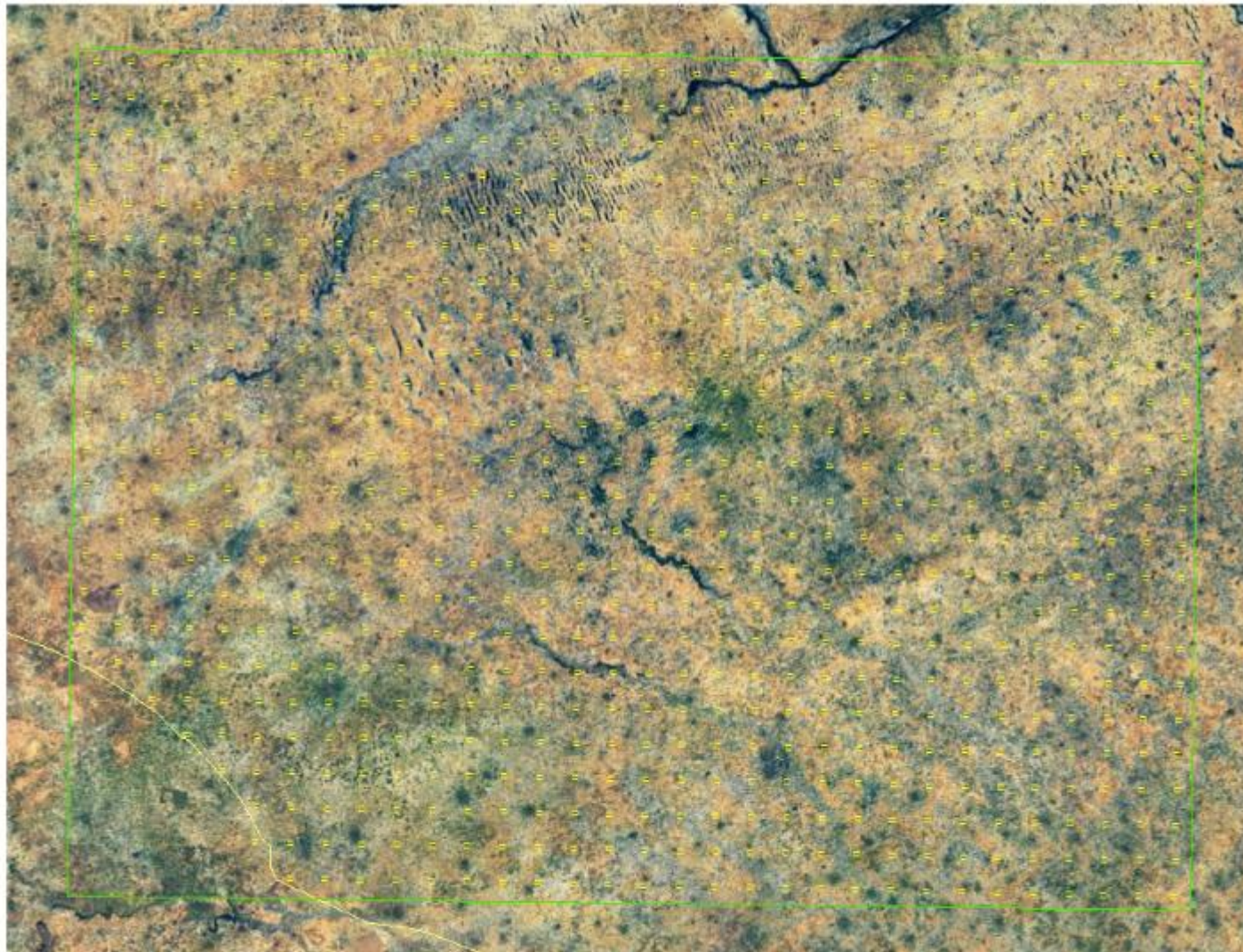


0 5 10 20 30 40 50 Kilometers



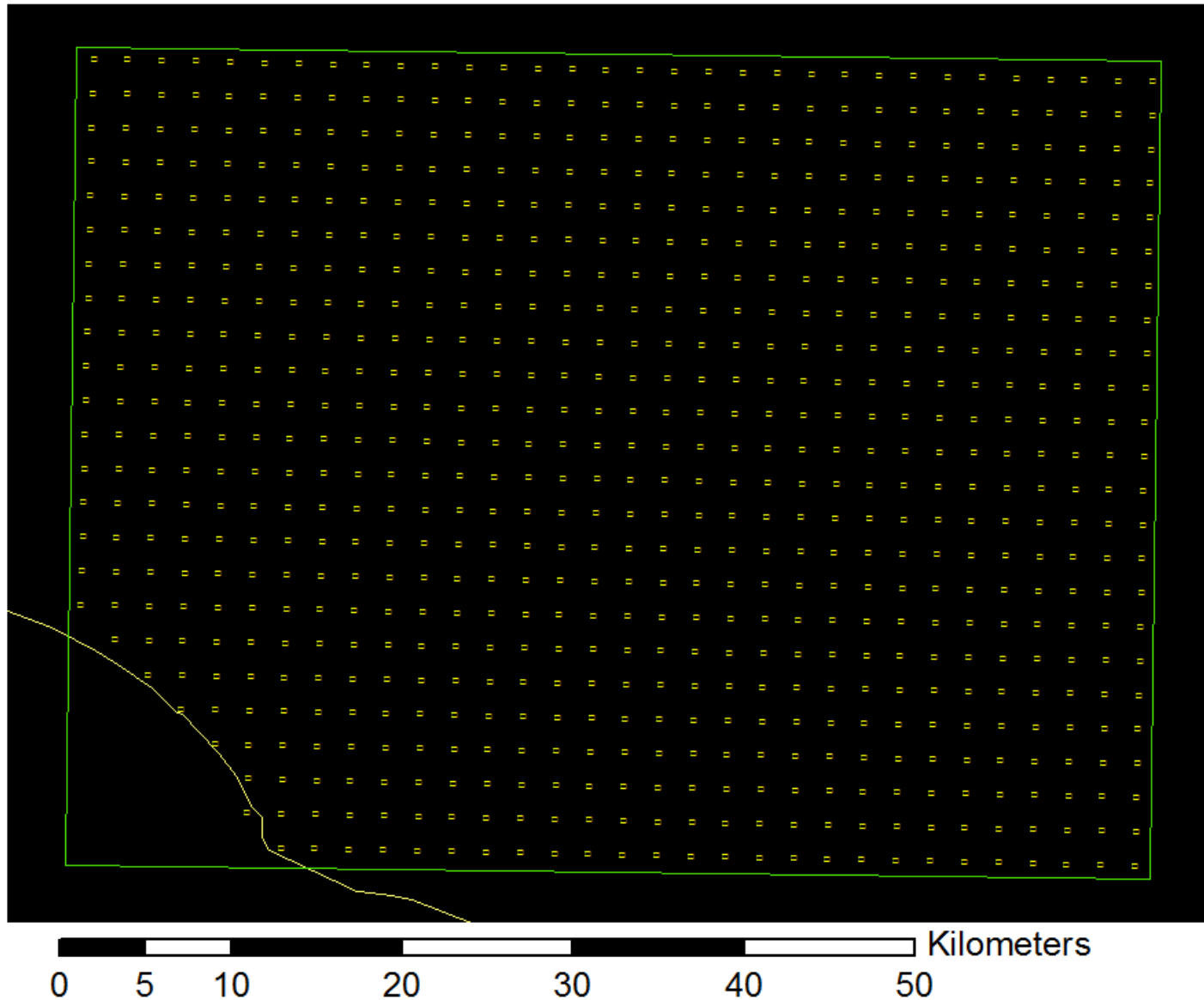
## Study Area 1 –Tree cover mapping

Overlay a grid of 10 ha squares (742 squares)



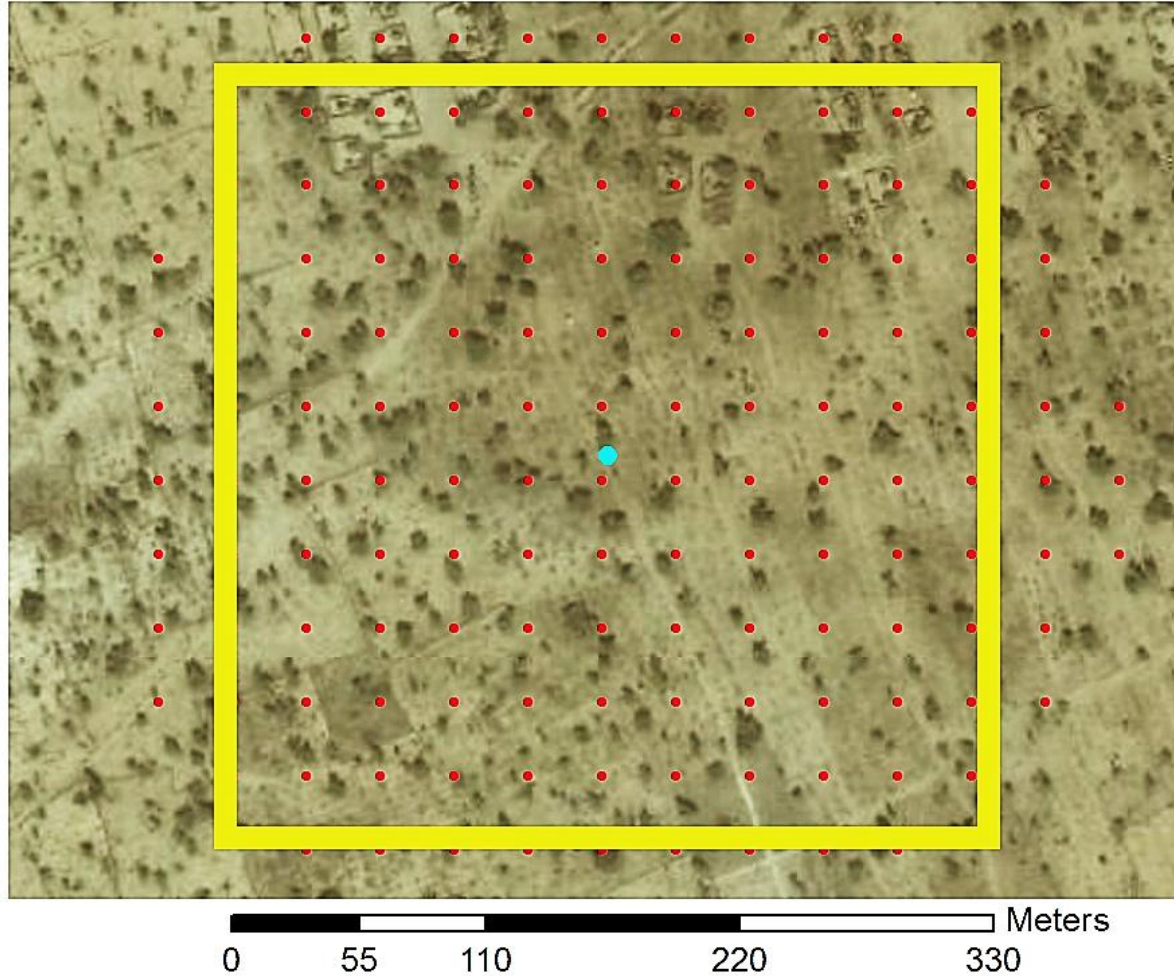
# Study Area 1 –Tree cover mapping

Overlay a grid of 10 ha squares (742 squares)





# Study Area 1 –Tree cover mapping



Mapping Scale 1:3,000

Percent Cover Dialog

Point Layer must be first in TOC

☒ Input Box ☐ List Box

5

OK Back

Table

PointGrid\_RLCM\_2km

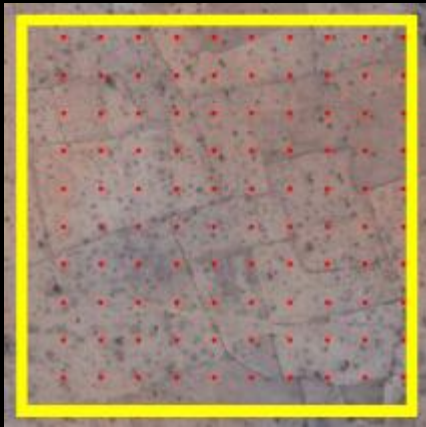
FID	Shape *	ID	X	Y	Percent
87	Point	88	497558.46	1471705.214	2
88	Point	89	499559.349	1471663.405	2
89	Point	90	501560.2544	1471621.615	0
90	Point	91	503561.1765	1471579.845	2
91	Point	92	505562.1155	1471538.095	0
92	Point	93	507563.0716	1471496.366	2
93	Point	94	509564.0451	1471454.656	2
94	Point	95	511565.0363	1471412.966	0
95	Point	96	513566.0453	1471371.296	0
96	Point	97	451495.7259	1470675.413	5
97	Point	98	453496.3133	1470633.16	2
98	Point	99	455496.9113	1470590.928	5
99	Point	100	457497.5203	1470548.715	2
100	Point	101	459498.1404	1470506.523	2
101	Point	102	461498.7721	1470464.351	2
102	Point	103	463499.4154	1470422.198	2

1 (1 out of 742 Selected)

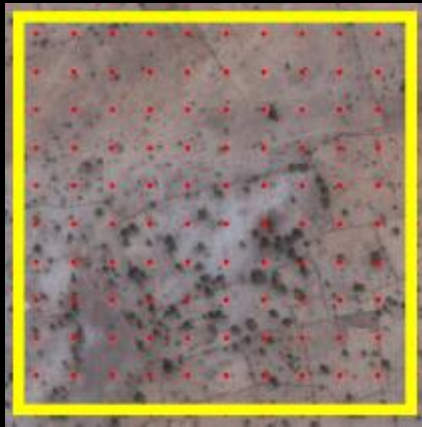
PointGrid\_RLCM\_2km

## **Study Area 1 –Tree cover mapping**

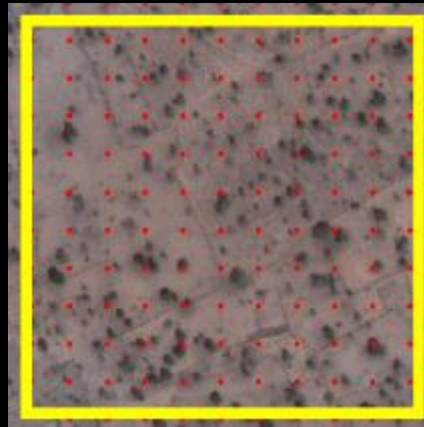
### **4 classes (in this study area)**



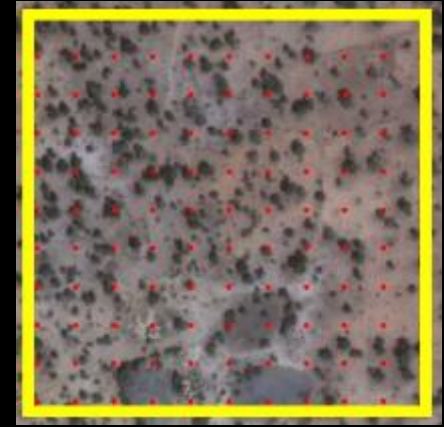
**0 %  
No tree cover**



**0 - 2 %  
Low density  
tree cover**



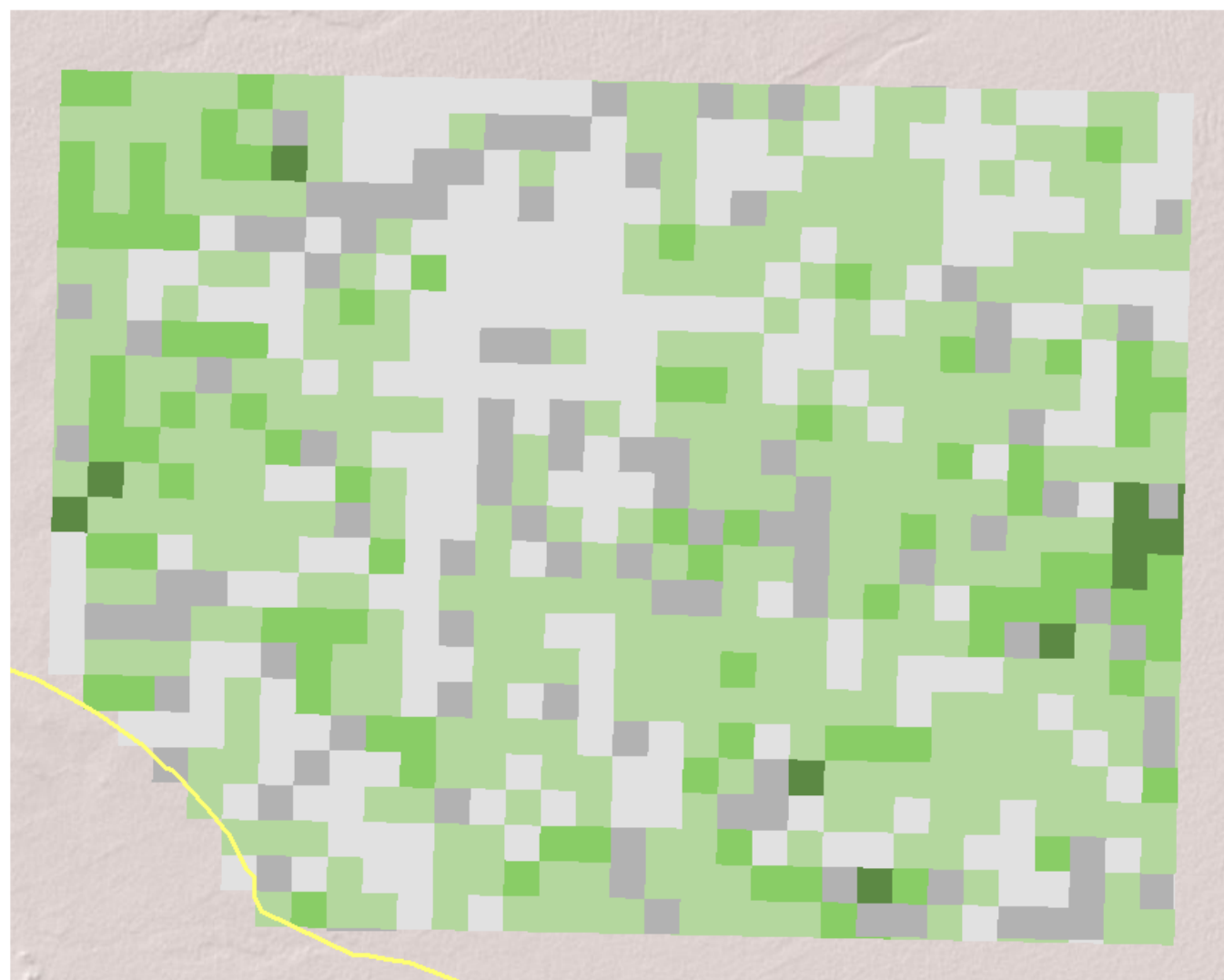
**2 - 5 %  
Medium density  
tree cover**



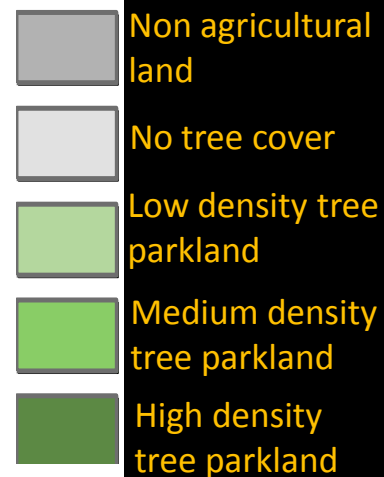
**5 - 10 %  
High density  
tree cover**



## Study Area 1 –Tree cover mapping



### Tree Cover Density (2km resolution)



0 5 10 20 30 40 50 Kilometers

# New Opportunities

- Low cost of imagery – Google Earth, Bing, etc
- Low barriers of entry – visual classification
  - Can use national and local land experts
  - Can use regular computers
- Rapid (weeks)
- Easy to understand and explain
- **Need to pilot test!**



# The Plan: a “Drylands Forest and Trees Mapping Hackathon”

## FAO, WRI, USGS, ICRAF, AGRHYMET Regional Center





An aerial photograph of a savanna landscape. A winding river flows through the upper half of the image. In the center, there is a dense cluster of trees and structures, likely a village or a protected area. The surrounding land is a mix of green vegetation and brown, open fields. The text "Thank you" is overlaid in the center in a bold, yellow font.

**Thank you**