



Francesco Fiondella



CCAFS site atlas

# Segou / Cinzana Mali

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Site Atlas

**Correct citation:**

Sijmons K., Kiplimo J., Förch W., Thornton P.K., Moussa, A.S. and Zougmore, R. (2013). CCAFS Site Atlas – Segou / Cinzana. CCAFS site atlas series. The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org)

Titles in this series aim to disseminate interim climate change, agriculture and food security research and practices and stimulate feedback from the scientific community.

This document is published by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) which is a strategic partnership between CGIAR and Future Earth. CCAFS is supported by the CGIAR Fund, the Danish International Development Agency (DANIDA), the Australian Government Overseas Aid Program (AusAid), Irish Aid, Environment Canada, the Ministry of Foreign Affairs for the Netherlands, the Swiss Agency for Development and Cooperation (SDC), Instituto de Investigação Científica Tropical (IICT), UK Aid, the Government of Russia, and the European Union (EU). The Program is carried out with technical support from the International Fund for Agricultural Development (IFAD)

**Contact:**

CCAFS Coordinating Unit - Faculty of Science, Department of Plant and Environmental Sciences, University of Copenhagen, Rolighedsvej 21, DK-1958 Frederiksberg C, Denmark. Tel: +45 35331046; Email: [ccaafs@cgiar.org](mailto:ccaafs@cgiar.org)

Creative Commons License



This Atlas is licensed under a Creative Commons Attribution – NonCommercial–NoDerivs 3.0 Unported License.

Articles appearing in this publication may be freely quoted and reproduced provided the source is acknowledged. No use of this publication may be made for resale or other commercial purposes.

©2013 CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

**DISCLAIMER:**

This Atlas Series has been prepared as an output for Theme 4.2 under the CCAFS program and has not been peer reviewed. Any opinions stated herein are those of the author(s) and do not necessarily reflect the policies or opinions of CCAFS, donor agencies, or partners. The geographic designation employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of CCAFS concerning the legal status of any country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

All images remain the sole property of their source and may not be used for any purpose without written permission of the source.

# Contents

<b>Chapter 1: Introduction</b> .....	iv
Regional Map.....	1
Topographic Map .....	2
Satellite Map .....	3
<b>Chapter 2: Climate and Climate Variability</b>	
Annual Rainfall .....	4
Annual Temperature .....	5
Aridity Index .....	6
<b>Chapter 3: Bio-Physical Characteristics</b>	
Altitude.....	7
Soil Type .....	8
Agro-Ecological Zones .....	9
Landcover .....	10
Landuse .....	11
Length of Growing Period 2000 .....	12
Length of Growing Period 2030 .....	13
Crop Suitability .....	14

Livestock Production Systems .....	15
Livestock Density .....	16
<b>Chapter 4: Socio-Economic Factors</b>	
Livelihood Zones.....	17
Human Population Density .....	18
Market Access .....	19
Poverty .....	20
Conservations Areas.....	21
<b>References and Data Sources</b> .....	22

## Introduction

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) seeks to promote a food-secure world through the provision of science-based efforts that support sustainable agriculture and enhance livelihoods while adapting to climate change and conserving natural resources and environmental services.

Climate change is an unprecedented threat to the food security of hundreds of millions of people who depend on small-scale agriculture for their livelihoods. Climate change affects agriculture and food security, and likewise, agriculture and natural resource management affect the climate system.

CCAFS has initially focused on three regions; East Africa (EA), West Africa (WA) and South Asia (SA) to carry out its research. The 15 CCAFS sites in these areas represent areas that are becoming both drier and wetter, and are focal locations that will generate results that can be applied and adapted to other regions worldwide. In this year, 2013, CCAFS is expanding its portfolio to additional sites in Latin America and South-East Asia.

These sites serve as the initial focus of CCAFS partnership-building and long-term research activities falling within the following CCAFS Research Themes; Adaptation to Progressive Climate Change, Adaptation through Managing Climate Risk, Pro-Poor Climate Change Mitigation and Integration for Decision Making. At all 15 CCAFS sites, baseline surveys have been conducted, including three levels of data collection and analysis at household, village and organizational levels (see: <http://ccafs.cgiar.org/resources/baseline-surveys>).

More information on CCAFS work in all the three regions can be accessed at [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org)

To better understand the CCAFS sites' characteristics, a list of geospatial indicators for climate variability, bio-physical characteristics and socio-economic variables have been mapped into site atlases.

This Atlas was developed for the CCAFS site at Segou / Cinzana in Mali, in West Africa Region.

# CCAFS Sites: West Africa

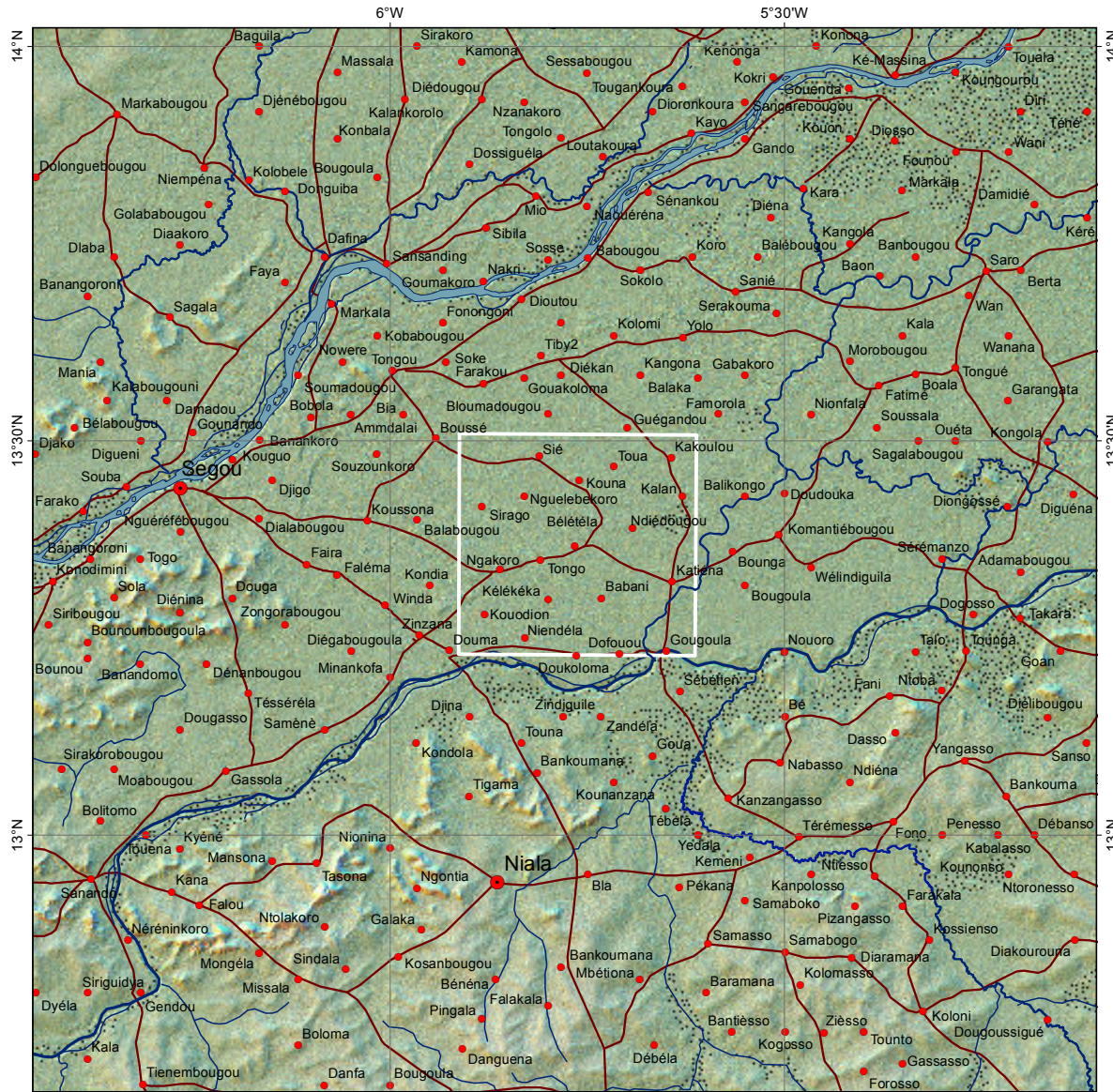


- Burkina Faso: Yatenga (BF01)
- Ghana: Lawra-Jirapa (GH01)
- Mali: Segou (MA01)
- Niger: Kollo (NI01)
- Senegal: Kaffrine (SE01)

CCAFS Country Sites

# Topography Segou

## CCAFS Site MA01 Segou / Cinzana, Mali.



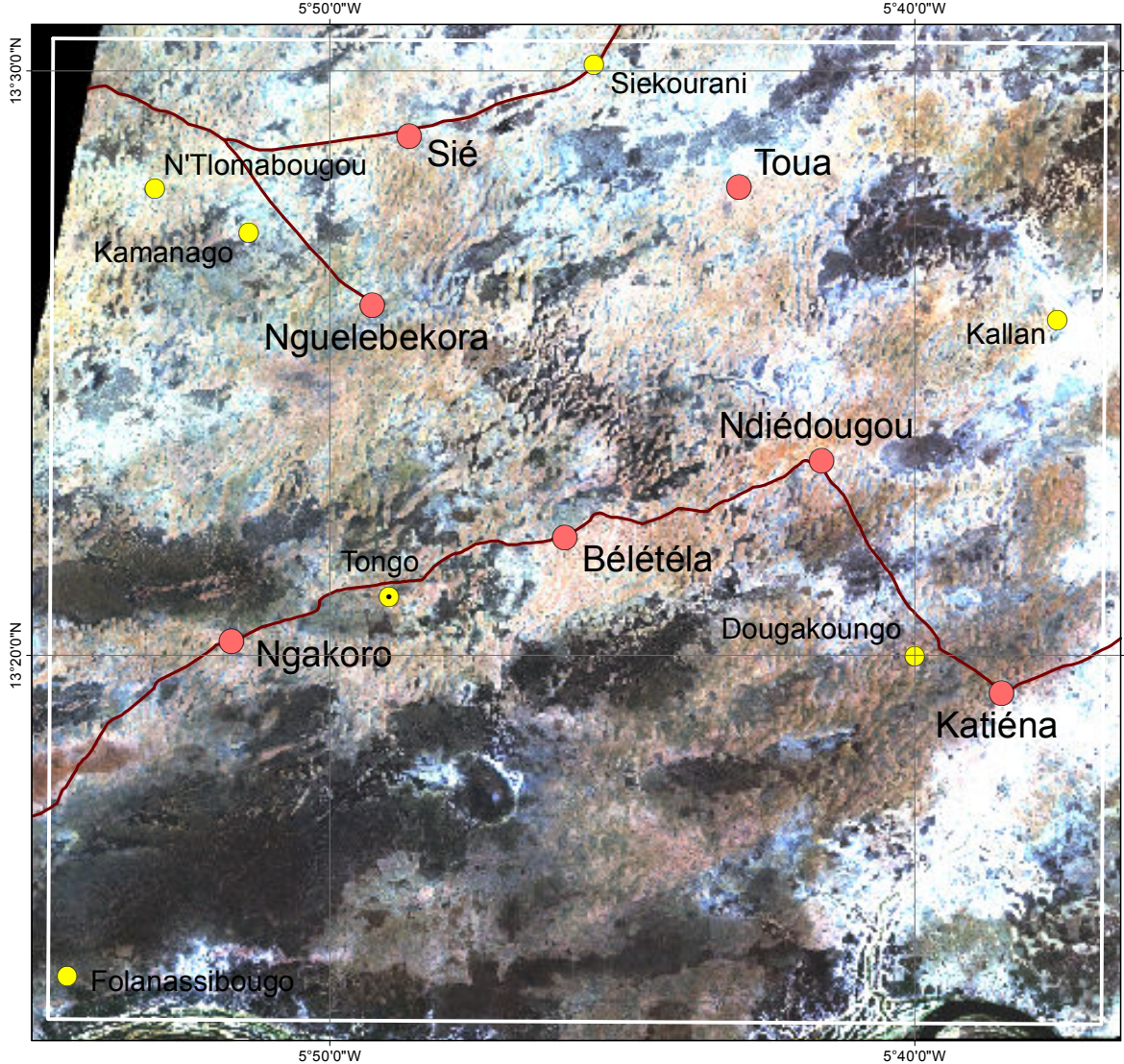
### Coordinates of the CCAFS Baseline Sampling frame

5.613W 13.228N  
 5.911W 13.228N  
 5.911W 13.509N  
 5.613W 13.509N



Sampling frame size: 30km x 30km

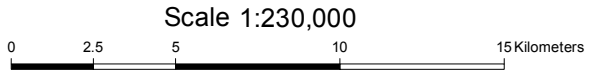
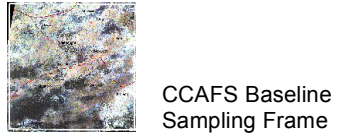
# Satellite Image Segou



RapidEye imagery from 17-04-2011  
 at 5m ground resolution

HBS= Household Baseline Survey  
 VBS= Village Baseline Survey  
 OBS= Organizational Baseline Survey

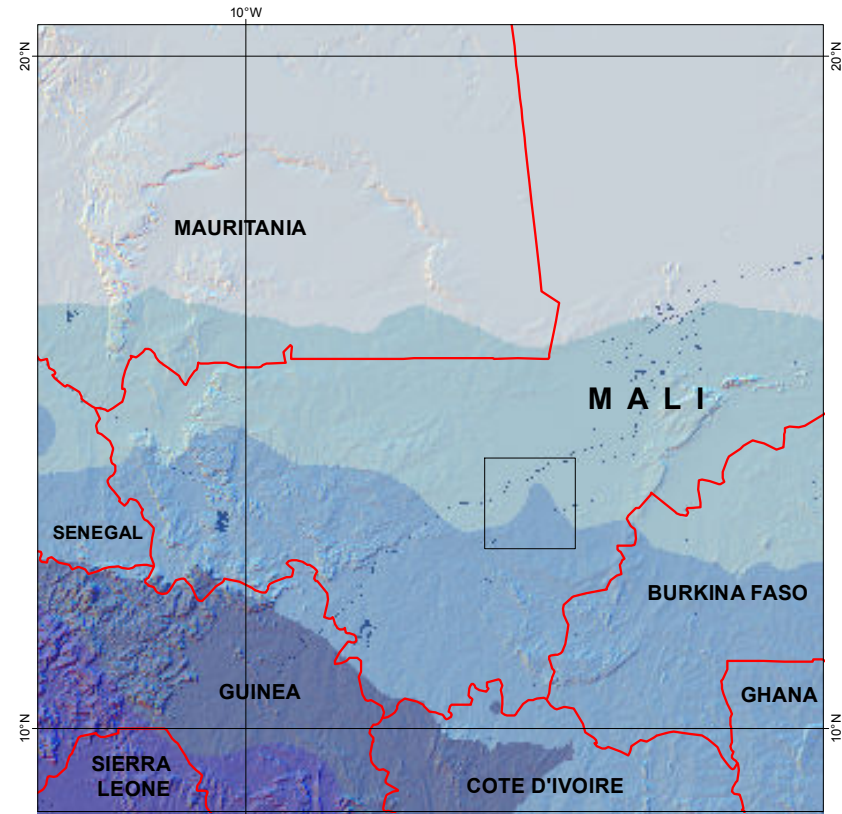
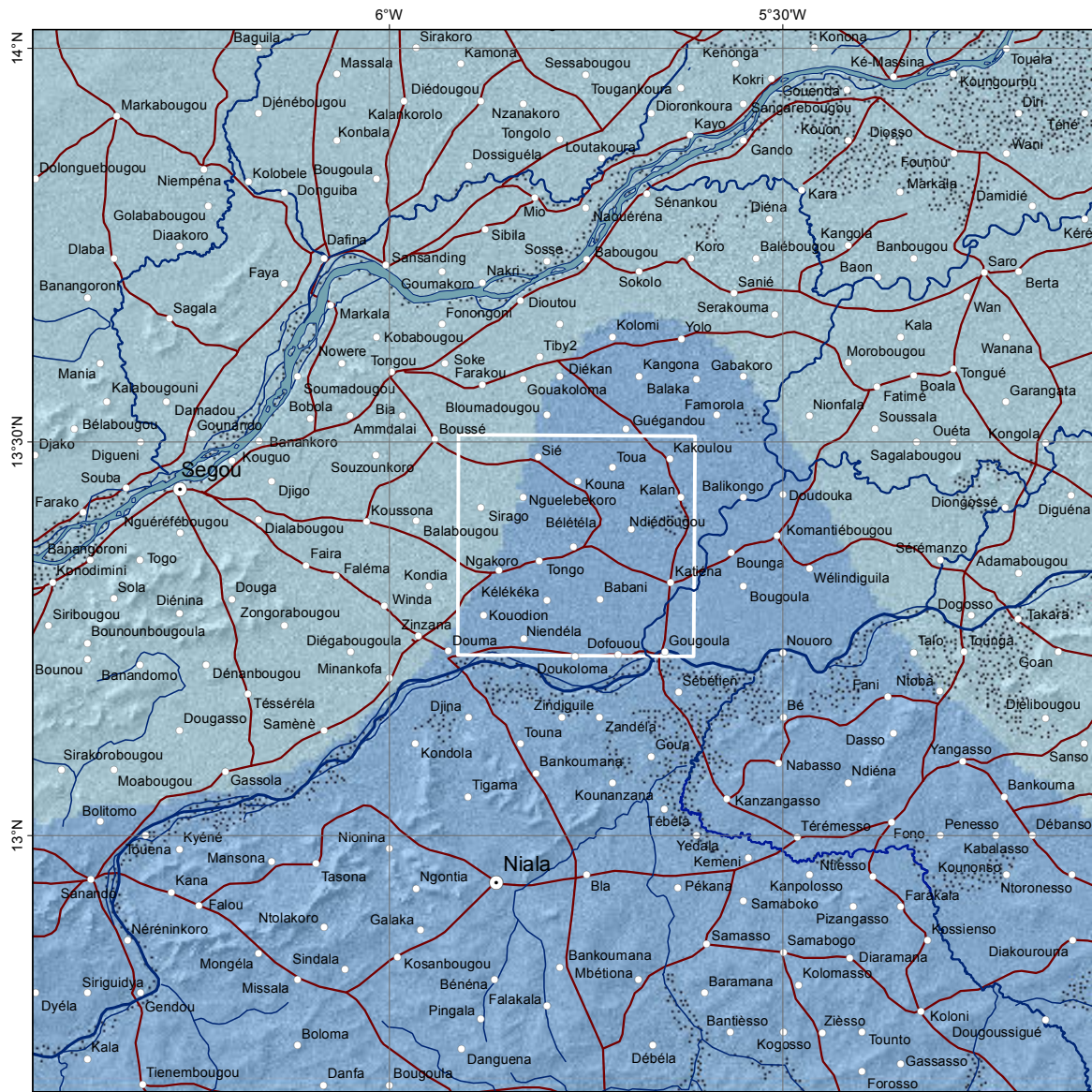
- Road
- Settlement
- CCAFS VBS/OBS village
- CCAFS HBS villages



Citation: RapidEye (2011)

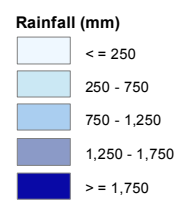


# Annual Rainfall

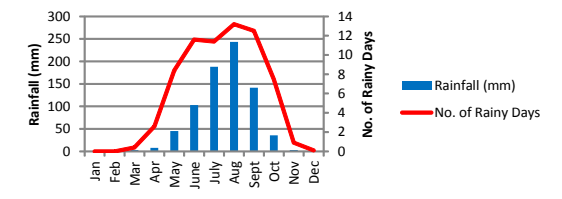


International boundary  
Scale 1:12,500,000  
0 125 250 500 Kilometers

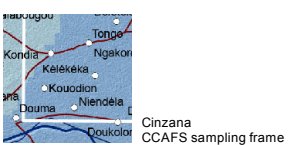
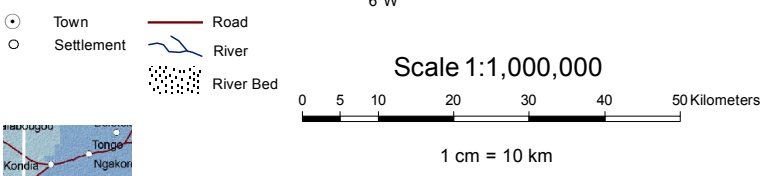
Corresponds to the map on the left



**Cinzana Mean Monthly Rainfall Distribution**



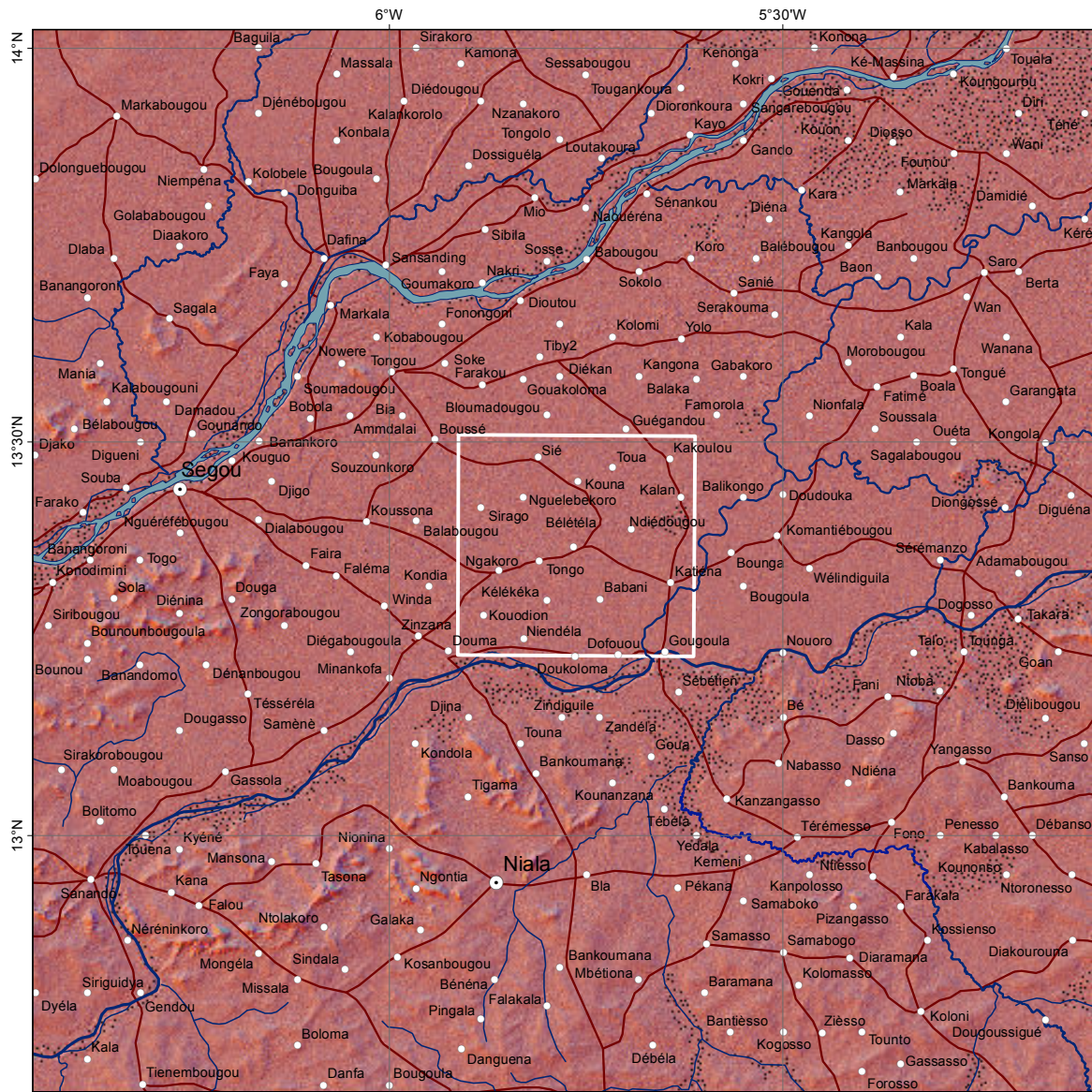
Citation: Jones et al (2002)



Annual Rainfall data of current interpolations of observed data, representative of 1950 - 2000

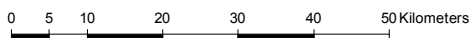
Citation: Hijmans et al (2005)

# Annual Temperature



- Town
- Settlement
- Road
- River
- River Bed

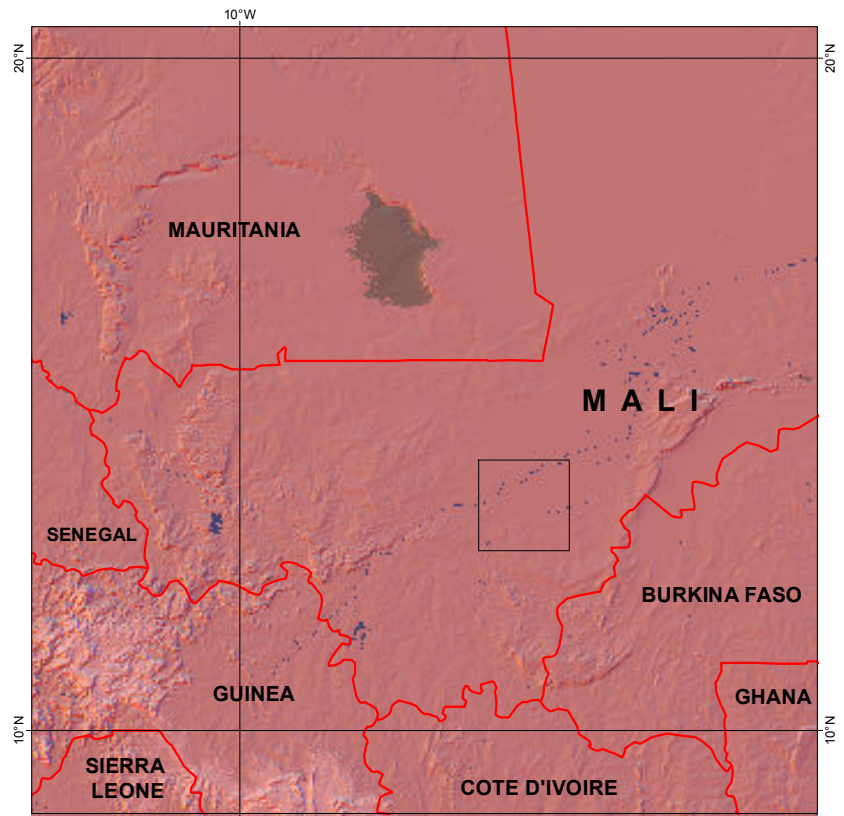
Scale 1:1,000,000



1 cm = 10 km

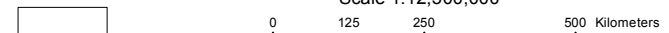


Cinzan CCAFS sampling frame



— International boundary

Scale 1:12,500,000

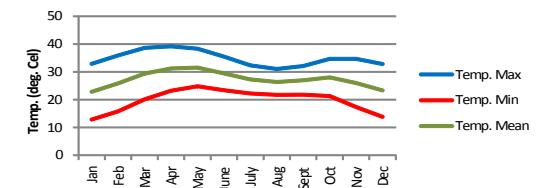


Corresponds to the map on the left

Temperature (°C)

- ≤ 15
- 15 - 20
- 20 - 25
- 25 - 30
- ≥ 30

Cinzana Mean Monthly Temperature Distribution

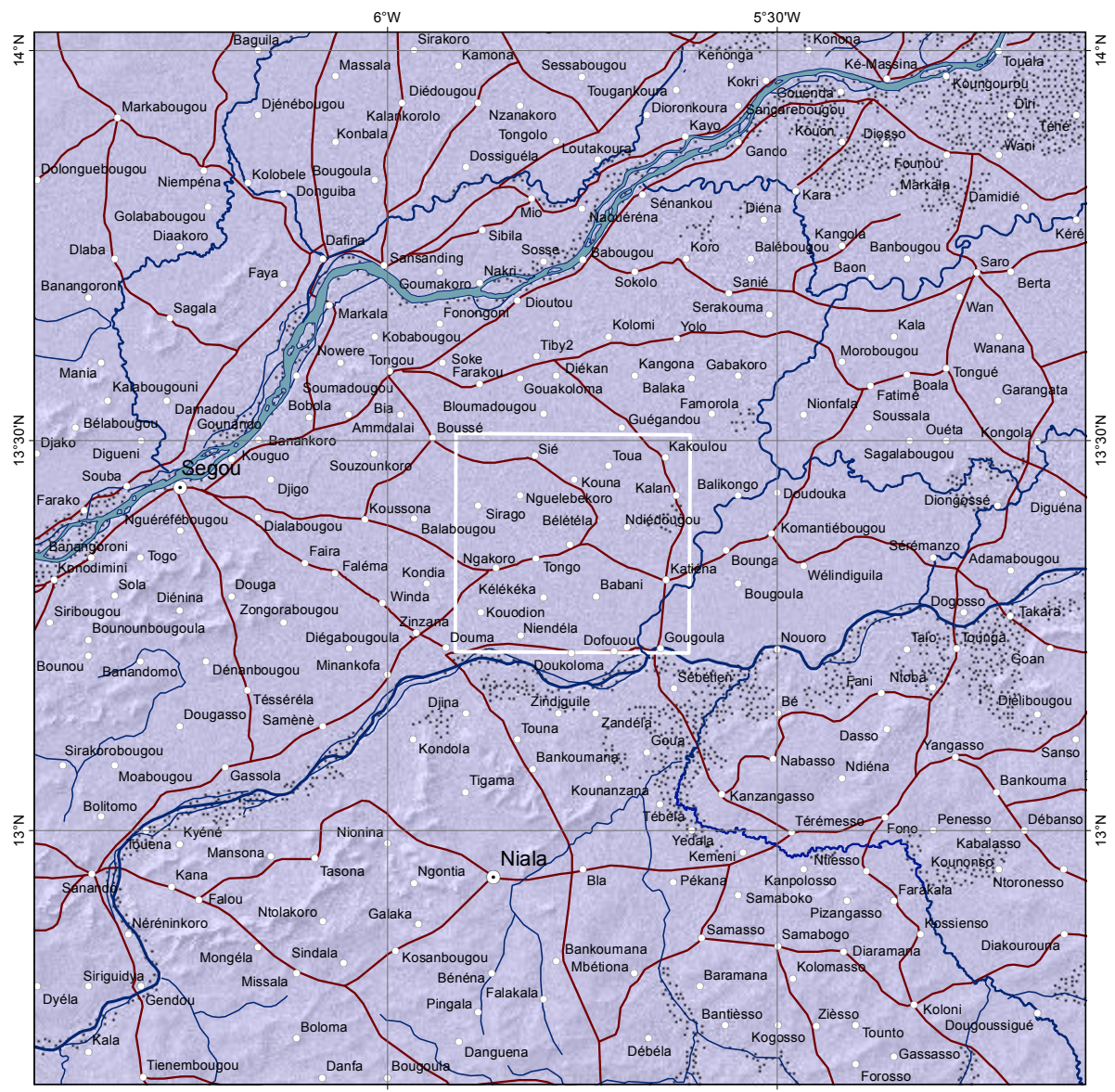


Citation: Jones et al (2002)

Annual Temperature represents annual temperature data of current interpolations of observed data, averaged for 1950 - 2000

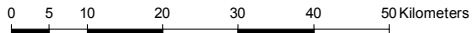
Citation: Hijmans et al (2005)

# Aridity Index

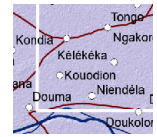


- Town
- Settlement
- Road
- River
- River Bed

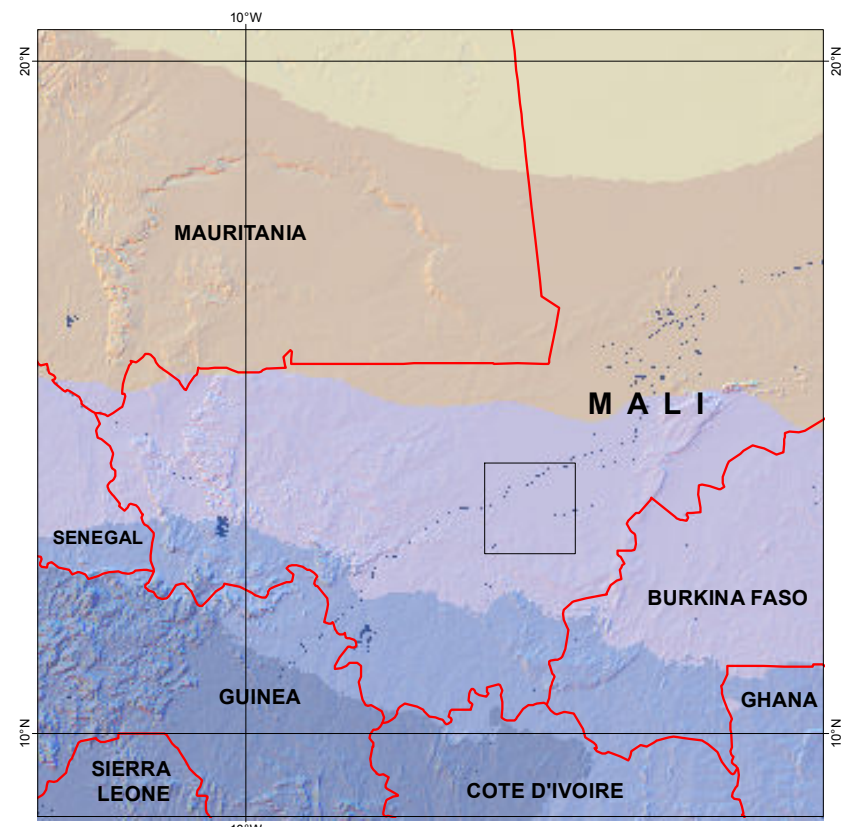
Scale 1:1,000,000



1 cm = 10 km



Cinzana CCAFS sampling frame



— International boundary

Scale 1:12,500,000



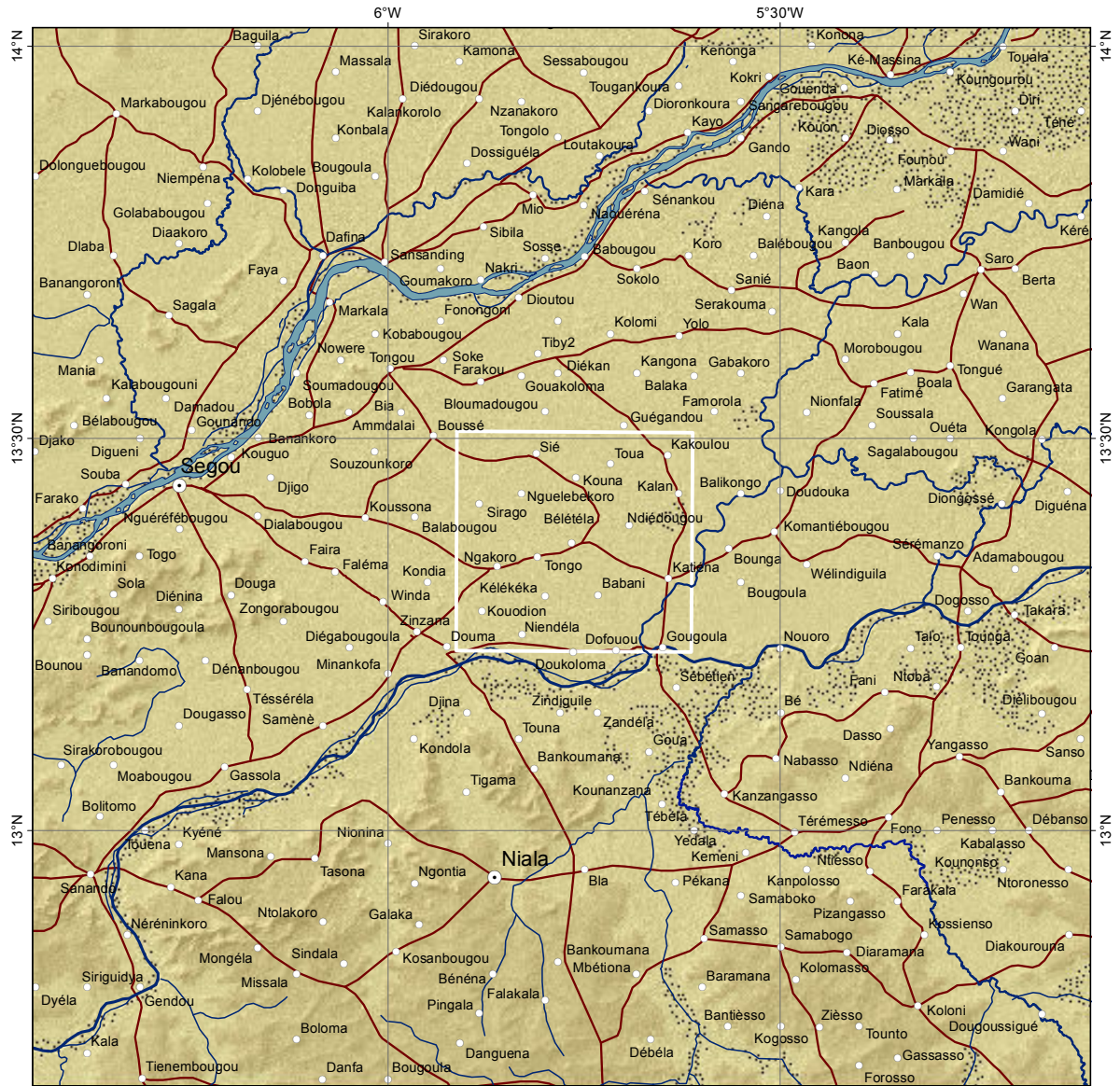
Corresponds to the map on the left

### Aridity Index

- Hyper Arid
- Arid
- Semi Arid
- Dry sub-humid
- Humid

Aridity Index indicates the level of dryness, taking evapotranspiration into account, at a given location of known rainfall

# Altitude

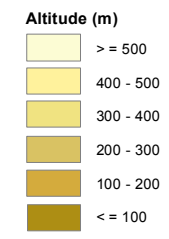


International boundary






Scale 1:12,500,000

0 125 250 500 Kilometers

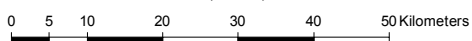
Corresponds to the map on the left



Altitude indicates the height above sea level in meters

-  Town
-  Settlement
-  Road
-  River
-  River Bed

Scale 1:1,000,000



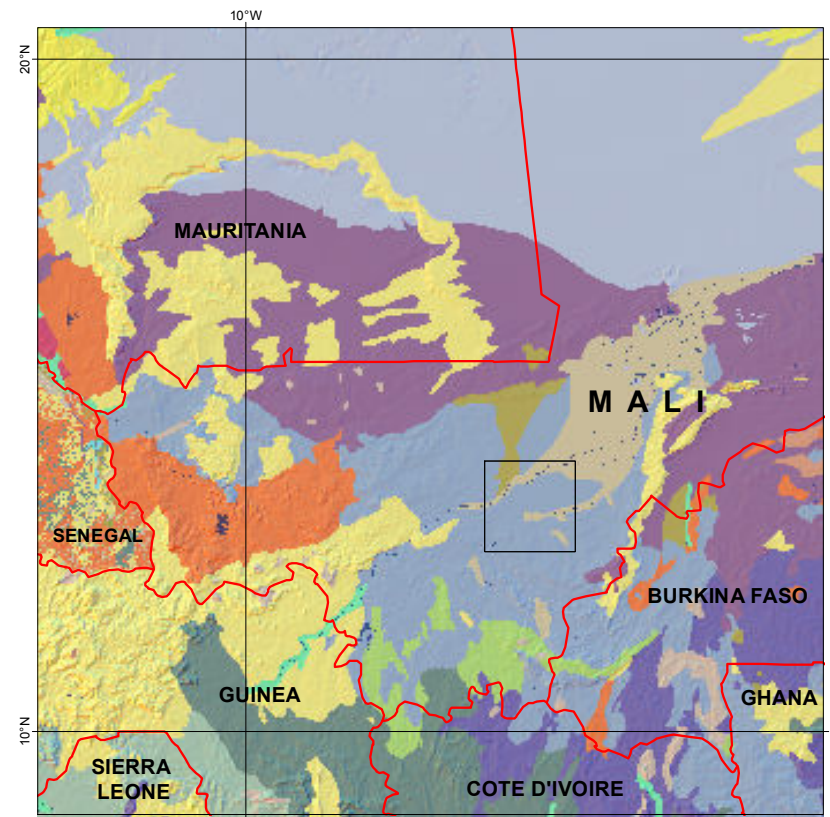
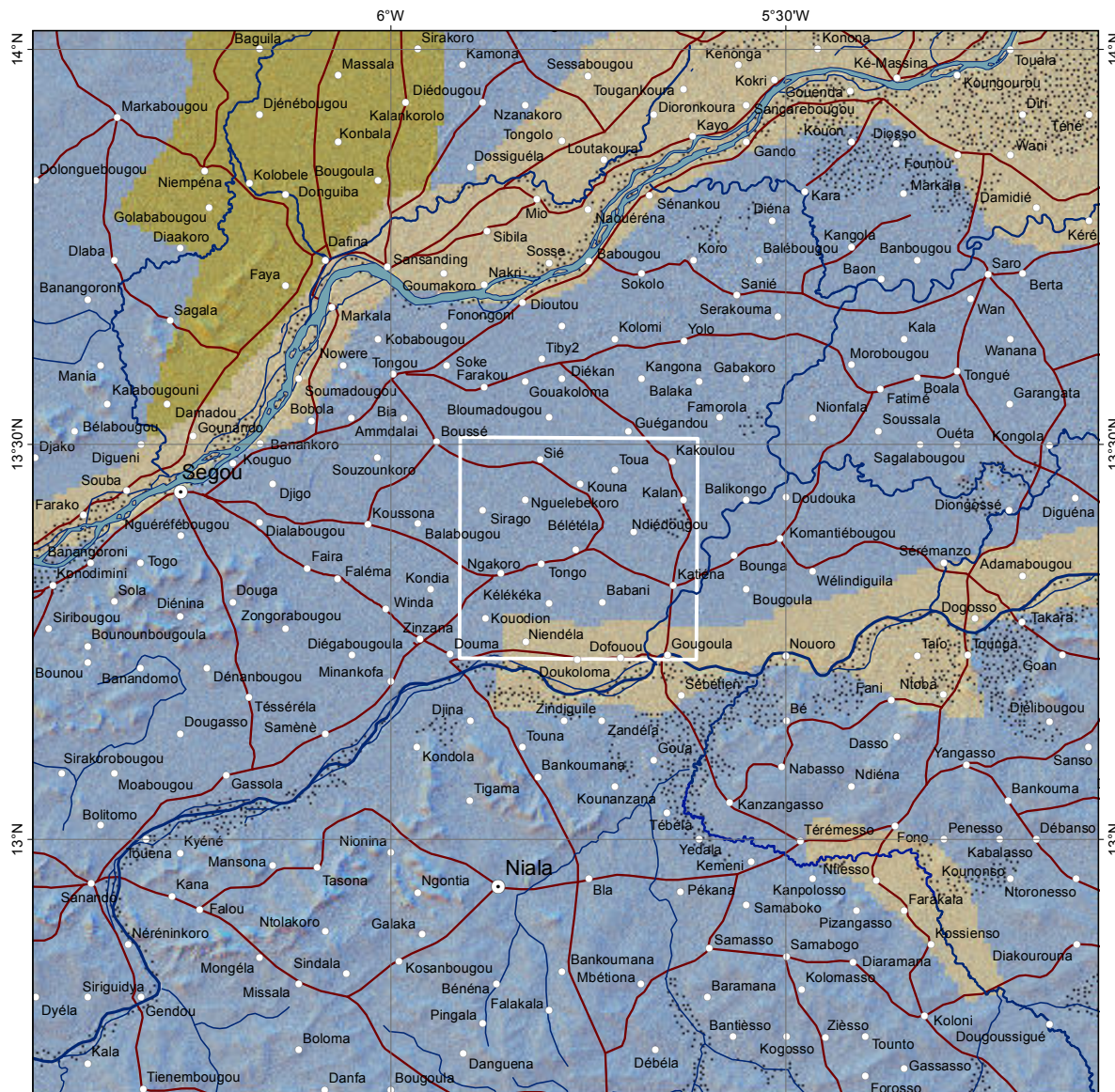
1 cm = 10 km



Cinzana CCAFS sampling frame

Citation: Jarvis et al (2008)

# Soil Type



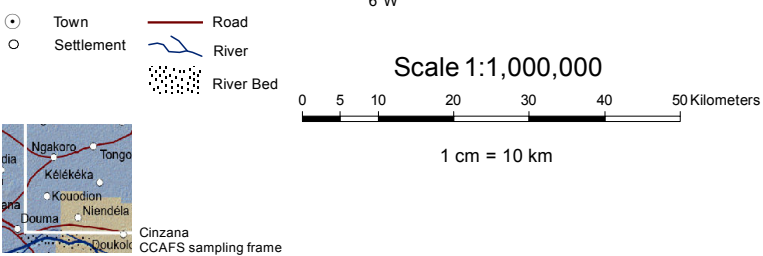
— International boundary  
 Scale 1:12,500,000  
 0 125 250 500 Kilometers

Corresponds to the map on the left

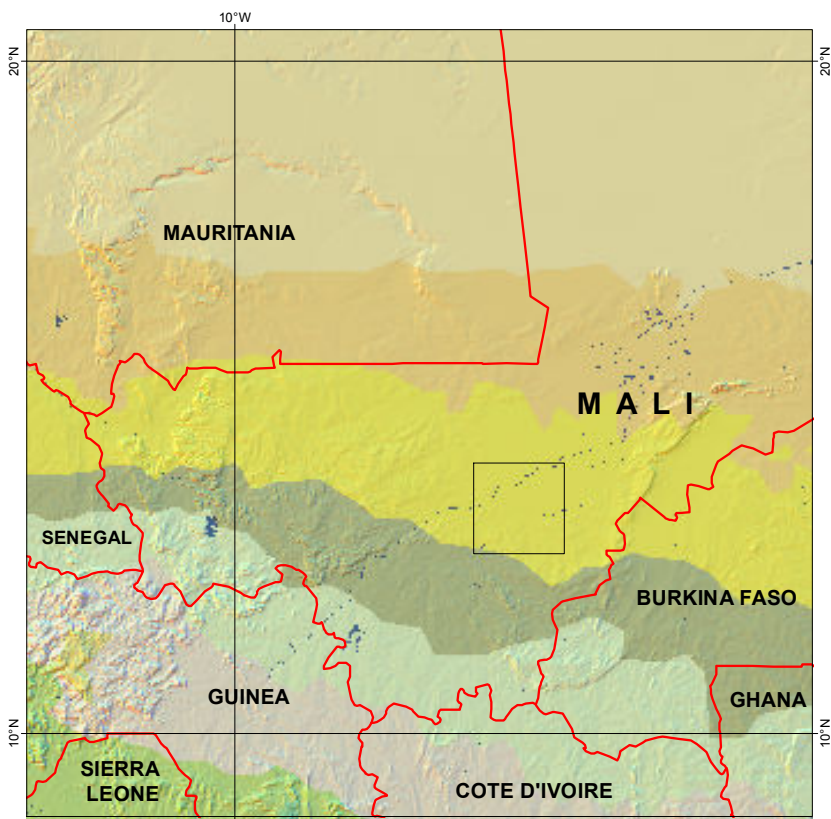
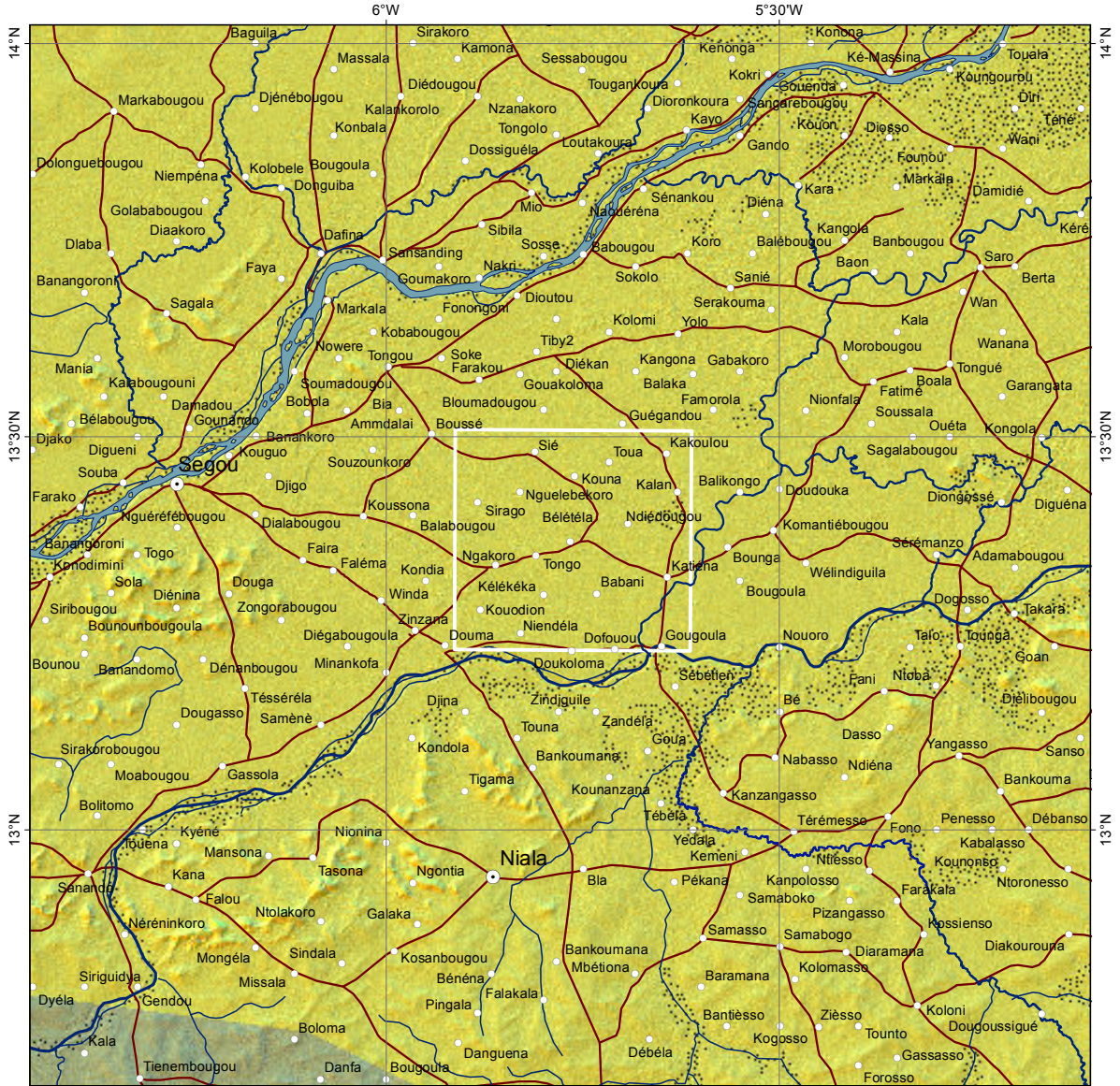
**Soil Type \***  
 Cambisols  
 Lixisols  
 Vertisols

\* Legend corresponds to left map

Soil Type refers to the soil group as per the FAO classification. Soil groups are defined by their parent material and morphogenetic characteristics in terms of structural properties and texture (sand, silt and clay content), as well as organic matter content.



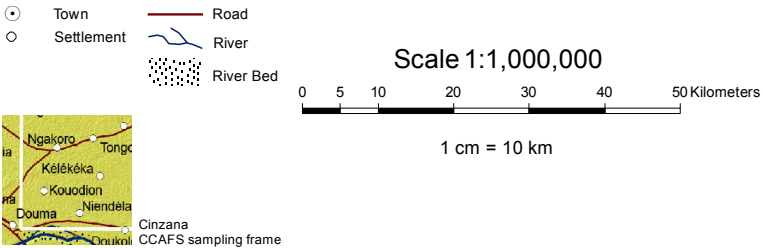
# Agro-Ecological Zones



International boundary  
 Scale 1:12,500,000  
 0 125 250 500 Kilometers  
 Corresponds to the map on the left

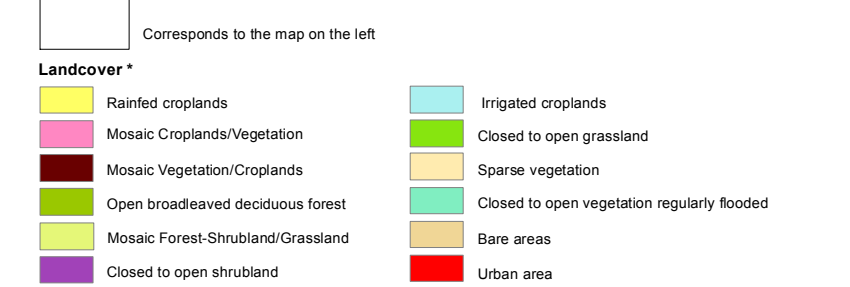
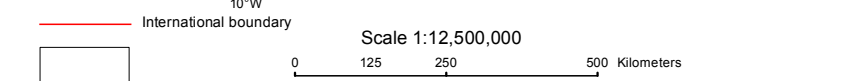
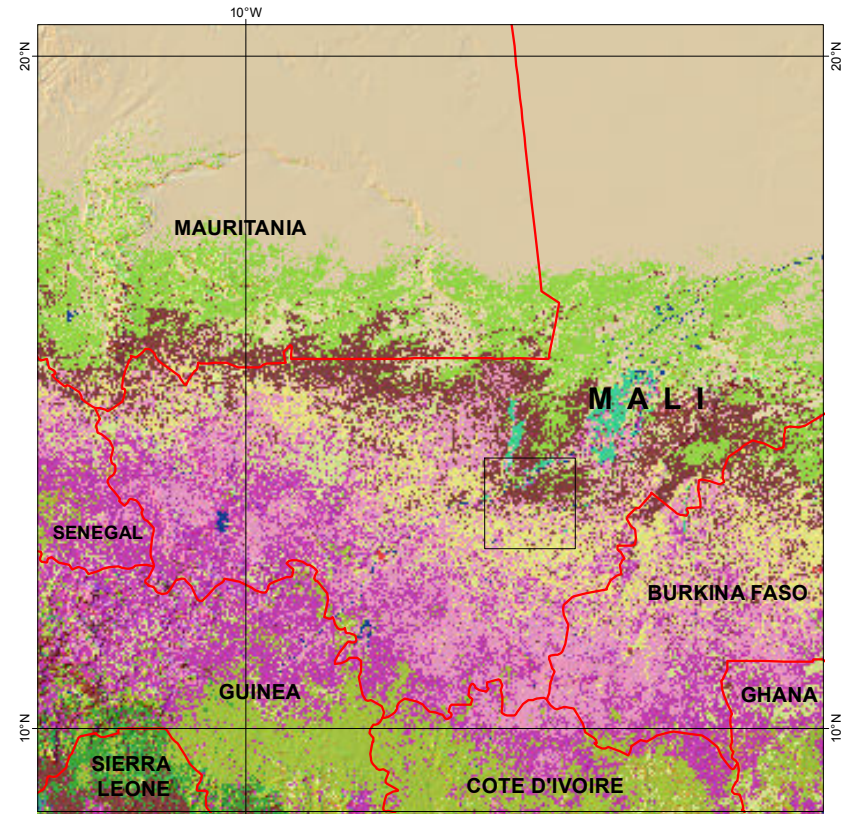
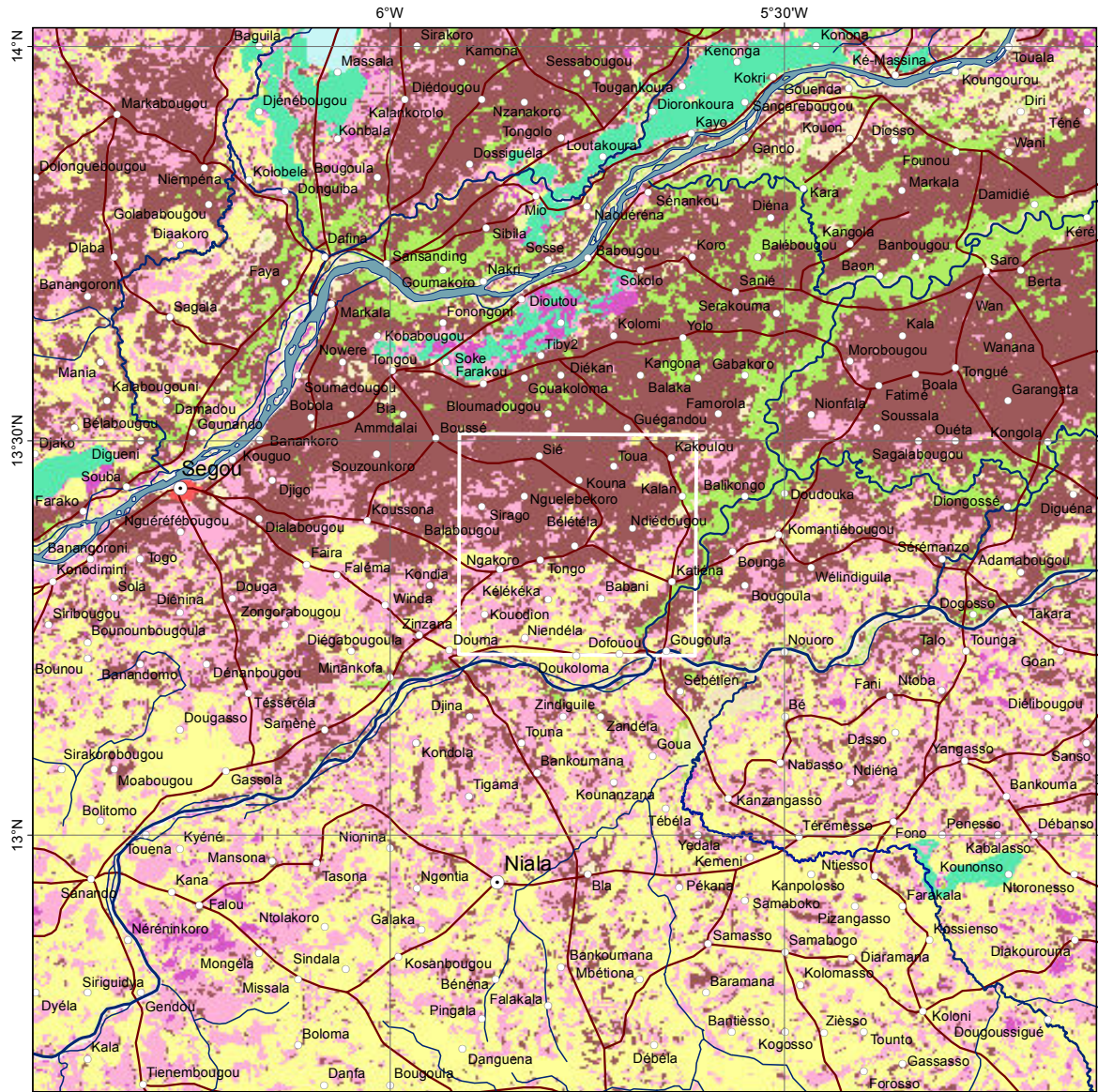
**Agro-Ecological Zones \***  
 Semi-arid/Sudan Savanna  
 Northern Guinea Savanna  
 \* Legend corresponds to left map

Agro-Ecological Zones indicate the division of land areas that have similar characteristics related to land suitability, potential agricultural production and environmental impact.

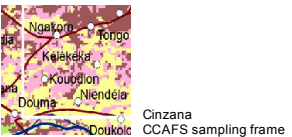
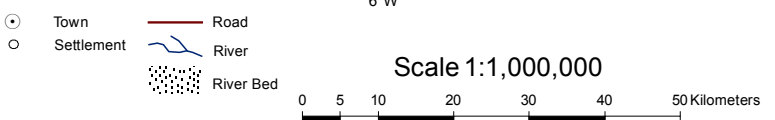


Citation: FAO (2008)

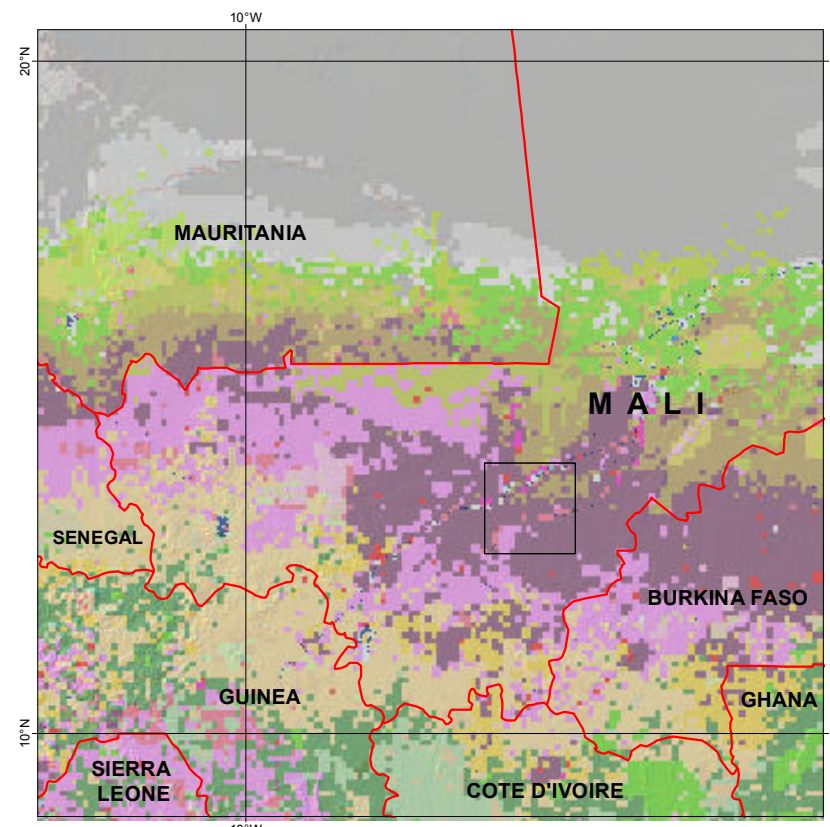
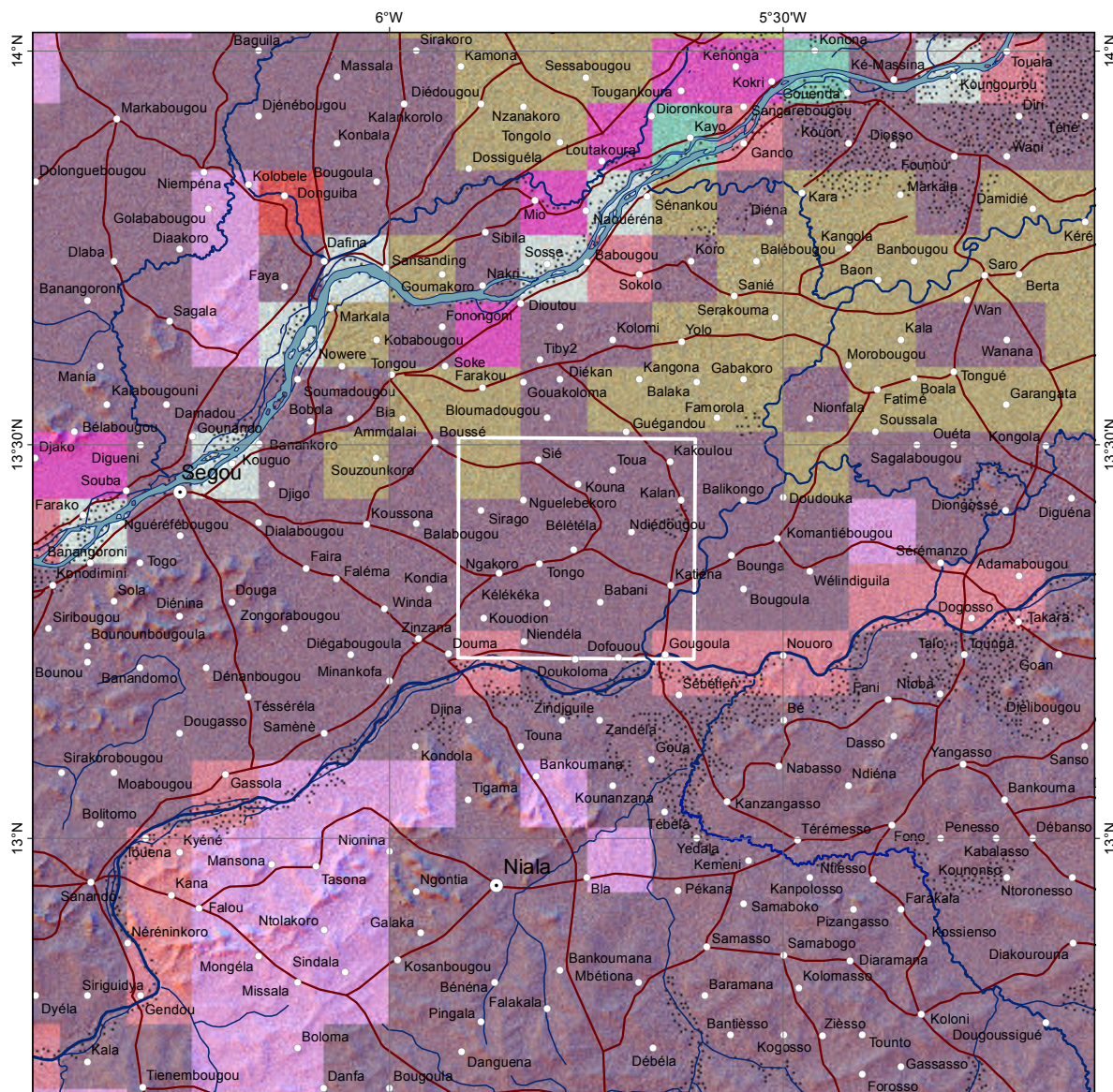
# Landcover



\* Legend corresponds to left map



Landcover shows the observed (bio)physical cover of the earth's surface, i.e. dominant vegetation, land use and man-made features.



International boundary  
 Scale 1:12,500,000  
 0 125 250 500 Kilometers  
 Corresponds to the map on the left

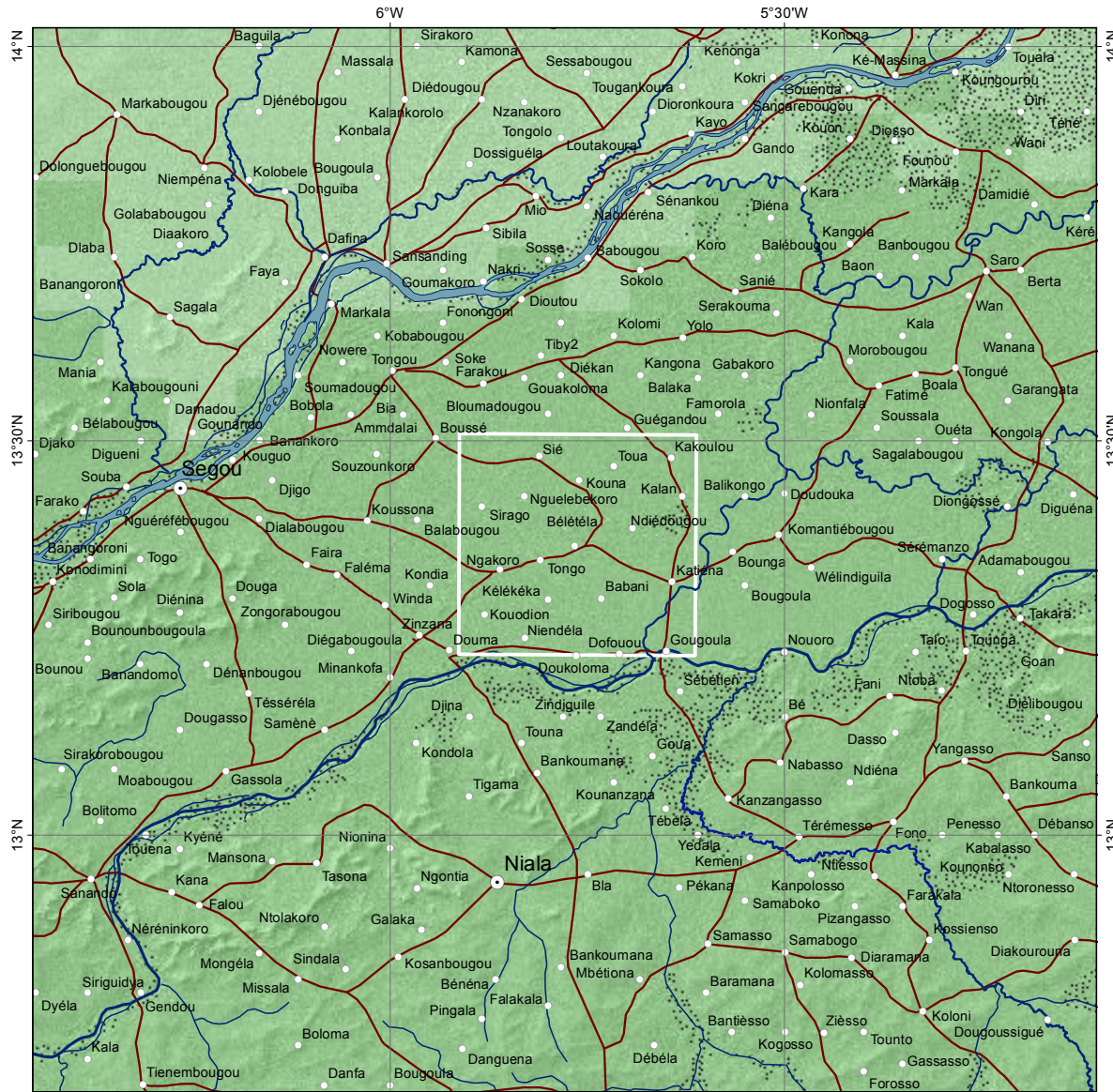
- Landuse \***
- Grasslands high livestock density
  - Rainfed crops (Subsistence/Commercial)
  - Crops and moderate intensive livestock density
  - Crops and high livestock density
  - Agriculture large scale Irrigation
  - Urban area
  - Open water inland Fisheries
  - Crops large-scale irrigated, moderate or higher livestock density

\* Legend corresponds to left map

Landuse is a description of how people utilize the land. It involves socio-economic activity, i.e. the management and modification of the natural environment into built environment, such as agricultural fields and settlements. At any place, there may be multiple land uses, the dominant one is presented here.

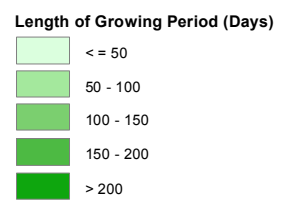


# Length of Growing Period 2000



— International boundary  
 Scale 1:12,500,000  
 0 125 250 500 Kilometers

Corresponds to the map on the left



The Length of Growing Period (LGP) is defined as the number of days in a year during which there is available rainfed soil moisture supply for plant growth.

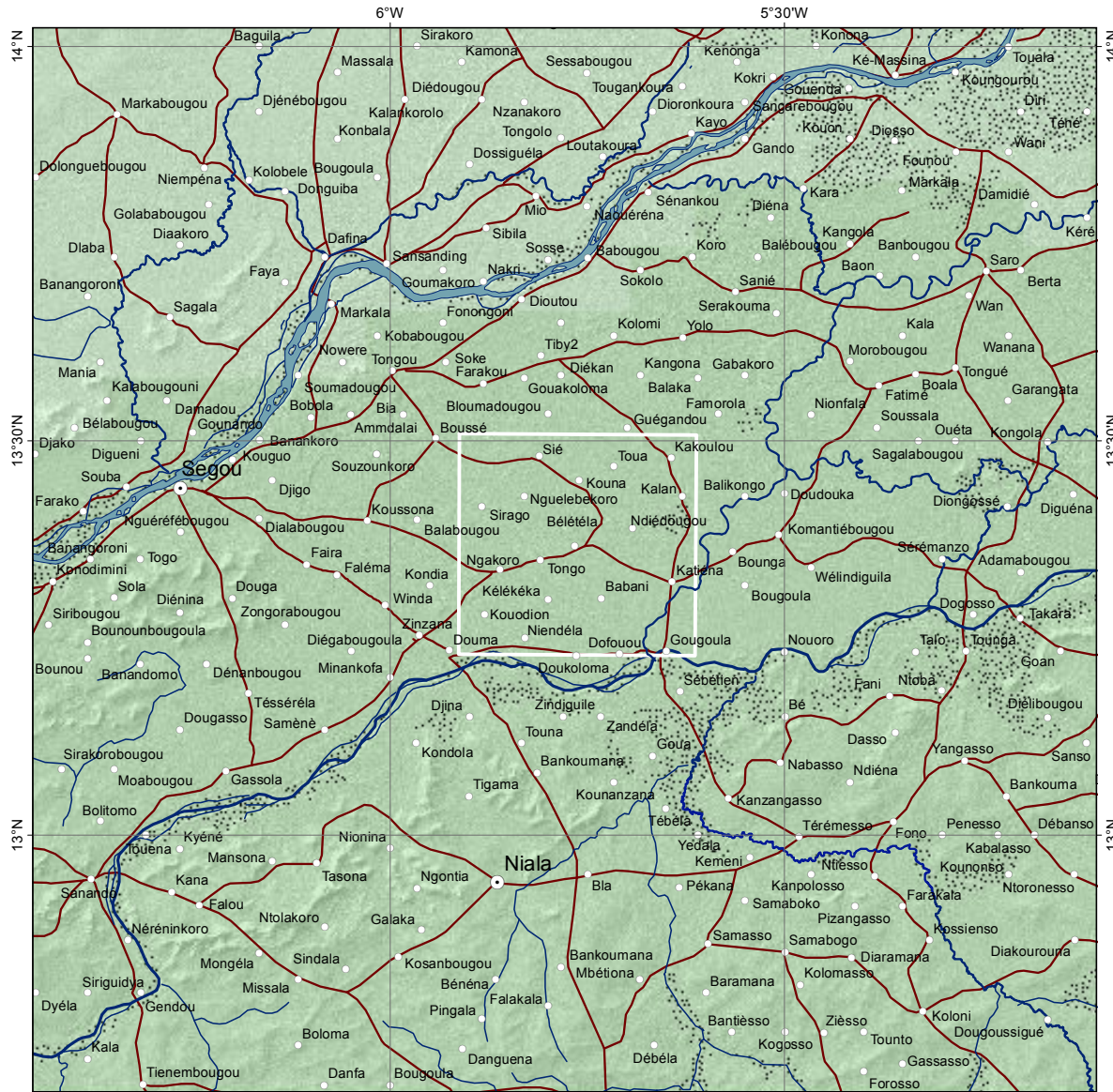
○ Town  
 ○ Settlement  
 — Road  
 — River  
 ■ River Bed

Scale 1:1,000,000  
 0 5 10 20 30 40 50 Kilometers  
 1 cm = 10 km



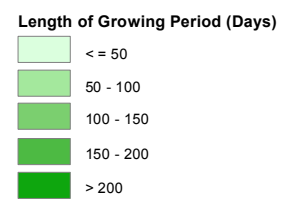
Citation: Thornton et al (2006)

# Length of Growing Period 2030

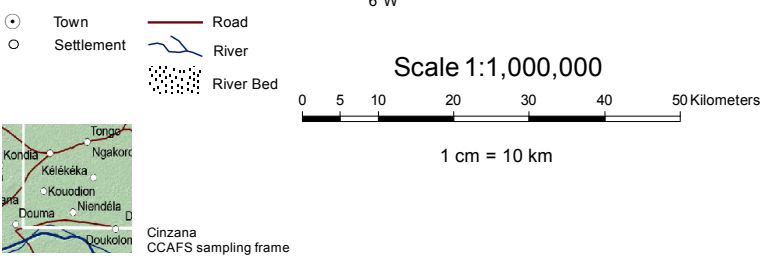


International boundary  
 Scale 1:12,500,000  
 0 125 250 500 Kilometers

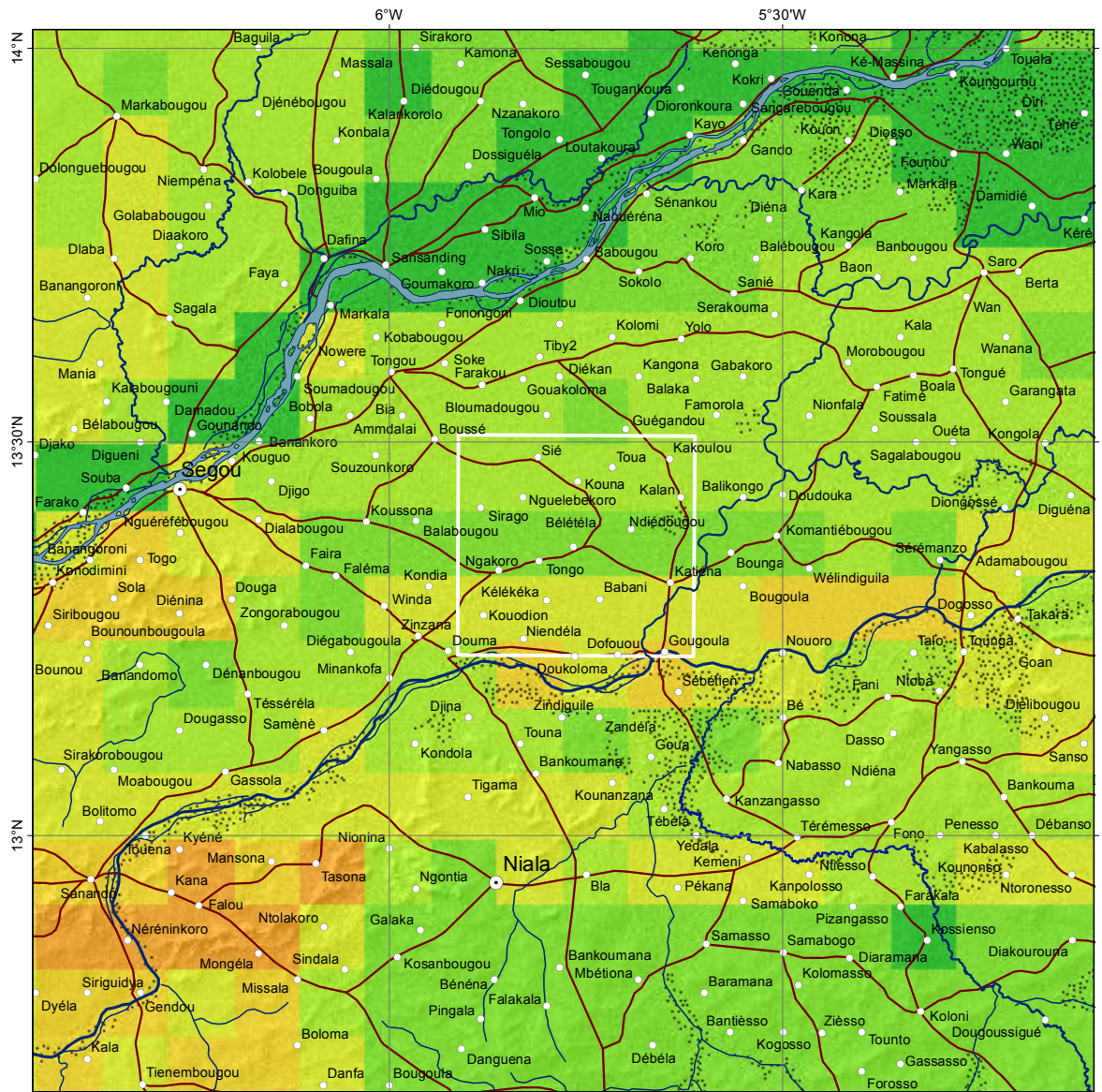
Corresponds to the map on the left



The Length of Growing Period (LGP) is defined as the number of days in a year during which there is available rainfed soil moisture supply for plant growth; here modeled for 2030.

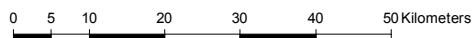


# Crop Suitability



- Town
- Settlement
- Road
- River
- ▨ River Bed

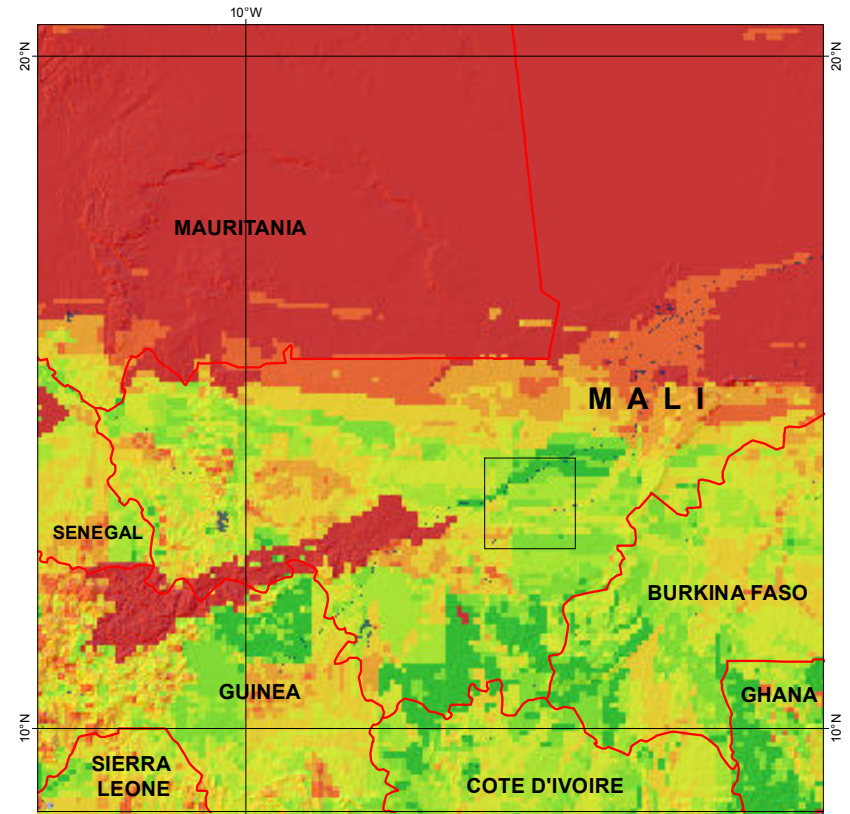
Scale 1:1,000,000



1 cm = 10 km



Cinzana CCAFS sampling frame



— International boundary

Scale 1:12,500,000



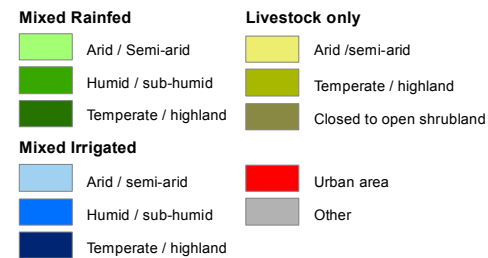
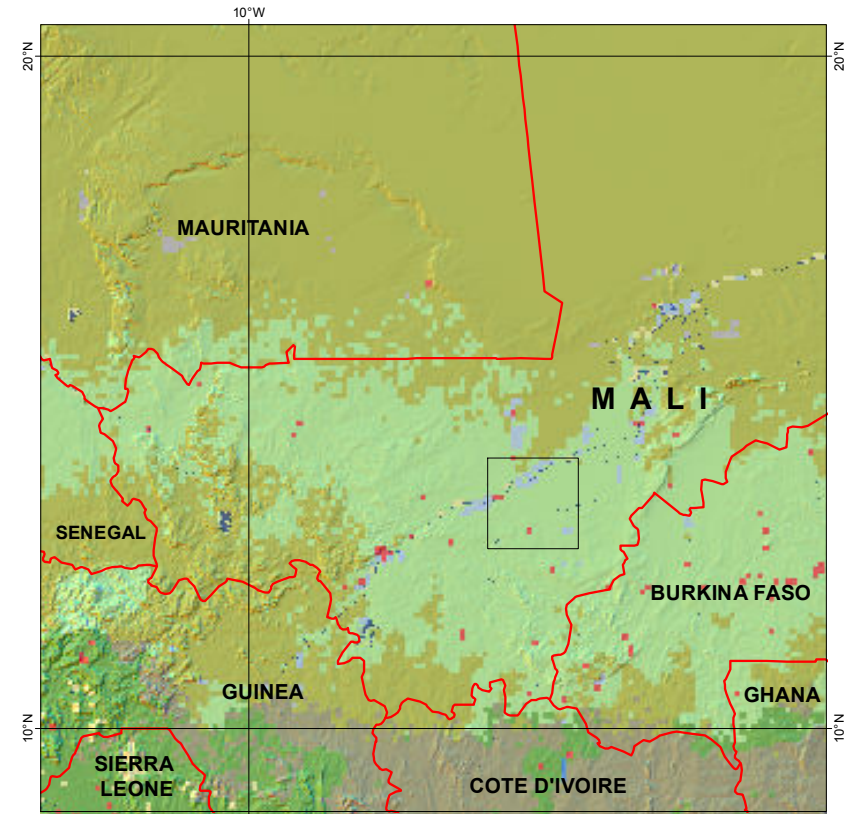
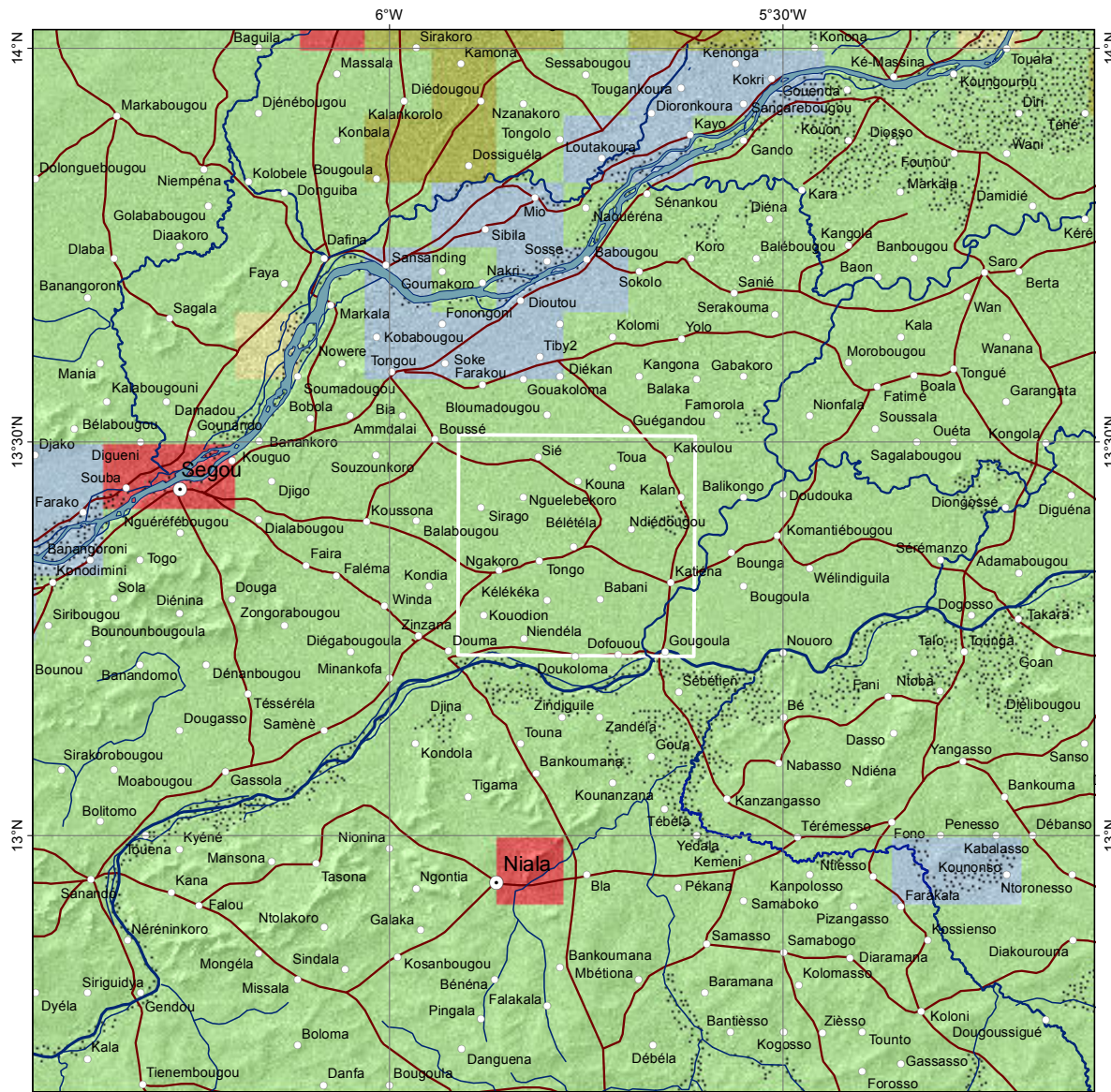
Corresponds to the map on the left

### Crop Suitability

- Not suitable
- Very low
- Low
- Medium low
- Medium
- Medium high
- High
- Very high

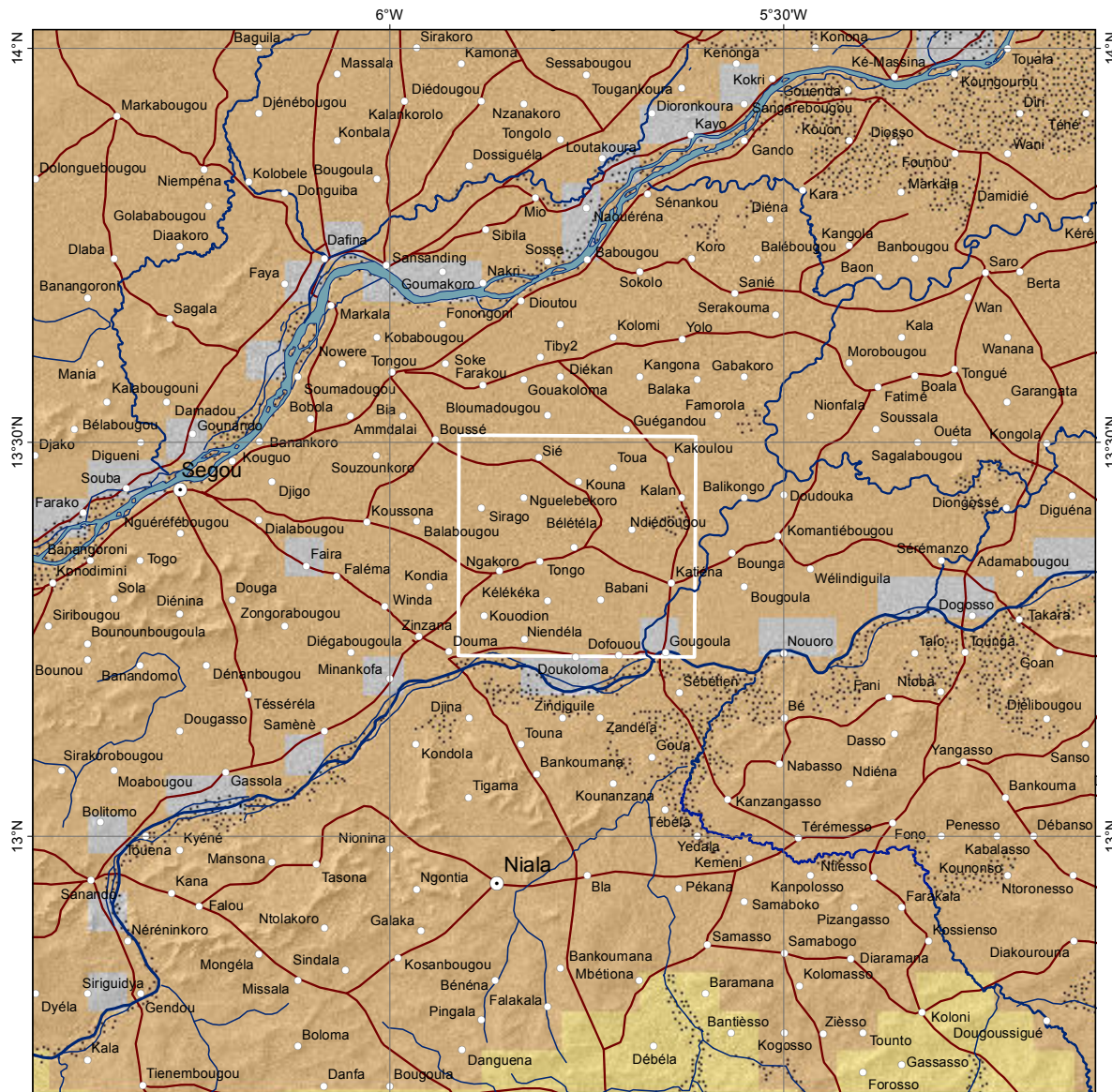
Crop Suitability refers to the land resource assessment that considers agricultural land use options with relevant agro-ecological condition to estimate expected cropping activities.

# Livestock Production Systems



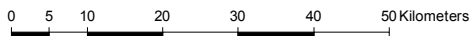
Livestock Production Systems as part of agricultural systems take agro-climatic conditions into account and are classified in terms of feed and livestock resources; livestock commodities produced; production technology; product use and livestock functions; area covered; geographic locations; and human populations supported.

# Livestock Density



- Town
- Settlement
- Road
- River
- River Bed

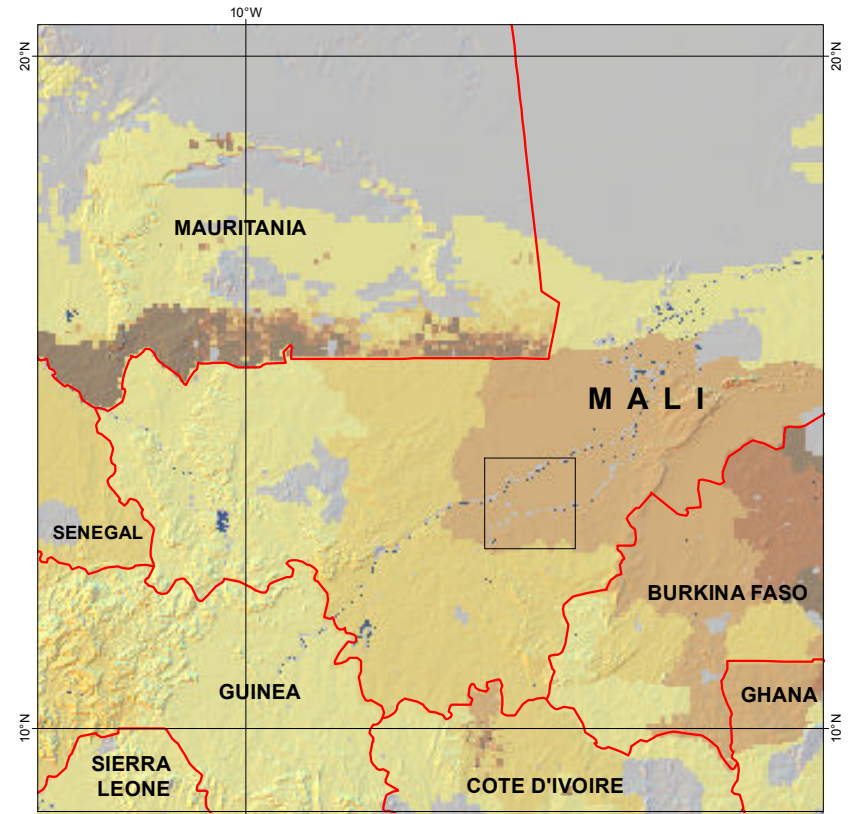
Scale 1:1,000,000



1 cm = 10 km

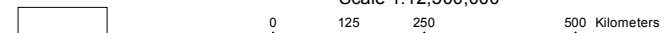


Cizana CCAFS sampling frame



— International boundary

Scale 1:12,500,000



Corresponds to the map on the left

Number per km<sup>2</sup>

- No Observations
- ≤ 5
- 5 - 10
- 10 - 15
- 15 - 20
- ≥ 20

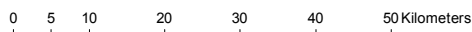
Livestock Density is measured in numbers of livestock, including cattle, goats and sheep, per km<sup>2</sup>

# Livelihood Zones



- Town
- Settlement
- Road
- River

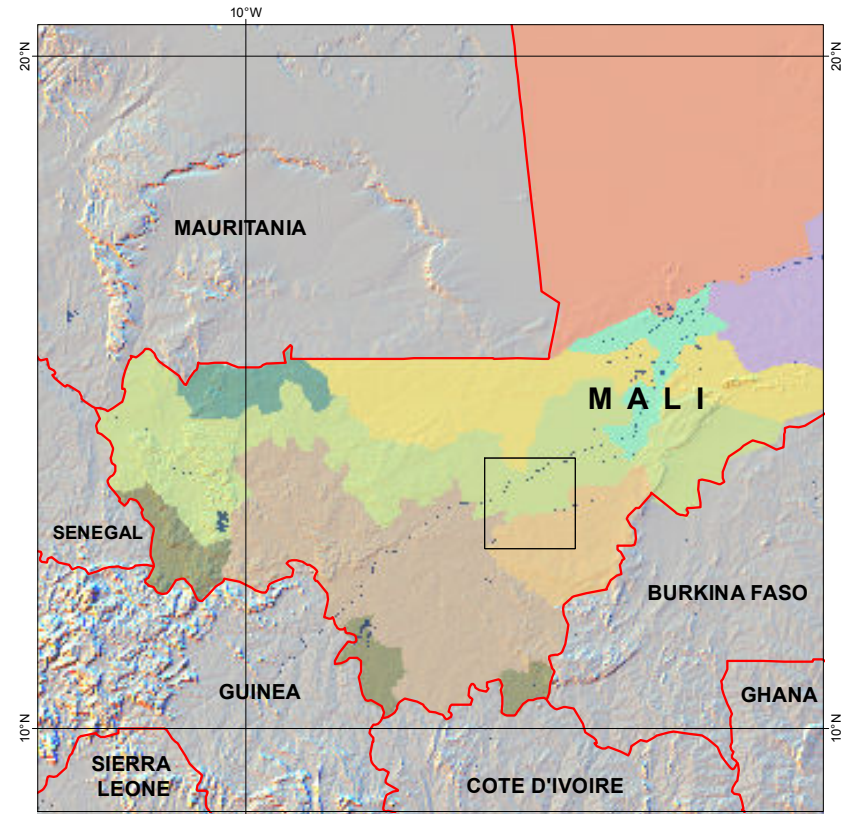
Scale 1:1,000,000



1 cm = 10 km



Cinzana CCAFS sampling frame



— International boundary

Scale 1:12,500,000



Corresponds to the map on the left

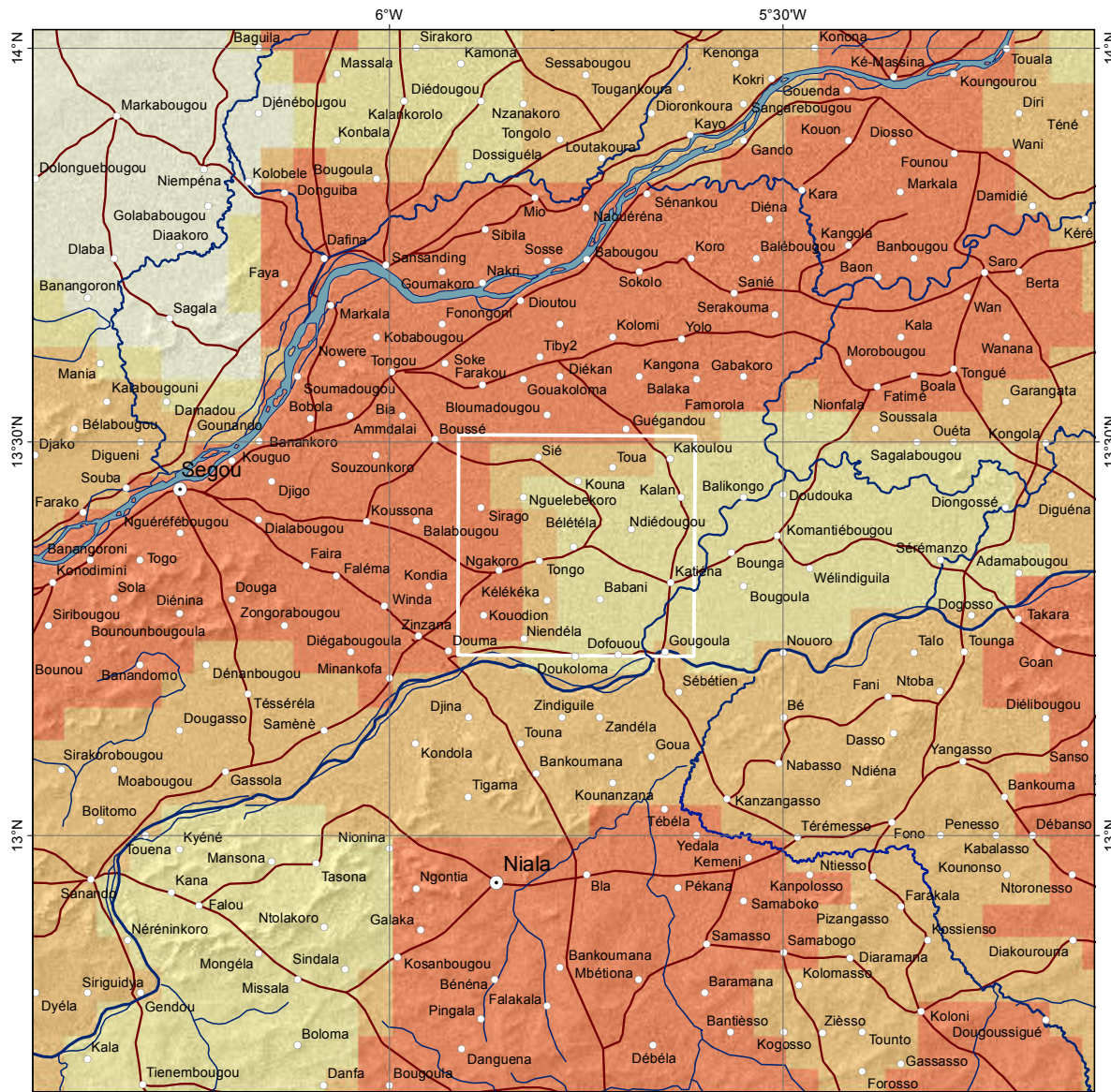
### Livelihood Zones \*

- Millet and transhumant livestock rearing
- West and central Rainfed millet/sorghum
- Sorghum, millet and cotton
- South maize, cotton and fruits

\* Legend corresponds to left map

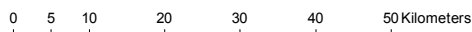
Livelihoods are complex and shaped by a variety of factors. These livelihood zone maps delineate geographic areas within which people broadly share the same livelihood patterns including access to food, income, and markets.

# Human Population Density



- Town
- Settlement
- Road
- River
- ▨ River Bed

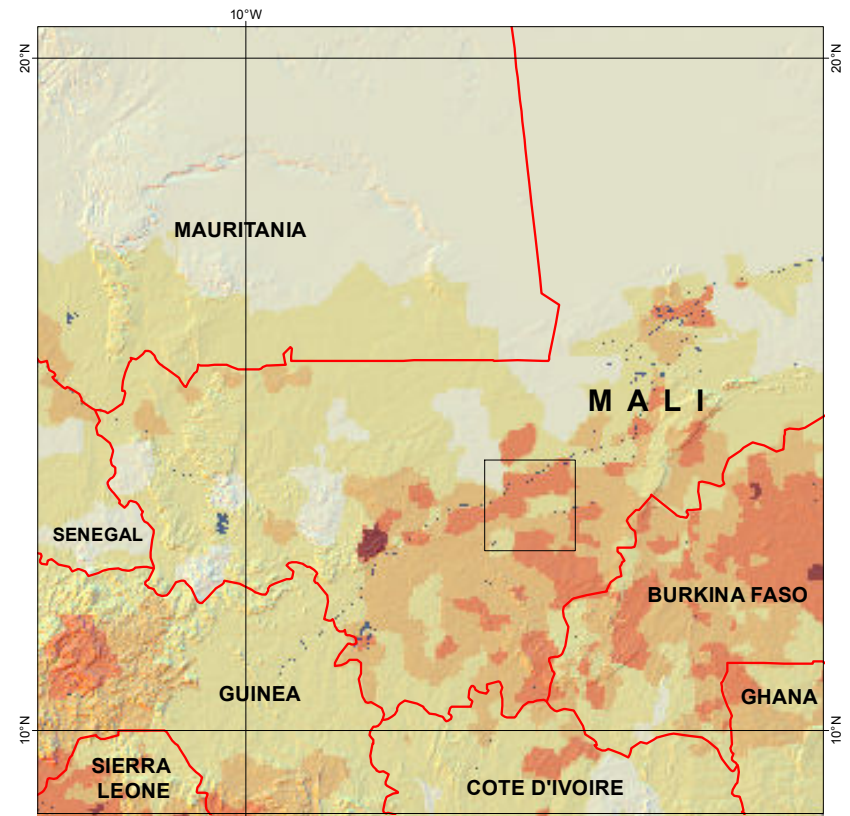
Scale 1:1,000,000



1 cm = 10 km



Cinzana CCAFS sampling frame



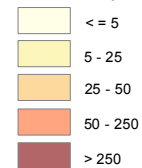
— International boundary

Scale 1:12,500,000



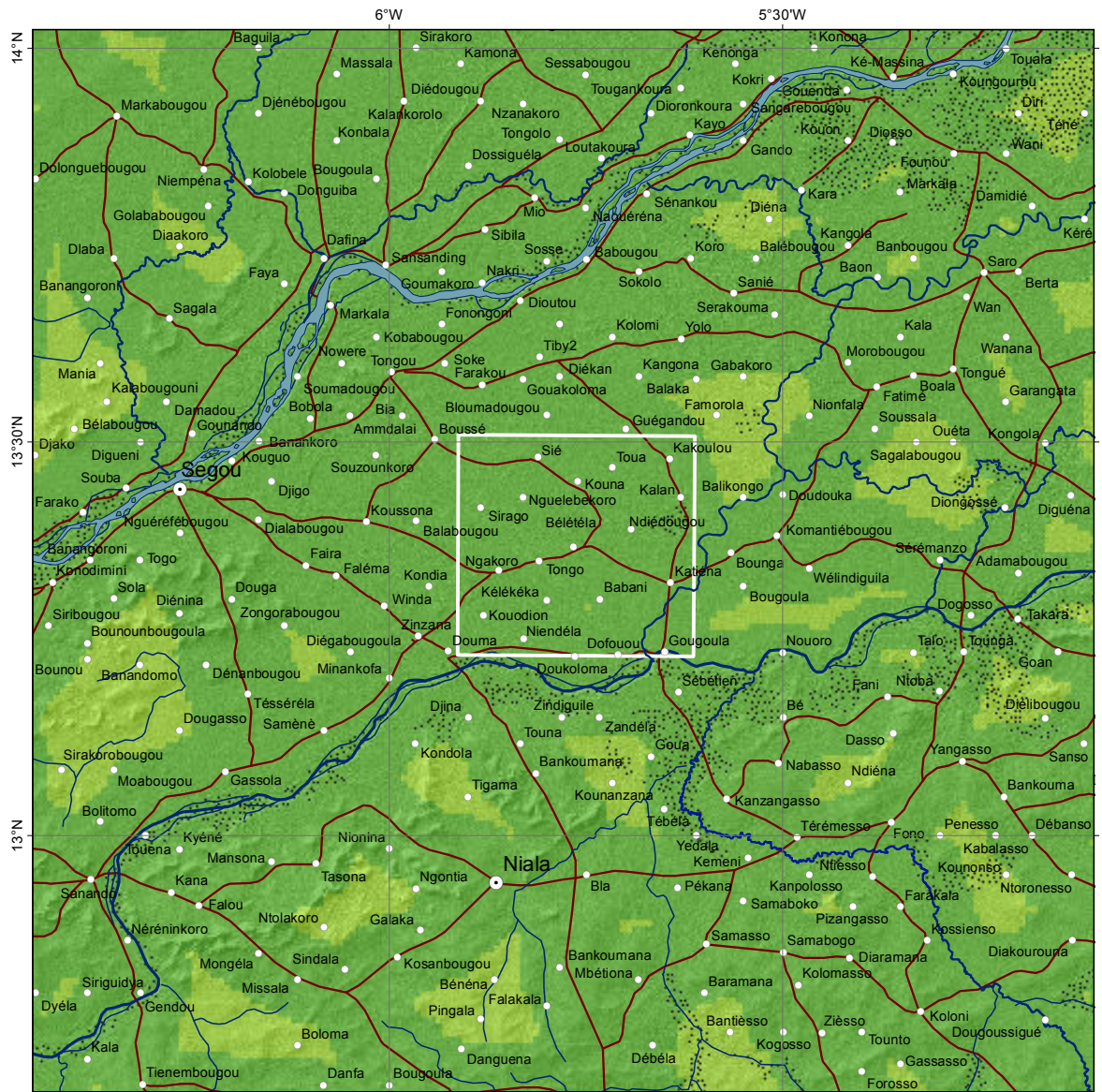
Corresponds to the map on the left

Number of persons per km<sup>2</sup>



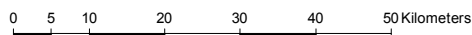
Human Population Density is the gridded number of persons per km<sup>2</sup> in 2005.

# Market Access



- Town
- Settlement
- Road
- River
- River Bed

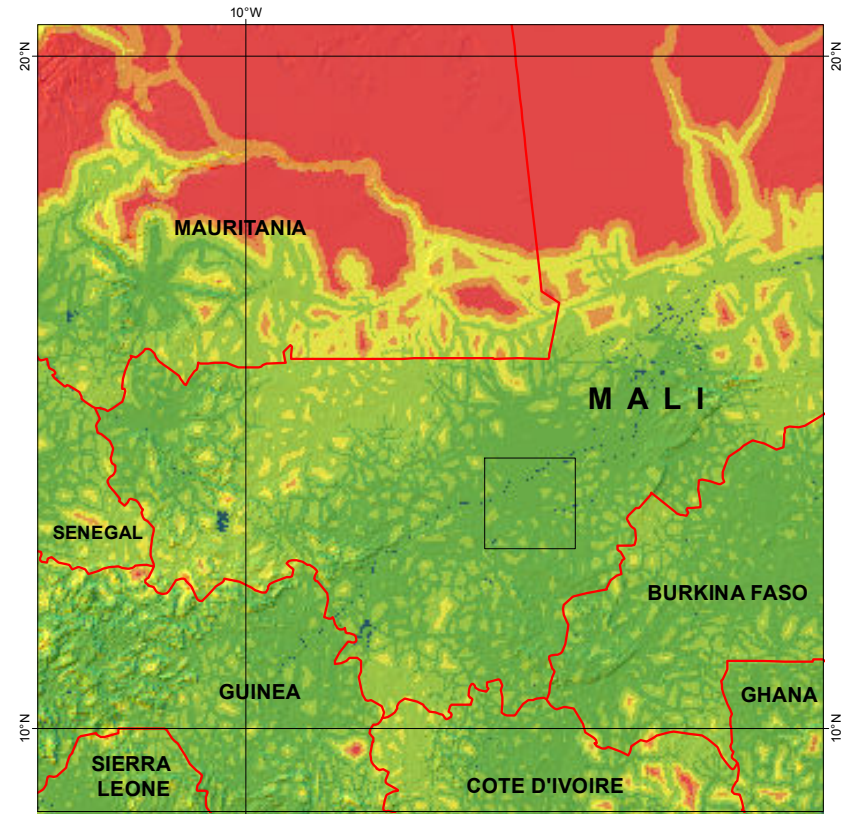
Scale 1:1,000,000



1 cm = 10 km



Cizana CCAFS sampling frame



— International boundary

Scale 1:12,500,000



Corresponds to the map on the left

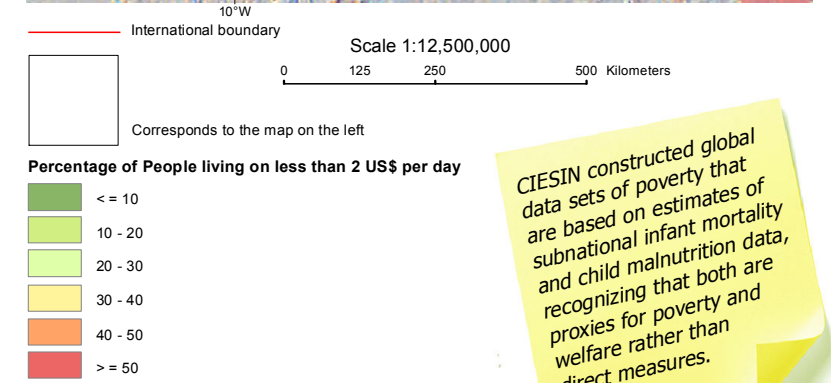
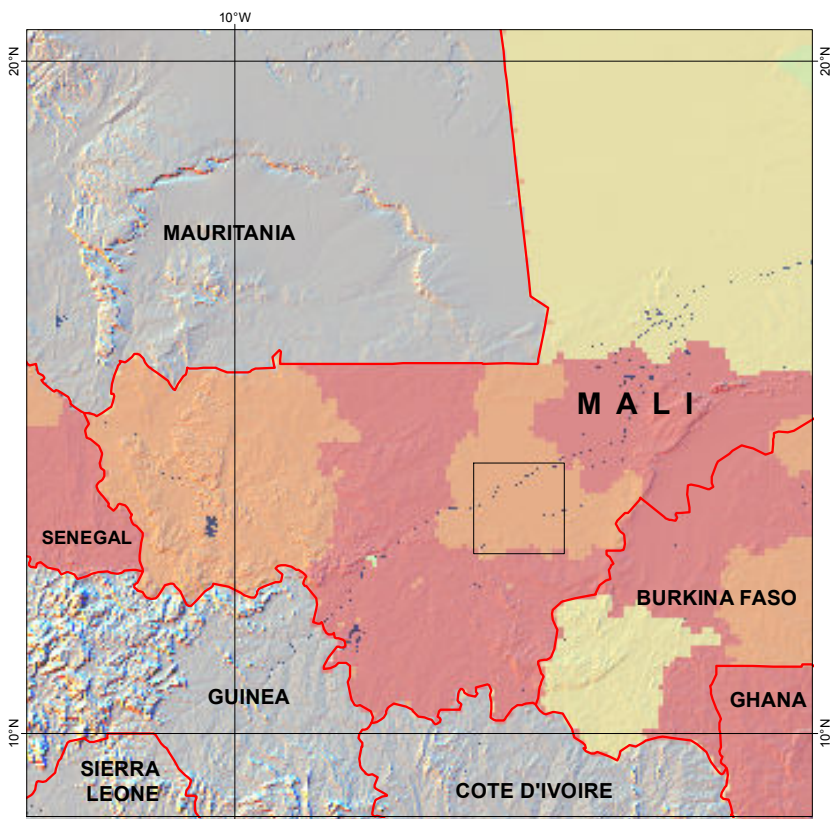
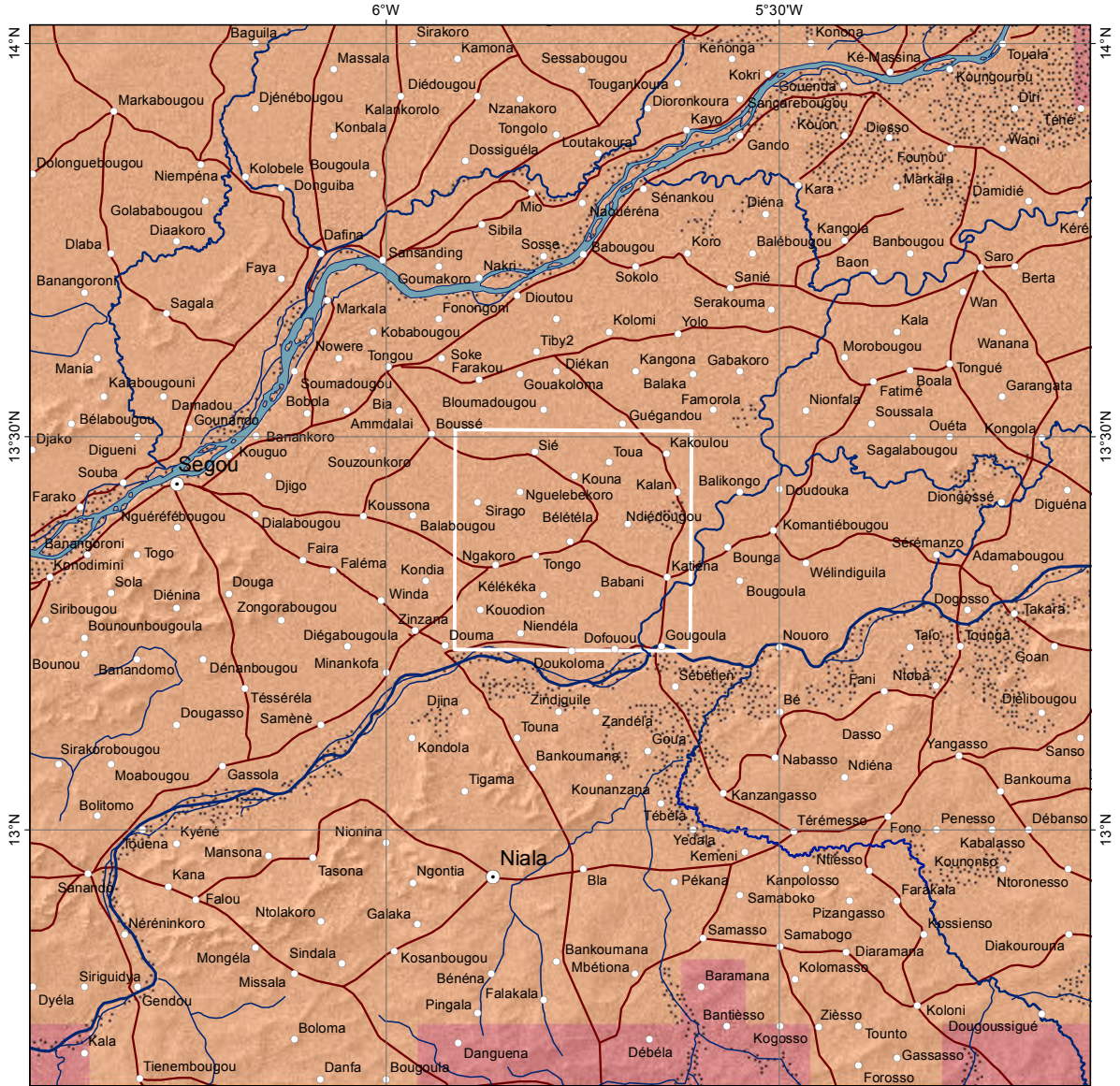
Travel time to nearest large town/city (Hours)

- ≤ 5
- 5 - 10
- 10 - 15
- 15 - 20
- ≥ 20

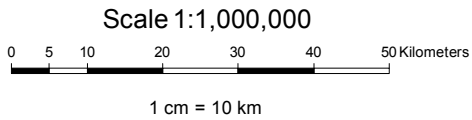
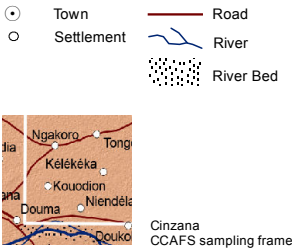
Travel time is a measure of accessibility determined in the time (hours) taken to the nearest urban centre, town or city of a population of 50,000 people or more (taking different means of transportation into account)



# Poverty

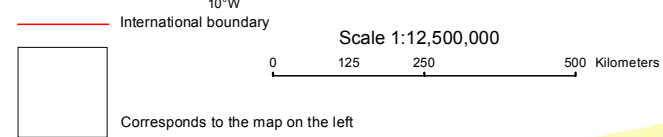
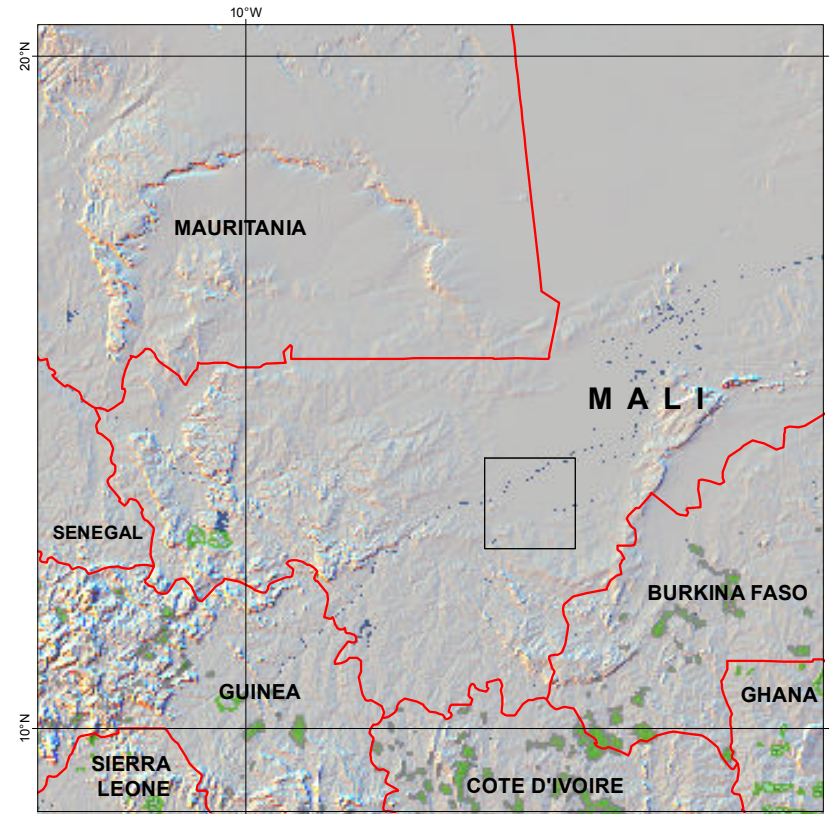
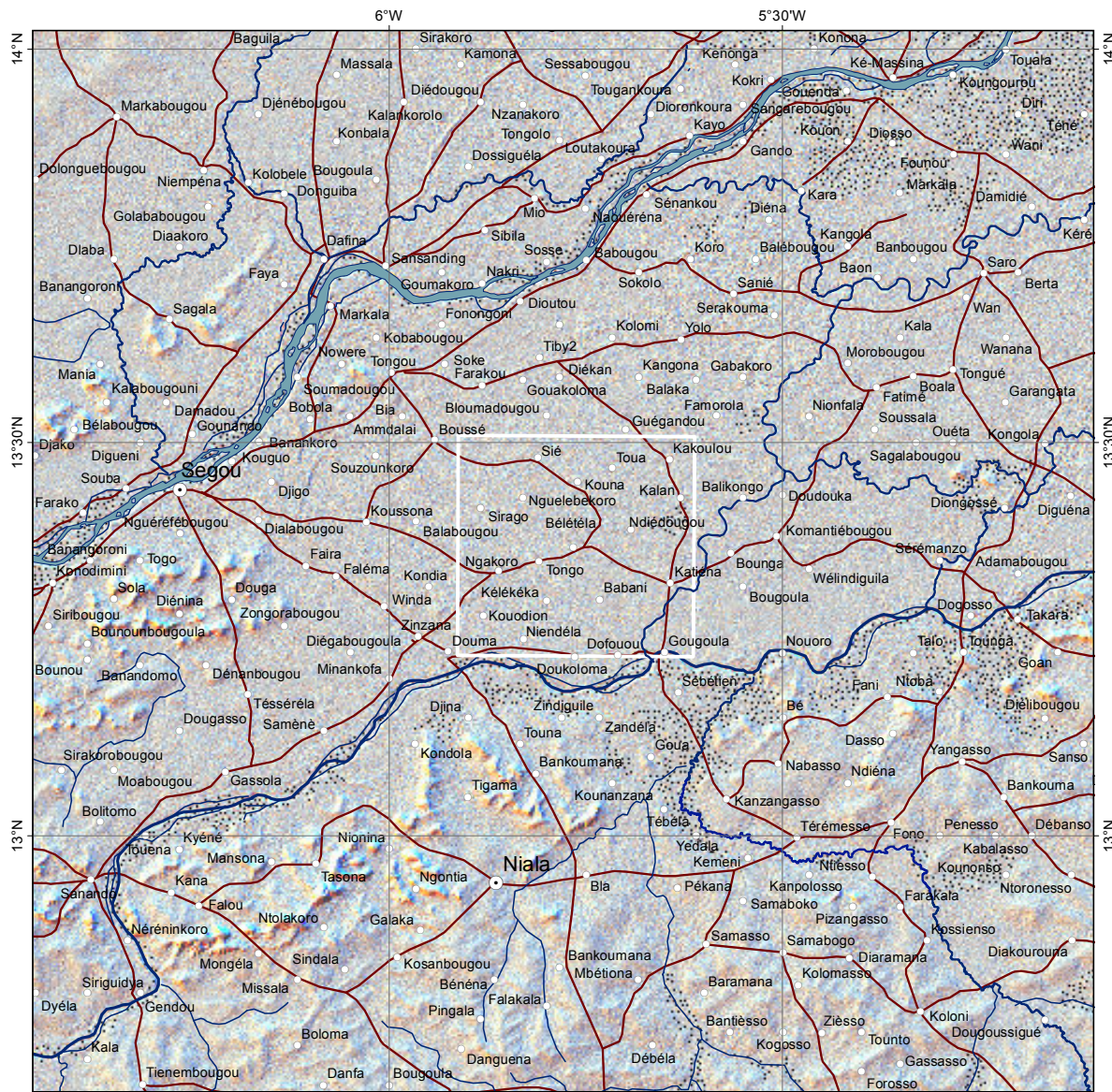


CIESIN constructed global data sets of poverty that are based on estimates of subnational infant mortality and child malnutrition data, recognizing that both are proxies for poverty and welfare rather than direct measures.



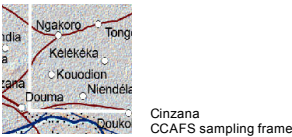
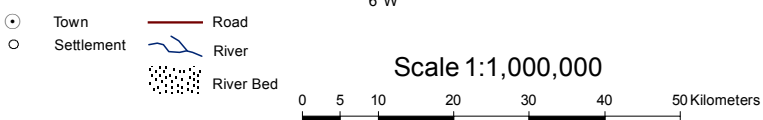
Citation: CIESIN (2005)

# Conservation Areas



- Conservation Areas**
- Classified Forest
  - National Park

Conservation Areas represent protected areas that, according to IUCN, are clearly defined geographic spaces, recognized, managed through legal or other effective means, to achieve long-term conservation of nature with associated ecosystem services and cultural value.



## References and Data Sources

### Regional Map

Sijmons K. 2013a. Digital Satellite Image based on, MODIS (Moderate Resolution Imaging Spectroradiometer ) NASA, 2009, Ground resolution : 1 Kilometer. GTOPO30, (DEM) Global Digital Elevation Model U.S Geological Survey, Ground resolution: 1 Kilometer. Topographic Features derived from: Global GIS, U.S. Geological Survey and Google Earth. Projection: Geographic, Lat/Long, WGS84

### Topographic Map

Sijmons K. 2013b. Relief representation derived from Digital Elevation Model (DEM) of SRTM (Shuttle Radar Topographic Mission) 2000, Ground resolution 90 meter and ASTER GDEM, Ground resolution 30 meter, NASA. Topographic Features digitized from Google Earth Projection: Geographic, Lat/Long, WGS84

### Satellite Image

RapidEye Satellite Image, 5 meter ground resolution, Image acquisition, 17-01-2011

### Annual Rainfall

Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology* 25: 1965-1978.

### Annual Rainfall Graph

Jones P G, Thornton P K, Diaz W and Wilkens P W. 2002. MarkSim, a computer tool that generates simulated weather data for crop modeling and risk assessment. Version 1, 2002. CD-ROM and Users Manual. CIAT, AA6713, Cali, Colombia, 87 pp.

### Annual Temperature

Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology* 25: 1965-1978.

### Annual Temperature Graph

Jones P G, Thornton P K, Diaz W and Wilkens P W. 2002. MarkSim, a computer tool that generates simulated weather data for crop modeling and risk

assessment. Version 1, 2002. CD-ROM and User's Manual. CIAT, AA6713, Cali, Colombia, 87 pp.

### Aridity Index

Trabucco, A., and Zomer, R.J. 2009. Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial Database. CGIAR Consortium for Spatial Information. Published online, available from the CGIAR-CSI GeoPortal at: <http://www.csi.cgiar.org/>

### Altitude

Jarvis, A., H.I. Reuter, A. Nelson, E. Guevara, 2008, Hole-filled SRTM for the globe Version 4, available from the CGIAR-CSI SRTM 90m Database. Available at <http://srtm.csi.cgiar.org>

### Soil Type

FAO/IIASA/ISRIC/ISS-CAS/JRC. 2009. Harmonized World Soil Database (version 1.1). FAO, Rome, Italy and IIASA, Laxenburg, Austria.

### Agro-Ecological Zones

Fischer, G., F. Nachtergaele, S. Prieler, H.T. van Velthuisen, L. Verelst, D. Wiberg, 2008. Global Agro-ecological Zones Assessment for Agriculture (GAEZ 2008). IIASA, Laxenburg, Austria and FAO, Rome, Italy

### Landcover

Arino, O., Perez J. R., Kalgirou V., Defourny P., Achard F. 2009. GlobCover. Version 2.3 Global. Accessed at <http://ionia1.esrin.esa.int/>

### Landuse

Nachtergaele F., Petri M., 2010. Mapping Land Use at global and Regional Scales for Land Degradation Assessment Analysis (LADA).Version 1.1. LADA Project FAO/UNEP GEF/. <http://www.fao.org/geonetwork/srv/en/metadata.show?id=37139&currTab=simple>

### Length of Growing Period 2000

Thornton P K, Jones P G, Owiyo T, Kruska R L, Herrero M, Kristjanson P, Notenbaert A, Bekele N and Omolo A, with contributions from Orindi V, Adwerah A, Otiende B, Bhadwal S, Anantram K, Nair S and Kumar V. 2006. Mapping climate vulnerability and poverty in Africa. Report to the Department for International Development, International Livestock Research Institute, Nairobi, Kenya, 200 p.

### Length of Growing Period 2030

Thornton P K, Jones P G, Owiyo T, Kruska R L, Herrero M, Kristjanson P, Notenbaert A, Bekele N and Omolo and Kumar V. 2006. Mapping climate vulnerability and poverty in Africa. Report to the

Department for International Development, International Livestock Research Institute, Nairobi, Kenya, 200 p.

#### **Crop Suitability**

FAO-IIASA 2007. Mapping biophysical factors that influence agricultural production and rural vulnerability. Food and Agriculture Organization and International Institute for Applied Systems Analysis, Rome 2007.

#### **Livestock Production Systems**

FAO. 2007. Gridded livestock of the world 2007, by G.R.W. Wint and T.P. Robinson. Rome, pp 131.

#### **Livestock Density**

Wint W, Robinson T, 2007. Gridded Livestock of the World. FAO, 131 pp.

#### **Livelihood Zones**

Livelihood Zone Products. Famine Early Warning Systems Network (FEWS NET). Accessed at <http://www.fews.net/pages/livelihoods.aspx?loc=6&l=en>.

#### **Human Population Density**

Center for International Earth Science Information Network (CIESIN)/Columbia University, and Centro Internacional de Agricultura Tropical (CIAT, 2005. Gridded Population of the World, Version 3 (GPWv3): Population Density Grid, Future Estimates, Edition: 3.0. NASA Socioeconomic Data and Applications Center (SEDAC. Online\_Linkage: <http://sedac.ciesin.columbia.edu/data/set/gpw-v3-population-density-future-estimates>

#### **Market Access**

Nelson, A. (2008) Estimated travel time to the nearest city of 50,000 or more people in year 2000. Global Environment Monitoring Unit - Joint Research Centre of the European Commission, Ispra Italy. Available at <http://www.tem.jrc.it/accessibility> (accessed 06/03/2004)

#### **Poverty**

Center for International Earth Science Information Network (CIESIN), Columbia University, 2005. Small Area Estimates of Poverty and Inequality (SAEPI) database. Palisades, NY: CIESIN, Columbia University. Available at <http://www.ciesin.columbia.edu/povmap>. ( Version 1.0) Available at <http://sedac.ciesin.columbia.edu/theme/poverty>

#### **Conservation Areas**

UNEP-WCMC (2012). Data Standards for the World Database on Protected Areas. UNEP-WCMC: Cambridge, UK.

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) brings together the world's best researchers in agricultural science, development research, climate science and Earth System science, to identify and address the most important interactions, synergies and tradeoffs between climate change, agriculture and food security. CCAFS is a strategic partnership of CGIAR and Future Earth, led by the International Center for Tropical Agriculture (CIAT).

For more information, visit [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org) and [www.geomapa.nl](http://www.geomapa.nl)



RESEARCH PROGRAM ON  
**Climate Change,  
Agriculture and  
Food Security**

