

# Examining the Links between Agriculture and Human Health in the Context of Climate Change: A Case Study of Three West African Countries - Mali, Burkina Faso and Niger

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## Research Goal and Approach:

The goals of this research are to construct community-level estimates of cultivated area and to use these estimates to examine the relationships between household-level malnutrition and local food availability in a context of climate change.

This goal will be accomplished through the use of several NASA products – the Moderate Resolution Imaging Spectroradiometer (MODIS) landcover product, Normalized Difference Vegetation Index (NDVI), the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) and a measure of soil moisture from an existing Land Data Assimilation System (LDAS) project - and population/health survey data.

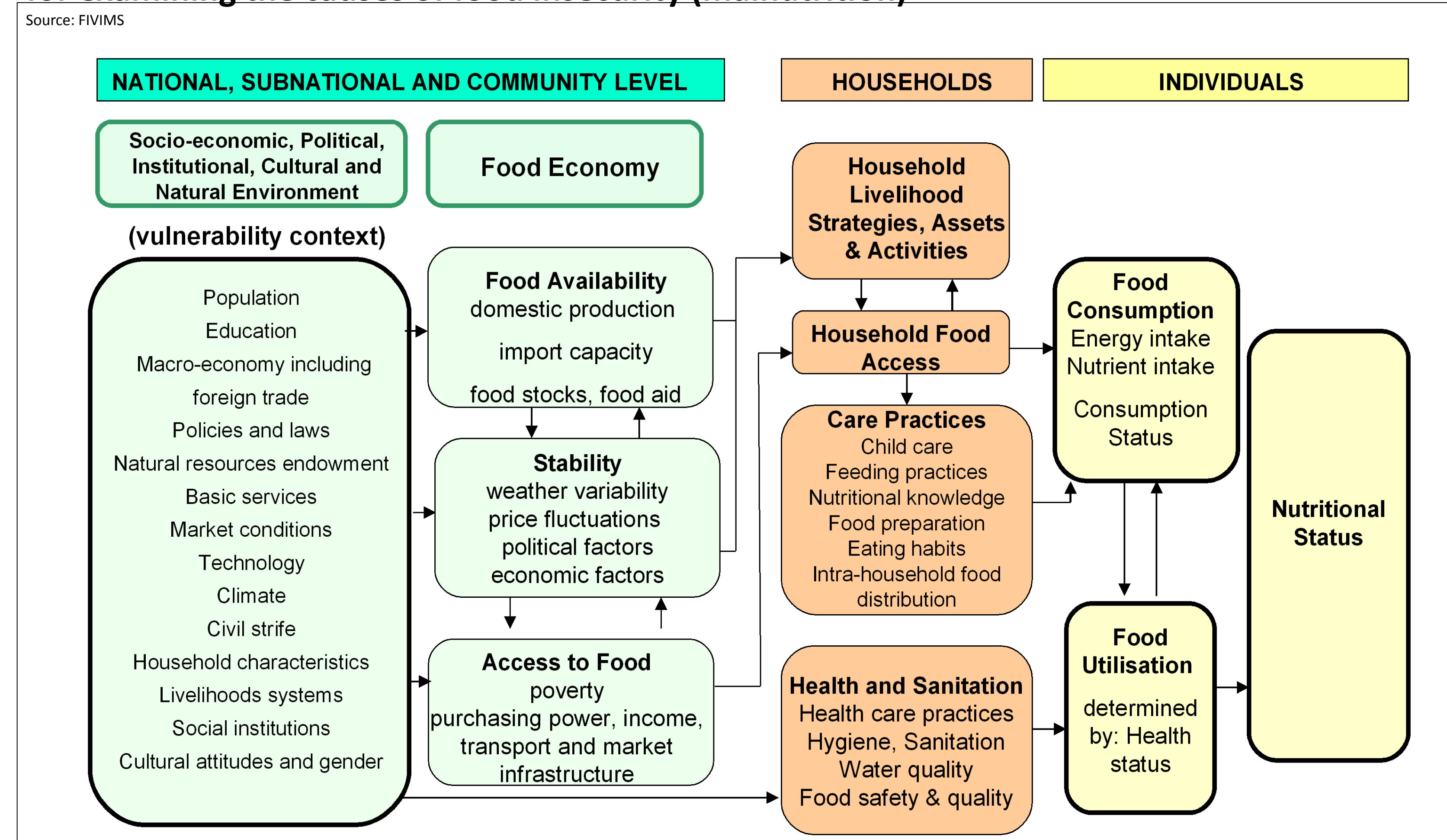
A three stage approach is adopted:

- 1) community/local-level estimates of locally available food,
- 2) country-specific models examining the relationship between measures of household food insecurity and locally available food, and
- 3) country-specific human-health impacts of climate change as outcomes of changes in expected agricultural output.

## Theoretical Framework:

*“Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. (World Food Summit, 1996)*

**Figure 1: Food Insecurity and Vulnerability Information and Mapping Systems Framework for examining the causes of food insecurity (malnutrition)**



### A focus on food access

Given the importance of the access component of food insecurity and the loss of arable land due to increasing temperatures, the focus in this project will be linking food production at a local level with human health outcomes. Very High Resolution imagery is used to construct these estimates at a community-level for each of the three countries.

### Food Insecurity in Mali, Burkina Faso and Niger

These countries are highly susceptible to food insecurity with women and children being the most likely to experience food insecurity. When children are food insecure they are more likely to experience serious illness.

Food insecure children are also characterized by lower educational attainment and they are more likely to become poor adults.

Girls who are food insecure are more likely to die when delivering a baby and are also more likely to deliver low birth weight babies.

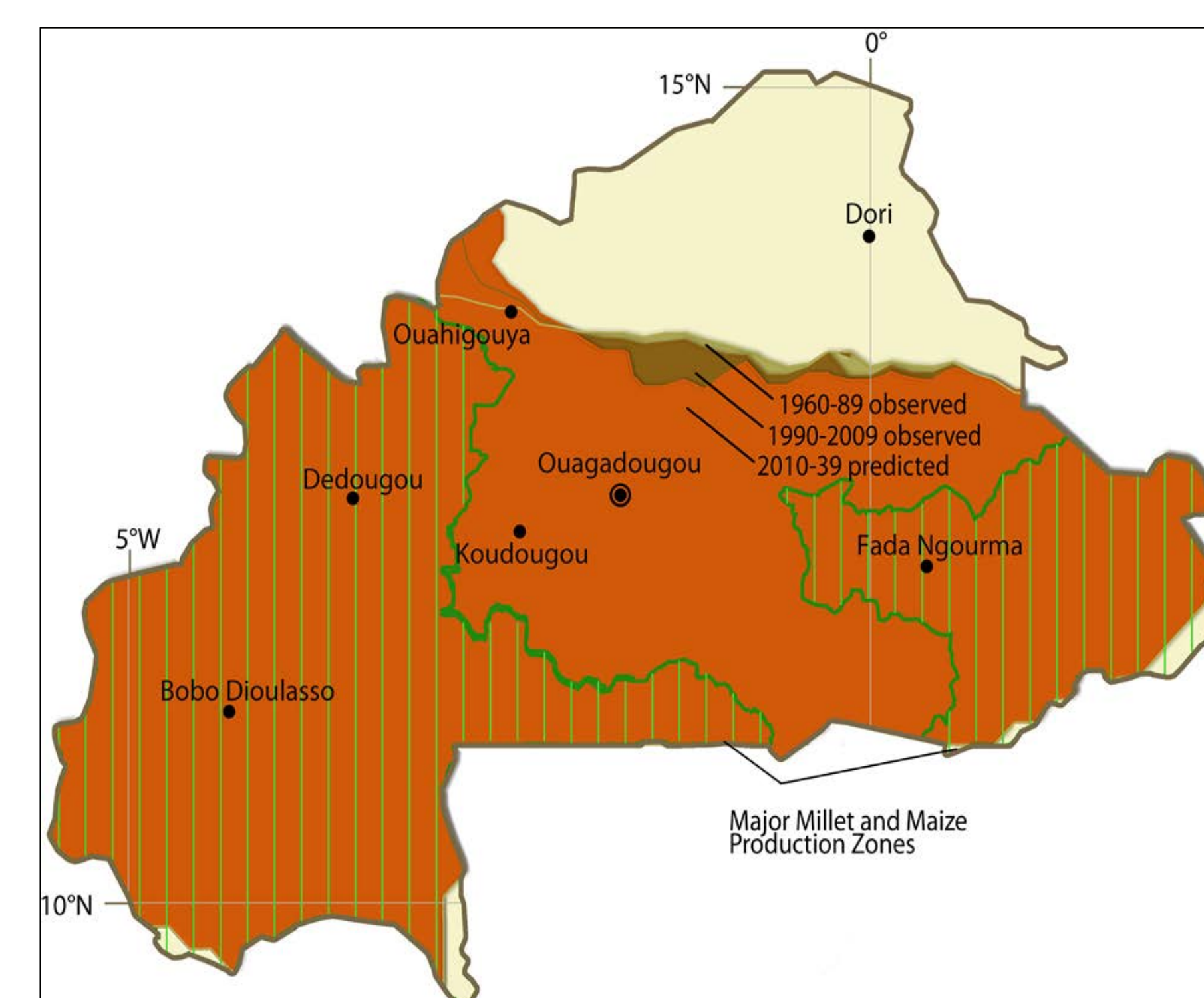
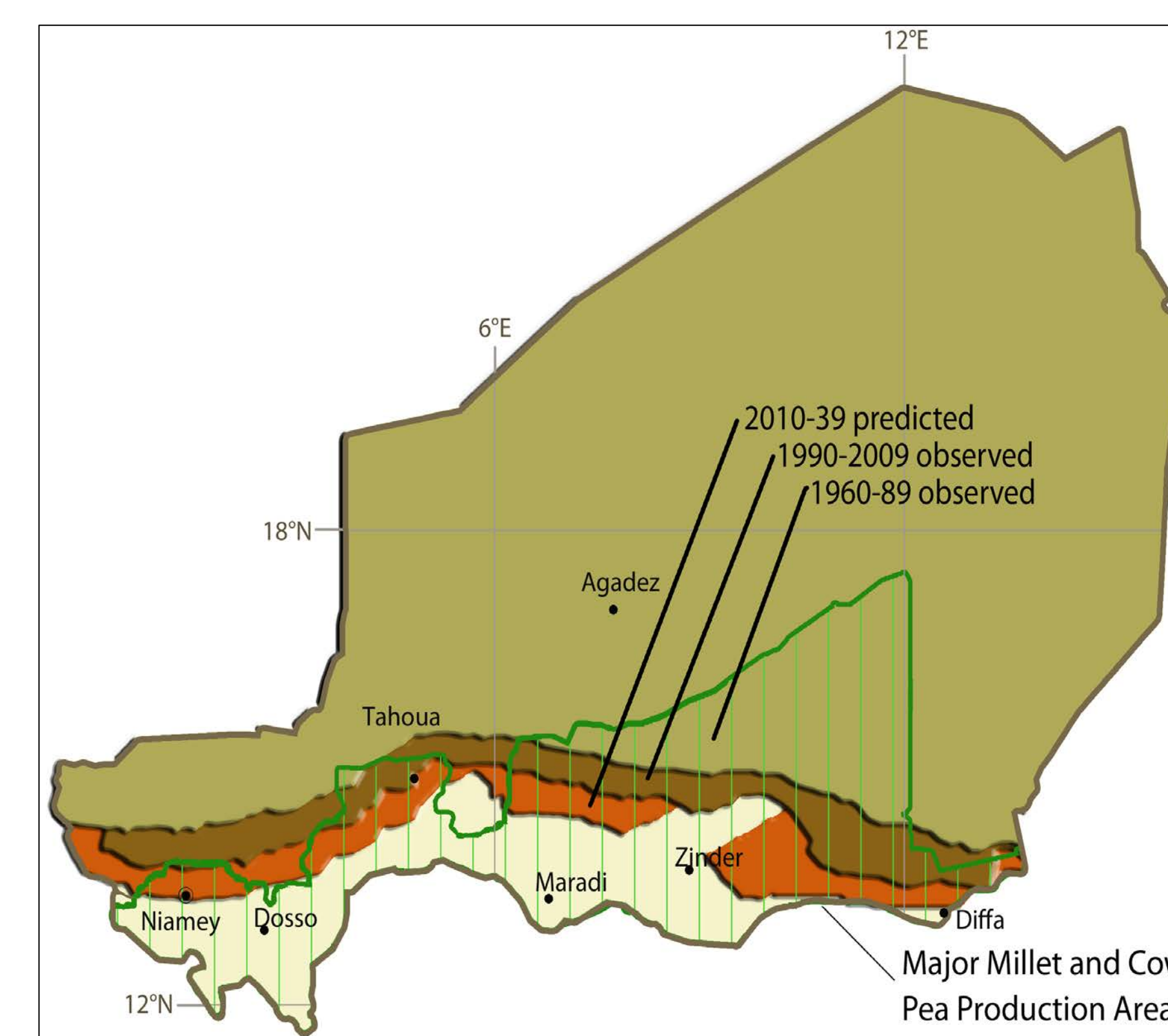
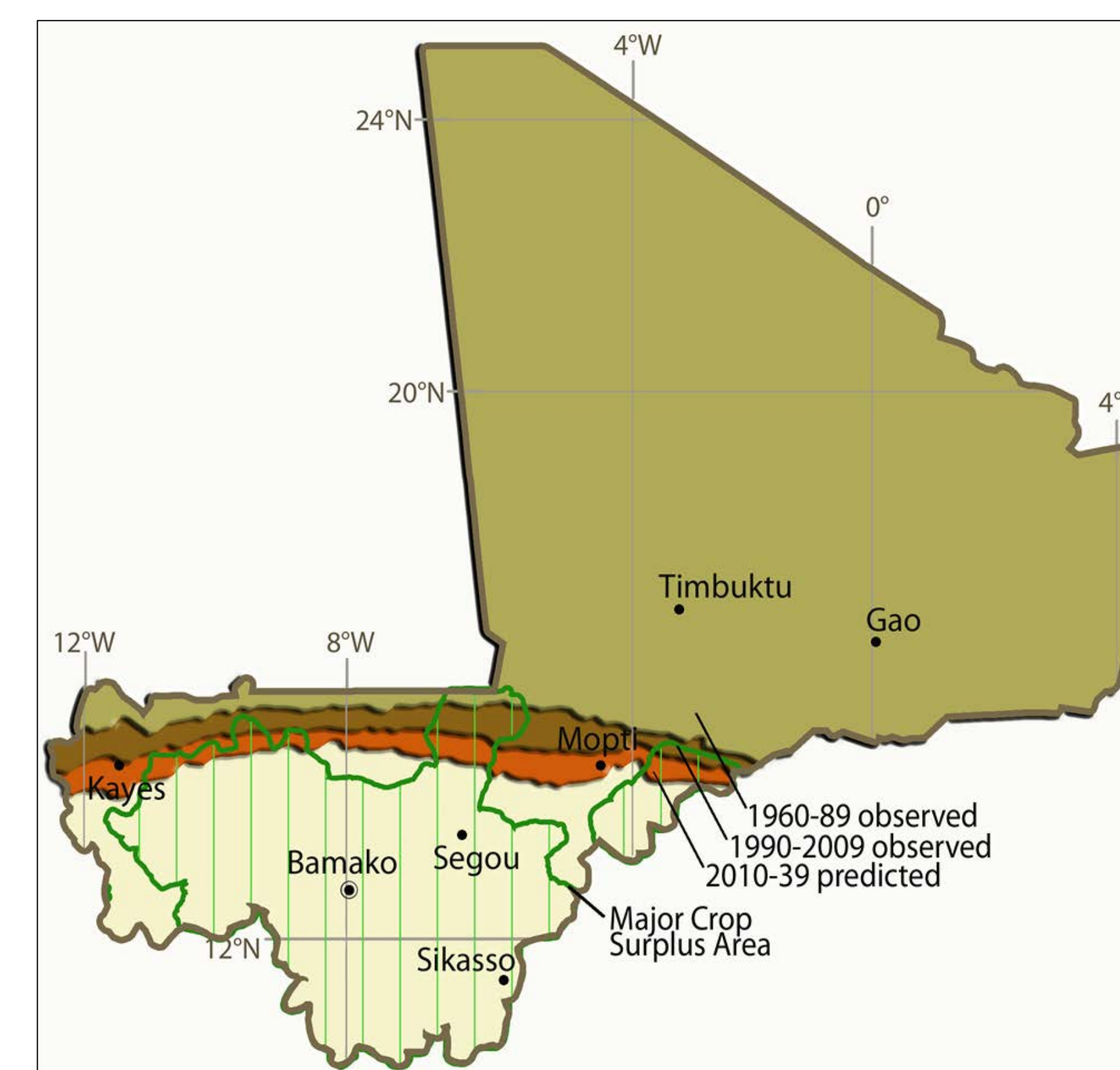
- 35% of children are stunted in Burkina Faso
- 38% of children are stunted in Mali
- 50% of children are stunted in Niger

## Agriculture and climate change in Mali, Burkina Faso and Niger

**Figures 2a-c: Temperature change in Mali, Niger and Burkina Faso (respectively)**

The maps show the average location of the June-September 30° Celsius air temperature isotherms for 1960–1989 (light brown), 1990–2009 (dark brown), and 2010–2039 (predicted, orange). The green polygons in the foreground show the main crop production regions.

Source: Maps produced by Chris Funk/CHG

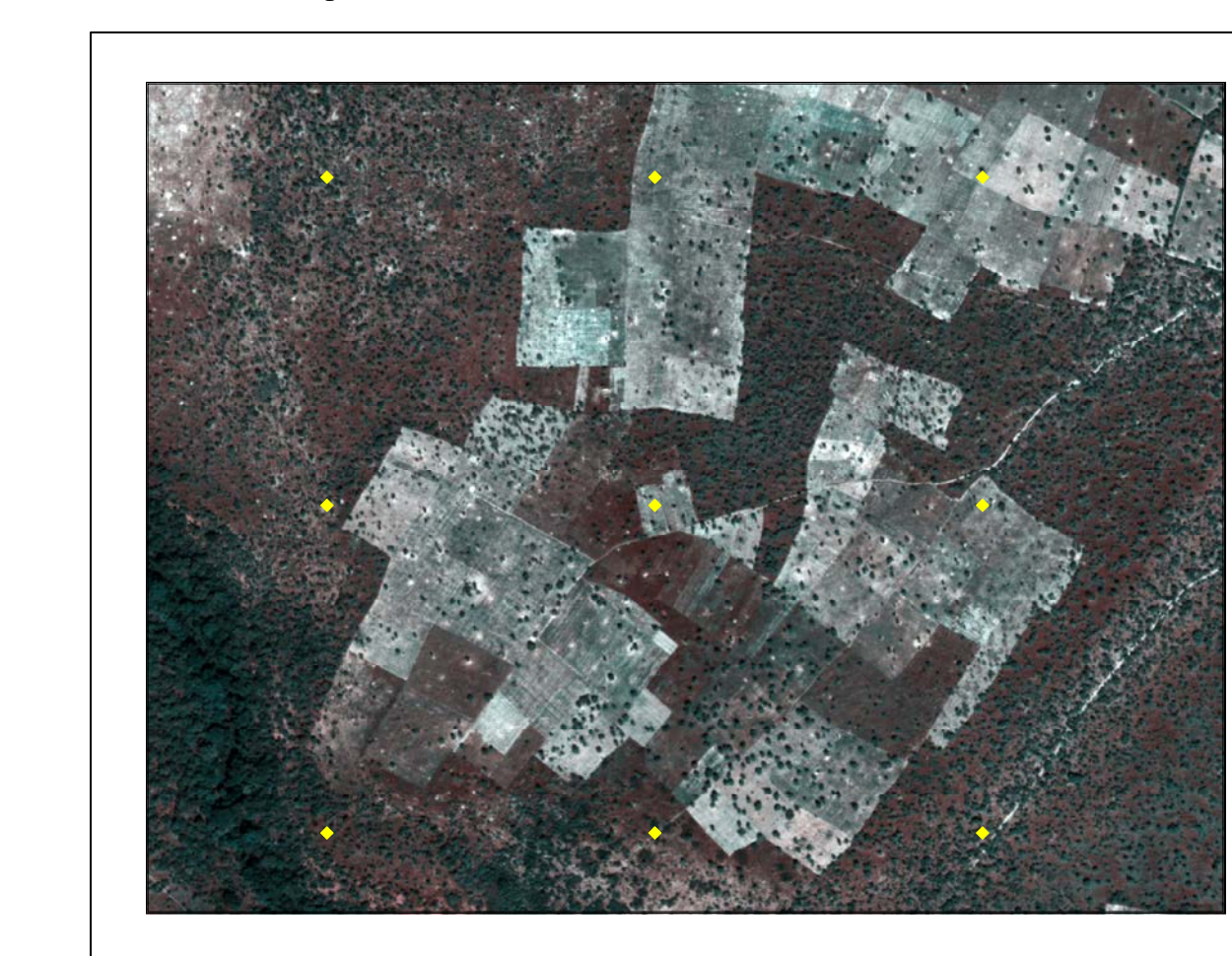


## Estimating cultivated area and linking it to health outcomes

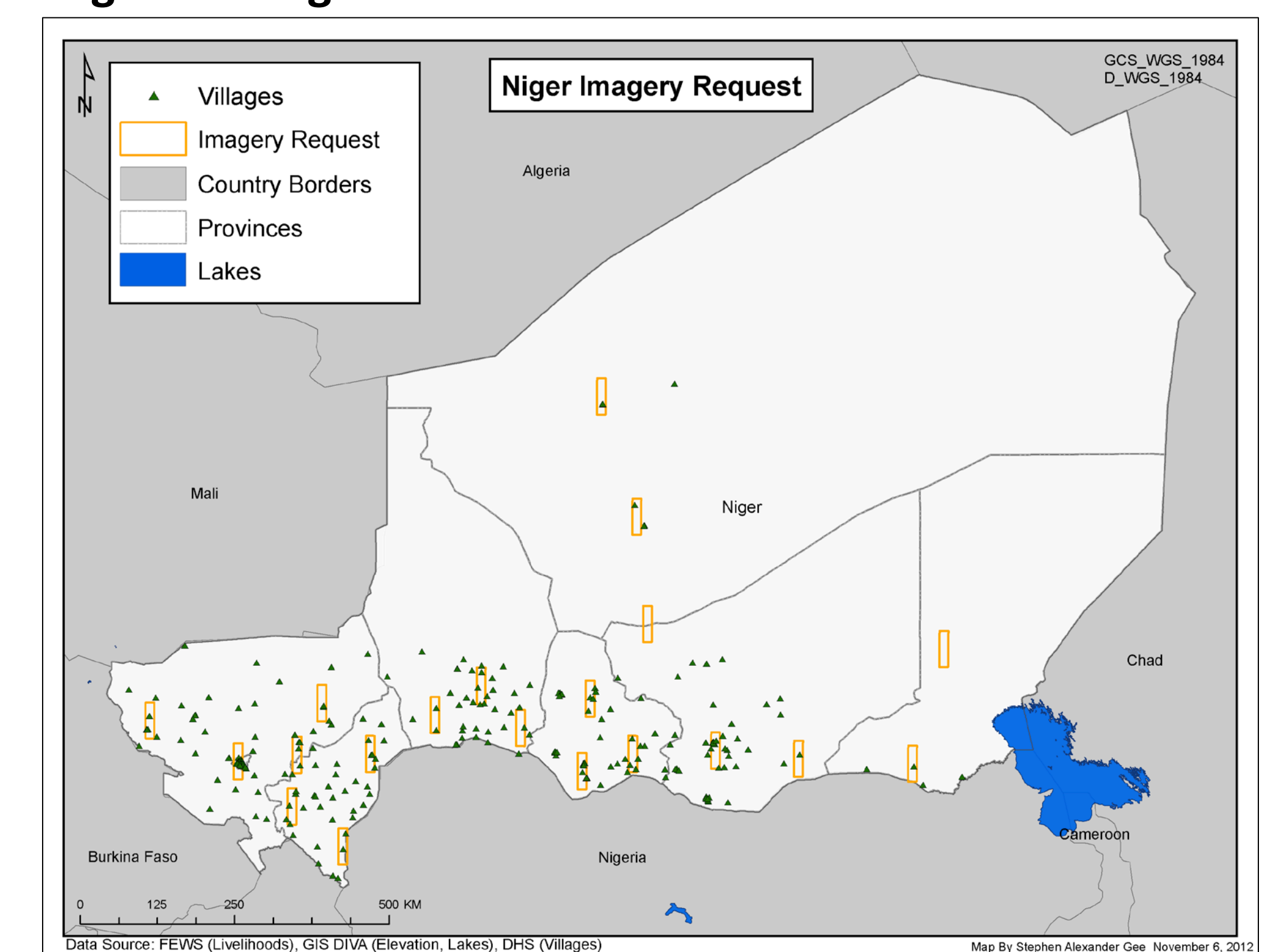
### Procedure for estimating cropped area (food availability)

- Step 1:** Identify growing season and use landcover maps (MODIS and Landsat) to identify agricultural zones and marginal agriculture zones in each of the countries
- Step 2:** Request images in our specified locations from NGA contacts and send imagery to RCMRD for interpretation of imagery points.
- Step 3:** Construct GAMs using geophysical/landscape supporting data (from CHG-LDAS, SRTM, Hydro 1K, MODIS NDVI, NOAA Rainfall)
- Step 4:** Validate the model – with field validations and evaluate estimates of past cultivation through comparisons to small samples of historical high resolution imagery and the existing small-area agricultural surveys
- Step 5:** Construct estimates of cultivated area at multiple scales

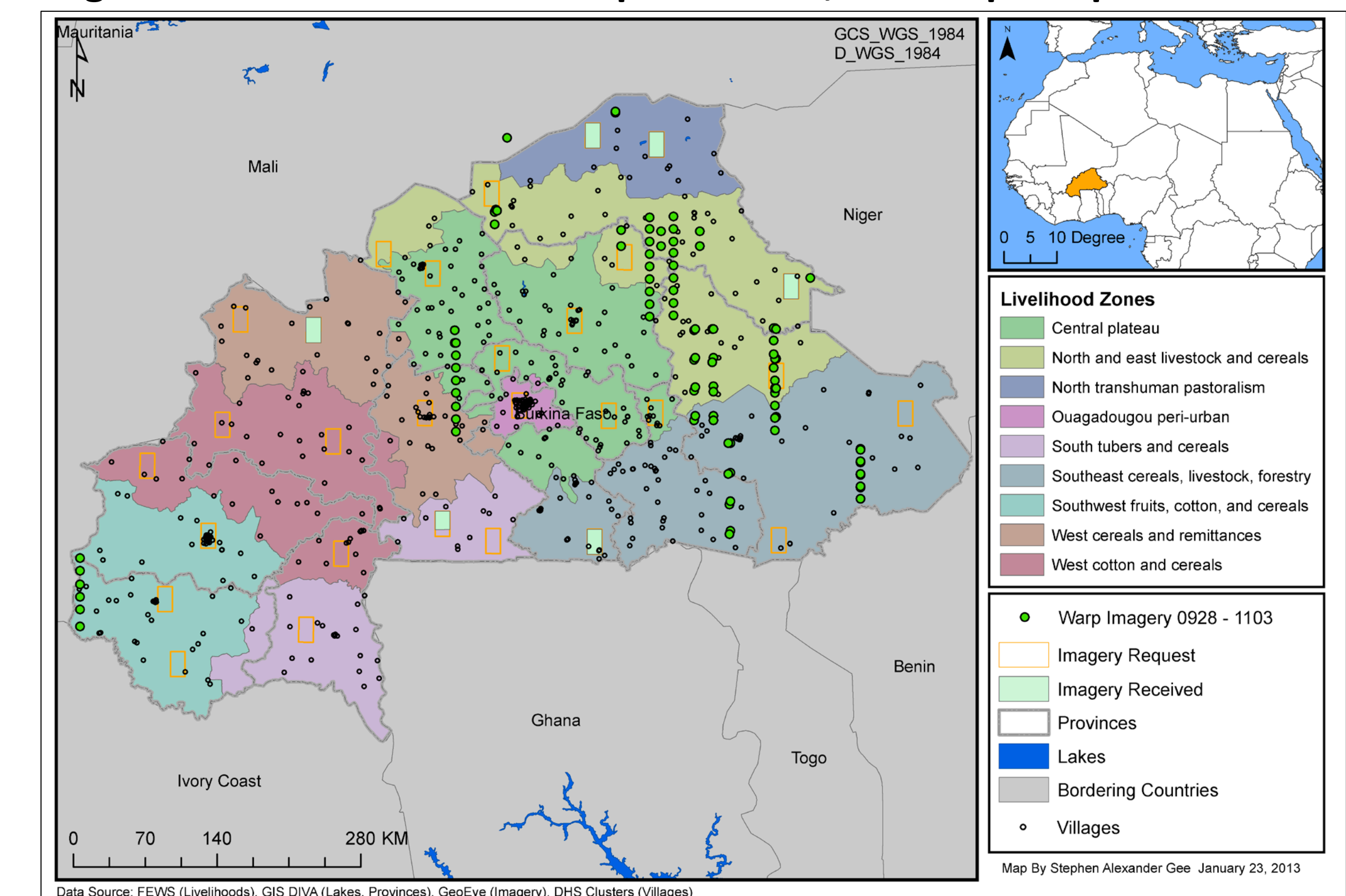
**Figure 3: Example of very high resolution imagery in Mali (resolution is approximately 1 meter)**



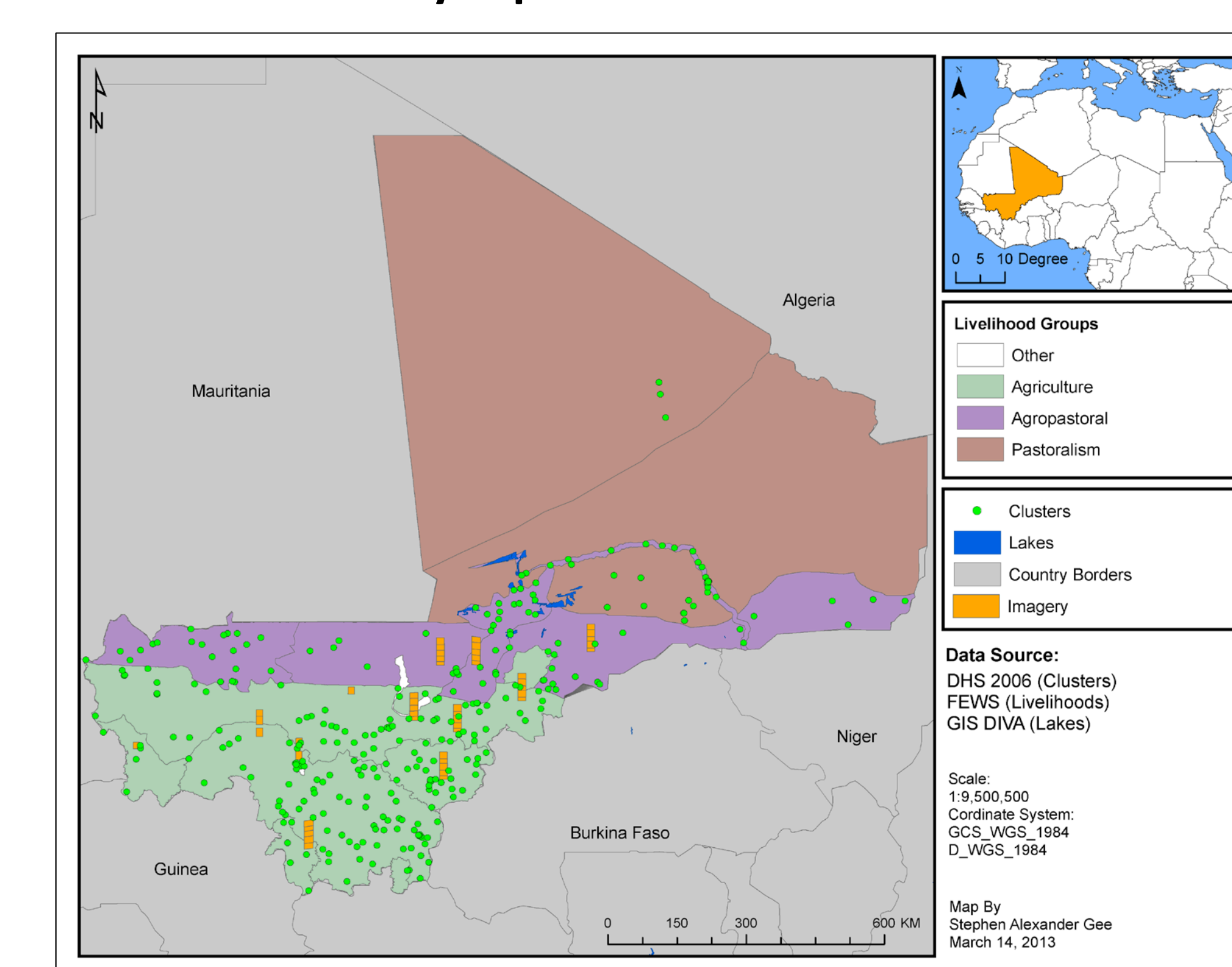
**Figure 4: Niger- Cultivated area estimates**



**Figure 5: Burkina Faso- Food production, farmer perceptions and family planning**



**Figure 6: Mali- Variation in cultivated area, livelihood zones and fertility aspirations**



**Figure 7: Mali- Seasonality of fertility according to livelihood zone**

