

All datasources and their related maps are included in this PDF document.

These component maps can be leveraged to better understand the dynamics and relative contributions of the different datasets to the overall structural vulnerability map for Burkina Faso. Before determining how to best intervene in a particular vulnerable zone, it is advisable to examine all the component maps listed in this document to determine which factors most contribute to the vulnerability identified in the specific geographic zone of interest. For example, if a particular vulnerable commune shows extremely high rates of illiteracy and very high poverty whereas food security/ag. production is relatively good for the commune – education and economic growth programming might be more appropriate than pure agricultural support. For more information contact: Jeremy Chevrier – Jchevrier@usaid.gov or Siaka Millogo – Smillogo@usaid.gov

Purpose of Map:

The purpose of the final vulnerability map is to better identify “hotspots” of structural vulnerability in order to better geographically target longer term resilience investments (development adapted to vulnerable contexts) where the need is greatest. Improved geographic targeting of the most vulnerable is critical to decision making regarding strategic investments for resilience and redressal of social justice related grievances which may lead to conflict.

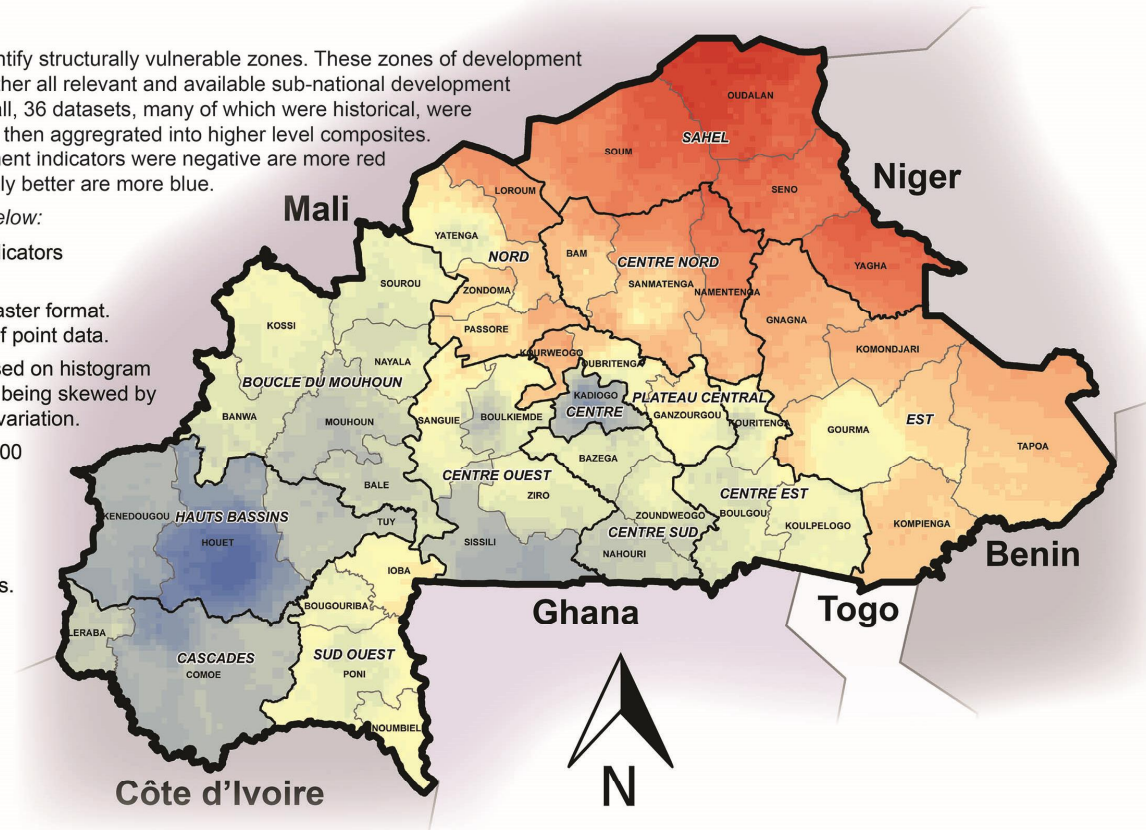


Basic Methodology:

Big data analytics were leveraged to identify structurally vulnerable zones. These zones of development need were calculated by averaging together all relevant and available sub-national development indicators across a broad spectrum. In all, 36 datasets, many of which were historical, were aggregated into composites, which were then aggregated into higher level composites. Geographic areas where most development indicators were negative are more red and areas where indicators were relatively better are more blue.

Basic data processing steps are listed below:

- 1) Identify most relevant sub-national indicators available for the analysis.
- 2) Convert each geographic dataset to raster format. Use Kriging interpolation in the case of point data.
- 3) Winsorize data where appropriate based on histogram analysis. This prevents the data from being skewed by outlier data and amplifies geographic variation.
- 4) Rescale all datasets to a common 0-100 scale so that they are comparable for averaging to create composites.
- 5) Average datasets using weighting based on consensual subject matter expert judgement to create composites.



Final Vulnerability Map

Resilience Capacities datasets and related maps:

All datasets used for composites (datasets averaged based on weightings listed):

* datasets averaged based on weightings listed

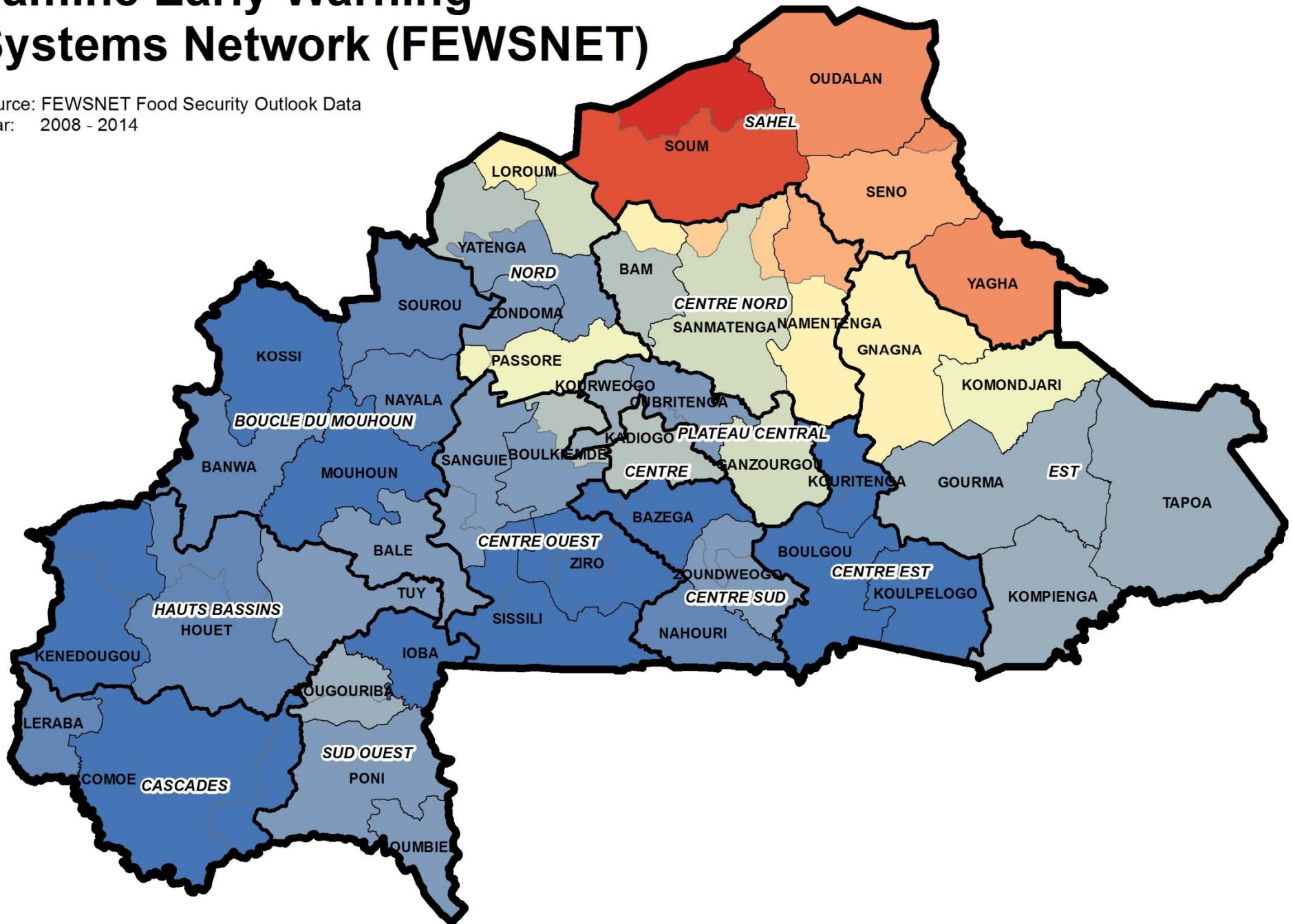
* historical datasets used when available in order to map structural vulnerability vs. conjunctural

* all time series datasets have been averaged over entire period to map tendency (structural issues)

Title	Source	Date Range	Admin Level	Methodology notes	SubComposite Weight	SubComposite Title	Final Weight	Composite Title	Composite Weight	Top Index Composite	Final Weight
FEWSNET	FEWSNET food security outlook data	2008-2014	Province/ Livelihood zone	Averaged IPC score per zone over entire time period.	50%	Food Security	50%	Food Security/Ag. Productivity	31%	Resilience Capacity	49%
SAP	Système d'Alerte Précoce (SAP) vulnérable communes	2009-2014	Commune	Commune score generated by totalling number of times communes identified as vulnerable during time period.	50%		50%				
% of non-self sufficient farm households	Ministry of Agriculture - Burkina Faso	2008-2009	Region	Averaged % per region over both years.	43%	Agricultural Productivity	50%				
Soil Organic Carbon Density	International Soil Reference and Information Centre - World Soil Information	2013	Raster	The soil organic carbon predicted mean for the 1st standard depth (0–5cm), 2nd standard depth (5–15cm) and 3rd standard depth (15–30cm) were summed for an approximation of the soil organic carbon in top soil, which is 0–20cm.	57%		50%				
Educational Level	Annuaire Statistique de l'éducation nationale	2010-2013	Province	The passing rates for grades 1 thru 5 were averaged and then these averages were averaged over the 4 years.		Literacy Rates	40%	23%			
Literacy Rates	Census Data	2006	Commune	During the 2006 census, everyone over the age of 3 were asked whether or not the respondent could read and write in any language.			60%				
Poverty	Burkinabè Household Living Conditions Survey (ECBVM)	2003, 2009	Region	Averaged poverty rates per region to approximate general tendency.	67%	Poverty (adjusted)	25%	Poverty	31%		
Remittances	Banque Centrale des Etats de l'Afrique de l'Ouest (BCEAO)	2011	Region	A per capital amount was calculated for remittances per region.	33%		25%				
Wealth Index	Demographic and Health Surveys (DHS)	2003, 2010	Cluster Points	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)		33%					
Lack of Access to Health Services on Account of Financial Constraints	Demographic and Health Surveys (DHS)	2003, 2010	Cluster Points	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)		8%					
Tropical Livestock Units	Ministry of Livestock - Burkina Faso	2012	Province	Projected Livestock figures converted to TLU		17%					
Immigration Rates	Census Data	2006	Commune	During the 2006 census, every family was asked if they had moved in the last year, and if so, from where to where. Immigration Rates were used as a proxy for vulnerability based on the assumption that generally zones that are less vulnerable are more attractive (offer more opportunities) and thus have higher rates of immigration.		17%					
Lack of Access to Health Services on Account of Distance	Demographic and Health Surveys (DHS)	2003, 2010	Cluster Points	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)	40%	Distance to Health Services	20%	Service Access	15%		
Distance to Health Center	Ministry of Health - Burkina Faso	2013	Province	Yearly report from the Ministry of Health that calculates how many people in each province are 10 km or more away from a health center	60%		20%				
# of People per Unit Area	AFRIPOP	2014 estimate	Raster	Areas of lower population are considered as a proxy to lack of access to services (remoteness)		27%					
Access to Improved Sanitation	Demographic and Health Surveys (DHS)	2003, 2010	Cluster Points	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)		20%					
Access to Improved Drinking Water Source	Demographic and Health Surveys (DHS)	2003, 2010	Cluster Points	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)		13%					
> 30 minutes walk to nearest drinking water source	Demographic and Health Surveys (DHS)	2003, 2010	Cluster Points	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)		20%					

Famine Early Warning Systems Network (FEWSNET)

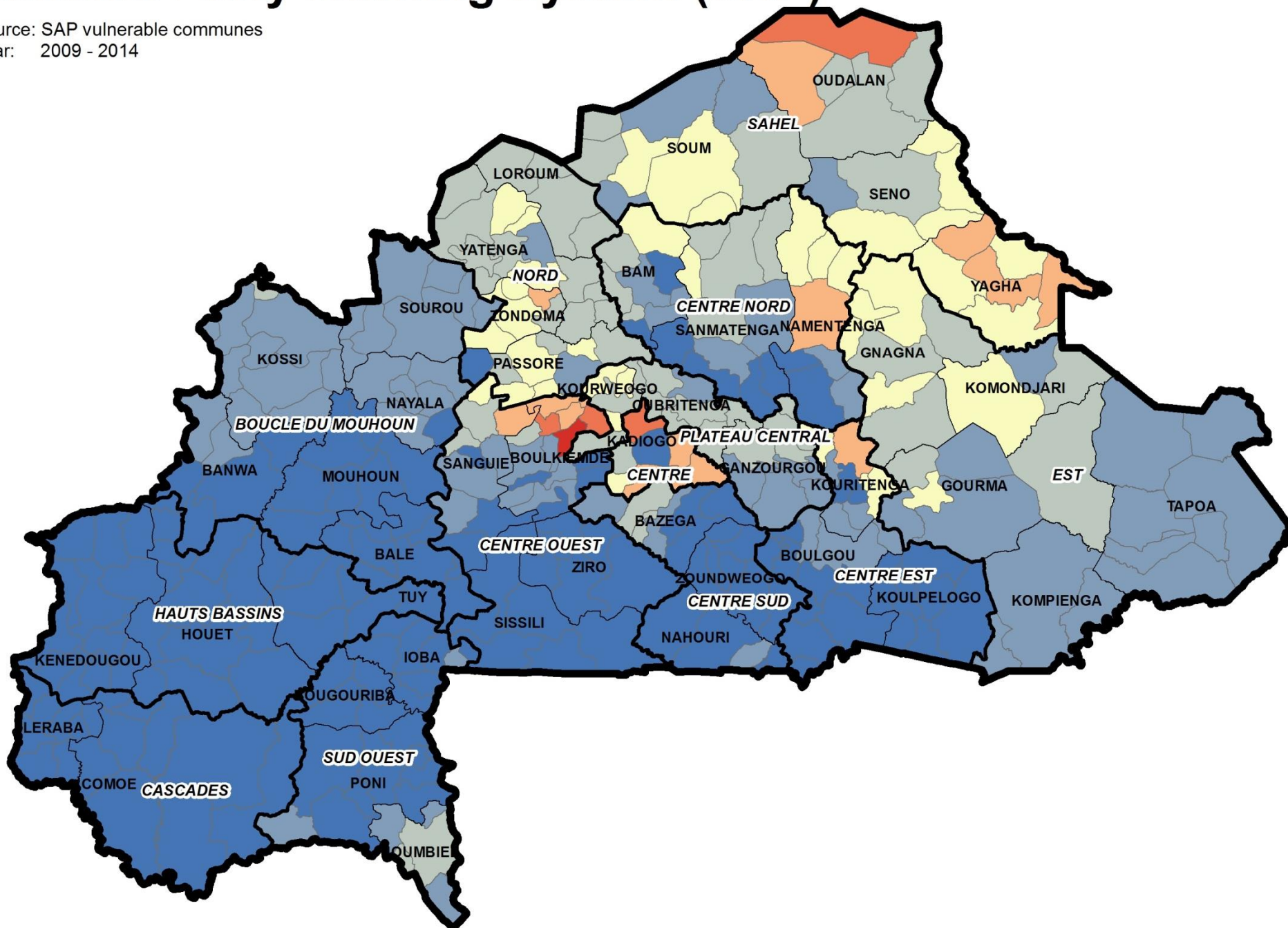
Source: FEWSNET Food Security Outlook Data
Year: 2008 - 2014



National Early Warning System (SAP)

Source: SAP vulnerable communes

Year: 2009 - 2014



% of non-self sufficient farm households

Source: Ministry of Agriculture - Burkina Faso
Year: 2008 - 2009

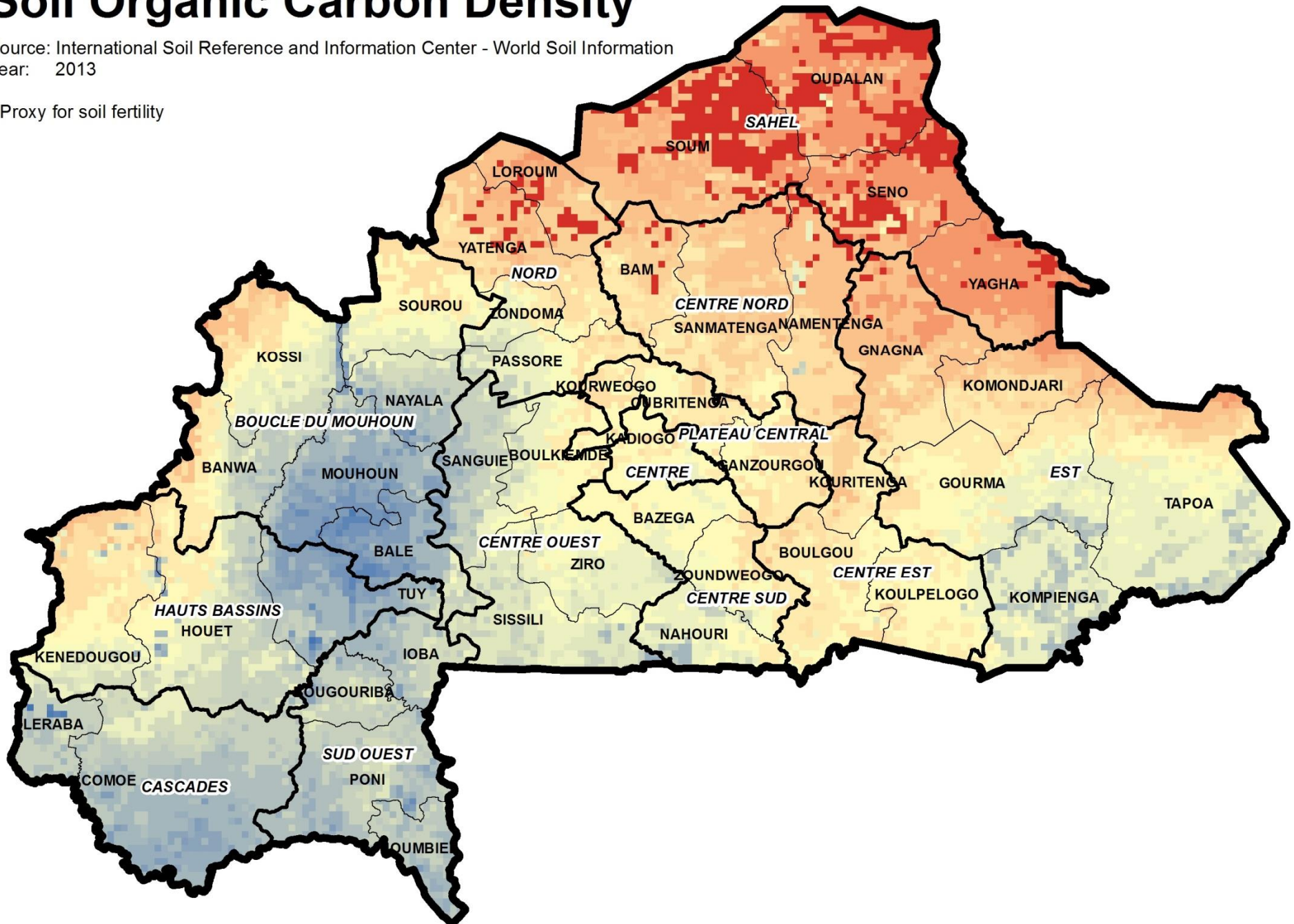


Soil Organic Carbon Density

Source: International Soil Reference and Information Center - World Soil Information

Year: 2013

* Proxy for soil fertility



Educational Level

Source: Annuaire Statistique de l'education nationale

Year: 2010 -2013

* The passing rates for grades 1 thru 5 were averaged and then these averages were averaged over the 4 years.



Poverty

Source: Burkina Faso Household Living Conditions Survey (ECBVM)

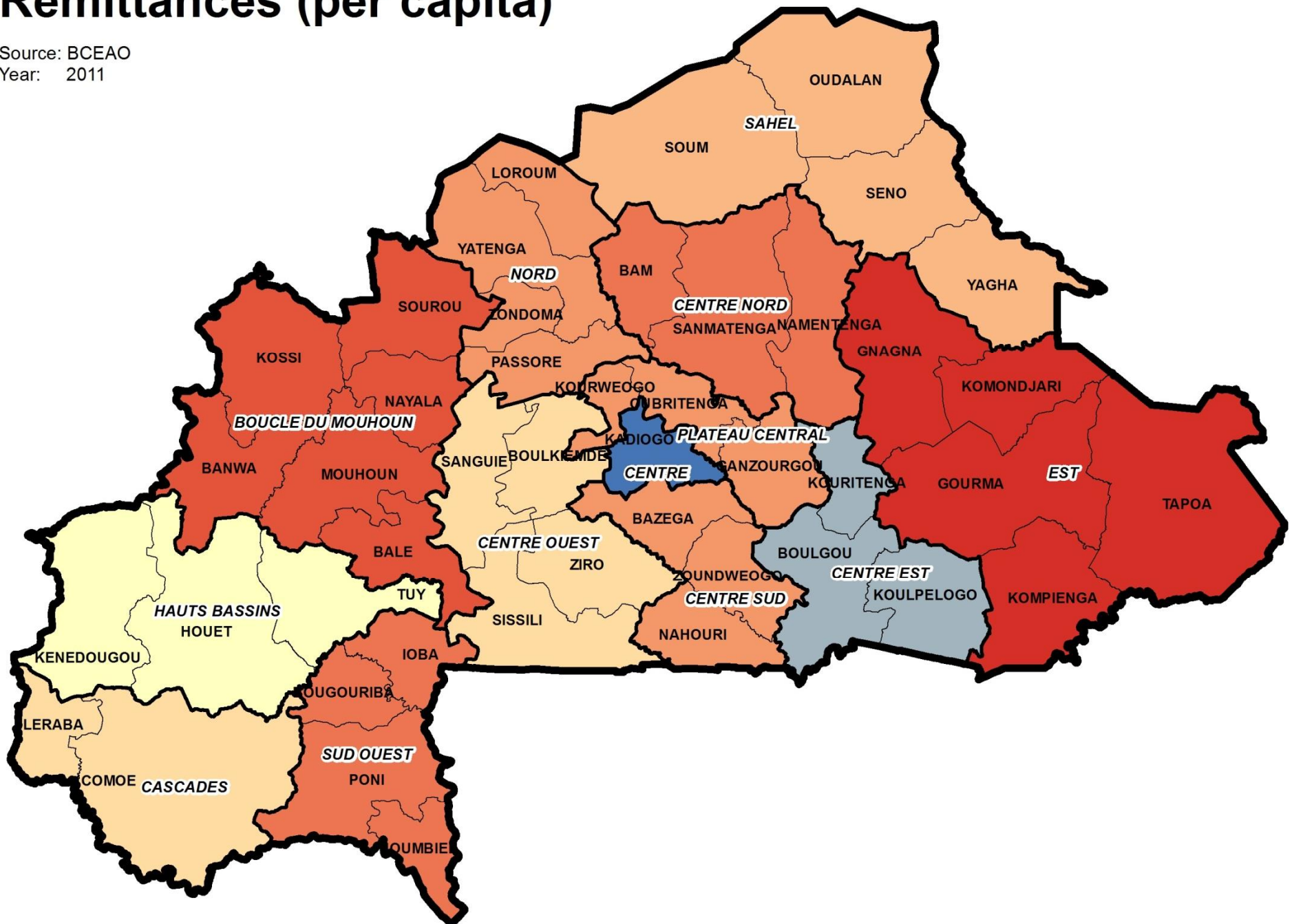
Year: 2003, 2009



Remittances (per capita)

Source: BCEAO

Year: 2011

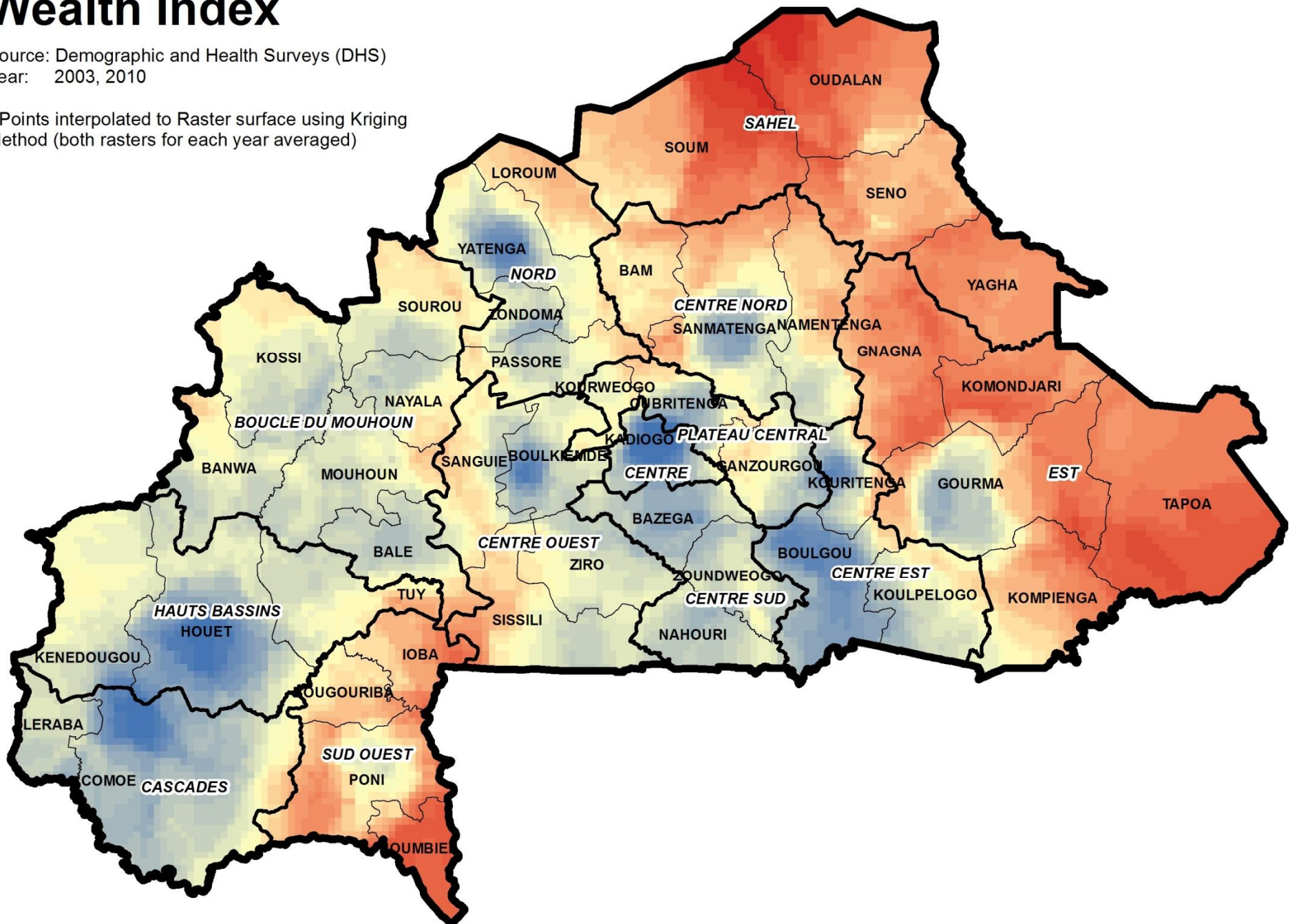


Wealth Index

Source: Demographic and Health Surveys (DHS)

Year: 2003, 2010

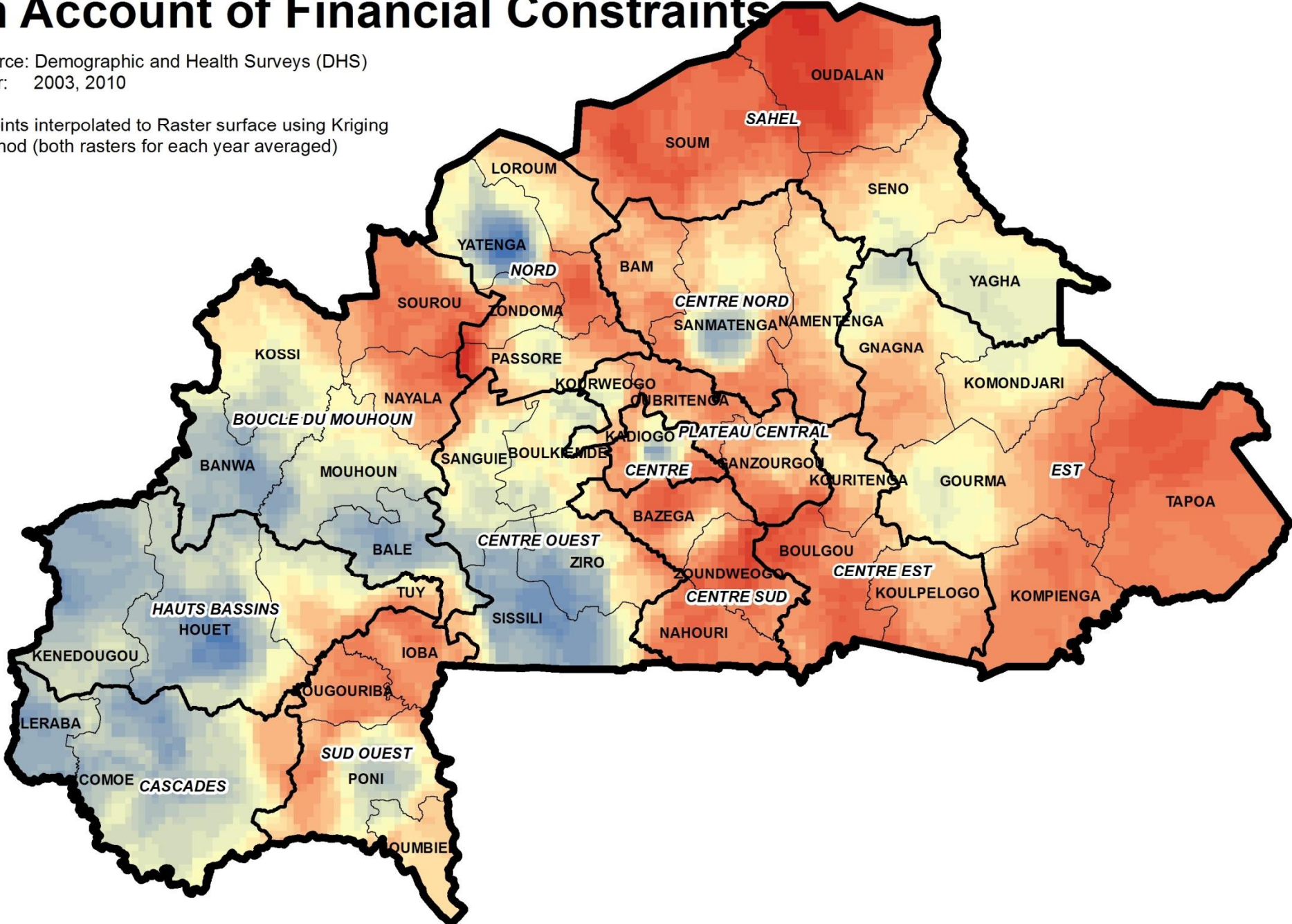
* Points interpolated to Raster surface using Kriging Method (both rasters for each year averaged)



Lack of Access to Health Services on Account of Financial Constraints

Source: Demographic and Health Surveys (DHS)
Year: 2003, 2010

* Points interpolated to Raster surface using Kriging Method (both rasters for each year averaged)

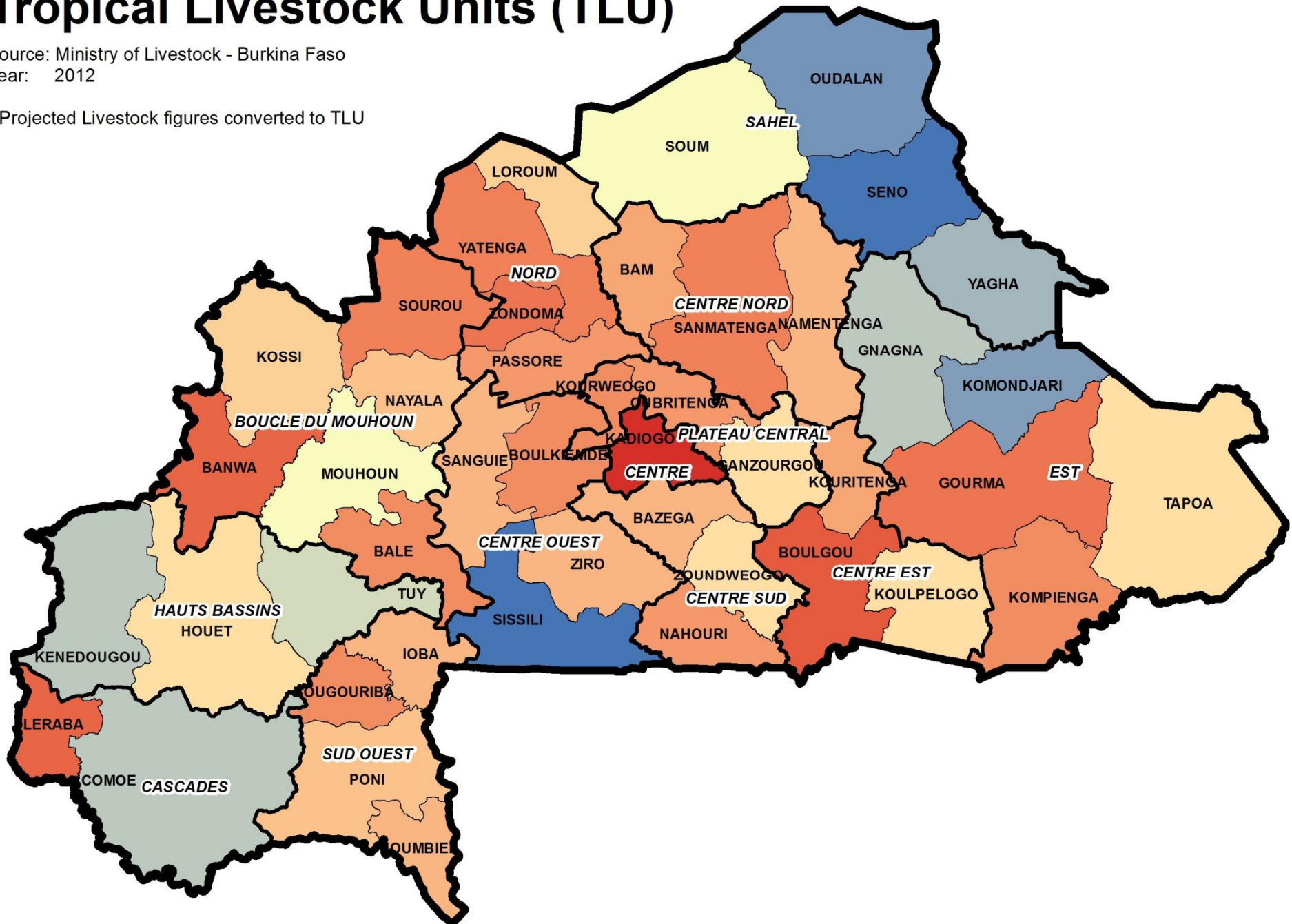


Tropical Livestock Units (TLU)

Source: Ministry of Livestock - Burkina Faso

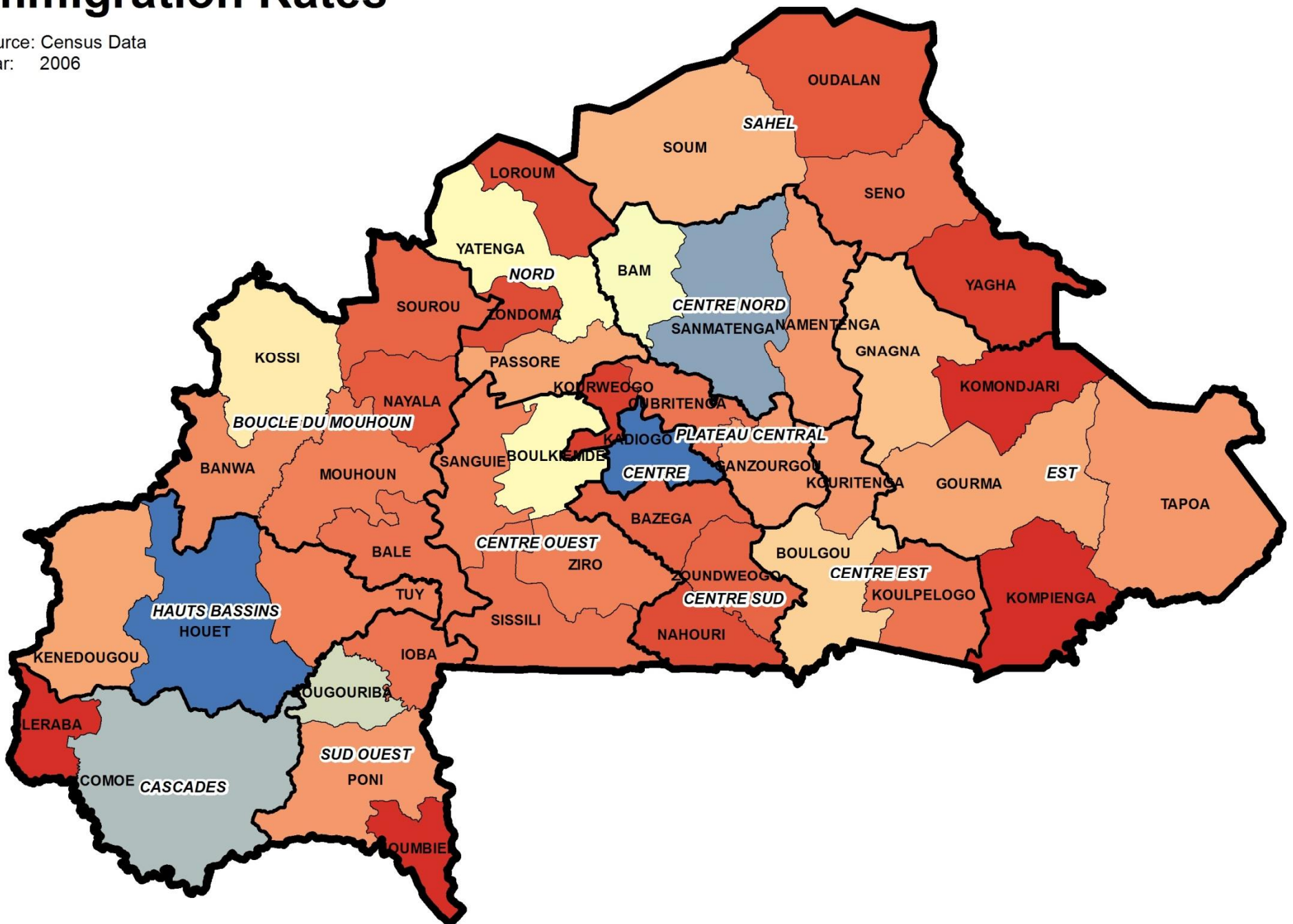
Year: 2012

* Projected Livestock figures converted to TLU



Immigration Rates

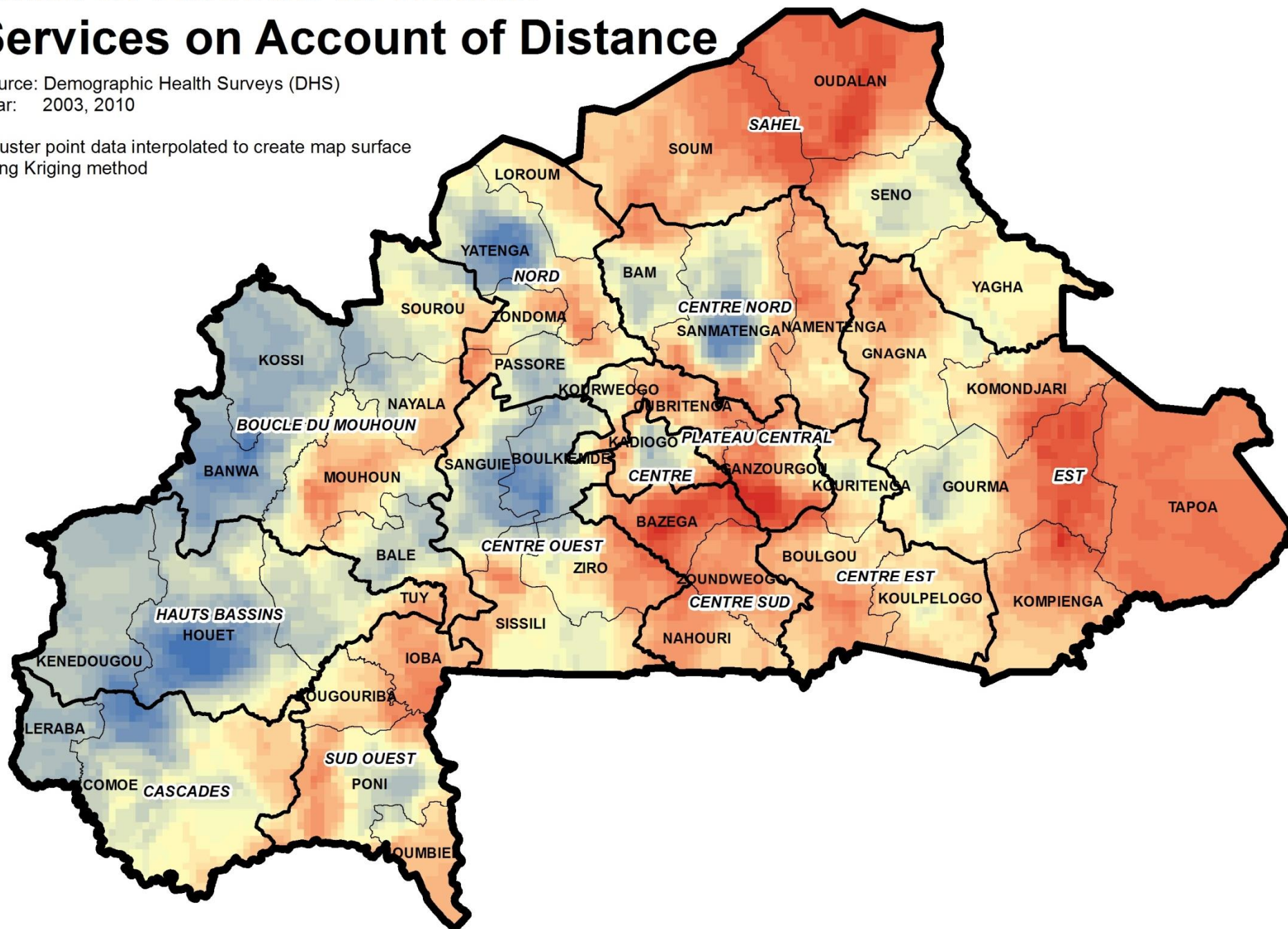
Source: Census Data
Year: 2006



Lack of Access to Health Services on Account of Distance

Source: Demographic Health Surveys (DHS)
Year: 2003, 2010

*Cluster point data interpolated to create map surface using Kriging method



Distance to Health Center

Source: Ministry of Health - Burkina Faso

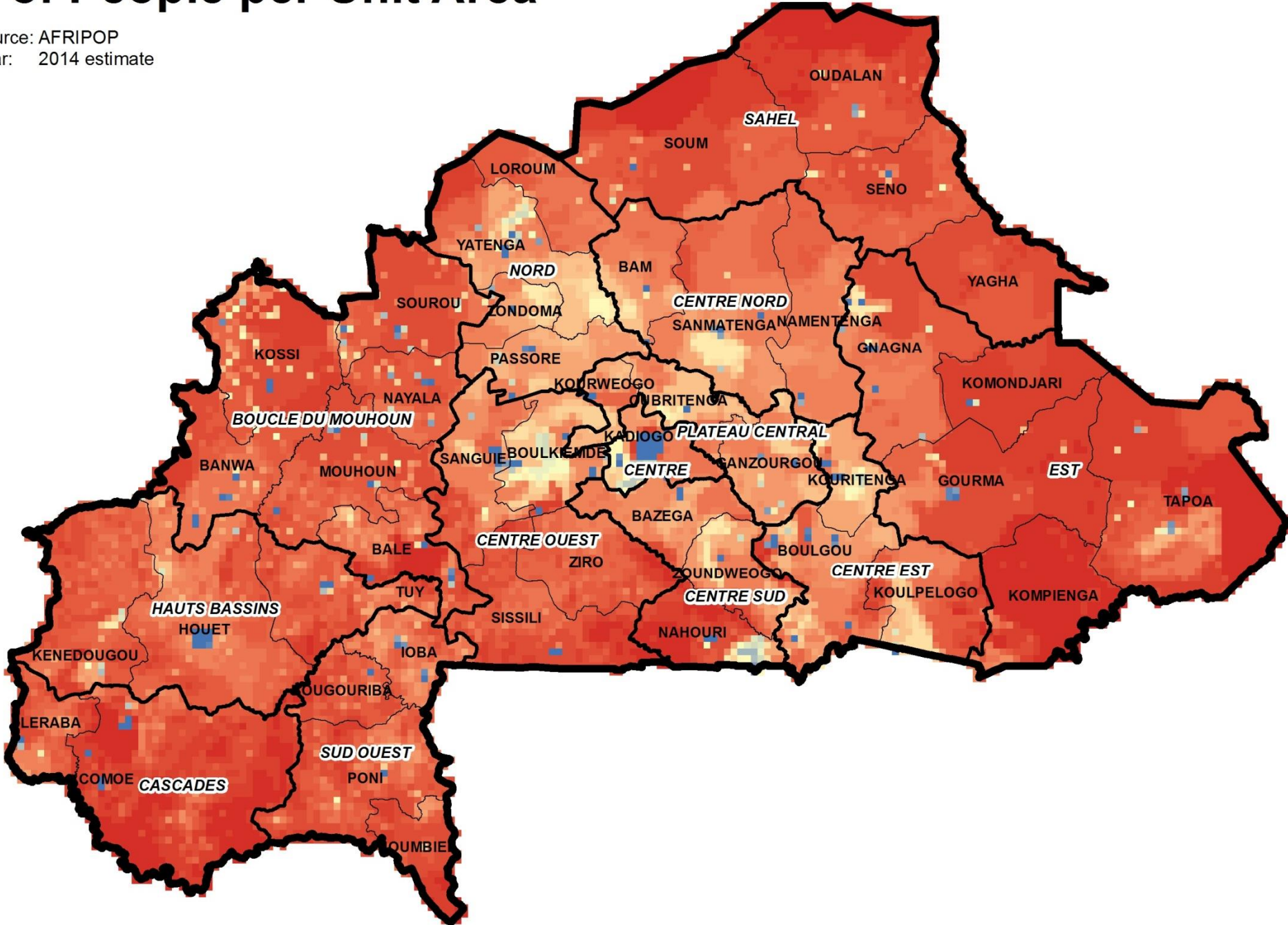
Year: 2013

*Percent of population >10 miles from nearest health center



of People per Unit Area

Source: AFRIPOP
Year: 2014 estimate

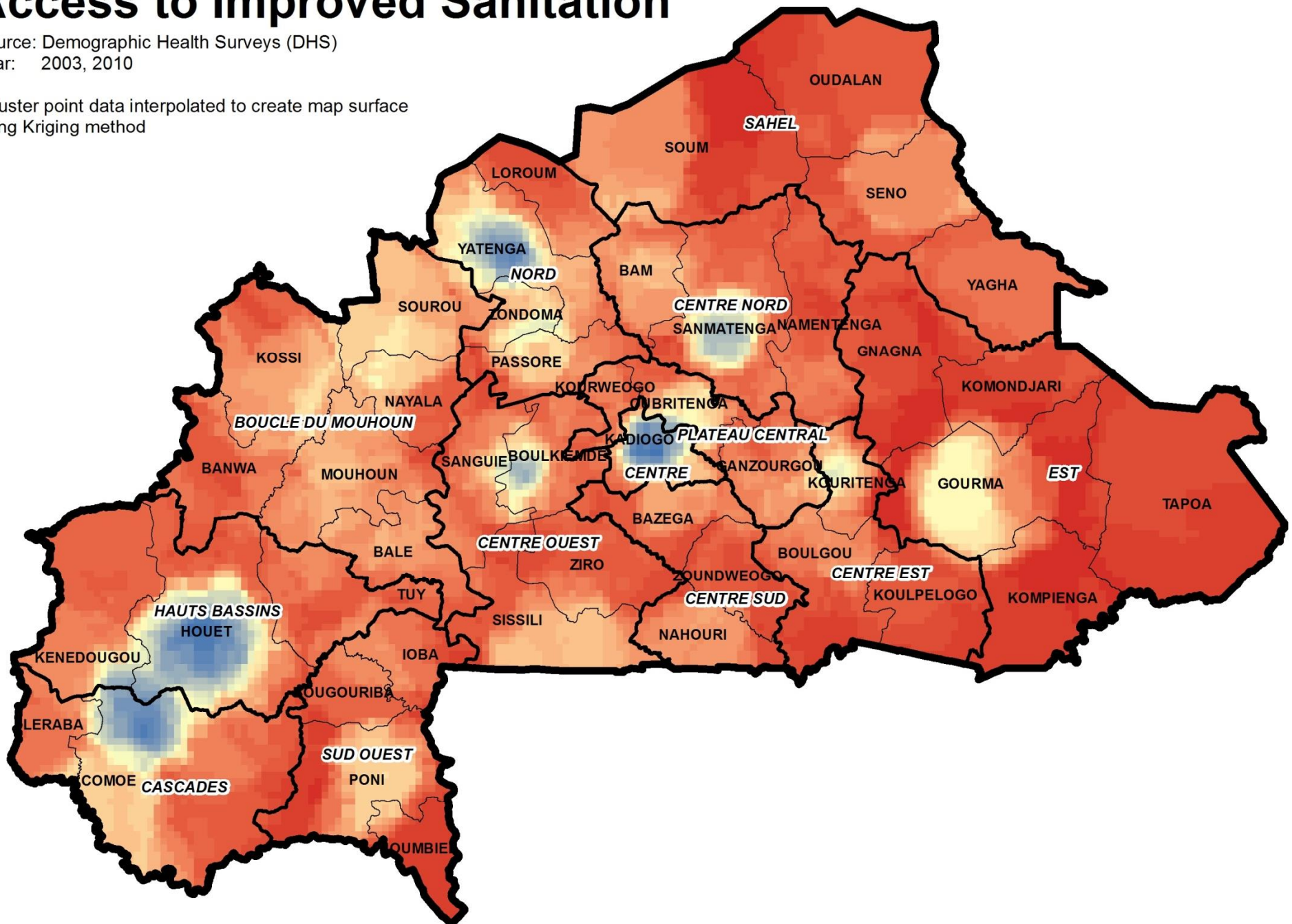


Access to Improved Sanitation

Source: Demographic Health Surveys (DHS)

Year: 2003, 2010

*Cluster point data interpolated to create map surface using Kriging method

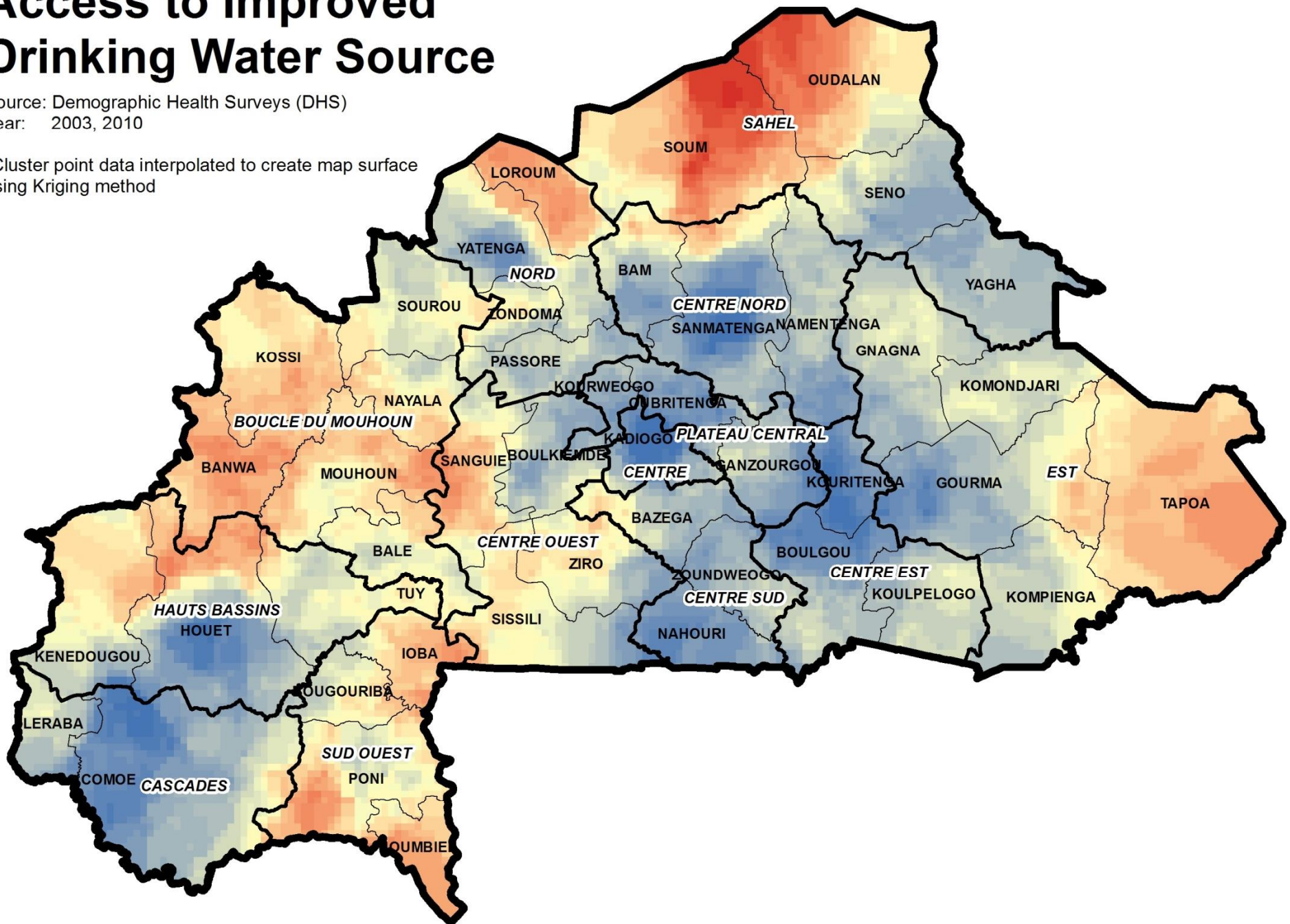


Access to Improved Drinking Water Source

Source: Demographic Health Surveys (DHS)

Year: 2003, 2010

*Cluster point data interpolated to create map surface using Kriging method

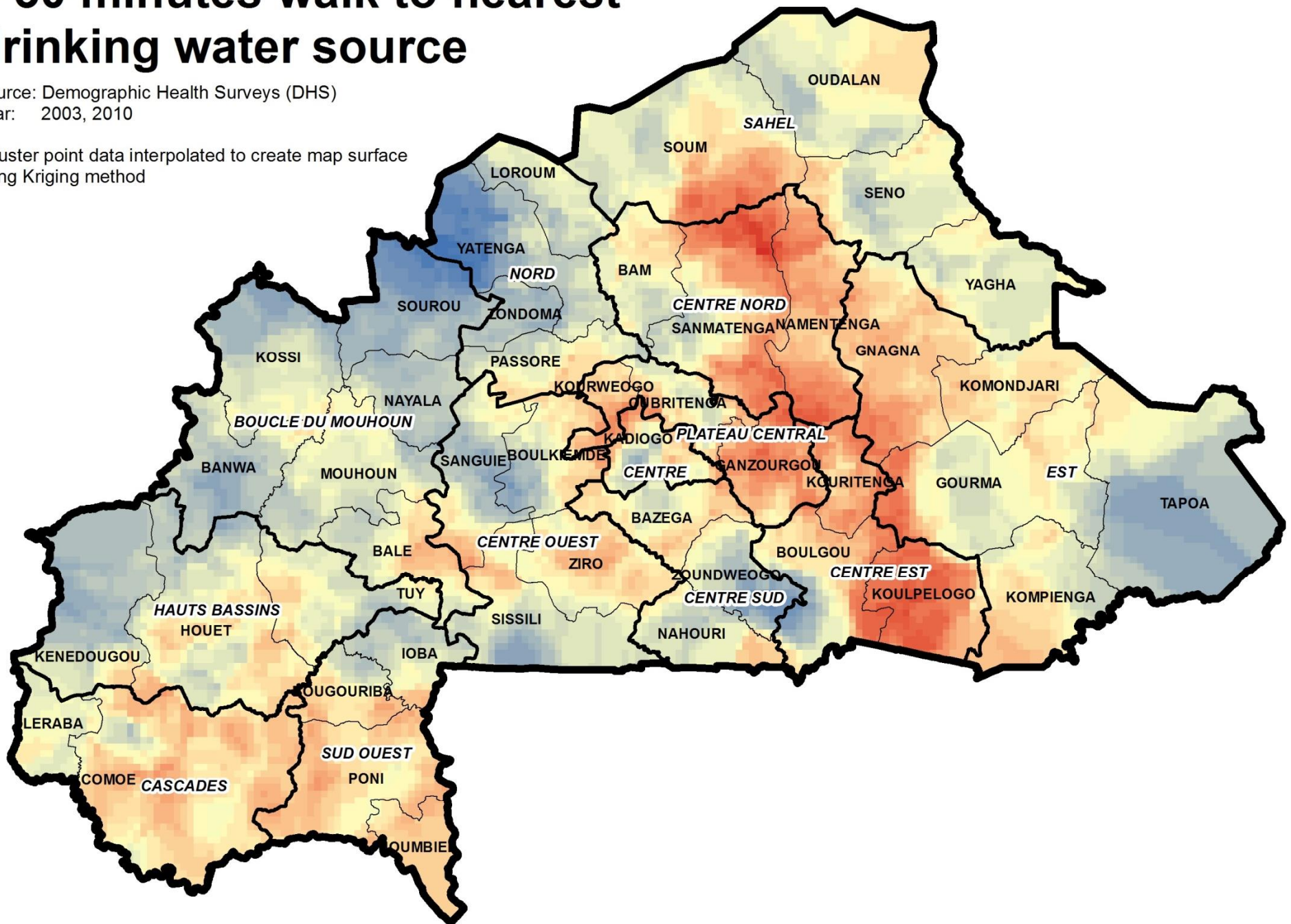


> 30 minutes walk to nearest drinking water source

Source: Demographic Health Surveys (DHS)

Year: 2003, 2010

*Cluster point data interpolated to create map surface using Kriging method



Exposure (Shocks & Stresses) datasets and related maps:

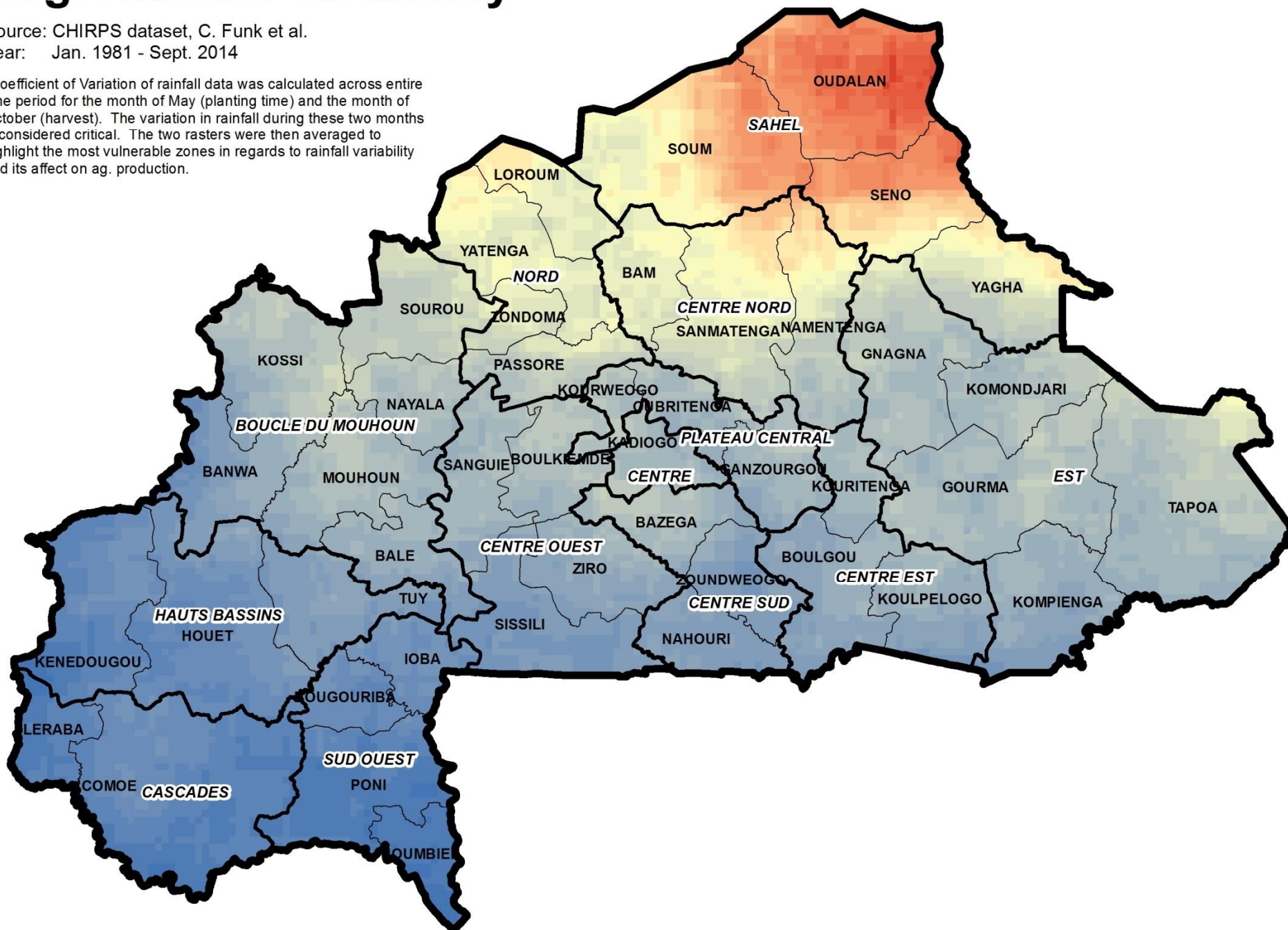
Average Rainfall Variability	CHIRPS dataset, C. Funk et al.	Jan. 1981 - Sept. 2014	Raster	Coefficient of Variation of rainfall data was calculated across entire time period for the month of May (planting time) and the month of October (harvest). The variation in rainfall during these two months is considered critical. The two rasters were then averaged to highlight the most vulnerable zones in regards to rainfall variability and its affect on ag. production.		29%	Recurrent Climate Shock	44%	Exposure (Shocks & Stresses)	21%	
Average Temperature during Rainy Season	University of East Anglia's Climatic Research Unit (UEA/CRU)	2000-2011 (JJAS- rainy season)	Raster	Average temperature during each rainy season (JJAS) over entire time period was averaged to get a general rainy season average temperature. Hotter average temperature during rainy season can be considered a proxy to plant stress at higher temperatures.		14%					
Average Length of Rainy Season	Famine Early Warning Systems Network (FEWSNET)	2001-2010	Raster	Zones with shorter rainy seasons are considered more vulnerable.		29%					
Average Total Annual Precipitation	CHIRPS dataset, C. Funk et al.	Jan. 1981 - Sept. 2014	Raster	Calculated over entire time period. Zones of lower average total precipitation are considered more vulnerable.		29%					
Historical Conflict	Armed Conflict Location & Event Data (ACLED) database	1/1/1997 to 7/16/2014	Point Data	# of incidents per location plus number of fatalities multiplied by two was used to generate a "conflict score" per point location. All types of conflict from database were included (ie. protests, armed groups, police, ethnic militias, etc.).		67%	Historic Sites of Conflict	11%			
Refugees	World Food Programme (WFP)	2014	Point Data	Total refugee count was used per location as a proxy to conflict because of population and resource pressures created by refugee presence.		33%					
Malaria Prevalence	Demographic and Health Surveys (DHS)	2010	Point Data	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)		100%	Health Shock	11%			
Average millet price during lean season	SIM/SONAGESS	2004-2014	Point Data	Point data represents all markets surveyed monthly for prices. Average market prices were calculated for all markets overtime during lean season. Lean season is when high prices have the biggest negative impact on household food security. Point data was interpolated to Raster using Kriging Method (both rasters for each year averaged). Relative weighting for each commodity was calculated proportionally to each commodities production level.		27%	Recurrent Price Shocks	33%			
Average yellow corn price during lean season	SIM/SONAGESS	2004-2014	Point Data	SAME METHODOLOGY NOTES FOR ALL PRICE DATA IN COMPOSITE (SEE NOTES FOR MILLET PRICES)	50%	Corn Prices					29%
Average white corn price during lean season	SIM/SONAGESS	2004-2014	Point Data	SAME METHODOLOGY NOTES FOR ALL PRICE DATA IN COMPOSITE (SEE NOTES FOR MILLET PRICES)	50%						
Average white sorghum price during lean season	SIM/SONAGESS	2004-2014	Point Data	SAME METHODOLOGY NOTES FOR ALL PRICE DATA IN COMPOSITE (SEE NOTES FOR MILLET PRICES)		33%					
Average red sorghum price during lean season	SIM/SONAGESS	2004-2014	Point Data	SAME METHODOLOGY NOTES FOR ALL PRICE DATA IN COMPOSITE (SEE NOTES FOR MILLET PRICES)		11%					

Avg. Rainfall Variability

Source: CHIRPS dataset, C. Funk et al.

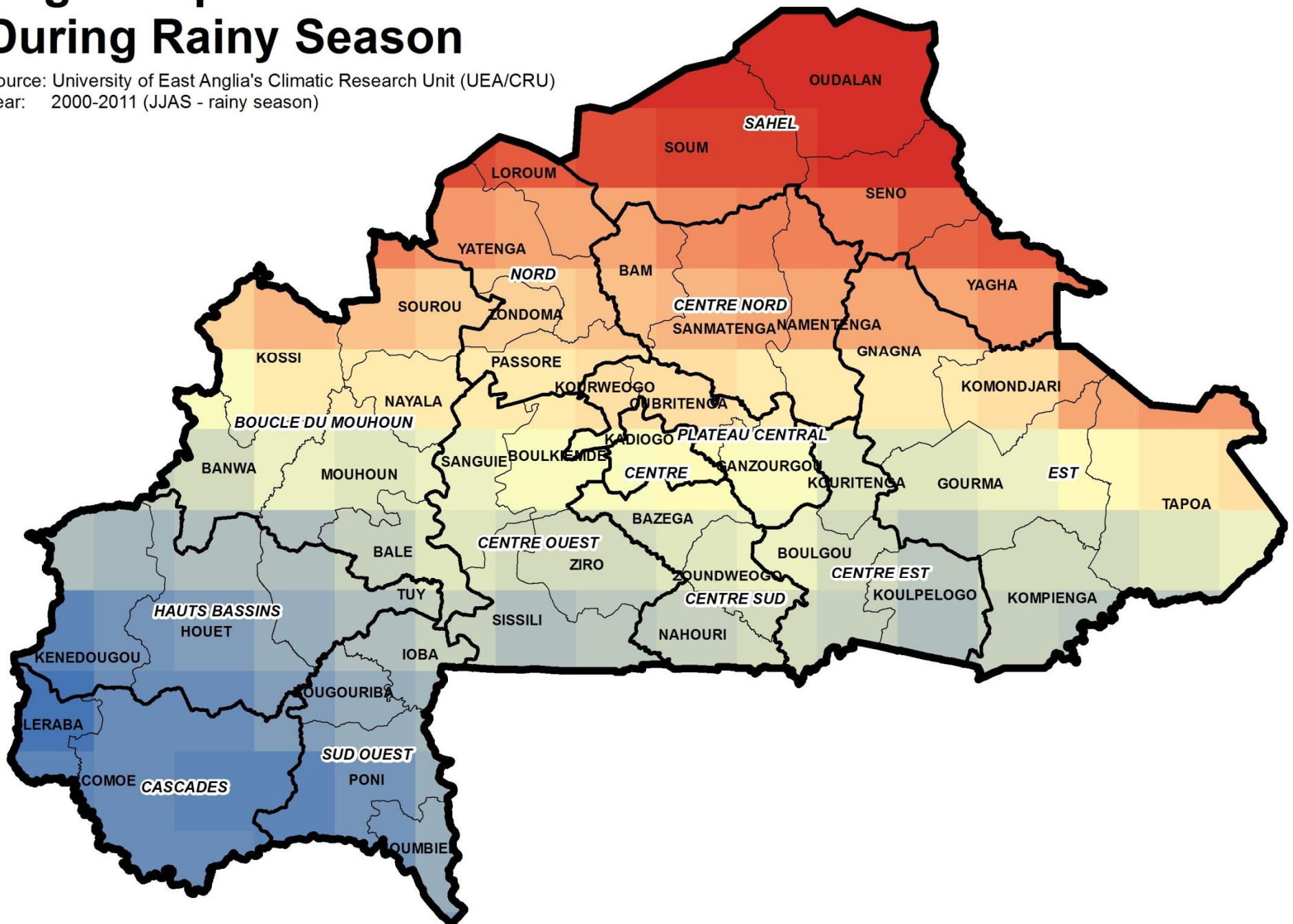
Year: Jan. 1981 - Sept. 2014

*Coefficient of Variation of rainfall data was calculated across entire time period for the month of May (planting time) and the month of October (harvest). The variation in rainfall during these two months is considered critical. The two rasters were then averaged to highlight the most vulnerable zones in regards to rainfall variability and its affect on ag. production.



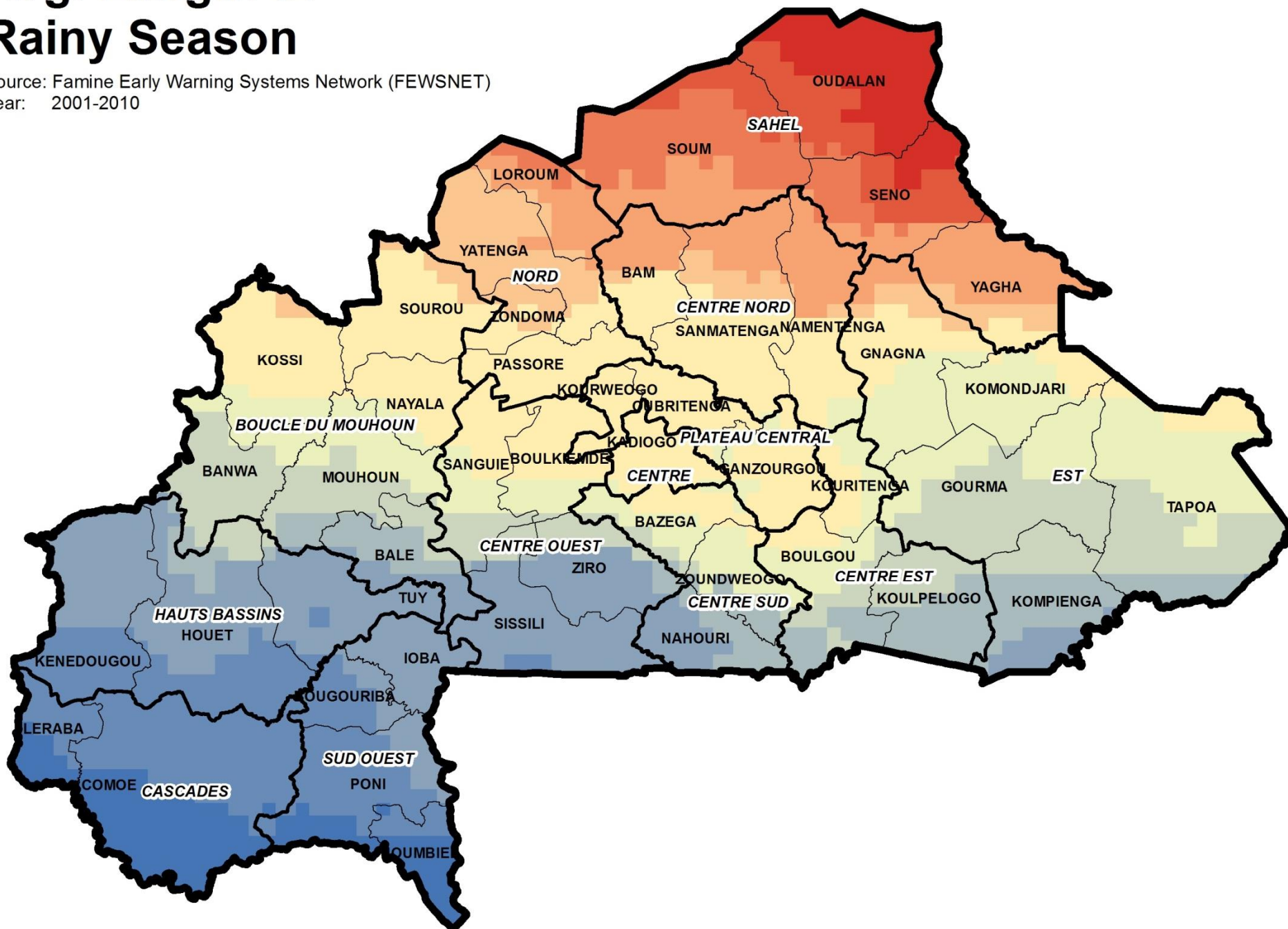
Avg. Temperature During Rainy Season

Source: University of East Anglia's Climatic Research Unit (UEA/CRU)
Year: 2000-2011 (JJAS - rainy season)



Avg. Length of Rainy Season

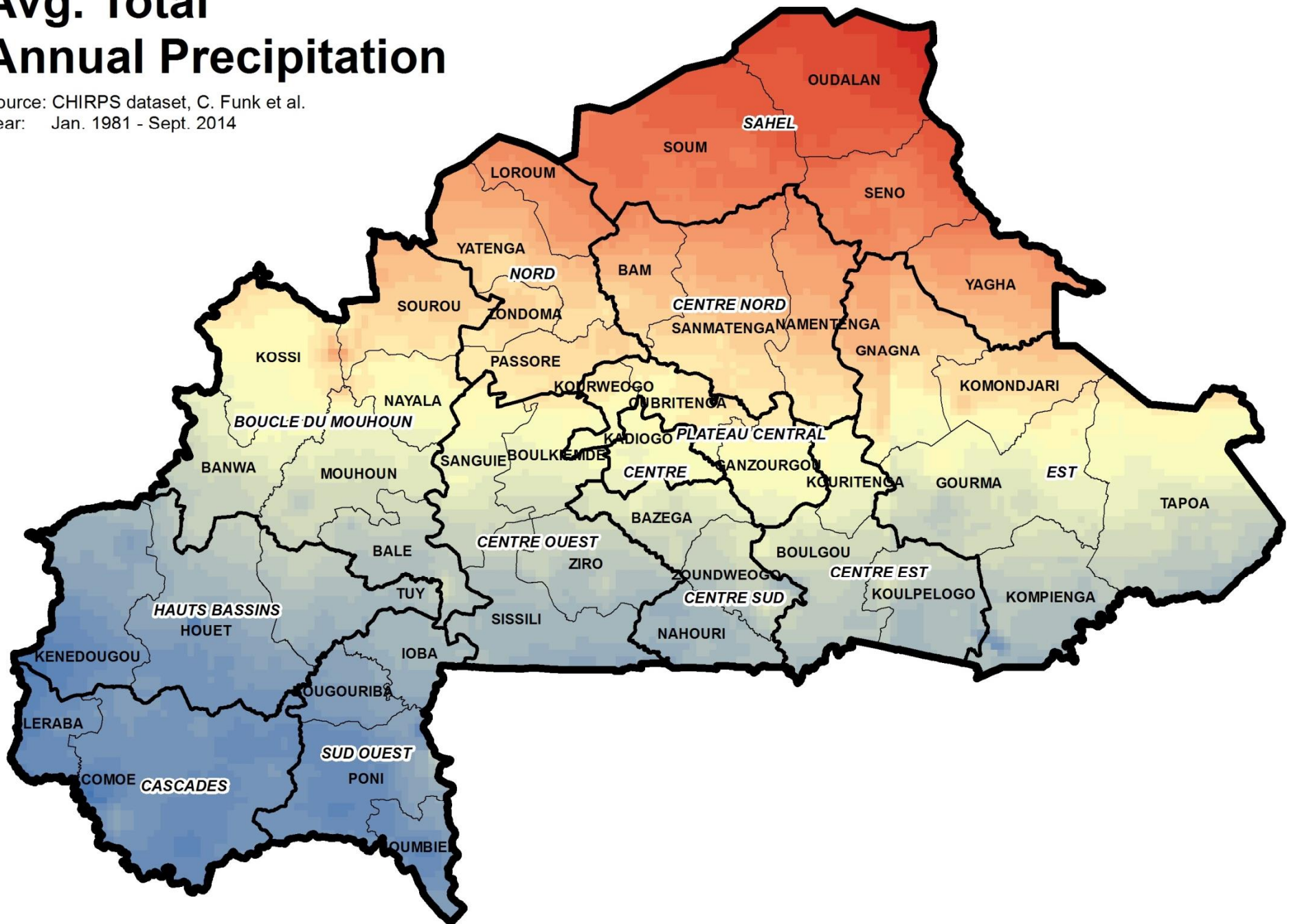
Source: Famine Early Warning Systems Network (FEWSNET)
Year: 2001-2010



Avg. Total Annual Precipitation

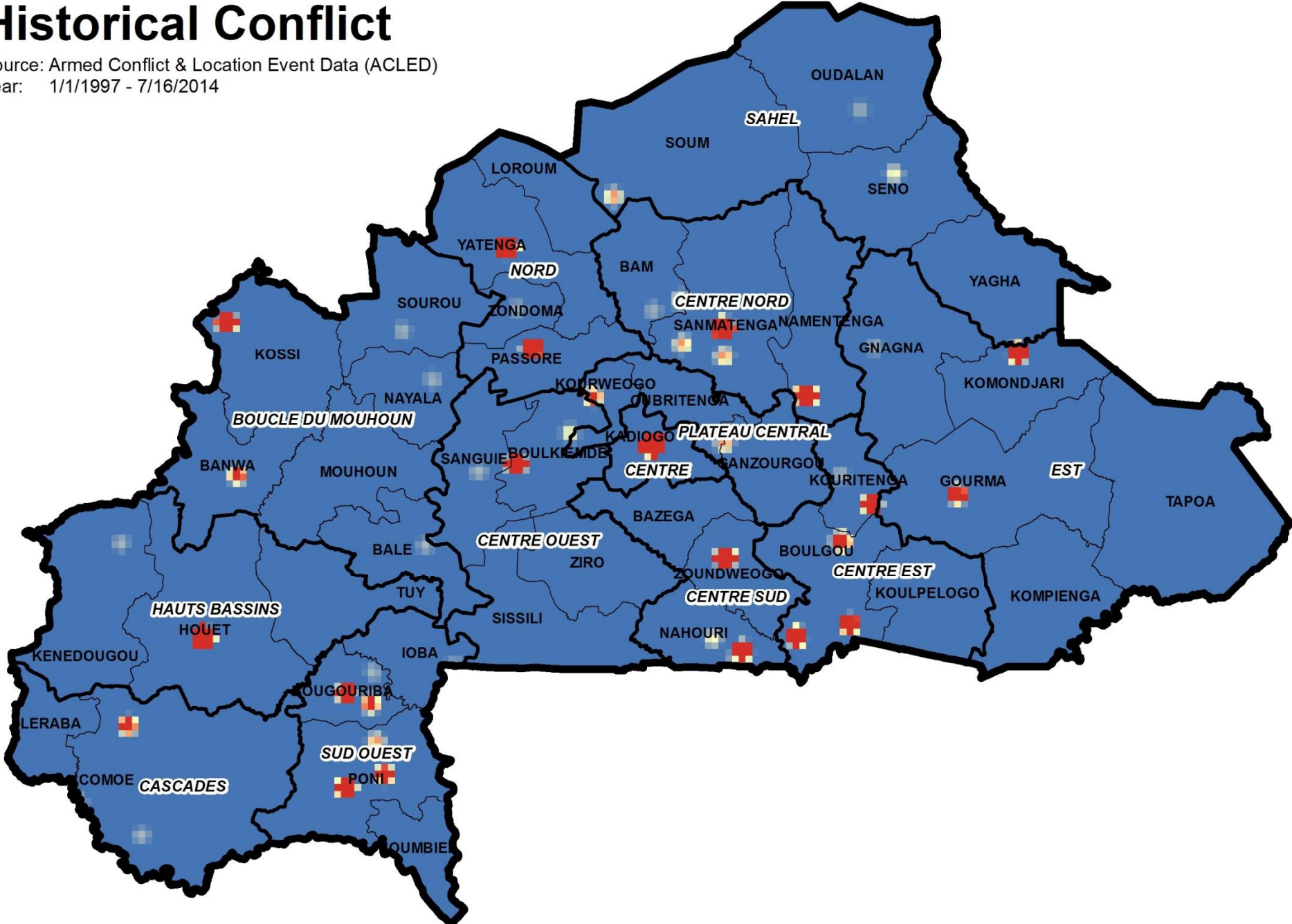
Source: CHIRPS dataset, C. Funk et al.

Year: Jan. 1981 - Sept. 2014



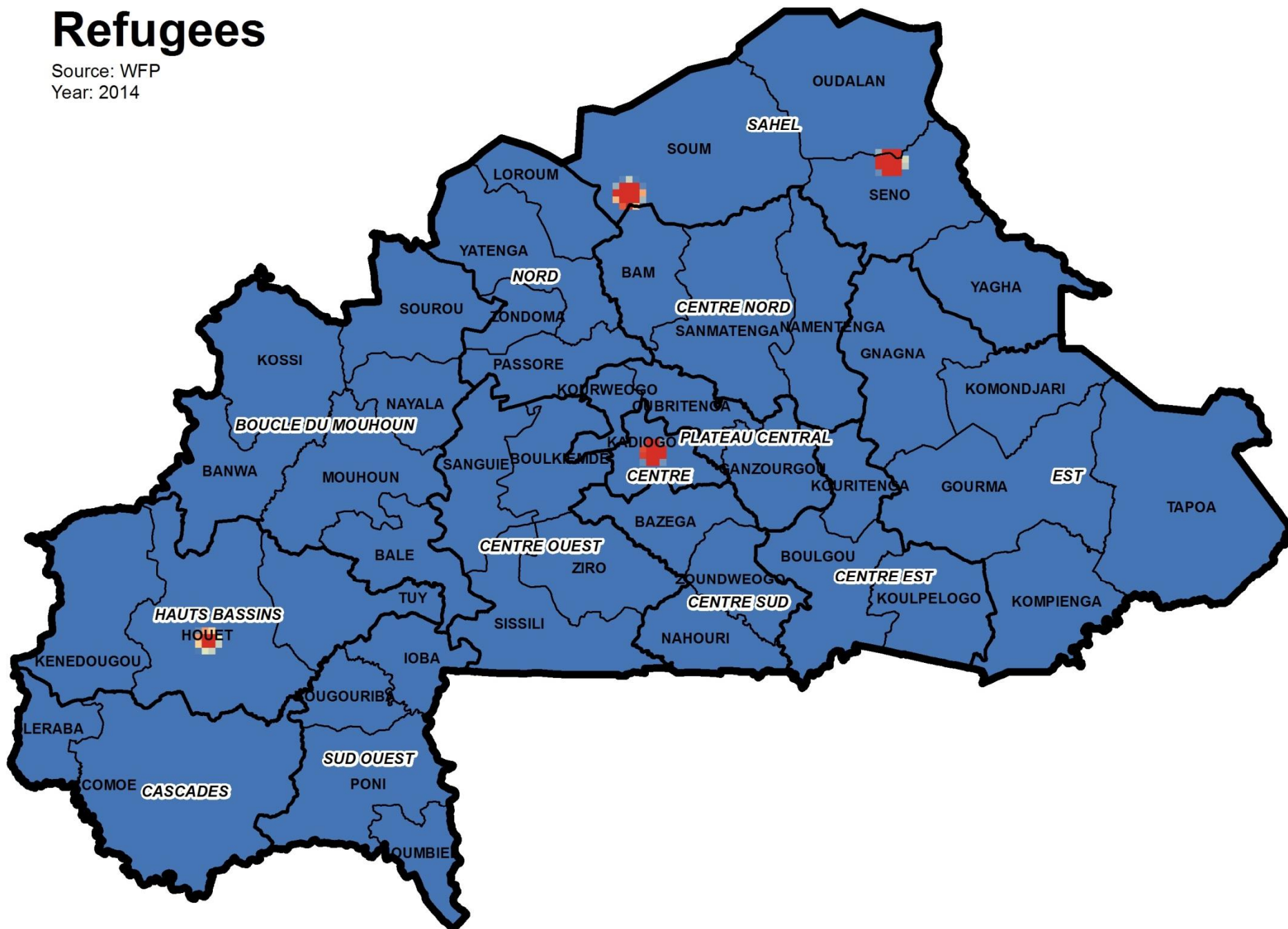
Historical Conflict

Source: Armed Conflict & Location Event Data (ACLED)
Year: 1/1/1997 - 7/16/2014



Refugees

Source: WFP
Year: 2014

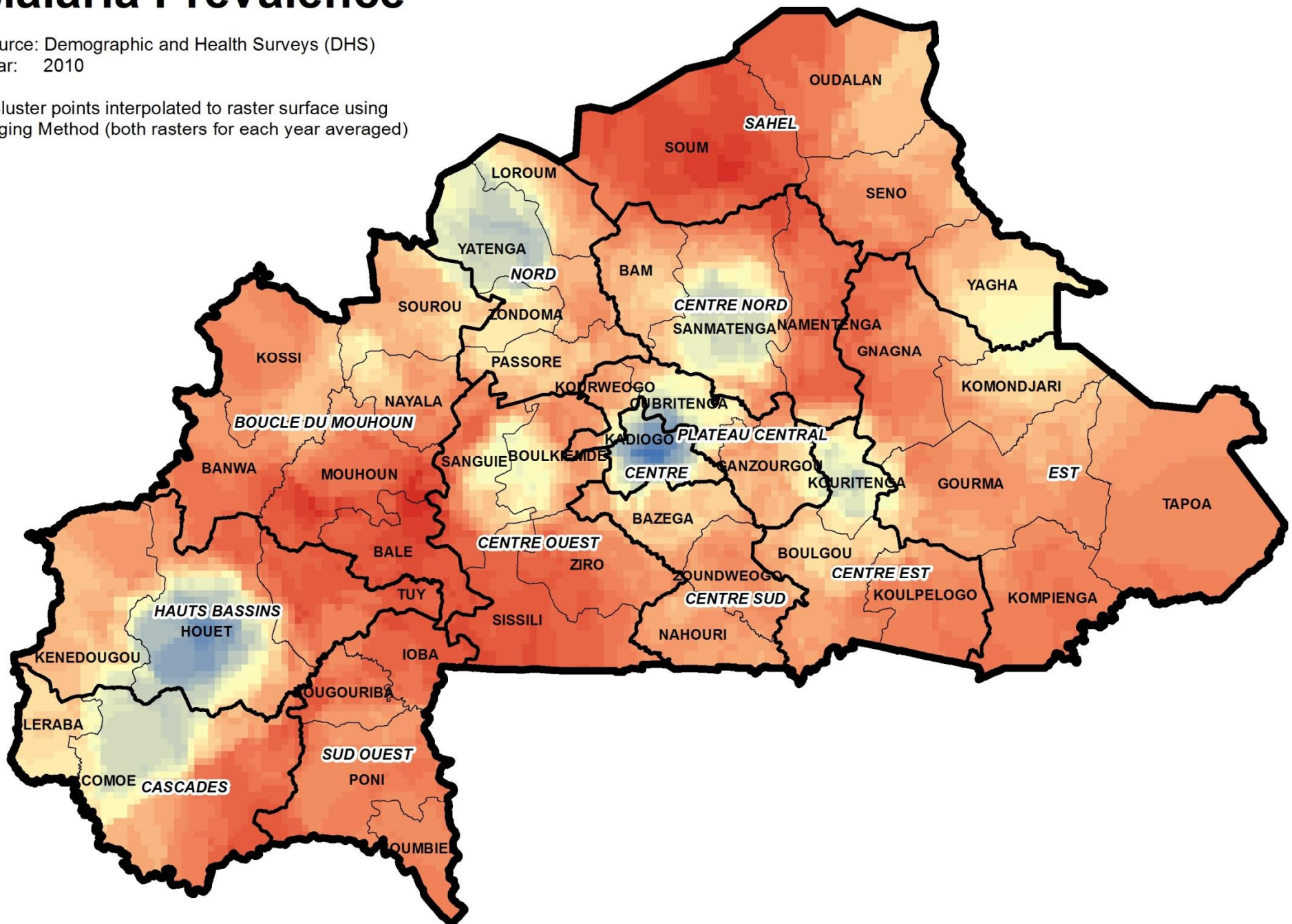


Malaria Prevalence

Source: Demographic and Health Surveys (DHS)

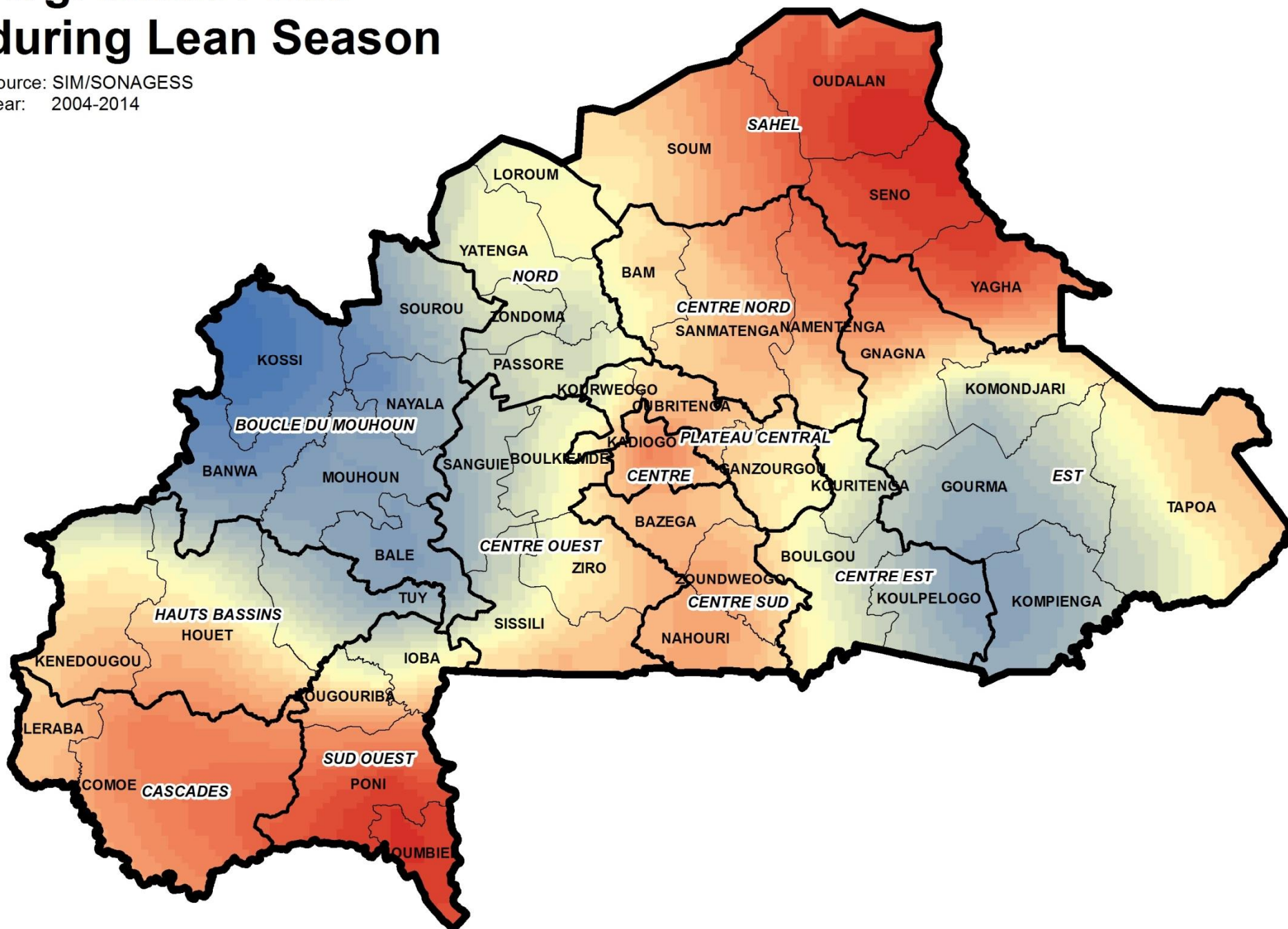
Year: 2010

* Cluster points interpolated to raster surface using Kriging Method (both rasters for each year averaged)



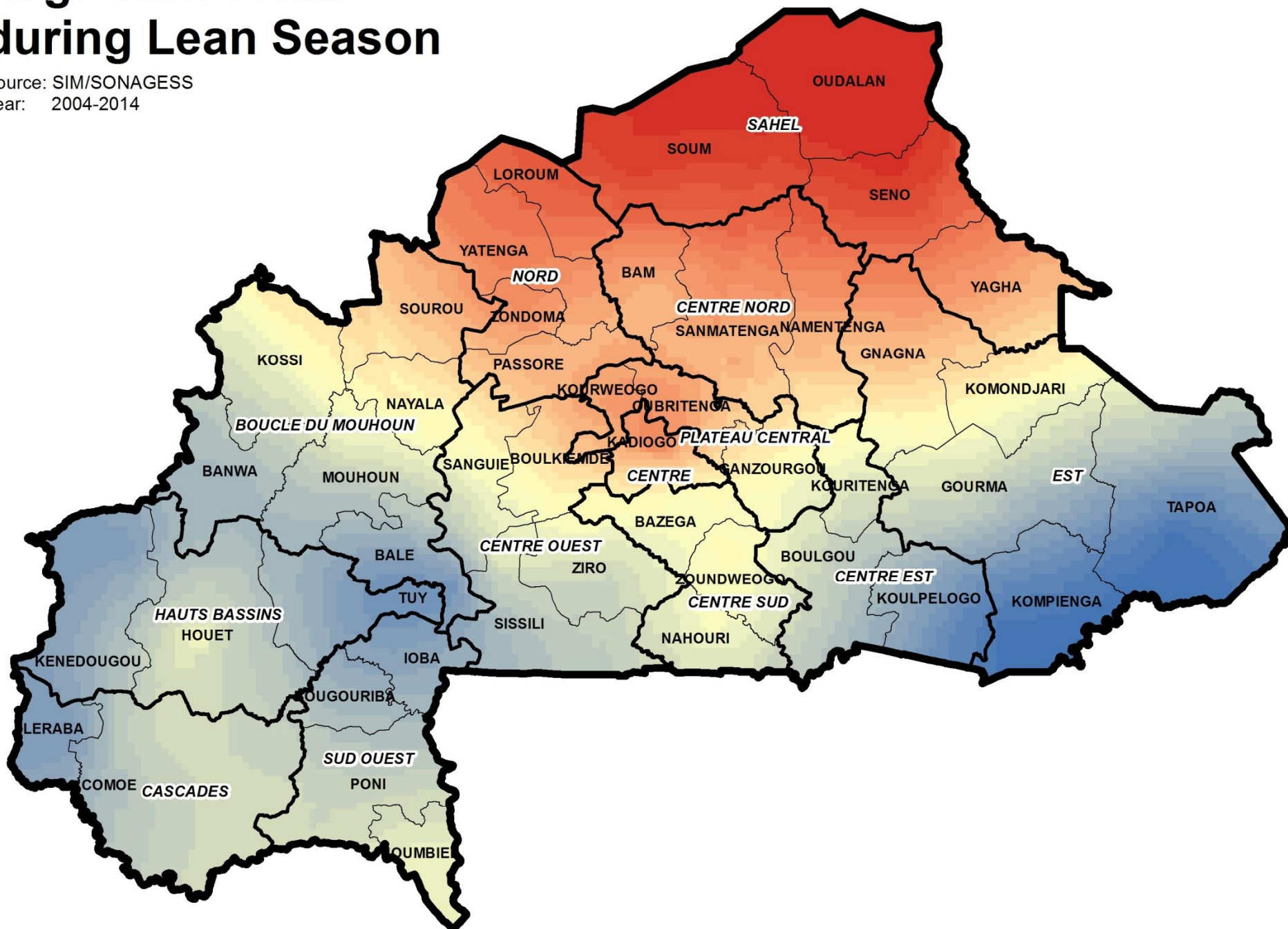
Avg. Millet Price during Lean Season

Source: SIM/SONAGESS
Year: 2004-2014



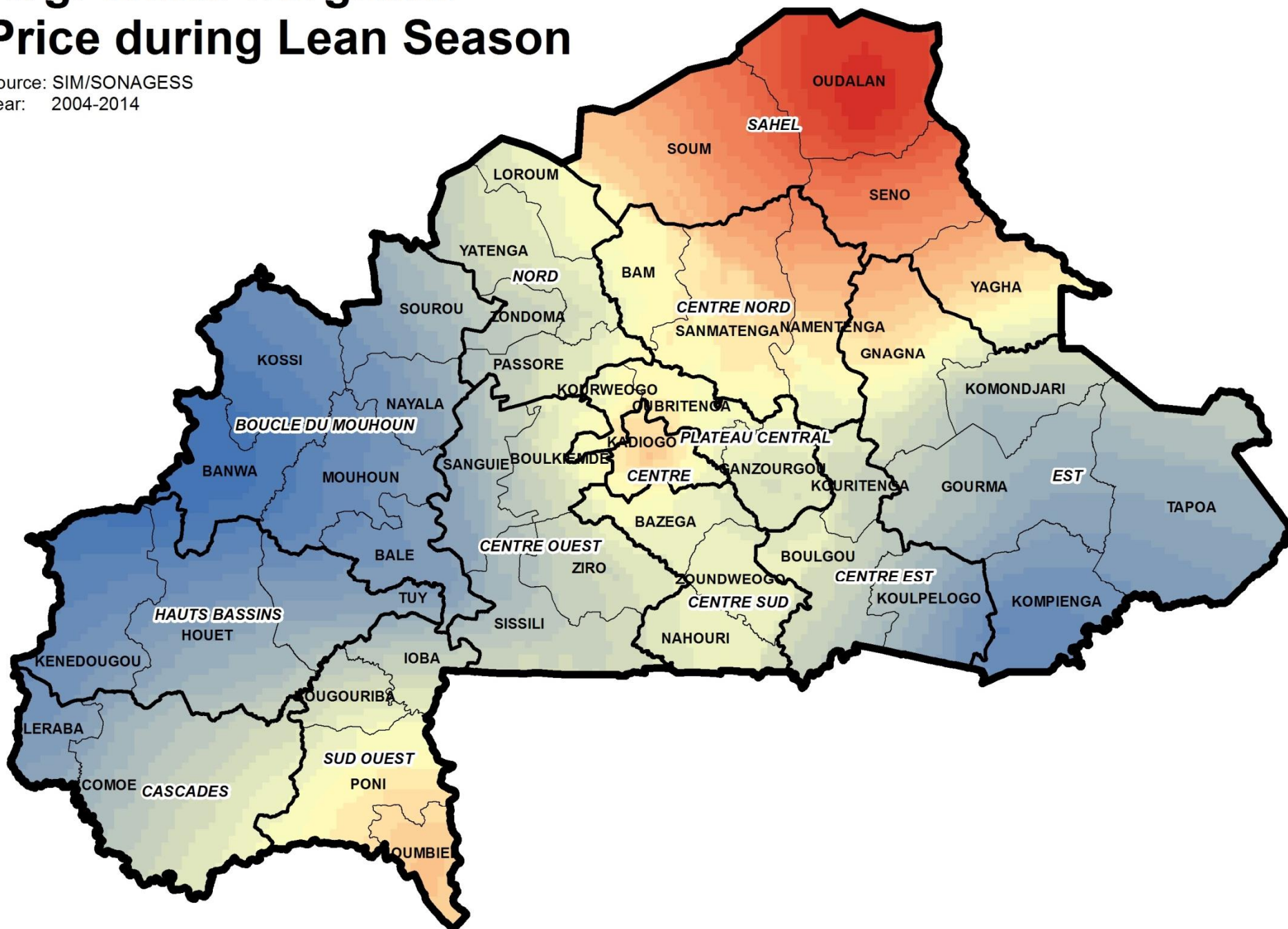
Avg. Corn Price during Lean Season

Source: SIM/SONAGESS
Year: 2004-2014



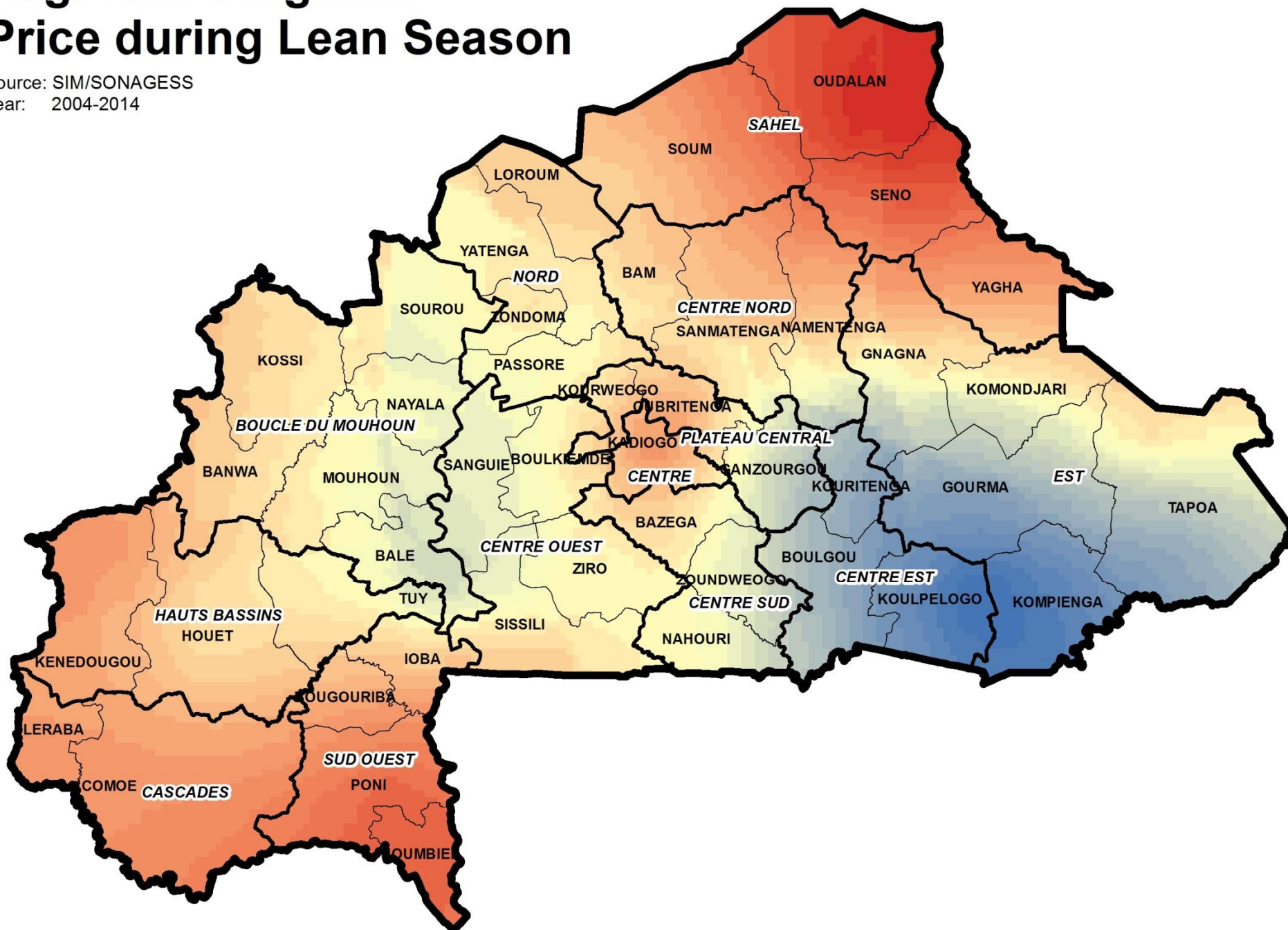
Avg. White Sorghum Price during Lean Season

Source: SIM/SONAGESS
Year: 2004-2014



Avg. Red Sorghum Price during Lean Season

Source: SIM/SONAGESS
Year: 2004-2014



Well-Being Outcomes datasets and related maps:

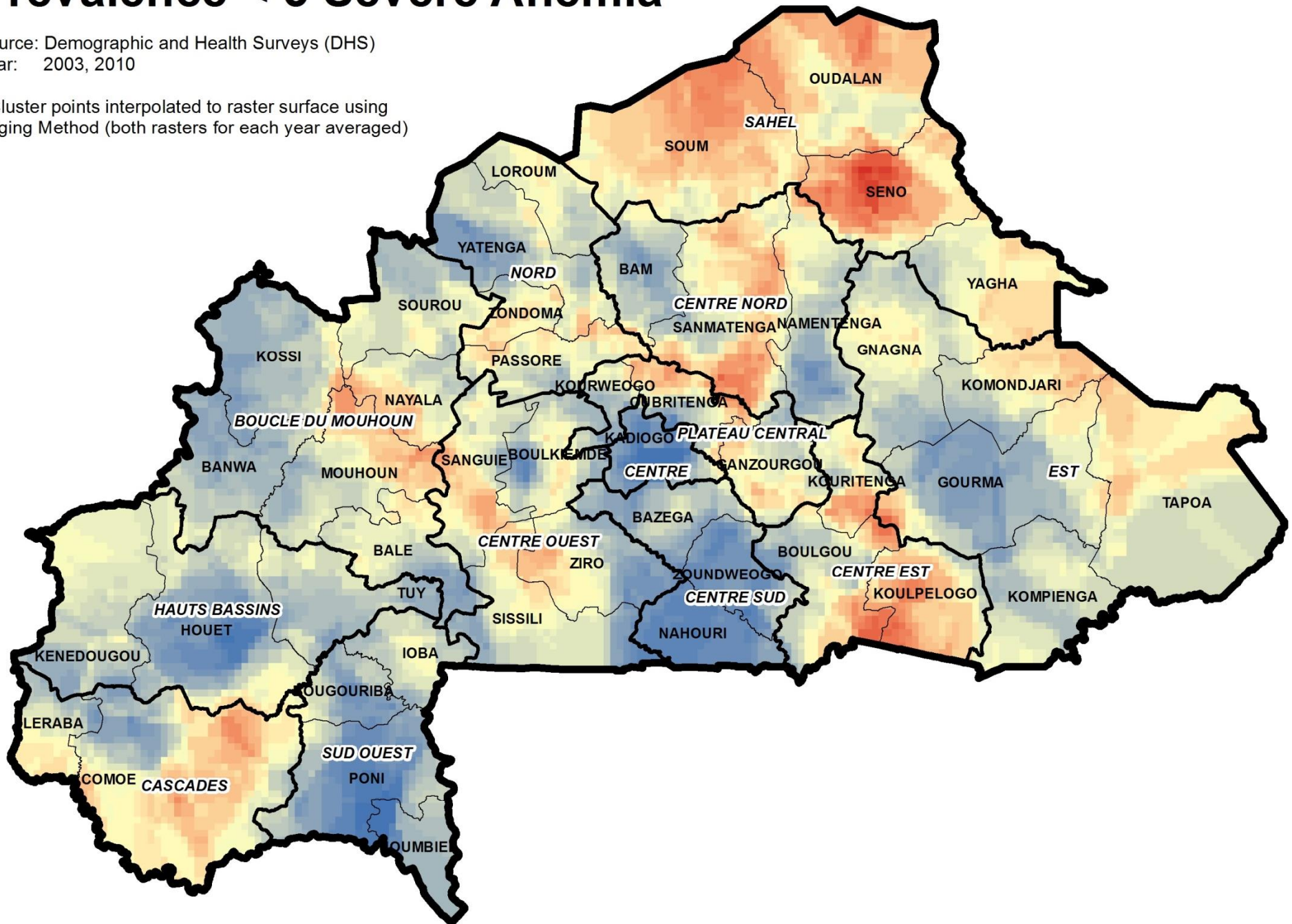
Prevalence < 5 Severe Anemia	Demographic and Health Surveys (DHS)	2003, 2010	Cluster Points	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)			67%	Anemia Prevalence	20%	Well-Being Outcome	30%
Anemia Prevalence (Women)	Demographic and Health Surveys (DHS)	2003, 2010	Cluster Points	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)			33%				
Average GAM Rates (SMART)	Standardized Monitoring and Assessment of Relief and Transitions (SMART)	2009-2013	Region	Each region was polled by SMART every other year, all information was averaged together	50%	Average GAM Rates	67%	Undernutrition	80%		
Average GAM Rates (DHS)	Demographic and Health Surveys (DHS)	2003, 2010	Cluster Points	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)	50%						
Average Stunting Rates (SMART)	Standardized Monitoring and Assessment of Relief and Transitions (SMART)	2009-2013	Region	Each region was polled every other year, all information was averaged together	50%	Average Stunting Rates	33%				
Average Stunting Rates (DHS)	Demographic and Health Surveys (DHS)	2003, 2010	Cluster Points	Points interpolated to Raster using Kriging Method (both rasters for each year averaged)	50%						

Prevalence < 5 Severe Anemia

Source: Demographic and Health Surveys (DHS)

Year: 2003, 2010

* Cluster points interpolated to raster surface using Kriging Method (both rasters for each year averaged)

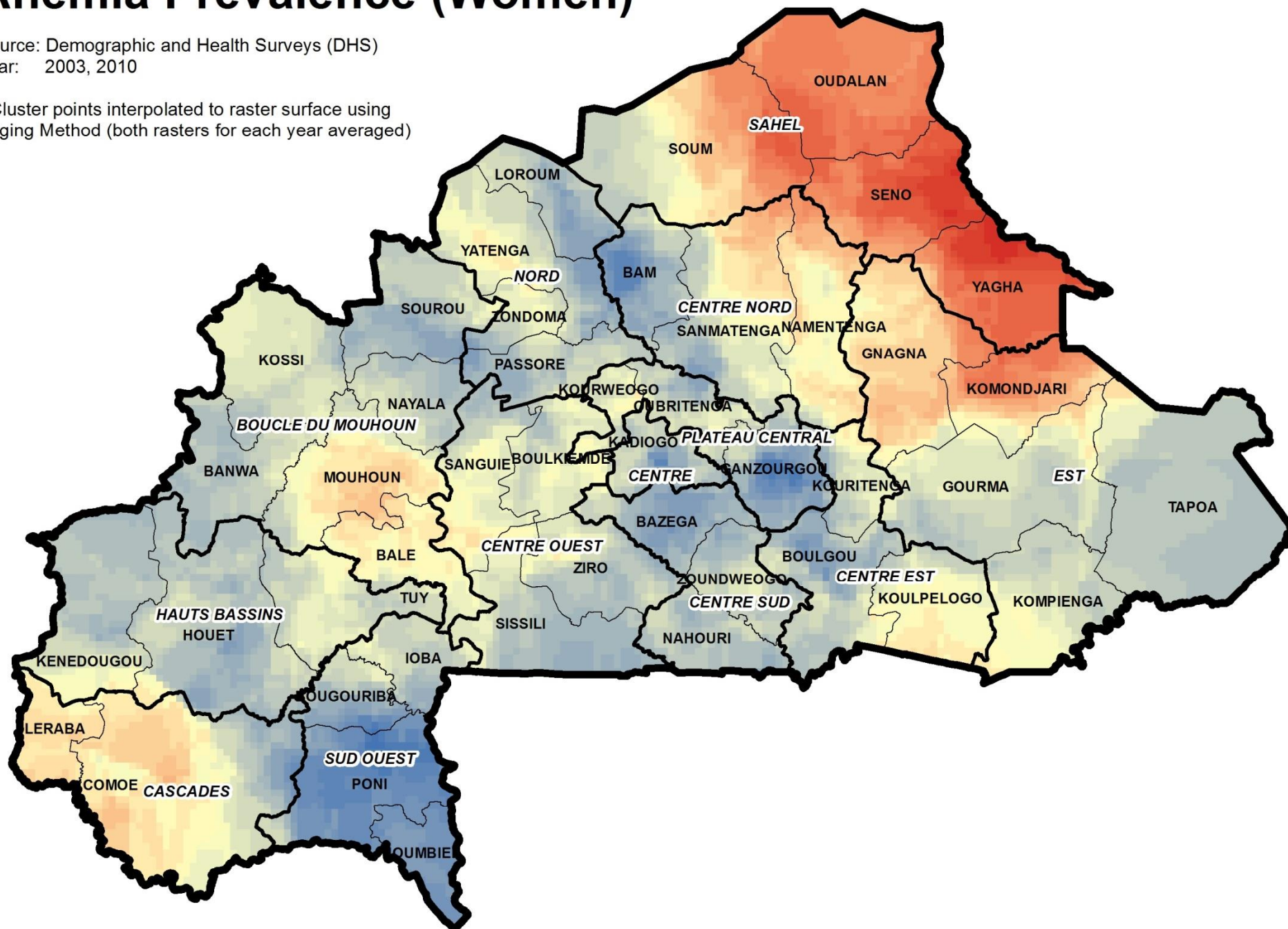


Anemia Prevalence (Women)

Source: Demographic and Health Surveys (DHS)

Year: 2003, 2010

* Cluster points interpolated to raster surface using Kriging Method (both rasters for each year averaged)



Average GAM Rates (SMART)

Source: SMART Surveys
Year: 2009 - 2013

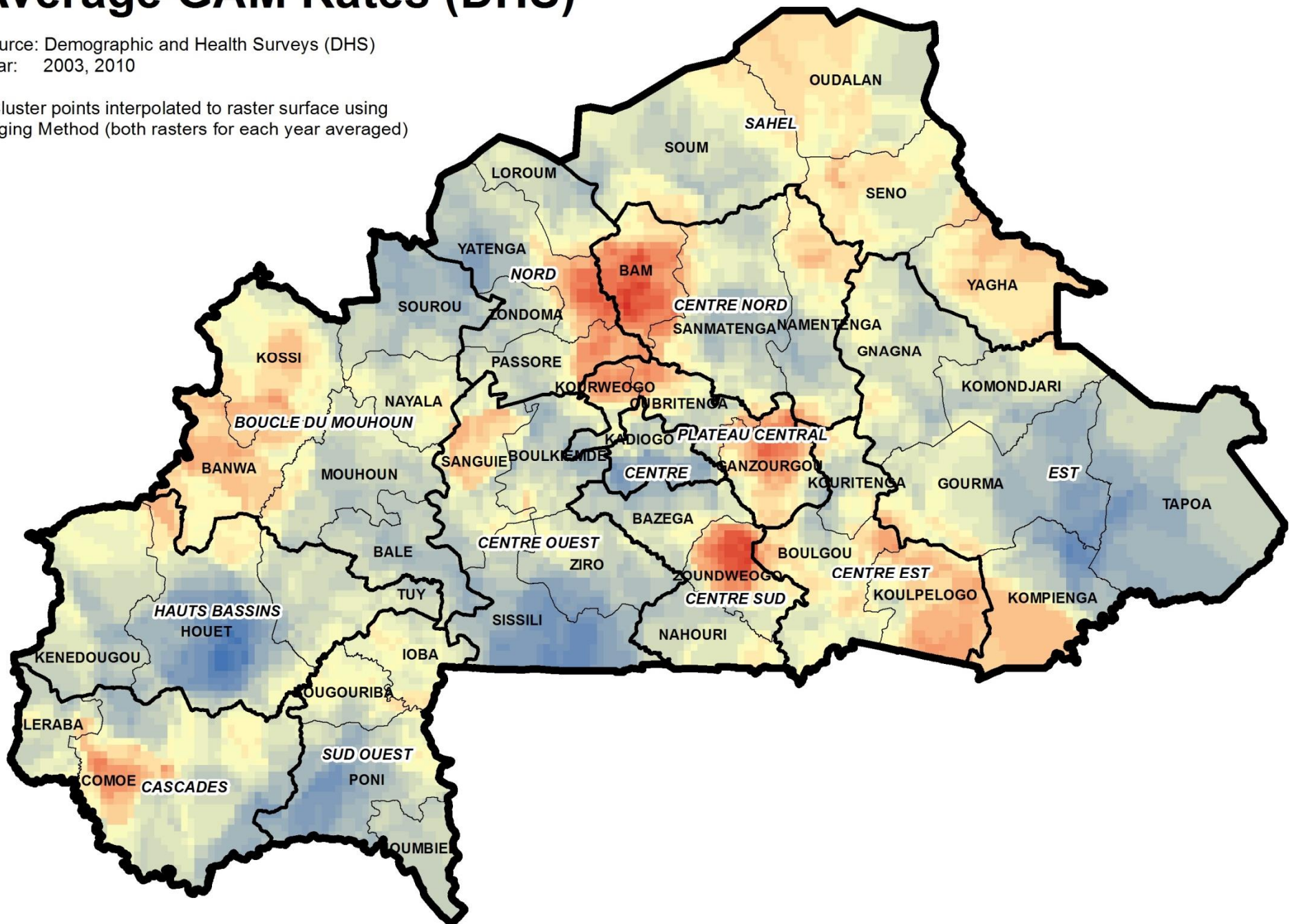


Average GAM Rates (DHS)

Source: Demographic and Health Surveys (DHS)

Year: 2003, 2010

* Cluster points interpolated to raster surface using Kriging Method (both rasters for each year averaged)



Average Stunting Rates (SMART)

Source: SMART Surveys
Year: 2009 -2013



Average Stunting Rates (DHS)

Source: Demographic and Health Surveys (DHS)

Year: 2003, 2010

* Cluster points interpolated to raster surface using Kriging Method (both rasters for each year averaged)

