Site selection for the Africa RISING project in Northern Ghana

Produced by: Zhe Guo and Carlo Azzarri, International Food Policy Research Institute (IFPRI)

Published by: International Food Policy Research Institute (IFPRI)

January 2013

www.africa-rising.net

The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.

This document was made possible with support from the American people delivered through the United States Agency for International Development (USAID) as part of the US Government's Feed the Future Initiative. The contents are the responsibility of the producing organization and do not necessarily reflect the opinion of USAID or the U.S. Government.

Contents

Introduction

The Africa RISING program of the USAID-Feed the Future initiative proposes to initiate and test interventions to enable Sustainable Intensification (SI) of agriculture in three major regions of Africa by working in three “mega-sites” which exemplify the main climatic and human characteristics of these regions.

Some districts in Northern Ghana and Southern Mali are the target areas in the West Africa mega-site. This report provides the site selection analysis for the districts and communities in Northern Ghana, while the site selection in Southern Mali is managed by the ICRISAT-Mali office.

Nadowli, Wa, and Wa west from upper west region; Bawku West, Kassena Nankana, Bongo, and Talensi Nabdam from upper east region; Savelugu Nanton, Tolon-Kumbungu, Yendi, and Tamale from the northern region have been selected as focused areas in the country. The districts are highlighted in Figure 1. Collaborators on the ground chose communities within each district, also illustrated in the map. The full list of the 52 proposed sites/communities is shown in Table 1 with district names, community names and their associated location.

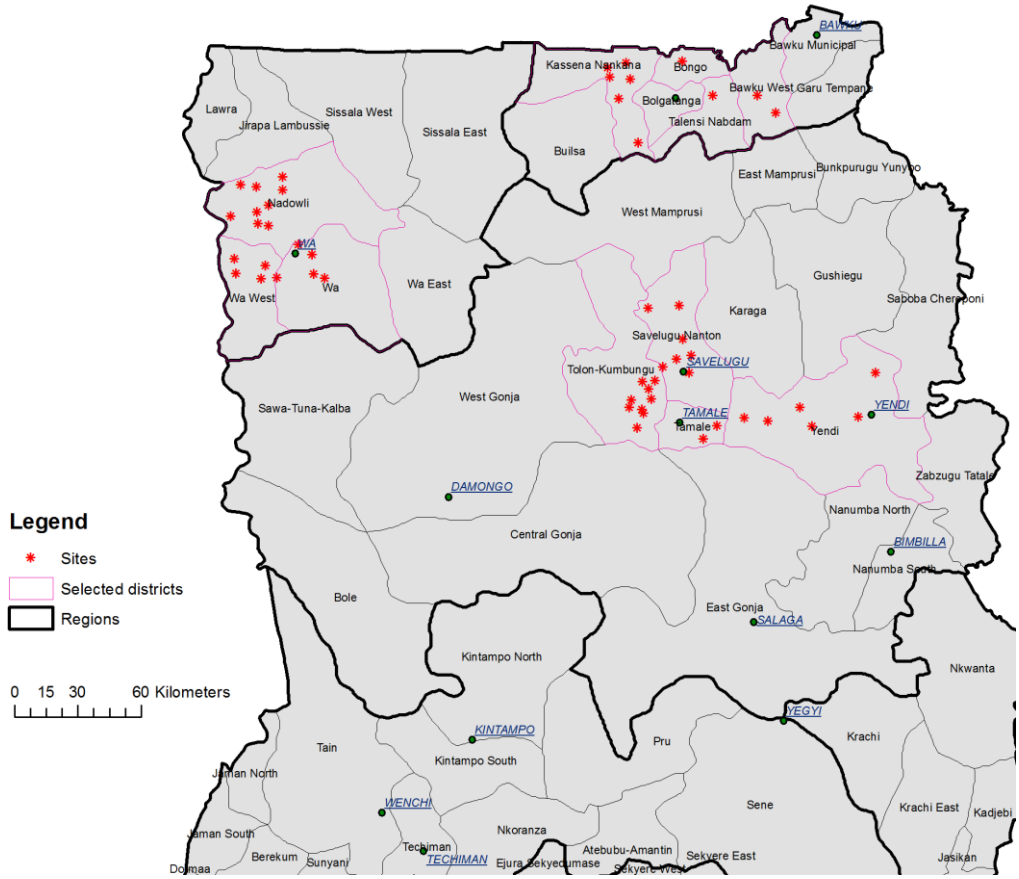

Figure 1. Focused districts and proposed sites in Northern Ghana

districts	community	longitude	Latitude
tolong	nyorin	-1.03546	9.49404
tolong	balinkpen	-0.99184	9.45408
tolong	cheyohi	-0.98544	9.43944
tolong	gizaa	-1.04614	9.46353
tolong	tingoli	-1.01167	9.37538
kassena-nankana	tampola	-1.08969	10.77788
kassena-nankana	bonia	-1.12764	10.87064
kassena-nankana	gia	-1.13678	10.91069
mion	zuro	-0.55516	9.41941
mion	zakpalsi	-0.3194	9.46281
mion	sanzei	-0.26779	9.38305
mion	tuya	-0.45429	9.40533
savelugu	zosali	-0.83315	9.8968
savelugu	nakpanzoo	-0.81673	9.75487
savelugu	kpallung	-0.78154	9.6845
savelugu	tibali	-0.84488	9.66808
savelugu	botingli	-0.78975	9.6106
wa west	janke	-2.59458	10.06642
wa west	tomare	-2.72591	10.09518
wa west	guabe	-2.71903	10.03452
wa west	oir	-2.61272	10.01138
wa west	nakori	-2.54581	10.01576
nadowli	kulankagla	-2.7432	10.27752
nadowli	natordari	-2.62636	10.24522
nadowli	papu	-2.58076	10.23668
nadowli	goli	-2.63016	10.29462
nadowli	bili	-2.58171	10.32502
bawku west	azoawera	-0.49997	10.79173
bongo	sabulunga	-0.82034	10.93778
talensi-nabdam	pelungu	-0.68861	10.79233
bawku west	buliga	-0.42078	10.71754
kassena nankana	naaga	-1.00759	10.59122
kassena nankana	doba	-1.04008	10.86181
kassena nankana	nyangua	-1.05948	10.93018
kumbungu	kpirim	-0.98988	9.57207
kumbungu	logushegu	-0.96302	9.5421
kumbungu	gbanzogu	-0.95095	9.49927
tamale mun	yimahinayili	-0.672	9.38491
tamale mun	jerigo	-0.72985	9.32981
yendi	kulukpene	-0.0698	9.42348
yendi	nasiuk	0.00457	9.6119
savelugu	dinga	-0.96566	9.88546
savelugu	tarikpaa	-0.90299	9.63615
savelugu	zugu	-0.93467	9.57761

nadowli	paria	-2.69981	10.41093
nadowli	tachiripie	-2.63232	10.40198
nadowli	bakpa	-2.52144	10.44606
nadowli	wola	-2.52075	10.38958
wa municipal	sako	-2.45463	10.1568
wa municipal	kodali	-2.3954	10.11479
wa municipal	dodayiri	-2.38921	10.03146
wa municipal	sakaripea	-2.34306	10.01287

Table 1. Proposed sites in Northern Ghana

Review of biophysical and socio-economic characteristics in the proposed northern districts

In order to stratify and characterize the focused districts, a review of available spatial biophysical and socio-economic data layers is presented. The main purposes are to: 1. Understand the spatial pattern and homogeneity of each of the candidate data layers; 2. Choose the appropriate dataset for the stratification analysis.

Among the candidate layers on population density, Agro-Ecological Zones, precipitation, elevation, slope, farming system, market access, Length of Growth Period (LGP), and land cover datasets (listed in Table 2), only some of them were deemed to be appropriate to characterize and stratify districts in Northern Ghana, given their spatial variability.

Datasets	Spatial Resolution	Year	Source
Population density	1 sqkm	2000	CIESIN
Agro-Ecological Zones	~10 sqkm	-	IIASA
Precipitation	50 sqkm	long term (> 50 years)average	CRU
	1 sqkm	long term (> 50 years)average	WorldClim
	100 sqkm	long term (> 50 years)average	NASA POWER
	50 sqkm	long term (> 50 years)average	GPCC
Elevation	1 sqkm	-	USGS
Slope	1 sqkm	-	USGS
Farming systems	shape file	-	John Dixon (2012 version)
Market access	1 sqkm	2000	HarvestChoice
Length of Growth Period	5km		ICRISAT
	~10 sqkm	long term (> 50 years)average	IIASA
Land cover	1 sqkm	2000	GLC2000

Table 2. Characteristics of the candidate data layers

The relevant variables are first mapped in order to visualize their spatial distribution, and then they are aggregated by classes.

1. Population density

Population density in Northern Ghana is generally low. Most of the area shows population density lower than 100 persons per squared kilometer, and it is classified into 3 categories with the following cut-offs: less than 15, 16 -50, and greater than 50.

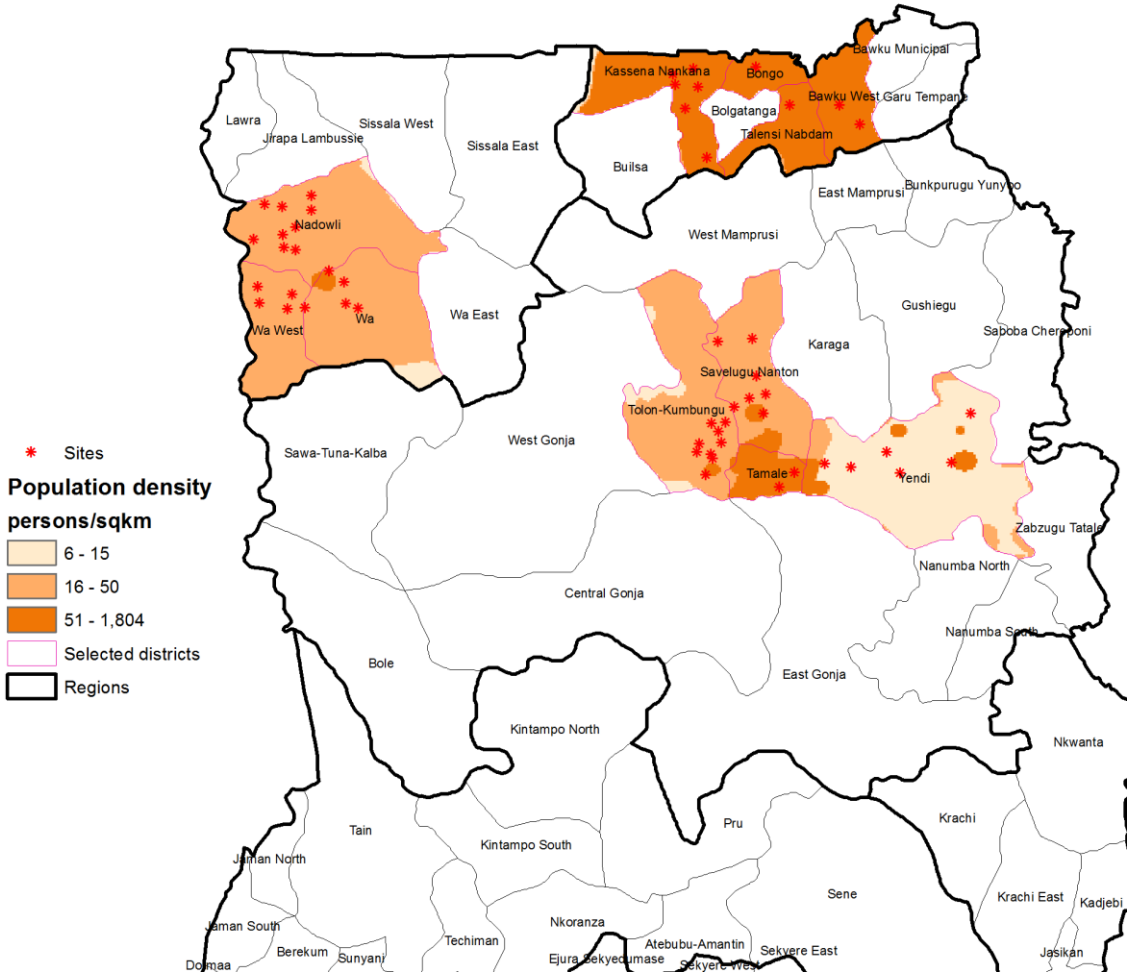

Figure 2. Population density

2. Elevation

There are many datasets available on elevation for Ghana: the USGS Hydro1k data layer has been chosen because most of the other data used in Africa RISING site selection analysis is at 1km resolution. In order to avoid arbitrary selection of cut-off values, the quintile of elevation distribution at 1km pixel level has been used. In Northern Ghana, the spatial heterogeneity in the measurement of altitude is relatively low, as the elevation ranges from 87 meters to 393 meters.

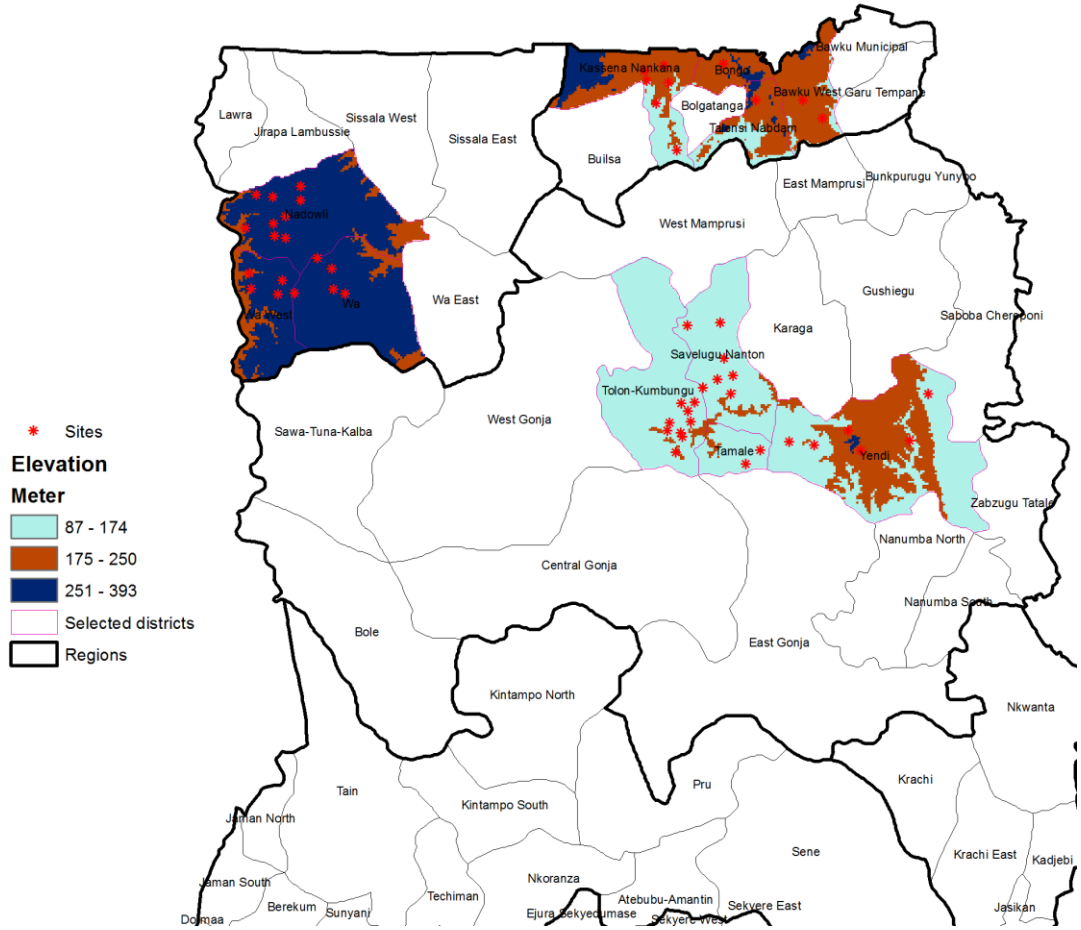

Figure 3. Elevation

3. Precipitation

Even though there are several publicly available precipitation data layers, most of them are more suitable to global studies than to country or sub-national analysis, being at a very coarse resolution. There are two methods to derive precipitation data point at the pixel level. One is from weather station records with spatial interpolation. The second method is from satellite observation.

The data from WorldClim has the highest spatial resolution, at 1km (**Error! Reference source not found.**4). Nevertheless, these data need to be used with caution, as their reliability has been questioned from various parts.

Other possible climatic data sources are CRU, NASA POWER, and GPCC, being all at half degree resolution. Their main drawback is the very coarse resolution, which makes them inadequate for the analysis on the focused districts.

To overcome the low resolution problem, the suggested option is to look at the length of growth period, analyzed in the next paragraph.

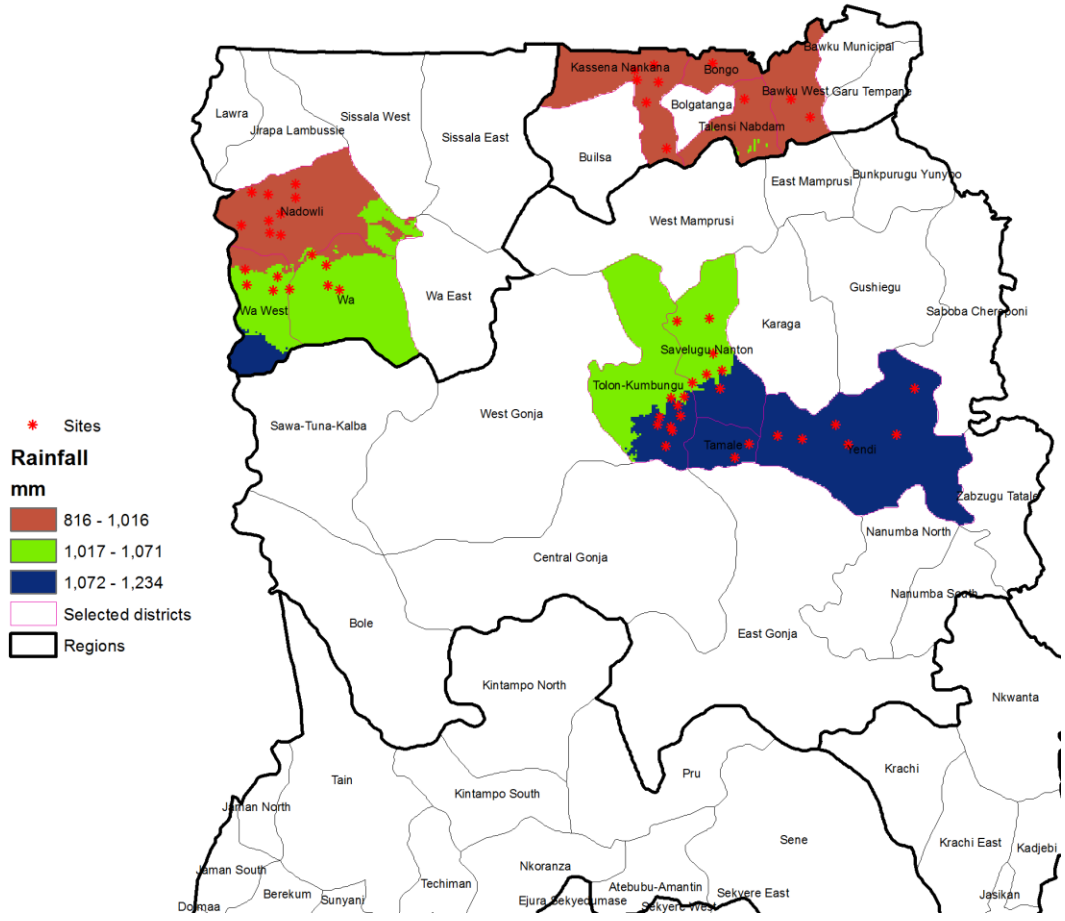

Figure 4. Long-term average precipitation (source: WorldClim)

4. Length of growth period

The length of growth period, a good proxy of agriculture potential, measures how many continuous suitable days are available for the crop to grow based on soil water capacity holding, soil moisture, temperature, and elevation. Two sources of length of growth period datasets are proposed. One is by IIASA at global scale at 10km^2 resolution. The other one is by ICRISAT and is at a finer resolution level (5km^2). Both maps are displayed in Figure 5 and 6. For this analysis, the LGP by ICRISAT is used, as it is at a higher resolution and deemed to be more reliable. Northern Ghana shows a clear gradient in terms of agriculture potential from North to South looking at ICRISAT data, which makes its use particularly appropriate in the stratification analysis.

The continuous distribution of LGP in Figure 6 was classified in four groups, with a flexible first threshold of 162 days (taken as the first quartile), and a predetermined thresholds of 180 and 190 days, shown in Figure 7 below. The four classes are then used for stratification purposes. According to this classification, the focused districts in the Upper West region are classified into low agriculture potential, while the Yenti district has the highest potential.

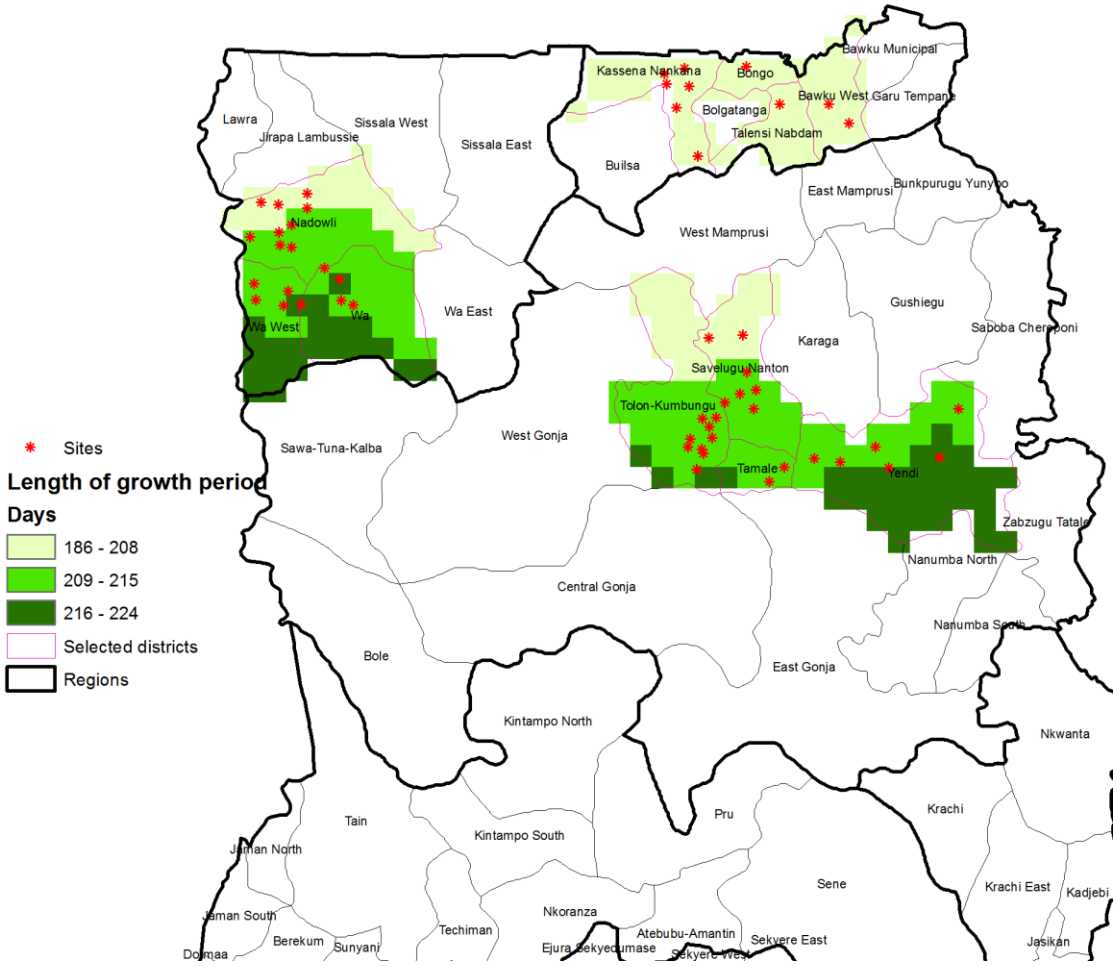

Figure 5. Length of growth period (source: IIASA)

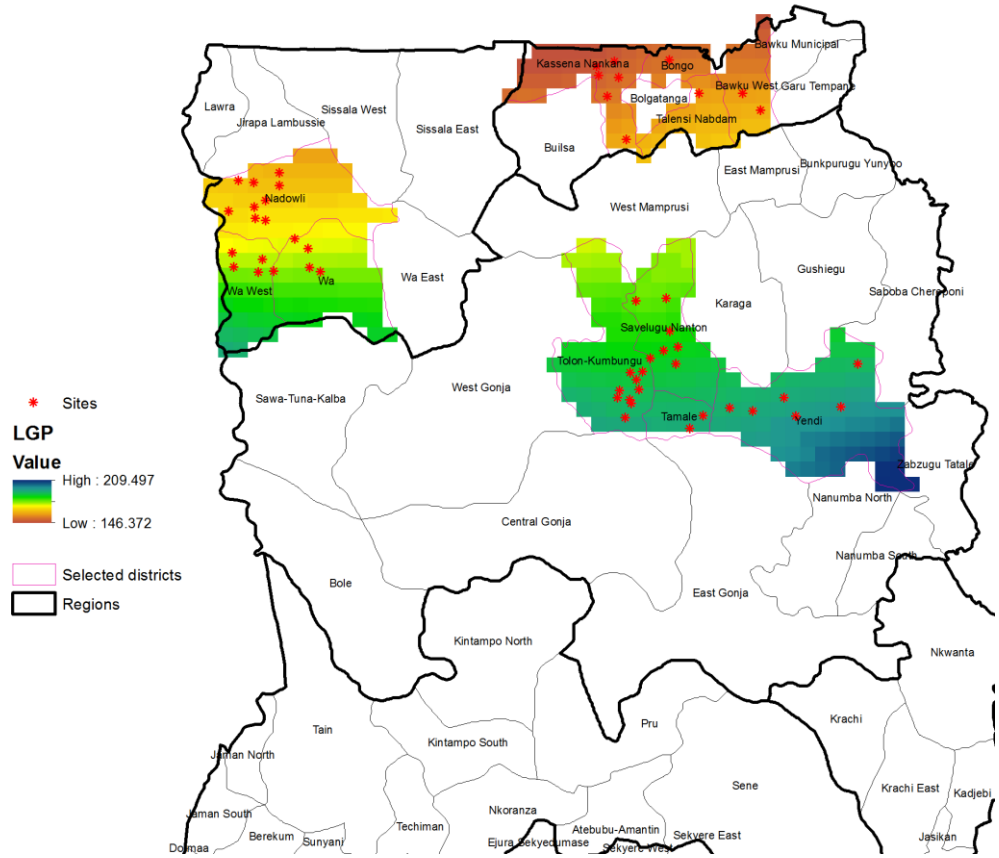

Figure 6. Length of growth period (source: ICRISAT)

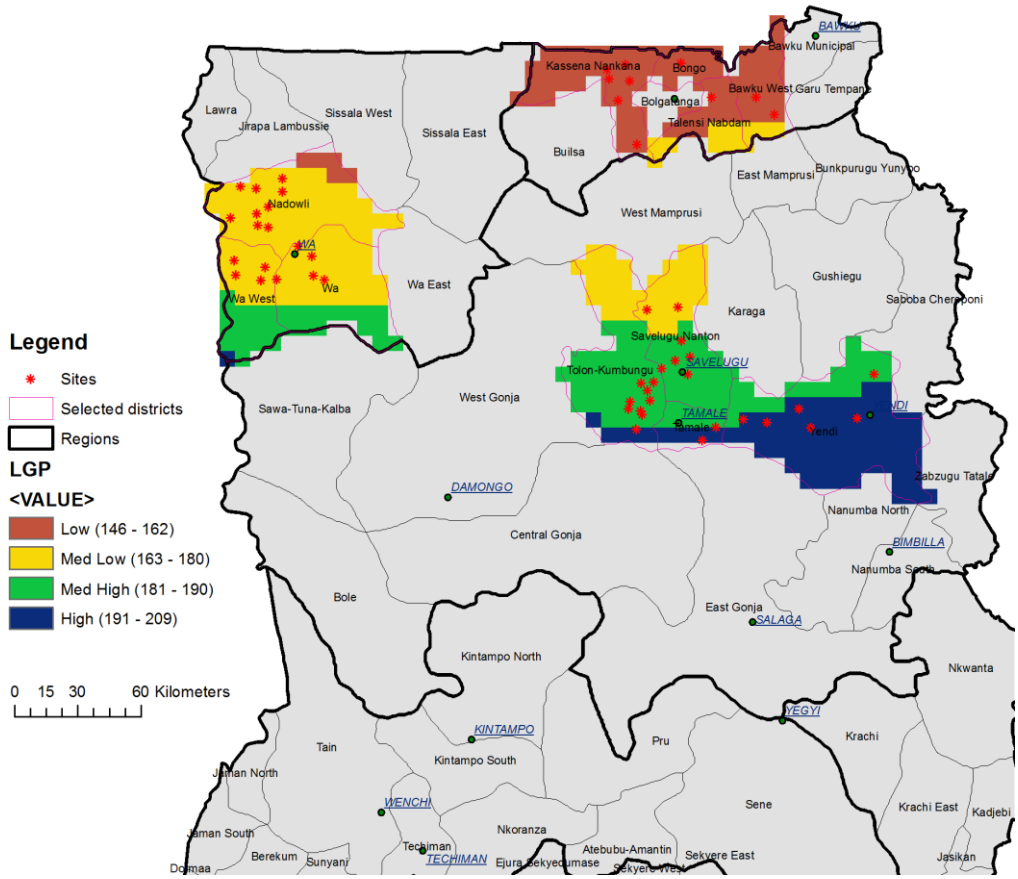

Figure 7. Classified LGP from ICRISAT (four classes: low, med-low, med-high, high)

5. Market Access

Market access is largely used as an indicator of accessibility. The tercile classification (high, medium, and low) based on travel time in minutes to the nearest city with at least 50 thousand people is applied in this analysis. The district of Tamale has the highest accessibility, while Wa has the lowest.

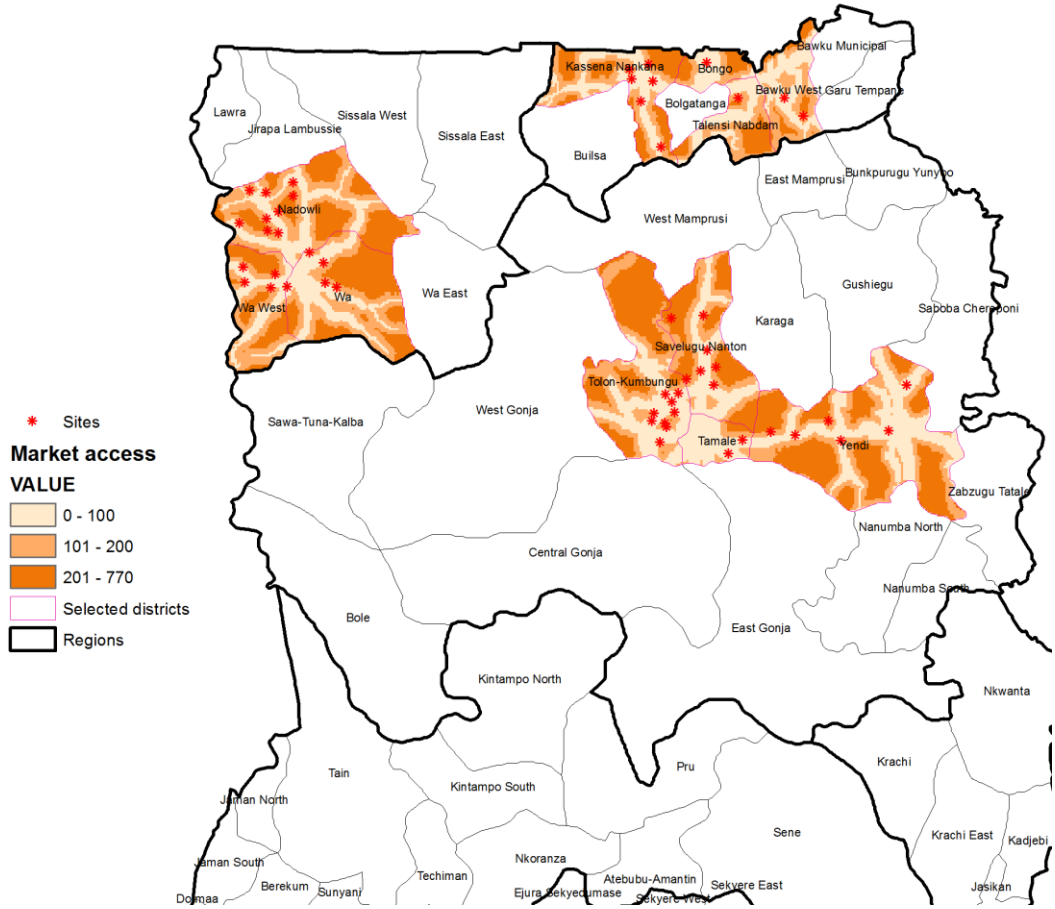

Figure 8. Market access

6. Land cover

There are various land cover datasets available at global scale. One of the commonly used is by GLC 2000. The map is shown in Figure 9.

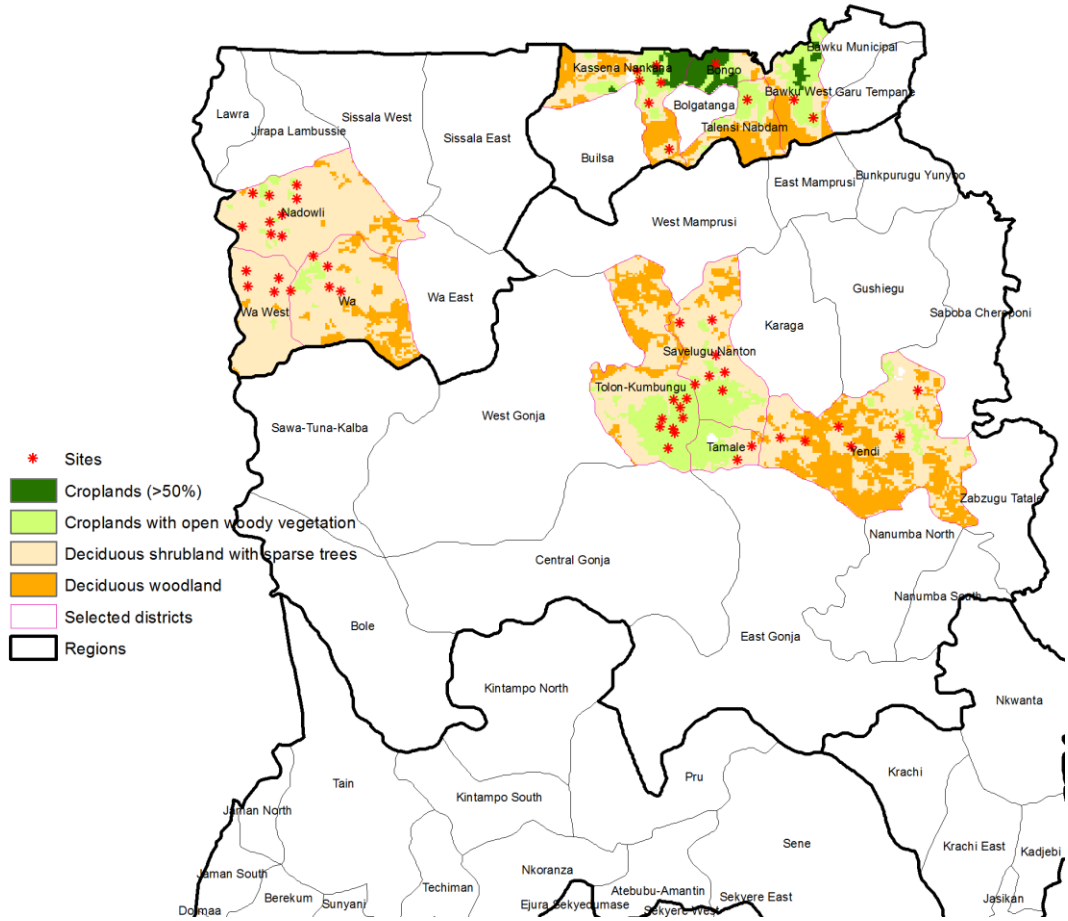

Figure 9. Land cover

Proposed stratification for site selection

After a review of the candidate variables, the variables of length of growth period by ICRISAT and market access are the final chosen variables used for the stratification process. The LGP is classified into 4 classes: low, med-low, med-high, high. The market access layer is classified into 3 classes: low, med, high. The cut-offs are shown in Table 3.

Class	Length of Grow period	Market access
Low	<= 162	>= 200
Med Low	162 – 180	100 - 200
Med high	180 – 190	
High	>190	<= 100

Table 3. Proposed variables and their cut-offs

The chosen variables are summarized at the district level, and average values are reported in Table 4.

Admin names	Length of growth period	Population density	Rainfall	Elevation	Market access
Nadowli	166	1,350	990	283	187
Bawku West	158	85	961	205	123
Kassena Nankana	152	181	953	208	165
Bongo	154	173	917	224	148
Talensi Nabdam	161	142	994	194	148
Wa	178	1,350	1,039	298	201
Wa West	180	19	1,048	268	160
Savelugu Nanton	181	866	1,067	138	176
Tolon-Kumbungu	183	1,797	1,057	133	186
Yendi	194	1,195	1,176	170	181
Tamale	189	1,780	1,105	146	60

Table 4. Average values at the district level

Similarly, Table 5 reports average values of the same variables at the community level.

Community	District	longitude	latitude	Land cover	LGP	Population density	Rainfall	Elevation	Market access
nyorin	tolong	-1.03546	9.49404	19	188	31	1074	137	105
balinkpen	tolong	-0.99184	9.45408	19	187	31	1081	144	153
cheyohi	tolong	-0.98544	9.43944	19	189	31	1087	158	114
gizaa	tolong	-1.04614	9.46353	19	188	31	1080	159	40
tingoli	tolong	-1.01167	9.37538	19	191	50	1093	171	82
tampola	kassena-nankana	-1.08969	10.77788	19	155	93	962	167	62
bonia	kassena-nankana	-1.12764	10.87064	19	152	93	948	173	62
gia	kassena-nankana	-1.13678	10.91069	19	150	93	945	212	171
zuro	mion	-0.55516	9.41941	11	190	9	1117	122	167
zakpalsi	mion	-0.3194	9.46281	11	190	9	1165	196	188
sanzei	mion	-0.26779	9.38305	11	192	9	1183	213	64
tuya	mion	-0.45429	9.40533	10	190	9	1140	154	82
zosali	savelugu	-0.83315	9.8968	11	179	26	1053	129	139
nakpanzoo	savelugu	-0.81673	9.75487	11	182	26	1057	115	60
kpallung	savelugu	-0.78154	9.6845	11	183	26	1073	144	198
tibali	savelugu	-0.84488	9.66808	19	183	26	1068	138	50
botingli	savelugu	-0.78975	9.6106	19	185	886	1077	142	55
janke	wa west	-2.59458	10.06642	11	174	35	1021	282	169
tomare	wa west	-2.72591	10.09518	11	173	35	1017	252	83
guabe	wa west	-2.71903	10.03452	11	174	35	1033	254	121
oir	wa west	-2.61272	10.01138	11	177	35	1035	286	139
nakori	wa west	-2.54581	10.01576	19	177	35	1032	302	37
kulankagla	nadowli	-2.7432	10.27752	11	167	16	969	259	105
natordari	nadowli	-2.62636	10.24522	11	167	16	990	308	211
papu	nadowli	-2.58076	10.23668	11	167	16	991	295	115
goli	nadowli	-2.63016	10.29462	19	166	16	975	287	144
bili	nadowli	-2.58171	10.32502	11	166	16	974	287	179
azoawera	bawku west	-0.49997	10.79173	19	160	86	977	222	121
sabulunga	bongo	-0.82034	10.93778	18	154	162	903	224	49
pelungu	talensi-nabdam	-0.68861	10.79233	19	159	121	981	219	197
buliga	bawku west	-0.42078	10.71754	19	162	86	992	224	157
naaga	kassena nankana	-1.00759	10.59122	19	161	93	994	160	101
doba	kassena nankana	-1.04008	10.86181	18	153	93	924	175	23
nyangua	kassena nankana	-1.05948	10.93018	18	151	93	888	199	161
kpirim	kumbungu	-0.98988	9.57207	19	186	31	1067	135	35
logushegu	kumbungu	-0.96302	9.5421	19	186	31	1074	143	30
gbanzogu	kumbungu	-0.95095	9.49927	19	188	31	1084	167	100
yimahinayili	tamale mun	-0.672	9.38491	11	189	105	1110	119	42
jerigo	tamale mun	-0.72985	9.32981	19	191	105	1113	142	16
kulukpene	yendi	-0.0698	9.42348	11	194	58	1194	171	7
nasiuk	yendi	0.00457	9.6119	11	188	9	1164	153	30
dinga	savelugu	-0.96566	9.88546	11	178	26	1046	123	322
tarikpaa	savelugu	-0.90299	9.63615	19	185	26	1068	139	195
zugu	savelugu	-0.93467	9.57761	19	185	31	1074	140	51
paria	nadowli	-2.69981	10.41093	19	164	16	943	276	144
tachiripie	nadowli	-2.63232	10.40198	19	164	16	961	306	146
bakpa	nadowli	-2.52144	10.44606	11	162	16	983	339	139
wola	nadowli	-2.52075	10.38958	11	164	16	981	326	219
sako	wa municipal	-2.45463	10.1568	11	172	16	1021	352	45
kodali	wa municipal	-2.3954	10.11479	11	172	35	1021	295	57
dodayiri	wa municipal	-2.38921	10.03146	11	177	35	1038	340	100
sakaripea	wa municipal	-2.34306	10.01287	11	177	35	1039	324	128

Table 5. Average values at the community level

In order to reduce the number of combinations, the final variables used are length of growth period and market access. The latter variable has been chosen as being a proxy of population density (relatively homogeneous in Northern Ghana, therefore not suitable for stratification purposes). LGP is classified into 4 classes (low, med-low, med-high, high), while market access is classified into 3 classes (low, med, high). LGP and market access classes are then matched to stratify the districts in Northern Ghana. Average values and combined classes of LGP and market access at the district level are listed in Table 6 and the associated map is displayed in Figure 10.

Admin name	LGP	LGP class	Market access	Market access class	Final class
Nadowli	166	Med-Low	187	Med	Med-Low LGP * Med mkt
Bawku West	158	Low	123	Med	Low LGP * Med mkt
Kassena Nankana	152	Low	165	Med	Low LGP * Med mkt
Bongo	154	Low	148	Med	Low LGP * Med mkt
Talensi Nabdam	161	Low	148	Med	Low LGP * Med mkt
Wa	178	Med-High	201	Low	Med-High LGP * Low mkt
Wa West	180	Med-High	160	Med	Med-High LGP * Med mkt
Savelugu Nanton	181	Med-High	176	Med	Med-High LGP * Med mkt
Tolon-Kumbungu	183	Med-High	186	Med	Med-High LGP * Med mkt
Yendi	194	High	181	Med	High LGP * Med mkt
Tamale	189	Med-High	60	High	Med-High LGP * High mkt

Table 6. LGP, market access, and their intersection at the district level

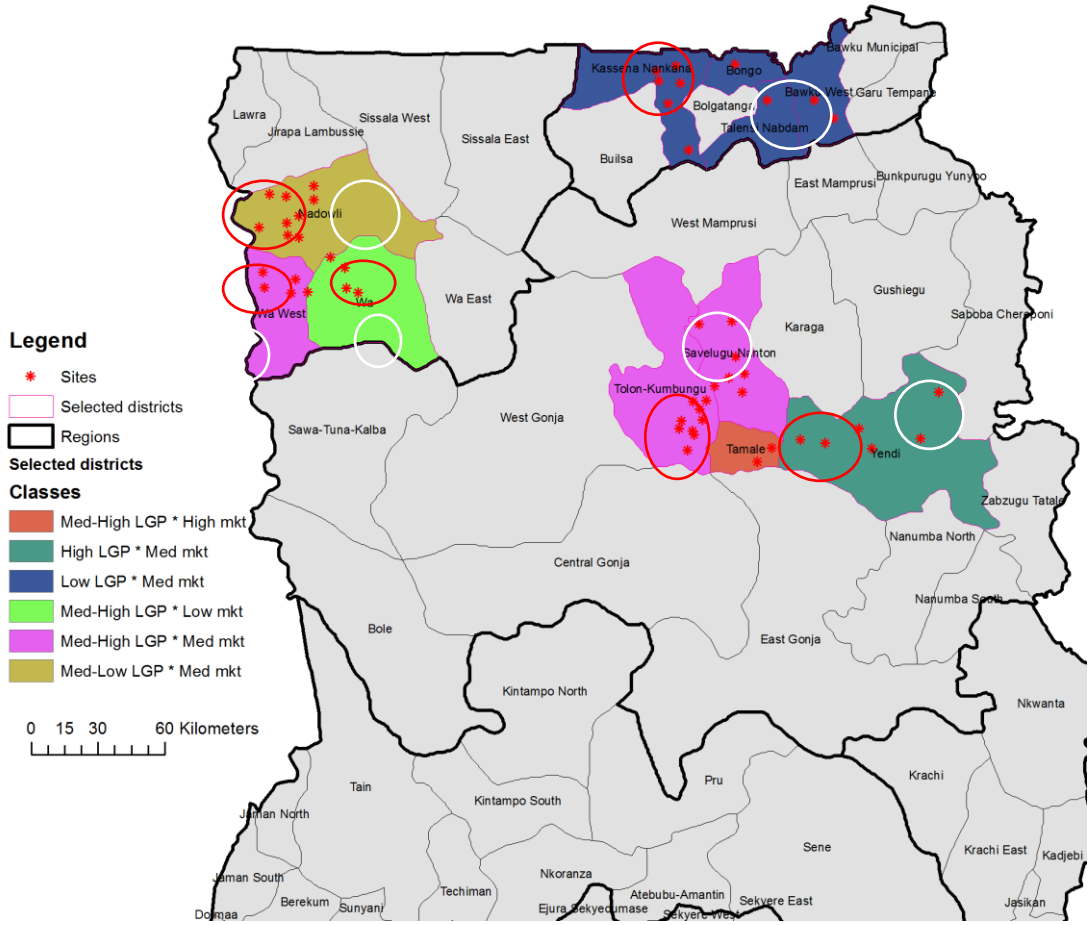

Figure 10. Combination of Length of growth period (4 classes) and Market access (3 classes)

Conclusions

The stratification process uses length of growth period (LGP) and market access as proxies of agriculture potential and socio-economic integration in the food value chain, respectively. Combining the two criteria, six unique classes are derived. It is suggested to choose the intervention communities in five classes/strata, perhaps avoiding the Tamale district (the only one with mid-high LGP and high market access), because its small size does not allow ruling out contamination of control sites given the inevitable proximity to action sites.

Given the close proximity between the 29 intervention and the 23 counterfactual communities/sites previously identified, and the new stratification proposed in this document, a re-selection of communities in the 11 districts is advised. The re-selection would need to guarantee an adequate coverage of the spectrum of biophysical and socio-economic conditions prevailing in the targeted districts, allowing for a broad assessment of the interventions in areas with different agricultural potential.

In particular, it is recommended to keep the identified 52 communities, but disregard the previous distinction between intervention and counterfactual communities. Action sites/communities should be chosen within the red circles, while control communities should be chosen within the white circles, shown in Figure 10. This way the control communities would be located within the same stratum identified, but with enough remoteness to reasonably avoid potential contamination between actions and counterfactual sites, although the final selection between intervention and control areas should be informed by local knowledge (e.g. to check if they share markets or other public facilities and verify their actual agricultural potential). Only after intervention communities will be chosen, control communities will be selected randomly within the identified control areas.