Characterisation of the impact zones and mandate areas in the N2Africa project

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N2Africa

Putting nitrogen fixation to work for smallholder farmers in Africa

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1   Objectives of this report

This report gives an overview of the readily available information on farming and livelihood characteristics of the geographical areas where N2Africa works. In this document we describe zones not only in terms of agro-ecological potential, but also in terms drivers of intensification (market access, institutional environment), and provide some key indicators of development. The comparisons between and within impact zones were based on metadata and interviews with experts active in each of the areas where N2Africa works. This description will be complemented in 2011 by data collected through the baseline farm household survey conducted in the eight countries where N2africa works. This report fulfils both Milestone 1.2.2 "At least 10 action sites identified in the different impact zones" as well as Milestone 1.4.1 "A background document characterizing (e.g., climate, population, soil type) the target impact zones".

2 General information on impact zones

The three regions (or hubs) targeted by N2Africa correspond to three major agro-ecological zones of sub-Saharan Africa (Table 1). These zones have a high potential for agriculture including legume production and a high population density, relative to other regions in sub-Saharan Africa. Only some areas in southern Africa, especially in Mozambique, are relatively sparsely populated. While the agro-ecological conditions in the zones in West and Southern Africa have some similarities in terms of climate and dominant crops, the East and Central African zone is clearly different because of its higher altitude and cooler and more humid climate. Agriculture represents a large share of the GDP (between 21-41%) in these zones.

Table 1. General information on the three regions covered by N2Africa.

Impact zones	East and Central Africa	West Africa	Southern Africa	Sources
Countries targeted by N2Africa	Kenya, Rwanda, Democratic Republic of Congo	Ghana, Nigeria	Malawi, Mozambique, Zimbabwe	
Agro-ecological zone	Tropical cool, humid and subhumid	Tropical warm, sub-humid and semi-arid	Tropical warm, sub-humid and semi-arid	FAO/IIASA, 2000
Ecoregion	East African arc montane forest & East African Sudannian savanna	Northern Guinea Savanna & Sudan Savanna	Southern Miombo woodlands	Burgess et al. 2004
Agriculture (% GDP)	21-41	31-32	19-34	World Bank

Table 2: Selected development indicators, averages for eight African countries

	Kenya	Rwanda	DRC	Ghana	Nigeria	Malawi	Mozambique	Zimbabwe	Source
Population (thousands)	38 765	9 720	64 257	23 350	151 212	14 280	22 383	12 460	UN
Gross Net Income (US$ per capita)	1 580	1 010	290	1 430	1 940	830	770	nd	World bank
Population below poverty line[a] (%)	20	60	59	30	64	53	75	68	World bank
GDP (billion US$)	34.5	4.46	11.59	16.12	212.08	4.27	9.74	3.42[f]	World bank
Agriculture (%GDP)	21	35	41	32	31	34	28	19[f]	World bank
Children under 5 (thousands)	6 540	1 646	11 829	3 319	25 020	2 591	3 920	1 707	UN
Stunting prevalence[b] (%)	35	51	46	28	41	53	44	33	UNICEF, WHO
Children stunted (thousands)	2 269	836	5 382	929	10 158	1 368	1 670	570	UNICEF, WHO
Underweight prevalence[c] (%)	21	18	25	14	23	15	18	12	UNICEF, WHO
Wasting prevalence[d] (%)	6	5	10	9	14	4	4	7	UNICEF, WHO
Children under 5 mortality rate (%)	12.1	18.1	16.1	11.5	18.9	11.1	16.8	9.0	World bank
Women with low BMI[e] (%)	12	10	19	9	15	9	9	9	UNICEF

[a] Poverty line defined as people living on less than US$1.25 per day
[b] Stunting prevalence: Percentage of children under 5 years old who fall below minus two to three standard deviations from median height for age of reference population.
[c] Underweight prevalence: Percentage of children under 5 years old who fall below minus two to three standard deviations from median weight for age of reference population.
[d] Wasting prevalence: Percentage of children under 5 years old who fall below minus two to three standard deviations from median weight for height of reference population.
[e] Body Mass Index (BMI) (bodyweight expressed in kg divided by squared height in cm) lower than 18.5
[f] Estimates from 2005

Among the eight countries targeted by N2Africa, Nigeria has the largest population and by far the largest Gross Domestic Product (GDP) (Table 2). The GDP of Nigeria is about six times higher than that of Kenya, the country with the second highest GDP among the eight countries. Also the Gross Net Income per capita is highest in Nigeria, followed by Kenya and Ghana. DRC has by far the lowest Gross Net Income per capita.

The selected development indicators in Table 2 show that poverty prevails in all eight countries. Only in Kenya and Ghana, more than half of the population lives above the poverty line. In Nigeria, a high Gross Net Income per capita and a high percentage of people living below the poverty line indicate a highly unequal distribution of wealth among the population. Under- and malnutrition among women and children (indicated by the prevalence of stunting and wasting among children and women with a low BMI) are common in all eight countries. Countries like Rwanda, DRC, Nigeria, Malawi and Mozambique perform particularly poor with regard to these nutrition indicators. Mortality rate of children under five is 9% or more in all eight countries with particularly high mortality rates (>16 %) in DRC, Rwanda, Nigeria and Mozambique.

3   Production and import of grain legumes in target countries

Among the eight countries where N2Africa works, only Nigeria plays a relevant global role as a grain legume producer with an estimated total legume grain production of 7.4 million tonnes in 2008 (Table 3), which is about three times greater than the total production of the other seven countries together (2.4 million tonnes). Beans play a major role in Eastern and Central Africa and in Malawi. Soybeans are mostly grown in Nigeria and Zimbabwe. Cowpea is grown at a large scale in Nigeria, the world's largest producer of cowpeas, with smaller areas in Kenya, Malawi and DRC. Groundnut is cultivated in all eight countries with a particularly large national production in Nigeria, followed by Ghana, DRC and Malawi. The area devoted to grain legume production varies between from 271 thousand ha in Zimbabwe to 7.2 million ha in Nigeria (Table 4).

Table 3: Production of main grain legumes in eight countries in Africa in 2008 (metric tonnes grain) and the countries' ranking in the world as grain legume producers. Source: FAOstat (2010)

	Kenya	Rwanda	DRC	Ghana	Nigeria	Malawi	Mozambique	Zimbabwe
Beans	265 000	280 000	113 000	nd	nd	124 700	nd	30 300
Soybean	2 100	27 000	16 800	nd	591 000	45 000	nd	105 000
Cowpea	48 000	nd	55 000	nd	2 916 000	55 000	nd	nd
Groundnut	21 000	10 000	370 000	428 600	3 900 000	243 000	94 000	78 600
Total	336 100	317 000	554 800	428 600	7 407 000	467 700	94 000	213 900
Ranking of producers in the world	Cowpea 6th Beans 9th	Beans 13th	Groundnut 11th Cowpea 11th	Groundnut 10th	Cowpea 1st Groundnut 3rd Soybean 13th	Cowpea 10th		

nd: no data

Table 4: Area cultivated with grain legumes in eight countries in Africa in 2008. Source: FAOstat (2010).

	Kenya	Rwanda	DRC	Ghana	Nigeria	Malawi	Mozambique	Zimbabwe
Beans (ha)	642 000	360 000	209 000	nd	nd	260 000	nd	56 300
Soybean (ha)	2 500	43 000	34 800	nd	609 000	70 000	nd	65 000
Cowpea (ha)	148 000	nd	110 000	nd	4 289 000	80 000	nd	nd
Groundnuts (ha)	17 000	17 000	475 600	460 000	2 300 000	266 000	295 000	150 000
Total (ha)	809 500	420 000	829 400	460 000	7 198 000	676 000	295 000	271 300

nd: no data

Table 5. Yield of main grain legumes in eight countries in Africa in 2008. Source: FAOstat (2010).

	Kenya	Rwanda	DRC	Ghana	Nigeria	Malawi	Mozambique	Zimbabwe
Beans (t/ha)	0.41	0.78	0.54	nd	nd	0.48	nd	0.54
Soybean (t/ha)	0.84	0.63	0.48	nd	0.97	0.64	nd	1.62
Cowpea (t/ha)	0.32	nd	0.50	nd	0.68	0.69	nd	nd
Groundnuts (t/ha)	1.24	0.59	0.78	0.93	1.70	0.91	0.32	0.52

nd: no data

Grain legume yields are generally poor in the eight countries, where in total 11 million hectares are used for the production of 9.8 million tonnes of grains (Table 4 and 5). Overall average grain legume yields are thus less than 1 ton per ha. Differences in yield between countries can be considerable (Table 5). Soybean yields in Zimbabwe are much higher than

in other countries. Bean yields are relatively high in Rwanda, while groundnut yields stand out in Nigeria.

Among the 8 countries, only the DRC is a major importer of legume grains and in this country, the import of beans and soybeans exceeds domestic production (Table 6). Also Kenya imports relatively large amounts of beans and soybeans, despite a substantial domestic production.

Table 6: Grain legumes imported in eight countries in Africa in 2007. Source: FAOstat (2010).

	Kenya	Rwanda	DRC	Ghana	Nigeria	Malawi	Mozambique	Zimbabwe
Beans (t)	93 000	1 500	188 900	2 375	2 860	3 000	nd	23 500
Soybean (t)	45 200	80	189 500	496	23 000	nd	470	33
Cowpea (t)	nd	nd	nd	nd	nd	nd	nd	nd
Groundnuts (t)	21 850	1 930	nd	nd	14	170	840	950

nd: no data

4 Characteristics of mandate areas

4.1 Overview of mandate areas

In this section we present the mandate areas targeted by N2Africa and the action sites where N2Africa has initiated activities in the first growing season with statistics on production characteristics, access to markets and the role of legumes in farming and diets. The information presented originate from various sources: spatial metadata bases and opinions of experts who conducted previous characterisations in the areas. Table 7 and Figure 1 give an overview of the mandate areas where N2Africa works.

Table 7: Overview of mandate areas and action sites within the mandate areas where N2Africa runs or plans to run activities in the first growing season of the project (as per October 2010).

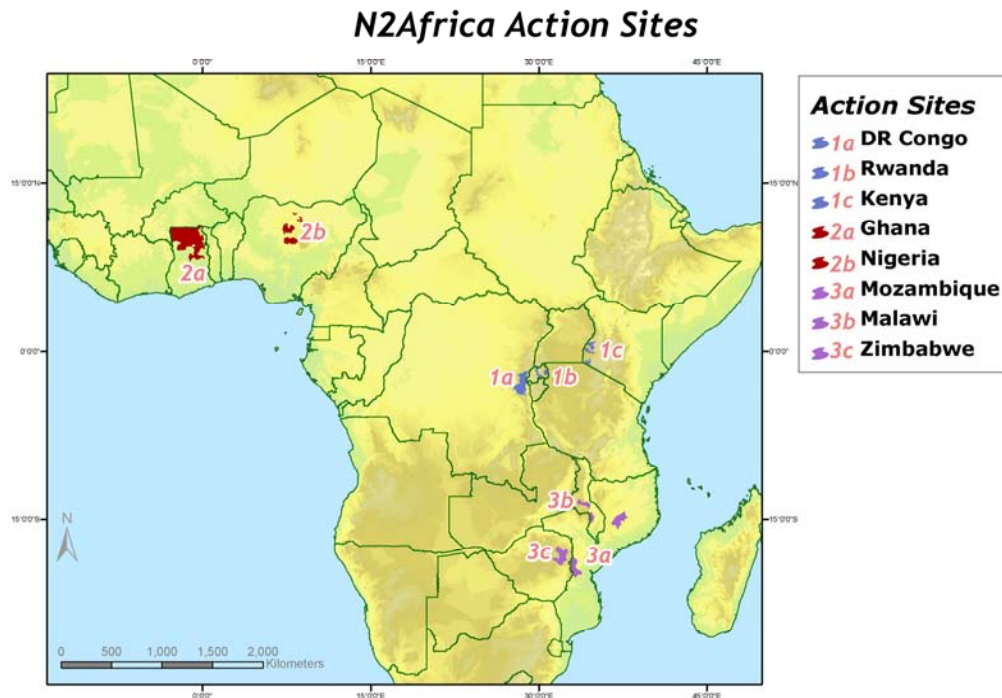| DRC	Rwanda	Kenya	Ghana	Nigeria	Malawi	Mozambique	Zimbabwe
Kalehe - Kalehe Kabare - Birava - Murhesa - Bughore - Mumosho - Bwirhemba-Bushwira Walungu - Walungu - Mulamba - Mushinga - Nyangezi - Mushinga - Muhanga-Kamisimbi Mwenga - Burhinyi	Kamonyi - Musambira - Nyamiyaga - Nyarubaka Busegera - Musenyi - Mareba Kayonza - Rukara - Nyamirama - Rwinkwavu Burera - Kinoni - Nemba Gakenke - Kivuruga - Rwaza	Western - Bungoma - Kakamega - Vihiga Nyanza - Migori - Siaya - Kisumu	Northern region - Chereponi - Karaga Upper West - Nadowli - Wa Municipal - Wa East Upper East - Kassena Nankana - Bawku Municipal - Bawku West	Kano State - Bichi - Garko - Tudun Wada - Wudil - Bunkure - Warawa - Albassu - Dawakin Kudu Northern Kaduna State - Soba - Giwa - Igabi Southern Kaduna State - Kachia - Zango Kataf	Lilongwe - Chata - Nkhoma - Kalumbu - Mpenu - Mlodzeni Ntcheu - Nsipe - Kandeu Salima - Chitala - Ngodzi - Matowe Mchinji - Mikundi - Mlonyeni - Bas-Ntete - Msitu - Mkanda - Chiosya - Kalulu Kasungu - Mdunga - Chipala - Lisasadzi - Chuhu - Chamama	Zambesia - Gurue Manica - Sussudenga Tete - Angonia Nampula - Mogovolas Niassa - Mandimba	Mashonaland East - Wedza - Murehwa - Mudzi - Goromonzi Mashonaland West - Chegutu Mashonaland Central - Guruve Manicaland - Makoni

N2Africa Action Sites

Figure 1: Map of Africa depicting the eight countries and the approximate locations of action sites where the N2Africa project conducts activities in West, East and Central, and southern Africa.

4.2   East and Central Africa

4.2.1   Democratic Republic of Congo

The mandate areas Kalehe, Kabare, Walungu and Mwenga are all located in eastern regions of the DRC, south and north of the town Bukavu nearby Lake Kivu (Figure 1).

A comparison between the sites in the DRC is presented in Table 8 and Figure 2. Production statistics for the project sites in the DRC have not been retrieved. The mandate areas in the DRC are relatively cool and humid with long growing seasons of more than 300 days (Figure 2a, b and c). The districts show a gradient in population density and market access from Kabare, which is relatively accessible and densely populated, to Mwenga, which is relatively inaccessible and sparsely populated (Figure 2d & e). In the more remote areas of Mwenga and Kalehe there are no NARs working and the presence of other organisations is also rather limited. The four districts slightly differ in rainfall with Mwenga and Walungu being drier than the other two districts (Figure 2c). Annual temperatures fluctuate within mandate areas reflecting variation in altitude (Figure 2d). Differences in the length of the growing period are small in this part of DRC (Figure 2e), though in the northern areas the growing period is slightly longer than in the southern areas. The use of synthetic fertilisers in farming is almost nil. Beans make up a very important component of diets in all four districts.

Table 8: Site characteristics of mandate areas in the DRC. Experts: Yves Irenge et al.

| Indicators	Kalehe	Kabare	Walungu	Mwenga
Population density (inhabitants km^{-2})	70	262	225	38
Main markets for outputs - Towns where farmers sell produce	Kadutu, Bukavu, Kituku, Goma	Bukavu, Katana, Mudaka, Kabamba, Mana, Bukavu	Mugogo, Munya, Musiru, Kashunju Bukavu	Bukavu
Access to urban markets (h)	8	2-3	3	9
Presence of NARS	None	INERA, CRSN	INERA	None
Other organisations that are active	AZOP, ADI KIVU, GALE, CAB, PAD, APED, CENTRE OLAME, BDD, CIM BUSHI	CIALCA, PAD, SARCAF,ADI-KIVU, AZOP, ADI KIVU, GALE, CAB, APED, BDD, DIOBASS, SARCAF, BUSHI FORAL, CENTRE OLAME, ACOSYF, CIM	CIALCA,ASOP, PAD,SARCAF, CAB,ACOSYF, GALE, DIOBASS, CIM, BUSHI	DIOBASS, FORAL, PIL, APIDE, SOLIDARITE PAYSANNE, CIM, BUSHI
Dominant soil types	Ferrisols humifère, Ferrisols	Ferrisols humifère (Local name : Kanombe Civu)	Ferrisols (Local name : Kalongo Civu)	Ferralsol, Ferrisols humifère
Annual rainfall (mm)	1828±139	1643±141	1508±146	1523±101
Annual mean temperature (ºC)	17.8	18.2	19.2	20.0
Length growing period (d)	357	340	322	315
Main crops		cassava, beans, banana, maize	beans, potatoes, banana, maize, cassava	
Farm size (ha)		0.35-1.13	0.29-1.13	
Household size (#)	5.2	5.5	6	5.9
Fertiliser use (kg ha^{-1})	0	0	0	0
Main livestock species	Goats, cattle, rabbits, chicken, pigs	Goats, cattle, rabbit, chicken, pigs	Goats, cattle, rabbit, chicken, pigs	Cattle, rabbit, chicken
Livestock densities (# hh^{-1})		Cattle 0-6 Goats 4-10	Cattle 0-13 Goats 2-13	
Main staple food	Cassava, beans, banana, maize, soya, curdled milk, milk, meat	Cassava, beans, banana, maize, soya, curdled milk, milk, meat,	Sweet potatoes, beans, maize, cassava, banana, curdled milk, milk, meat	Cassava, beans, rice, meat, fish, sorghum, banana, plantain
Role of legumes in the diet	First place	First place	First place	First place

Figure 2: (a) Annual temperature, (b) Annual rainfall, (c) Length of the growing period, (d) Population density, and (e) Accessibility (time to travel of a town of more than 50,000 inhabitants) in mandate areas of Rwanda and DRC.

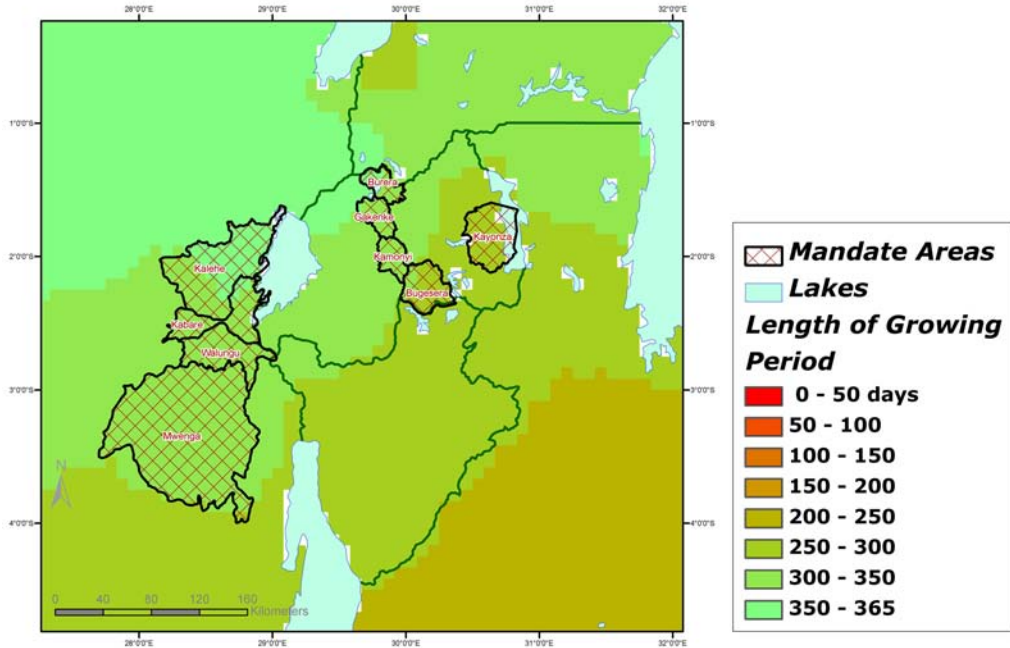**(a) Rwanda and DRC Mandate Areas: Annual Temperature**
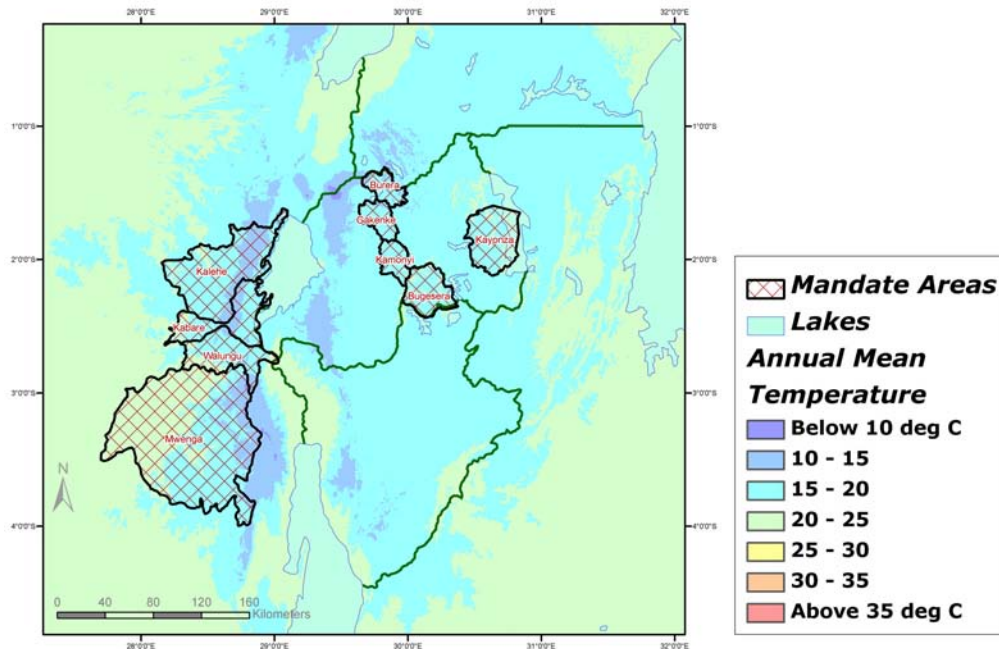
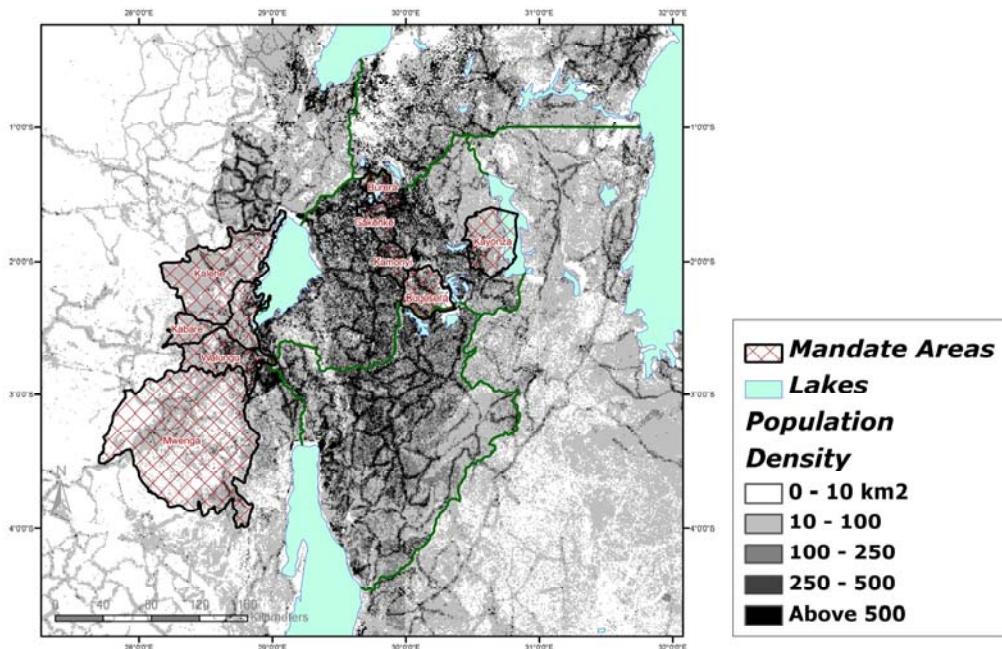**(b) Rwanda and DRC Mandate Areas: Annual Rainfall**
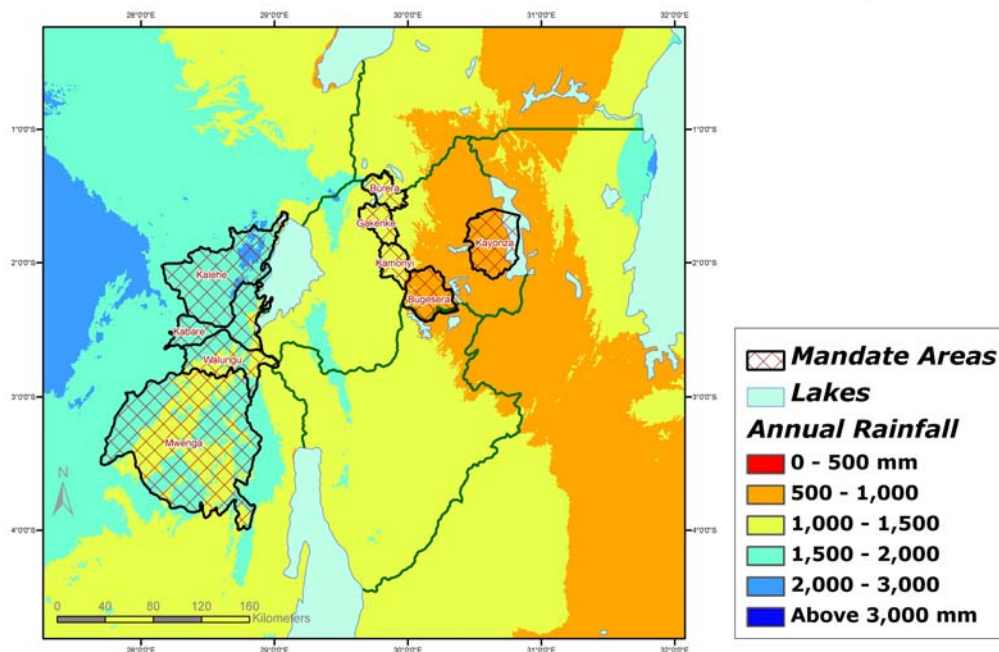
(c) *Rwanda and DRC Mandate Areas: Length of Growing Period*
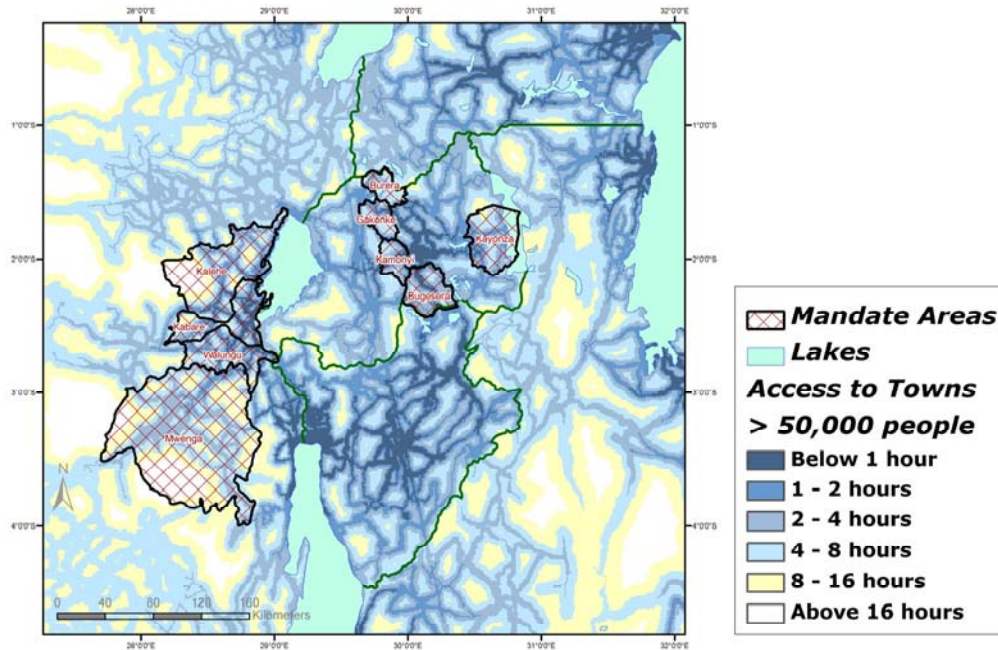

(d) *Rwanda and DRC Mandate Areas: Population Density*

(e) Rwanda and DRC Mandate Areas: Accessibility

Sources:

(a): WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean temperature. Available at http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010).

(b): WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean rainfall. Available at http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010).

(c): CIAT, 2010. Average Length of Growing Period. Derived from: Length of growing period (LGP) zones of the world (FGGD), FAO, 2007. Available at http://www.fao.org/geonetwork/srv/en/resources.get?id=14057&fname=Map4_2.zip&access =private (accessed 24/03/2010). The FGGD LGP zone map is a global raster datalayer with a resolution of 5 arc-minutes. Each pixel contains a class value for the dominant LGP zone found in the pixel. The data are from FAO and IIASA, 2000, Global agro-ecological zones, as reported in FAO and IIASA, 2007, Mapping biophysical factors that influence agricultural production and rural vulnerability.

(d): ORNL LandScan 2006TM/UT-Batelle, LLC

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(e): ORNL LandScan 2006TM/UT-Batelle, LLC

Estimated travel time to the nearest city of 50,000 or more people in year 2000. 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://bioval.jrc.ec.europa.eu/products/gam/ (accessed 24/03/2010).

4.2.2   Rwanda

The action sites are located in Burera and Gakenke districts (North province), Kamonyi district (Southern province), Kayonza and Bugesera districts (Eastern province). Government statistics for production of grain legumes for the five districts are shown in Table 9. Common bean is a major crop in all districts. Soybean is primarily grown in Kamonyi and Gakenke districts. Most groundnut is cultivated in Bugesera. No data is given on cowpea production, probably because cowpea production is uncommon in these districts.

Table 9: Production of legumes in the 5 districts targeted by N2Africa (tonnes grain)

	Groundnuts	Cowpea	Soybean	Beans
Kamonyi	1 113	nd	4 585	11 062
Bugesera	2 593	nd	855	8 813
Kayonza	1 050	nd	259	10 054
Burera	444	nd	537	14 974
Gakenke	202	nd	2 303	17 345
Total	5 402		8 539	62 248

Source: STATISTICS/MINAGRI, http://countrystat.org/rwa, nd: no data

There is a gradient in population density across the five districts (Table 10) from the more densely populated Burera and Gakenke to the less populated Bugesera and Kayonza (Table 10 and Figure 2). The sites differ in agro-ecology with Kayonza and Bugesera being drier and hotter with a shorter length of the growing period than the other districts. There appears to be a link between population density, and rainfall and length of the growing season. Densely populated areas have higher rainfall and a longer growing season than more sparsely populated areas. Burera and Gakenke in the North province are generally cooler because of their altitude. In all mandate areas of Rwanda, beans and bananas take an important place in arable farming. The importance of other crops varies between mandate areas, with the warmer areas being ecologically more suitable for cassava, maize and groundnut, and the cooler areas more suitable for (Irish) potato and sweet potato. The mandate areas in North province are further away from major urban markets than the other areas. Farm sizes are generally small, varying between 0.2 and 0.7 ha. In all districts, NARs and other development organisations are active. Beans make up a major component of the diets in all districts.

Table 10: Site characteristics of mandate areas in Rwanda. Experts S. Kantengwa et al.

Region	Kamonyi	Busegera	Kayonza	Burera	Gakenke
Population density (inhabitants km^{-2})	393	194	102	518	456
Main markets for outputs	Gacurabwenge, Muhanga, Kigali	Nyamata, Ruhuha, Kigali	Kabarondo, Mukarange, Rwamagana	Musanze, Kirambo	Gakenke, Base, Musanze
Access to urban markets (h)	2.5	2.5	3	5	4
Presence of NARS	Extension services	Extension services, ISAR Karama	Extension services	Extension services, ISAR Rwerere stat	Extension services
Other organisations that are active	COCOF, IFDC, Women for Women International	CARITAS, World Vision	Clinton Foundation, ADRA, Women for Women International	Imbaraga, DRD, DERN, Bleu Ciel, CTB, COAMIVU,	Imbaraga, DRD, DERN, Bleu Ciel, COAMIVU, World Vision, PADER, CTB
Annual rainfall^{c} (mm)	1068±49	937±42	842±24	1246±106	1179±68
Annual mean temperature (ºC)	20	21	21	16	18
Length growing period (d)	315	290	285	352	341
Main crops	Banana, cassava, maize, beans, soybean	Bean, cassava, maize	Banana, beans, cassava, maize	Beans, potatoes, banana, sweet potatoes	Beans, banana, maize
Farm size (ha)	0.2-0.7	0.2-0.7	0.2-0.7	0.2-0.7	0.2-0.7
Household size (#)	5.35	5.19	5.01	5.37	5.08
Yields of cereals (kg ha^{-1})				2500	1500
Main livestock species				Sheep, goats, pigs	Sheep, goats, pigs
Main staple food	Cassava-beans, maize-beans	Cassava-beans, sweet potato-beans	Banana-beans, maize-beans, sweet potato-beans	Maize-beans, potato-beans,	Sweet potato-beans, potato-beans, maize-beans, wheat-beans

4.2.3   Kenya

The mandate areas are all located in the highly populated and intensively farmed Western province and Nyanza province.

Common bean is widely cultivated in both provinces (Table 11). Cowpea is a minor crop in the two provinces while groundnut and soybean production is low. The sites selected in Kenya cover a range of population density from 300 to 1200 inhabitants km^{-2}, which indicates that some of the rural sites in the mandate areas of Kenya are extremely densely populated (Table 12, Figure 3). Soil fertility was originally high in most of this region, explaining the high population density, but soil fertility has declined in many areas due to soil degradation. In general, rainfall is relatively high and the length of the growing period is relatively long in western Kenya. Nyanza Province is a bit drier than Western Province, although there is little difference in length of the growing period between the two provinces. Differences in temperatures between districts are small. Market accessibility varies from area to area, but in principle it follows a similar pattern as that of the population density. In both provinces, the main cropping system is maize-based. Maize is often intercropped with common bean, which is a major crop in the mandate areas in Kenya. Maize and beans also make up the staple food in these regions. Farmers use 10-60 kg of fertiliser per ha of arable land. Farms are small-scale in these districts, with average landholdings as small as 0.6 ha.

Table 11: Production statistics for Western and Nyanza provinces in Kenya (ton grain yield)

	Groundnut	Cowpea	Soybean	Beans
Western	nd	2 354	nd	44 031
Nyanza	nd	2 316	nd	56 872
Total		4 670		100 903

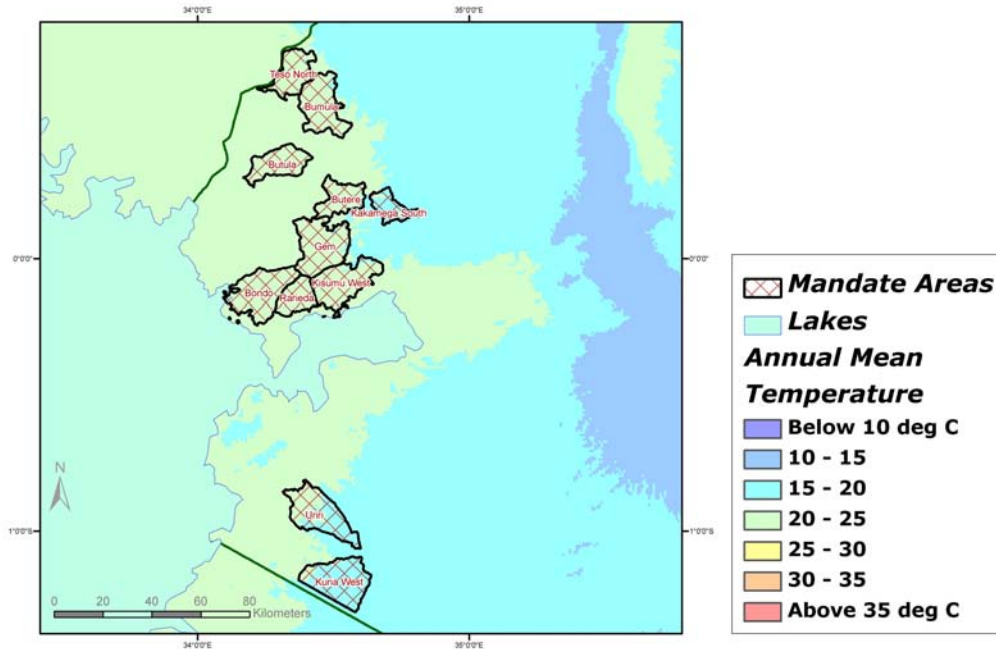Source: STATISTICS/MINAGRI, http://countrystat.org/rwa, nd: no data

Table 12: Site characteristics of mandate areas in Kenya. Experts: F. Baijukya, P. Woomer, B. Vanlauwe and J. Chianu.

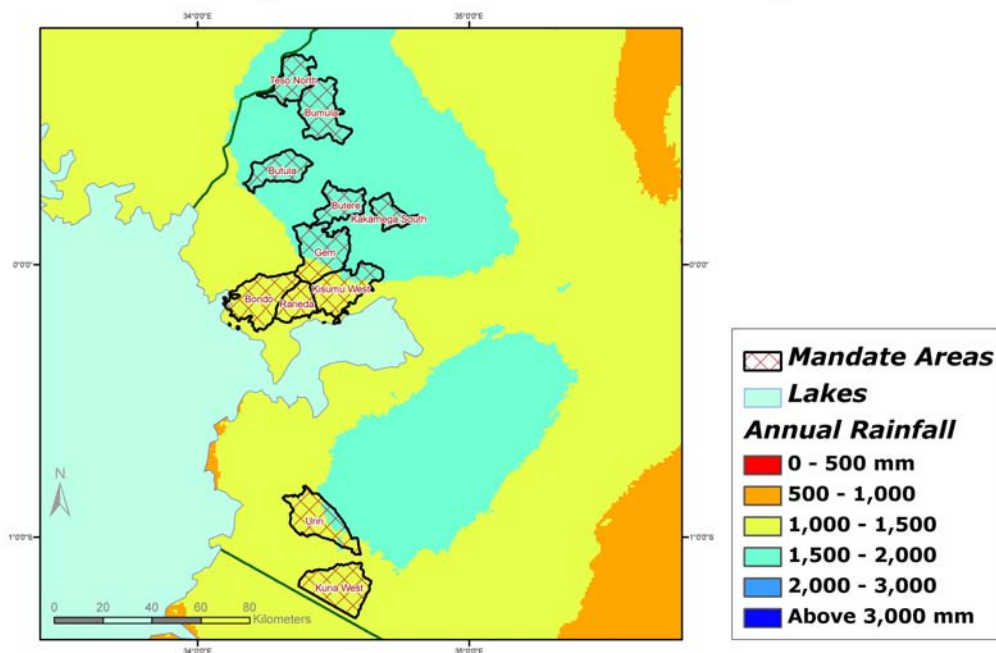| Mandate area	Western				Nyanza	
Site	Bungoma	Kakamega	Vihiga	Siaya	Kisumu	Migori
Agroecological zone	Midlands/ Upper Midlands	Midlands/ Upper Midlands	Upper Midlands	Lake Basin / Midlands	Lake Basin	Lake Basin
Population density (inhabitants km^{-2})	460	440	1200	340	750	300
Main markets for outputs	Bungoma, Chewele, Webuye	Kakamega, Khayega, Shinyalu	Mbale, Chavakali, Rwanda, Majengo	Ugunja, Siaya	Kisumu, Maseno, Aero	Migori, Rongo
Access to urban markets (h)	1 Bungoma 3 Kisumu 8 Nairobi	1 Kakamega 2 Kisumu 7 Nairobi	0.5 Kisumu 6 Nairobi	1 Kisumu 6 Nairobi 2 Maseno	5 Nairobi	5 Kisumu 10 Nairobi
Presence of NARS - National institutions that are active at the sites	Ministry of Agriculture (MoA)	KARI Kakamega MoA	MoA	MoA	KARI Kibos	KESREF MoA
Organisations that are active	BUSSFFO (FA)/ FOTC	CYEEP (NGO)	RPK , SOF-DI	UCRC, SCODP	many	KESOFA (FA), UFCS
Dominant soil types	Acrisol	Acrisols Nitisols Lixisols	Nitisol Acrisols Lixisols	Acrisols Nitisols Gleysols	Fluvisols, Cambisols Luvisols, Planosols	Planosols Phaoezoms Cambisols Acrisols
Annual rainfall (mm)	1590±182	1672±68	1800±200	1476±97	1435±81	1364±161
Annual mean temperature (ºC)	20	20	21	22	22	21
Length growing period (d)	278	325	315	315	315	344
Main crops	Maize, millet, sorghum, sugarcane, cassava, beans, sweet potato	Maize, beans, sugarcane, bananas, sweet potato, kales, tomatoes, cabbage	Maize, beans, tea, vegetables, bananas	Maize, cassava, beans, sweet potatoes	Maize, groundnut, sugarcane, sweet potato	Maize, groundnut, bananas, cassava, pineapple, sugarcane
Farm sizes (ha)	1.8	1.2	0.6	1.2	1	2
Household sizes (#)	6-10	6-8	6-8	6-8	6-8	6-8
Yields of cereals (kg ha^{-1})	650-1100	650-1100	650-1100	650-1100	650-1100	650-1100
Yields of legumes (kg ha^{-1})	300-1000	300-1000	300-1000	300-1000	300-1000	300-1000
Fertiliser use (kg ha^{-1})	10 - 60	10 - 60	10 - 60	10 - 60	10 - 60	10 - 60
Main livestock species	Poultry, goat, cattle	Poultry, goat, cattle	Poultry, goat, cattle	Poultry, goat, cattle	Poultry, goat, cattle	Poultry, goat, cattle
Livestock densities (# hh^{-1})	1 - 10	1 - 10	1 - 10	1 - 10	1 - 10	1 - 10
Main staple food	Maize, beans	Maize, beans	Maize, beans	Maize, beans	Maize, beans	Maize, beans

Figure 3: (a) Annual temperature, (b) Annual rainfall, (c) Length of the growing period, (d) Population density, and (e) Accessibility (time to travel of a town of more than 50,000 inhabitants) in mandate areas of Kenya. Note that due to a recent rearrangement of districts, the names on the maps of Figure 3 do not entirely correspond with the district names in Table 12.
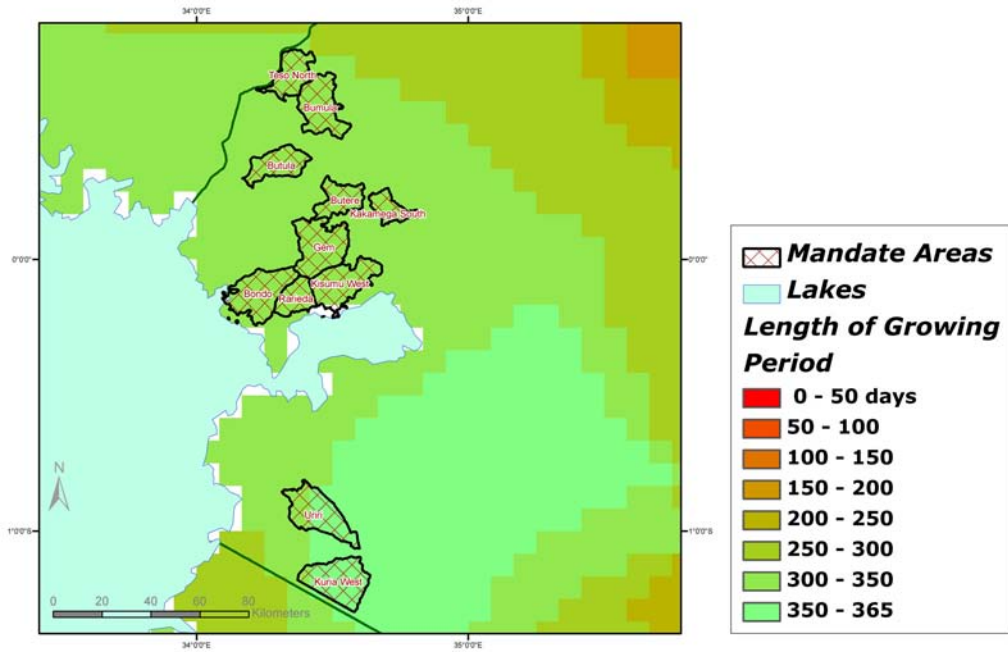
(a)

(b)

(c) *Kenya Mandate Areas: Length of Growing Period*

(d) *Kenya Mandate Areas: Population Density*

(e) Kenya Mandate Areas: Accessibility

Sources:

(a): WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean temperature. Available at http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010).

(b): Source: WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean rainfall. Available at http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010)

(c): CIAT, 2010. Average Length of Growing Period. Derived from: Length of growing period (LGP) zones of the world (FGGD), FAO, 2007. Available at http://www.fao.org/geonetwork/srv/en/resources.get?id=14057&fname=Map4_2.zip&access =private (accessed 24/03/2010). The FGGD LGP zone map is a global raster datalayer with a resolution of 5 arc-minutes. Each pixel contains a class value for the dominant LGP zone found in the pixel. The data are from FAO and IIASA, 2000, Global agro-ecological zones, as reported in FAO and IIASA, 2007, Mapping biophysical factors that influence agricultural production and rural vulnerability.

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(e): ORNL LandScan 2006TM/UT-Batelle, LLC

Estimated travel time to the nearest city of 50,000 or more people in year 2000. 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://bioval.jrc.ec.europa.eu/products/gam/ (accessed 24/03/2010).

4.3   West Africa

4.3.1   Ghana

Three mandate areas have been identified in Ghana: Northern Region, Upper Western Region and Upper East.

All three regions contain major groundnut producing areas. Also cowpea is a major crop, while soybean is mostly produced in the Northern Region. (Table 13). No information could be found on beans. Bean production in these regions is probably low, as temperatures are generally too high for bean cultivation.

Table 13: Production of grain legumes in 3 regions in Ghana (tonnes grain yield)

	Groundnuts	Cowpea	Soybean	Beans
Northern	100 200	55 900	34 700	nd
Upper-West	117 800	43 500	8 700	nd
Upper-East	121 100	31 300	1 200	nd
Total	*339 100*	*130 700*	*44 600*	*nd*

Source: Research and Information Directorate (SRID) of the Ministry of Food & Agriculture of Ghana, average for 200-2007, extracted from CountryStats, FAO.

Population densities vary across and within regions in Ghana (Figure 4; Table 14). All areas have access to urban markets in less than three hours. Temperatures are high in Ghana (relative to sites in other hubs). In general, rainfall distribution and length of the growing season are strongly affected by latitude with northern regions being drier with shorter growing periods than more southern regions. This also affects cropping patterns. Drier regions tend to have more millet and cowpea and less soybean than more humid regions, such as the Northern Region. Groundnut, maize and sorghum are grown throughout northern Ghana. NARS and NGO's are well present in all regions of northern Ghana.

Table 14: Site characteristics of mandate areas in Ghana.

| Indicators	Northern Region	Upper East Region	Upper West Region
Population density (inhabitants per km^2):	61-70	56 – 103	31 – 40
Selected districts	Chereponi, Karaga	Kassena Nankana, Bawku Municipal, Bawku West	Nadowli, Wa Municipal, Wa East
Main markets for outputs (grains, milk, etc)	Tamale, Yendi, Salaga, Tolon, and Gushegu	Bolga, Bawku, Navrongo, Zebilla, Pellingu, Garu, Fumbisi, Sandema	Wa, Babile, Gwollu, Bussie, Sankara, Lawra
Access to urban markets (hours)	2 hours	1 – 3 hours	40 min – 3 hours
Presence of NARS:	CSIR-Savanna Agricultural Research Institute (SARI); CSIR-Animal Research Institute (ARI); CSIR-Water Research Institute (WRI); University for Development Studies (UDS)	CSIR-SARI; CSIR-ARI; CSIR-WRI; CSIR-Soil Research Institute (SRI); CSIR-Forest Research Institute of Ghana (FORIG); UDS	CSIR-SARI; CSIR-ARI; uDS
Presence of NGOs:	MiDA, Action Aid, SEND Foundation, CARE International, ACDEP, UrbANet	CARE International; ACTION AID; World Vision International (WVI); NABOCARDO; ACDEP	PLAN Ghana; Technoserve; Action Aid; Upper West Agro-Industries; CARE International; ACDEP
Soil types:	Sandy-loam soil	Sandy-loam; Sandy-loam; Clay-loam	Sandy-loam Vertisol (only in Karni area)
Annual rainfall (mm)	800-1200 mm	850 – 1200 mm	100 – 1100 mm
Annual mean temperature in growing season (°C):	34°C-38°C	28°C - 35°C	28°C – 35°C
Annual mean temperature in off season (°C):	16°C-42°C	18°C - 40°C	22°C - 40°C

Main crops :	Maize, rice, sorghum, soybean, cowpea, groundnut	Millet; sorghum; maize; rice; groundnut, cowpea; soybean	Sorghum; maize; millet; cowpea; groundnut; soybean; bambara nut
Farm sizes (ha)	0.8– 1.0 ha	0.5 – 5 ha	0.4– 5.0 ha
Household sizes (#)	8 – 20 persons	5 – 7 persons	5 – 10 persons
Yields of cereals	Rice – 1.5 t/ha Maize – 2.5 t/ha	0.45 – 1.0 t/ha	Sorghum: 0.3 t - 0.8 t/ha Maize: 0.5 t – 1.0 t/ha
Yields of legumes	Soybean: 2.5 t/ha Cowpea: 1.2 t/ha	600– 1200 kg/ha	300-800 kg/ha
Fertilizer use (kg per ha)	Average: 625 kg/ha (NPK)	NPK (15-15-15): 250 kg/ha SA (Sulphate of ammonia): 125 kg/ha	Maize: 125 – 250 kg/ha (NPK); Sorghum & millet: no fertilizer applied
Main livestock species	Cattle; goat; sheep; pigs; poultry	Sheep; goats; cattle; pigs; poultry; donkeys	Small ruminants; cattle; pigs; poultry
Livestock densities	Cattle: 10 – 15/hh Sheep: 20 – 35/hh Goat: 50 – 100/hh	Cattle: 5 – 10 /hh	Cattle: 1 – 10/hh
Human diet	Maize + beans Rice + beans	Millet + vegetables + fish Maize + vegetables + fish Cowpea + vegetables + fish Rice + vegetables + fish	Maize; sorghum; cowpea; vegetables
Importance of legumes	Cowpea flour, bambara bean flour or soybean flour for *tubani* and *gablei* , Soybean khebab, soybean for porridge; soybean flour & maize flour for *tubani* and *gablei,* cowpea flour & bambara bean flour for *koshei* (bean cake), boiled cowpea; boiled bambara bean; Soybean for *dawadawa*	As cash crop; legumes are included in all diets; fodder used as feed for animals	Cash crop; food crop; fodder

Figure 4: (a) Annual temperature, (b) Annual rainfall, (c) Length of the growing period, (d) Population density, and (e) Accessibility (time to travel of a town of more than 50,000 inhabitants) in mandate areas of Ghana.

(a) *Ghana Mandate Areas: Annual Mean Temperature*
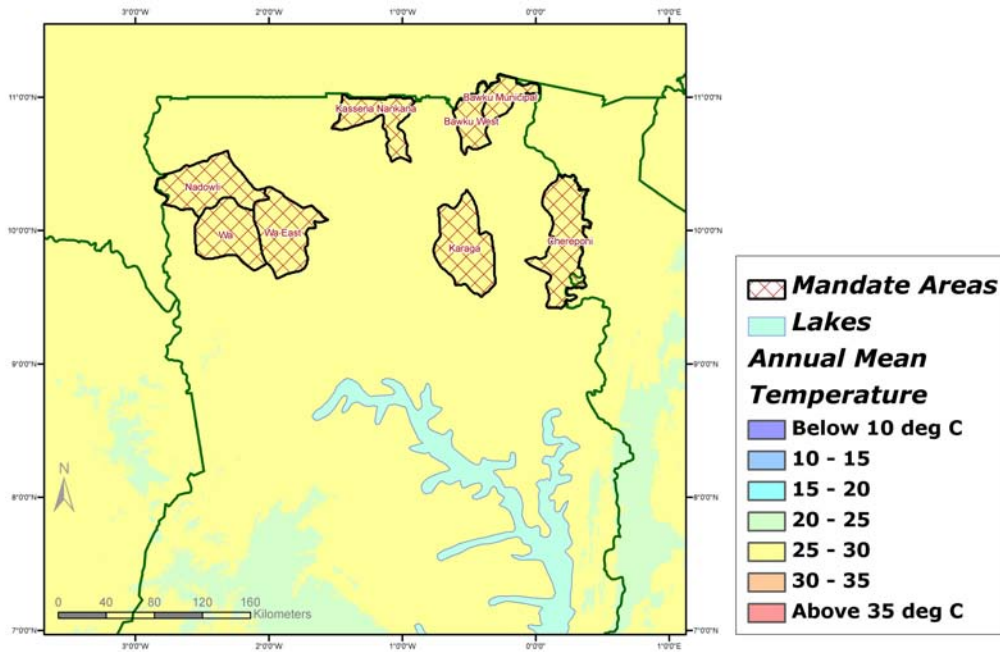
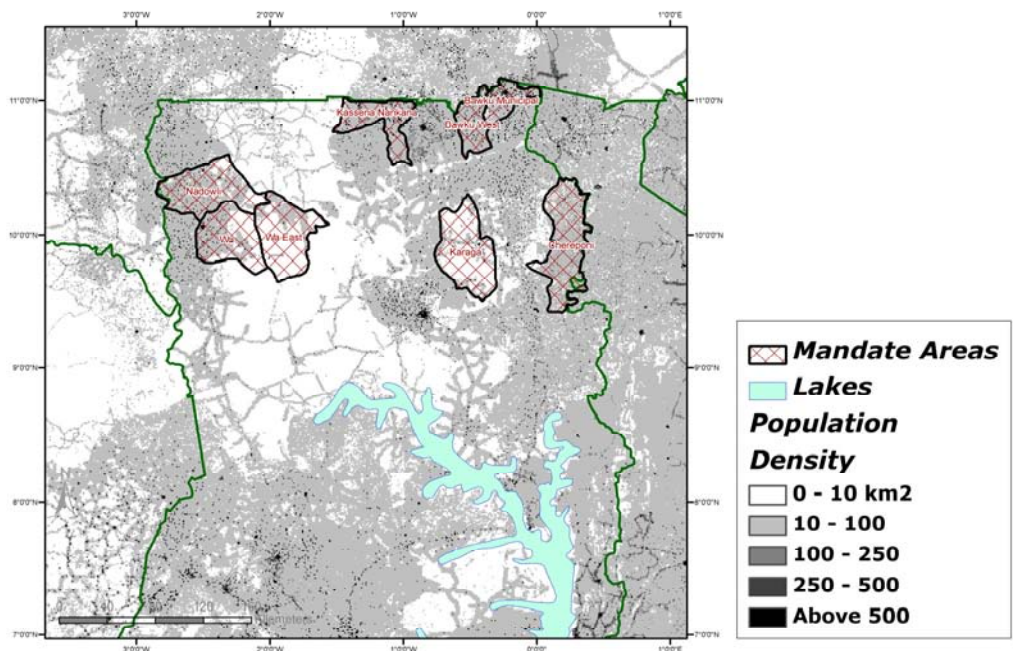**(b)** *Ghana Mandate Areas: Annual Rainfall*
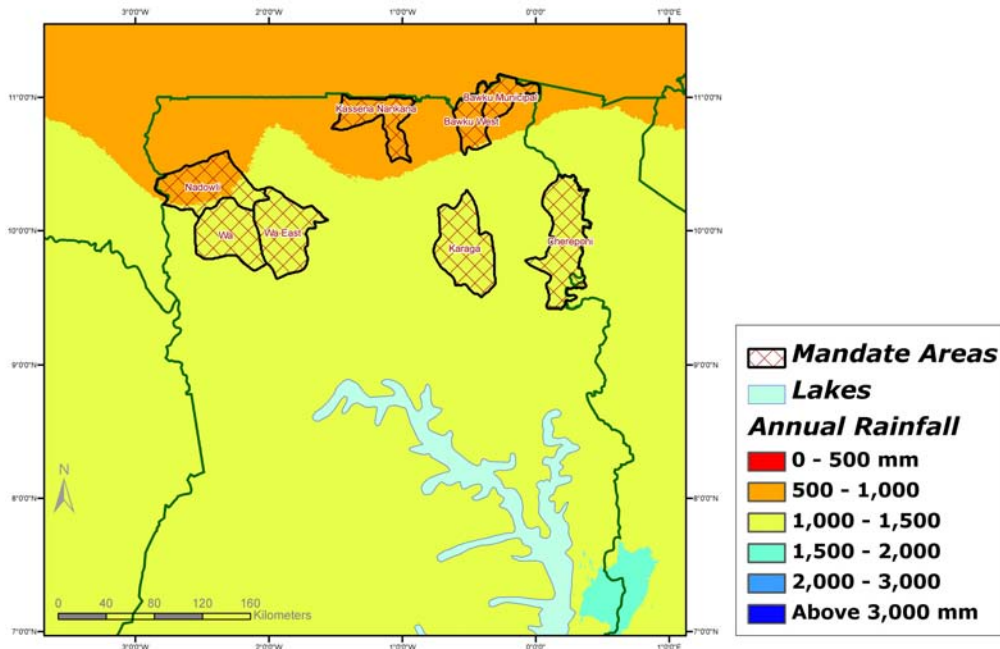
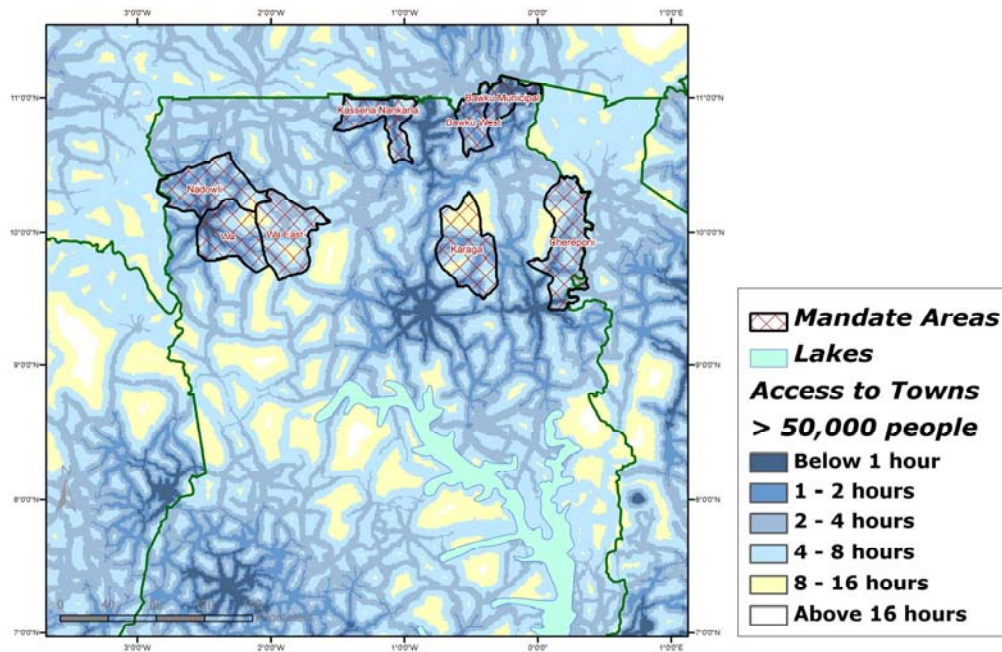**(c)** *Ghana Mandate Areas: Length of Growing Period*
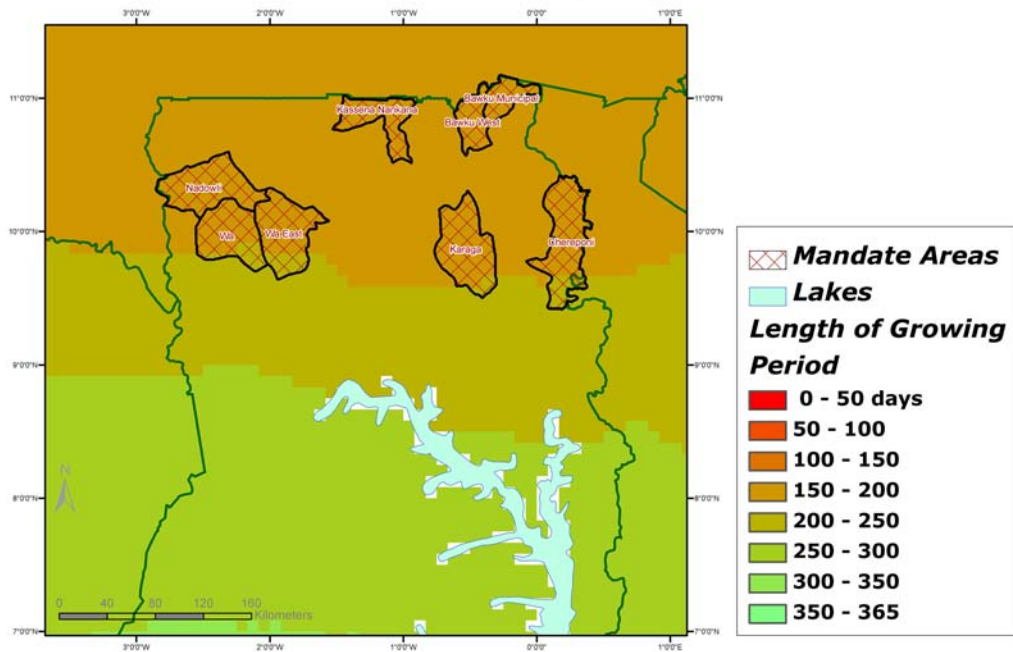
(d) *Ghana Mandate Areas: Population Density*

(e) *Ghana Mandate Areas: Accessibility*

Sources:
(a): WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean temperature. Available at http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010).

(b): Source: WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean rainfall. Available at http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010)

(c): CIAT, 2010. Average Length of Growing Period. Derived from: Length of growing period (LGP) zones of the world (FGGD), FAO, 2007. Available at
http://www.fao.org/geonetwork/srv/en/resources.get?id=14057&fname=Map4_2.zip&access =private (accessed 24/03/2010). The FGGD LGP zone map is a global raster datalayer with a resolution of 5 arc-minutes. Each pixel contains a class value for the dominant LGP zone found in the pixel. The data are from FAO and IIASA, 2000, Global agro-ecological zones, as reported in FAO and IIASA, 2007, Mapping biophysical factors that influence agricultural production and rural vulnerability.

(d): ORNL LandScan 2006TM/UT-Batelle, LLC

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Estimated travel time to the nearest city of 50,000 or more people in year 2000. 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://bioval.jrc.ec.europa.eu/products/gam/ (accessed 24/03/2010).

4.3.2 Nigeria

The mandate areas are Kaduna State with the action sites of Igabi, Giwa, Kachia, Soba and Zangon Kataf and Kano State with the action sites of Bichi, Bunkure, Garko, Warawa and Wudil. Within Kaduna state, a distinction can be made between sites in northern Kaduna (Giwa, Igabi and Soba) and sites in southern Kaduna (Kachia and Zangon Kataf). The distinction is based on differences in agro-ecology, socio-economics and culture.

The sites in Kano State are all relatively close to the major city of Kano (Table 15; Figure 5). Although this area is dry and the growing season is short, farming is rather intense and population densities are high here. Population densities in northern and southern Kaduna State are lower. Some major urban centres are situated in Kaduna State (Kaduna city and Zaria). The action sites in southern Kaduna State are further away from urban centres than the other action sites. The dominant cropping patterns change as rainfall and soil types change in northern Nigeria. Southern Kaduna has the highest rainfall and the longest growing season and important crops include yam, ginger, besides the cereals and legumes that are grown across the selected sites. The drier, northern areas produce more cereals (millet, maize, sorghum and rice) and cowpea. Nigeria is the world's largest cowpea producer and most of this production takes place in northern Nigeria. Only in Kaduna State, the length of the growing period is sufficient to grow soybean. Livestock densities are lower in southern Kaduna than in northern Kaduna and Kano State, where livestock make up an important component of the farming systems. Legumes (cowpea) form a major part of the diet at all sites.

Table 15: Site characteristics of mandate areas in Nigeria.

|	Kano state	Kaduna state	
		Northern Kaduna:	Southern Kaduna:
Action sites (Local Government Areas)	Bichi, Warawa, Wudil Bunkure, Garko	Giwa, Igabi, Soba	Kachia, Zangon Kataf
Agroecological zone	Northern Guinea/Sudan savanna	Northern Guinea savanna	Southern Guinea savanna
Population density (inhabitants per km^2)	304-587	109-129	37-86
Main markets for outputs	Dawanau, Garki, Kachako	Giwa	Kafanchan, Jos
Access to urban markets [b] (h)	1-2	2-3	3-4
Presence of NARS	IAR, BUK	IAR	IAR, NCRI
Other organisations that are active	KNARDA, SG2000, DDI, USAID, WASA, IFDC	KADP, SG2000, DDI, USAID, WASA, IFDC	KADP, SG2000, DDI, USAID, WASA, IFDC
Dominant soil types	Alfisols (Luvisols)	Alfisols (Luvisols)	Alfisols (Luvisols)
Annual rainfall (mm)	714-841	1090-1165	1392-1429
Annual mean temperature (ºC)	26-27	25	24-25
- growing season (ºC)	22	22	22
Length growing period (d)	135	165	195
Main crops	Rice, Maize, sorghum, millet, cowpea, groundnut, vegetables	Soybean, cowpea, maize, sorghum, millet	Sorghum, maize, yam, ginger, sesame, soybean
Farm size (ha)	0.5-1.0	0.5-1.0	0.5-1.0
Household size (#)	3-13	3-13	3-9
Yields of cereals (kg ha^{-1})	Millet: 500-800 Maize: 600-1100 Sorghum: 500-1000	Millet: 500-800 Maize: 600-1100 Sorghum: 500-1000	Millet: 500-800 Maize: 600-1100 Sorghum: 500-1000
Yields of beans (kg ha^{-1})	Cowpea: 500-850 G/nut: 800-1,200 Soybean: 900-1200	Cowpea: 500-850 G/nut: 800-1,200 Soybean: 900-1200	Cowpea: 500-850 G/nut: 800-1,200 Soybean: 900-1200
Fertiliser use (kg ha^{-1})	8-10 kg on cereals	8-10 on cereals	8-10 on cereals
Main livestock species	Cattle, sheep, goats, poultry	Cattle, sheep, goats, poultry	Sheep, goats, poultry, pigs
Main staple food	Maize, rice, cowpea	Maize, rice, cowpea	Maize, rice, yam
Role of legumes in the diet	Major source of protein	Major source of protein	Major source of protein

Figure 5: (a) Annual temperature, (b) Annual rainfall, (c) Length of the growing period, (d) Population density, and (e) Accessibility (time to travel of a town of more than 50,000 inhabitants) in mandate areas of Nigeria.

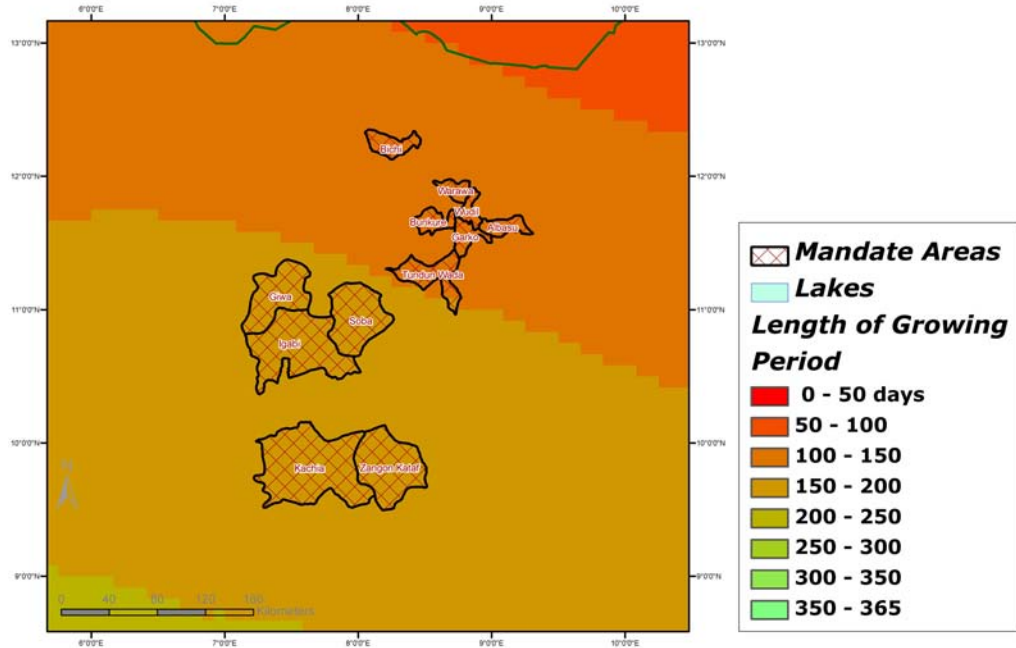**(a)** *Nigeria Mandate Areas: Annual Mean Temperature*
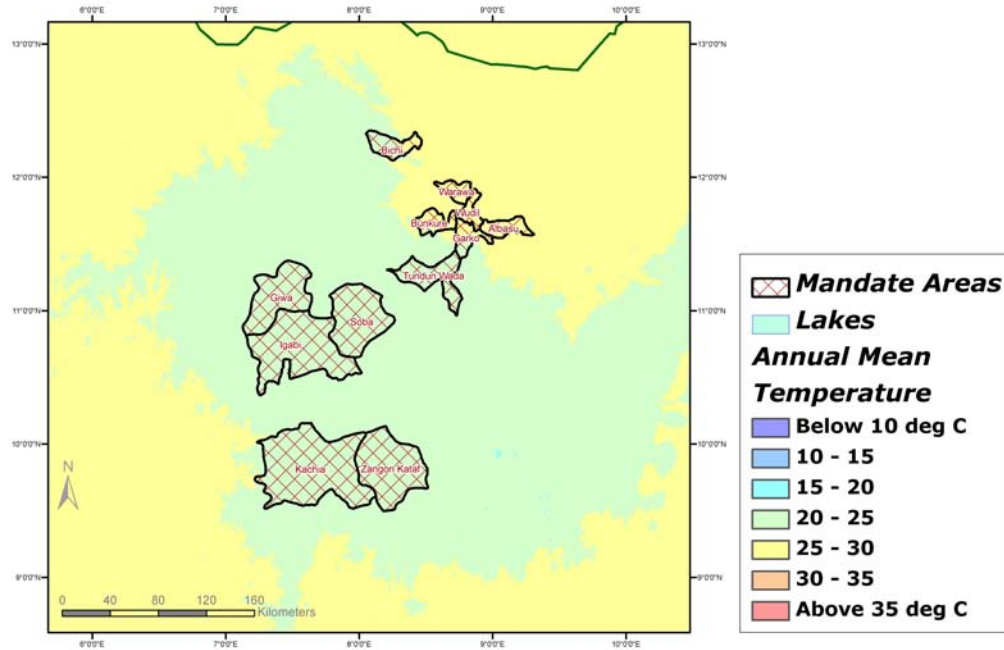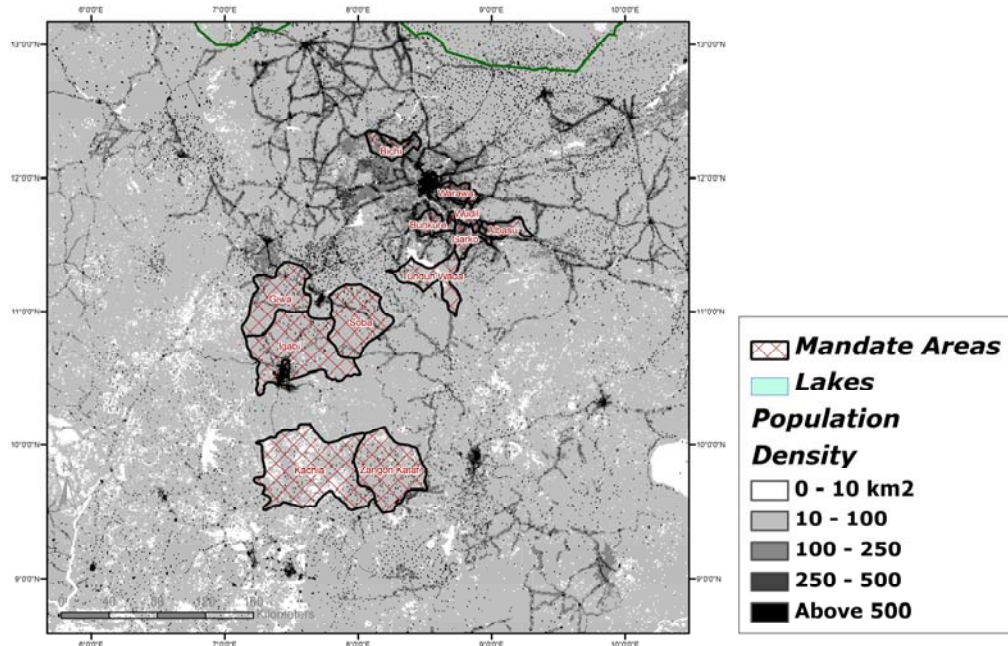

(b) *Nigeria Mandate Areas: Annual Rainfall*
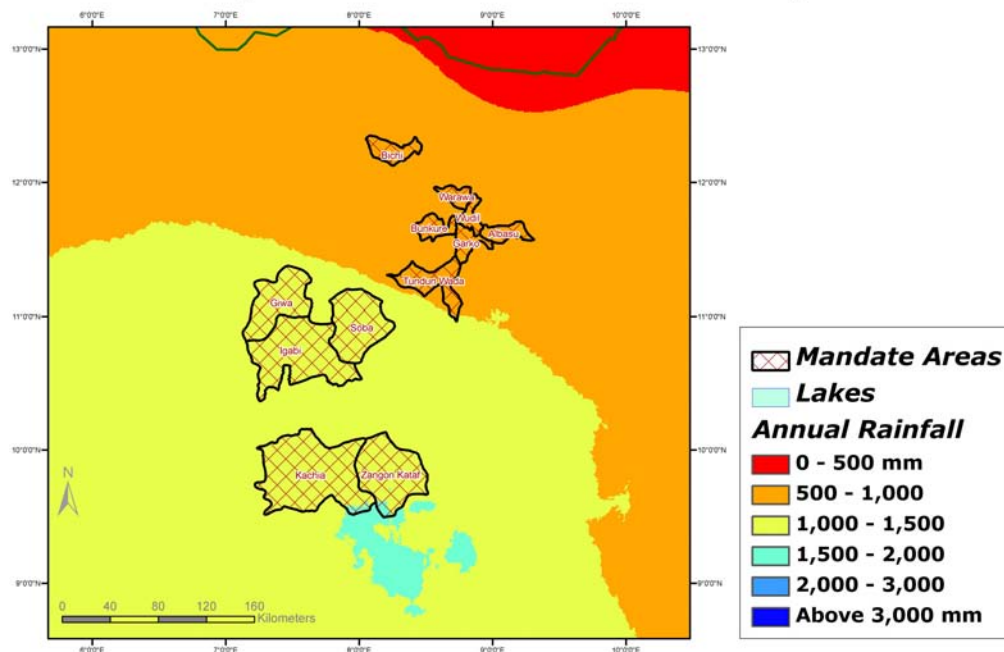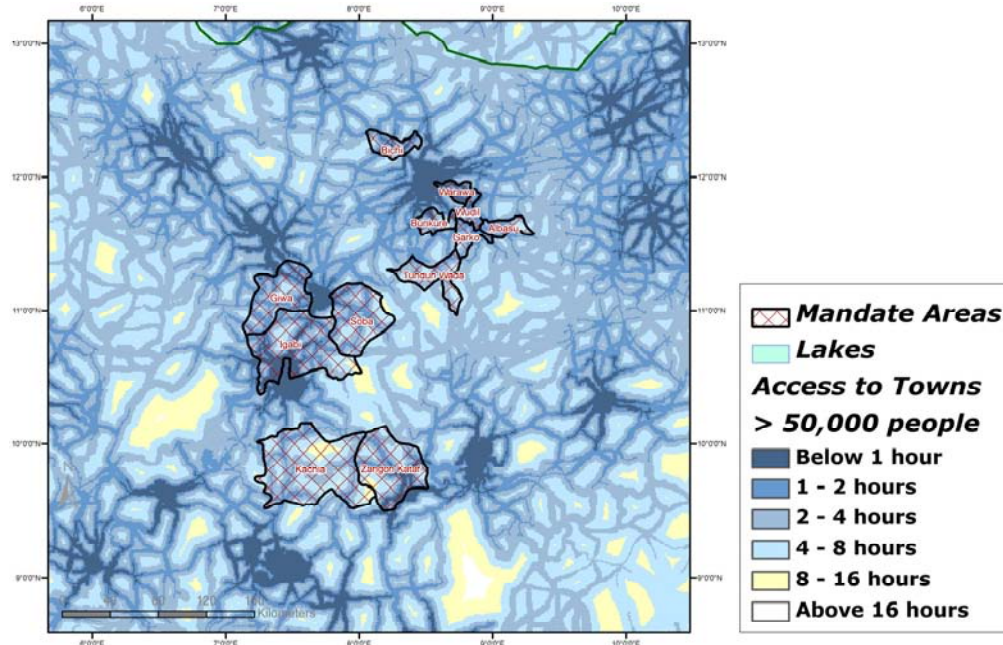
(c) *Nigeria Mandate Areas: Length of Growing Period*

(d) *Nigeria Mandate Areas: Population Density*

(e) Nigeria Mandate Areas: Accessibility

Sources:
(a): WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean temperature. Available at
http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010).

(b): Source: WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean rainfall. Available at
http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010)

(c): CIAT, 2010. Average Length of Growing Period. Derived from: Length of growing period (LGP)
zones of the world (FGGD), FAO, 2007. Available at
http://www.fao.org/geonetwork/srv/en/resources.get?id=14057&fname=Map4_2.zip&access =private
(accessed 24/03/2010). The FGGD LGP zone map is a global raster datalayer with a resolution of 5
arc-minutes. Each pixel contains a class value for the dominant LGP zone found in the pixel. The data
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Mapping biophysical factors that influence agricultural production and rural vulnerability.

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Monitoring Unit - Joint Research Centre of the European Commission, Ispra Italy. Available at
http://bioval.jrc.ec.europa.eu/products/gam/ (accessed 24/03/2010).

4.4   Southern Africa

4.4.1   Malawi

The districts in Malawi where N2Africa works are Lilongwe, Ntcheu, Salima, Mchinji and Kasungu. Agro-ecological characteristics (temperature, rainfall, length of the growing period, etc.) are approximately similar in all sites in Malawi (Table 16; Figure 6). Population densities and market access are clearly higher in Lilongwe district, obviously because of the proximity of Lilongwe city. Besides beans, groundnut, soybeans and cereals, tobacco is an important cash crop in most of the sites. In Salima district, also cotton is a major cash crop. Farmers in Malawi apply fertilizer in the form of urea and NPKS blends. Most of the fertiliser blends have been developed for application to tobacco. Maize is by far the most important staple food in all sites of Malawi. Farmers mostly grow groundnut as a legume crop, with smaller areas with cowpea, soybean or common bean.

Dowa district in Malawi indicated in Figure 6 was initially selected for N2Africa activities in the first year. However, plans for activities in this district were abandoned later onwards and characteristics from Dowa are therefore not included in Table 16.

Table 16: Site characteristics in Malawi. Experts: P.C. Nalivata, A. Kabuli

| Indicators	Salima	Ntcheu	Lilongwe	Mchinji	Kasungu
Population density (inhabitants per km^2)	129	128	250-500	100-250	100-250
Main markets for outputs	Salima Boma	Tsangano Market; Njolomole	LL Central Markt	Kamwendo Market	Kasungu Boma
Access to urban markets (h)	3-4	4	0.5-2	2-4	2-4
Presence of NARS	Chitala Research Station	Tsangano Research Station	Chitedze / Bunda / NRC	NONE	ARET Farm Institute
Other organisations					
Dominant soil types	Alluvial often calcimorphic	Lithosols & ferruginous			
Annual rainfall (mm)	953±44	938±92			
Annual mean temperature (ºC)	23	21	20	20	20
Length growing period (d)	165	165	165	165	165
Main crops	Cotton, maize, tobacco, soybeans, cowpea, rice	Maize, wheat, potato, common beans, rice	Maize, groundnuts, tobacco, beans,	Maize, tobacco, groundnuts, soybeans, beans	Tobacco, maize, soybeans, beans
Farm size (ha)	0.5 – 1.5	0.4 – 1.5	0.7-1.5	0.5-1.5	0.7-1.5
Household size (#)	4.7	4.7	4-5	5	5.3
Yields of cereals (kg ha^{-1})	Maize: 1600-3000; Rice: 1000-2000	Maize: 1600-2300; Rice: 1100-1200			
Yields of beans (kg ha^{-1})	G/nuts: 1000-1200; Beans: 800-1000	G/nuts: 620-1100; Beans: 400-800; Cowpea: 400-650; Soybean: 600-1200			
Fertiliser use (kg ha^{-1})	N:P:K:S (92:40:0:20) – use NPK+S & Urea or CAN - Usage vary greatly based on access	N:P:K:S (92:40:0:20) – use NPK+S & Urea or CAN - Usage vary greatly based on access			
Main livestock species	Cattle and goats	Cattle, goat, pigs	Goats, Poultry, Cattle, Pigs	Goats, Cattle, Pigs, Poultry	Cattle, Goats, Poultry, Pigs
Main staple food	Maize with beans, vegetables, fish, other legumes	Maize with beans, vegetables, fish, meat (rarely), other legumes	Maize, beans, meat	Maize, fish, beans, meat	Maize, meat, beans, fish
Role of legumes in the diet	Provide cheap source of protein, roasting, vitamins	Provide cheap source of protein, roasting, vitamins	Provide cheap source of protein, roasting, vitamins	Provide cheap source of protein, roasting, vitamins	Provide cheap source of protein, roasting, vitamins

Figure 6: (a) Annual temperature, (b) Annual rainfall, (c) Length of the growing period, (d) Population density, and (e) Accessibility (time to travel of a town of more than 50,000 inhabitants) in mandate areas of Malawi and northern Mozambique. Note that Dowa district is not included in the N2Africa project in the first growing season.

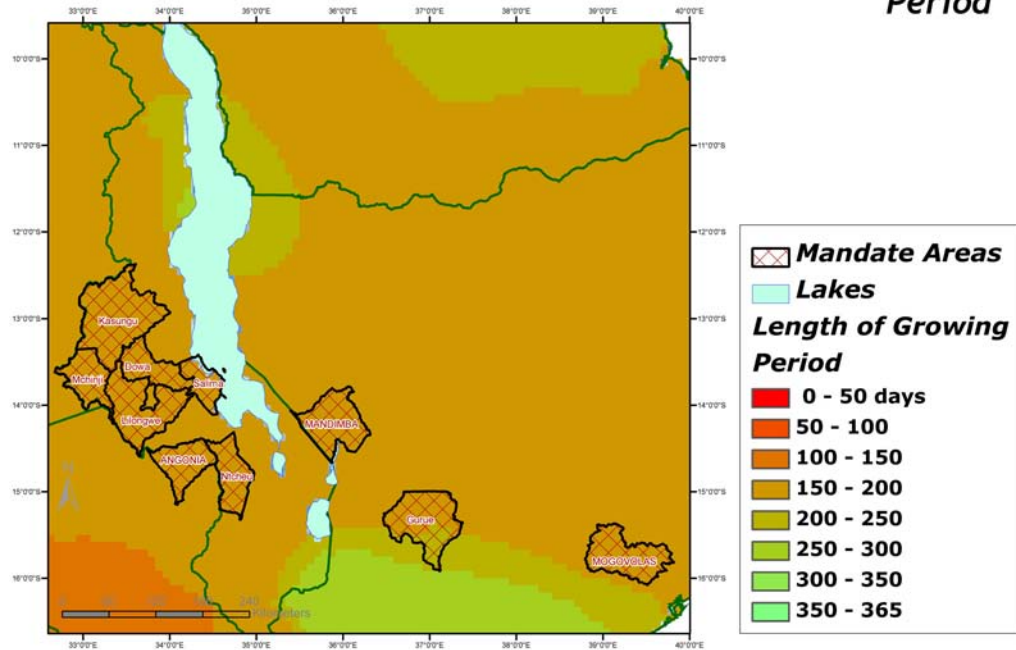**(a)** *Malawi & Mozambique Mandate Areas: Annual Mean Temperature*
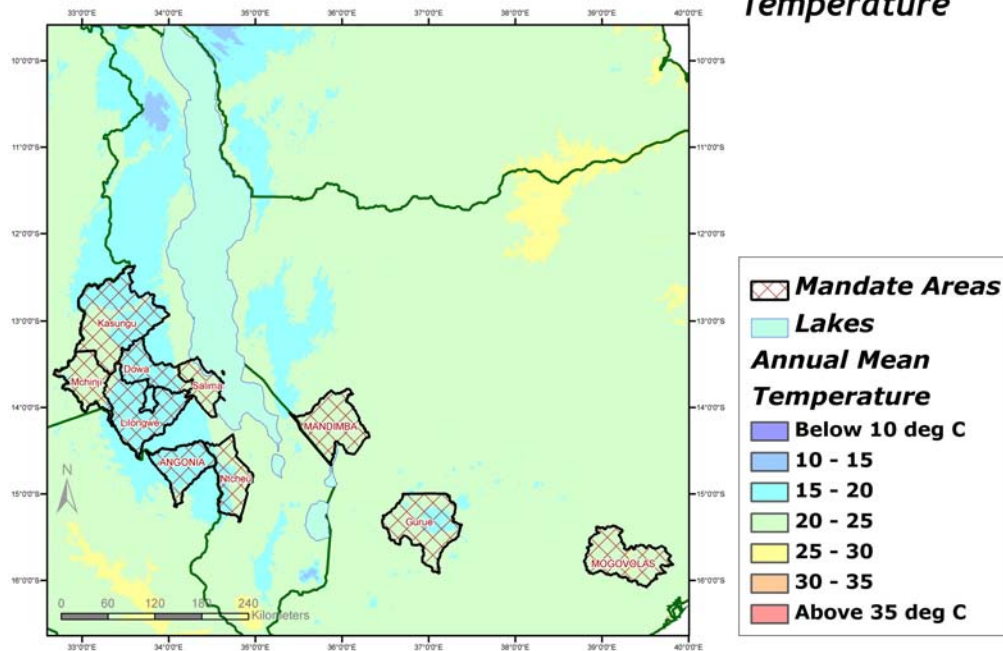
(b) *Malawi & Mozambique Mandate Areas: Annual Rainfall*
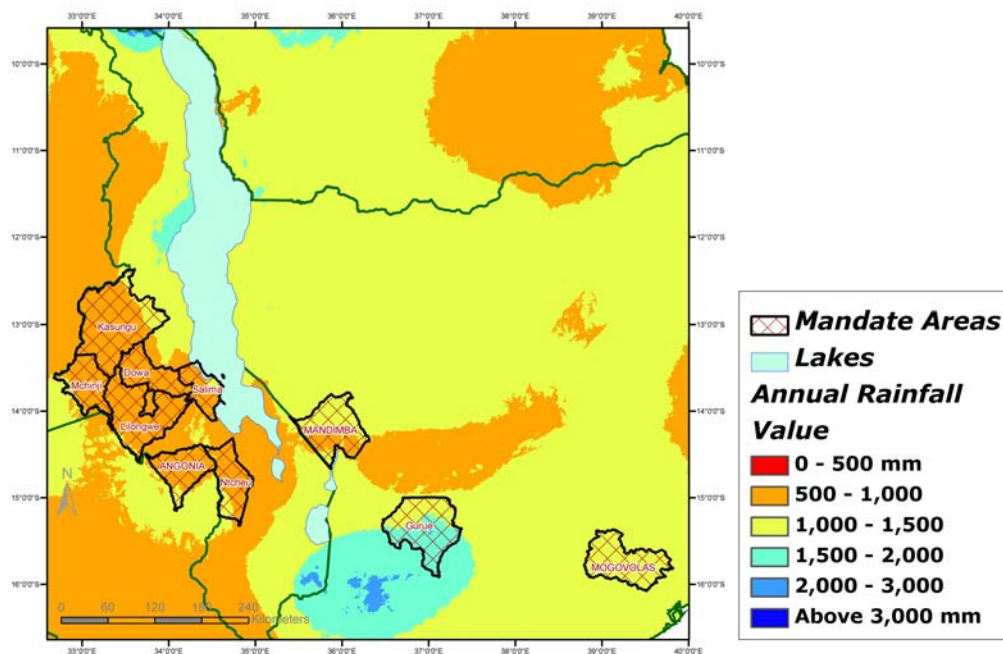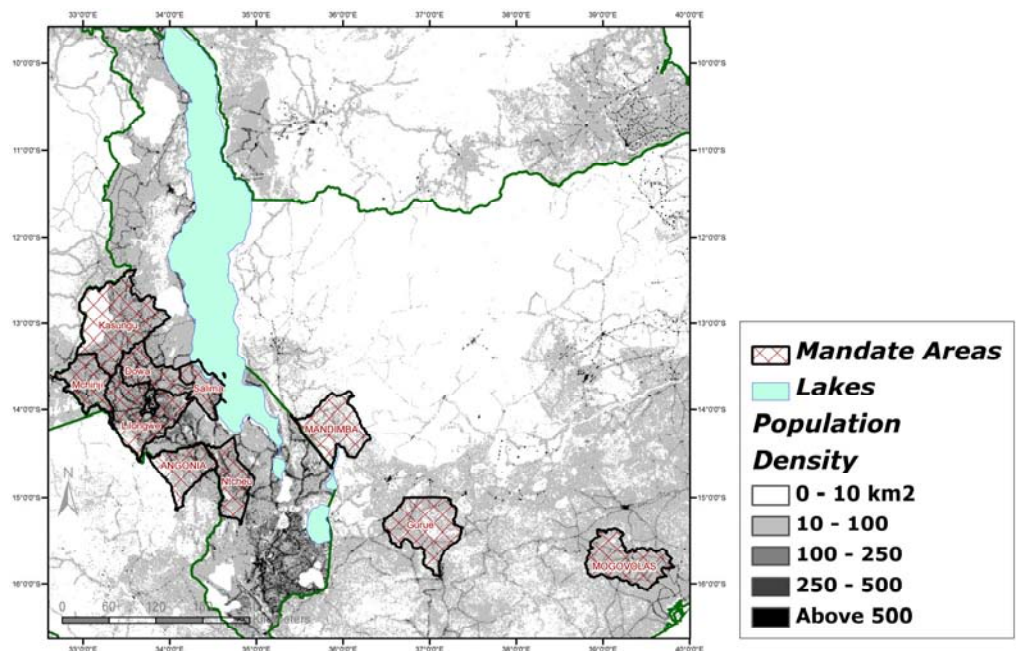
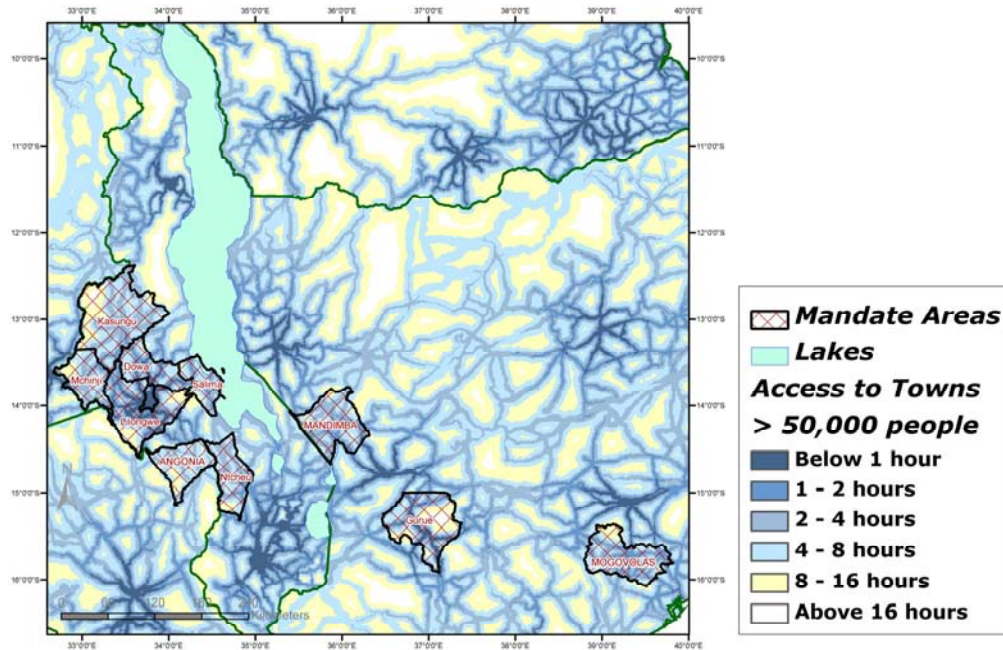**(c)** Malawi & Mozambique Mandate Areas: Length of Growing Period

(d) Malawi & Mozambique Mandate Areas: Population Density

(e) Malawi & Mozambique Mandate Areas: Accessibility

Sources:
(a): WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean temperature. Available at http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010).

(b): Source: WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean rainfall. Available at http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010)

(c): CIAT, 2010. Average Length of Growing Period. Derived from: Length of growing period (LGP) zones of the world (FGGD), FAO, 2007. Available at http://www.fao.org/geonetwork/srv/en/resources.get?id=14057&fname=Map4_2.zip&access =private (accessed 24/03/2010). The FGGD LGP zone map is a global raster datalayer with a resolution of 5 arc-minutes. Each pixel contains a class value for the dominant LGP zone found in the pixel. The data are from FAO and IIASA, 2000, Global agro-ecological zones, as reported in FAO and IIASA, 2007, Mapping biophysical factors that influence agricultural production and rural vulnerability.

(d): ORNL LandScan 2006TM/UT-Batelle, LLC

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(e): ORNL LandScan 2006TM/UT-Batelle, LLC

Estimated travel time to the nearest city of 50,000 or more people in year 2000. 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://bioval.jrc.ec.europa.eu/products/gam/ (accessed 24/03/2010).

4.4.2 Mozambique

The N2Africa project works in the provinces of Zambesia (Gurué), Manica (Sussudenga), Tete (Angonia), Nampula (Mogovolas) and Niassa (Mandimba). Sites are compared in Table 17 and in Figures 6 and 7. In general, population densities are low in Mozambique. As a result, the time required to reach main markets from the mandate areas is relatively high. In Angonia in Mozambique, Lilongwe City in Malawi is also a main market outlet for produce. In all areas, NARS and other agricultural organisations or projects are active, but this presence is not very intense. Altitude differs considerably between areas with Mogovolas having the lowest altitude and highest temperatures and Angonia the highest altitude and the lowest temperatures. Gurué receives considerably more rain than the other areas. Common crops are maize, common bean and potato. In the warm, low altitude region of Mogovolas, cassava, cowpea and groundnut are more dominant. In the highland altitude areas of Angonia, tobacco is also produced. Fertiliser use is generally low in Mozambique. Grain legumes play a major role as sources of protein in rural diets.

Table 17: Site characteristics in Mozambique. Expert: S.K. Boahen

| Indicators	Gurué	Sussundenga	Angonia	Mogovolas	Mandimba
Agro-ecological zone	Tropical Humid Savanna	Humid Savanna	Humid Savanna	Semi-Arid Savanna	Sub-Humid Savanna
Population density (inhabitants per km^2)	38	25	100	25	75
Main markets for outputs	Gurue, Quelimane and Nampula	Chimoio and Beira	Tete, Ulongwe and Lilongwe (Malawi)	Nampula	Lichinga
Access to urban markets (h)	Within 6 hours	Within 4 hours	Within 4 hours	Within 3 hours	Within 2 hours
Presence of NARS	Yes	Yes	Yes	Yes	Yes
Other active organisations	CLUSA/IKURU	TNS, SIWAMA / FO Farmers associations	CLUSA / TNS	IKURU	TNS
Dominant soil types	Clay Loam	Sandy Clay Loam	Clay Loam	Sandy Loam	Clay Loam
Annual rainfall (mm)	1800-2200	1000-1400	1300-1800	800-1000	1200-1400
Annual mean temperature (ºC)	22	21	20	24	22
- growing season (ºC)	15-23	20-24	15-22.5	20-26	18-24
- off-season (ºC)	12-22	15-21	12-20	20-24	18-20
Length growing period (d)	204	192	197	168	175
Average altitude (masl)	707m	630m	1389m	350m	750m
Main crops	Maize, common bean, soybean and potatoes	Maize, potatoes, common bean, cowpea	Maize, common bean potatoes, soybean, tobacco	Cassava, maize, cowpea, ground nut	Maize, cowpea, sorghum
Farm size (ha)	0.5-2.5	0.5-2.5	0.75-3.5	0.5-2	1-3
Household size (#)	5-6	4	5	4-5	3
Yields of cereals (kg ha^{-1})	900-100	1000-1500	800-1600	800	1000-1500
Yields of beans (kg ha^{-1})	750 (common bean) 800 (soybean)	150 (common bean) 600 (soybean)	600-700 (common bean) 750 (soybean)	500 (cowpea)	550 (Cowpea)
Fertiliser use (kg ha^{-1})	Less than 5 kg/ha	Less than 15 kg/ha	Less than 20 kg/ha	Less than 5 kg/ha	Less than 5 kg/ha
Main livestock species	Chicken, goat, pork	Chicken, pork, cow	Chicken, cow, goat, pork	Chicken, goat, sheep	Cow, chicken, duck, goat, pork
Main staple food	Maize, common bean, rice, potatoes	Maize, common bean, rice	Maize, common bean, potatoes	Cassava, maize, cowpea	Maize, cassava, cowpea
Role of legumes in the diet	Major source of protein	Major source of protein	Major source of protein	Major source of protein	Major source of protein

Figure 7: (a) Annual temperature, (b) Annual rainfall, (c) Length of the growing period, (d) Population density, and (e) Accessibility (time to travel of a town of more than 50,000 inhabitants) in mandate areas of Zimbabwe and central Mozambique. Note that Makonde district in Zimbabwe has been dropped as a mandate area in Zimbabwe in the first growing season, while neighbouring Chegutu has been added as a project area.

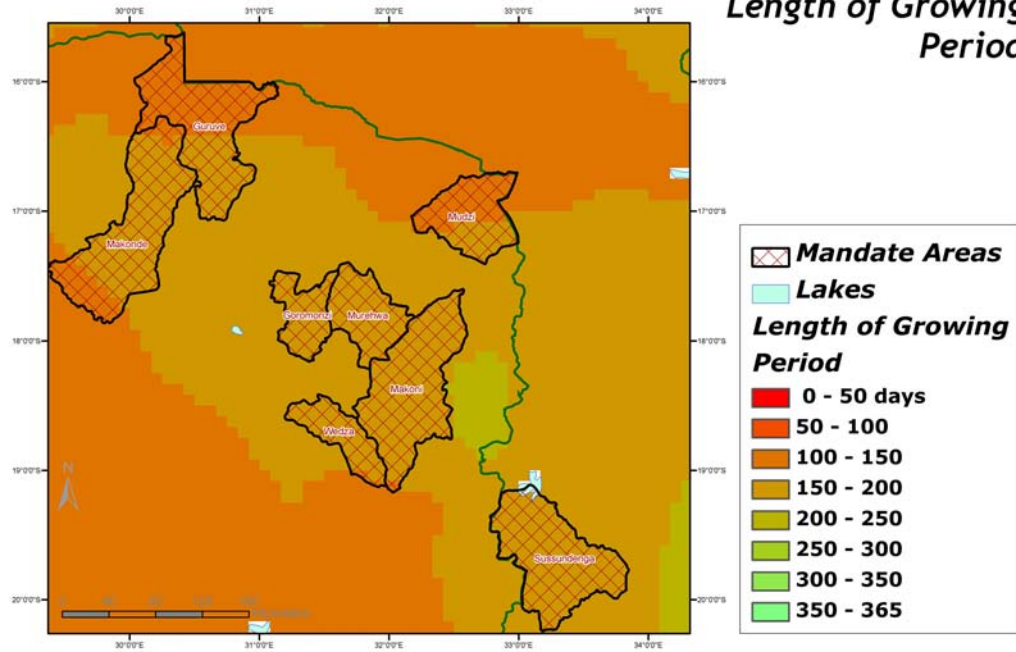**(a)** Zimbabwe & Mozambique Mandate Areas: Annual Mean Temperature
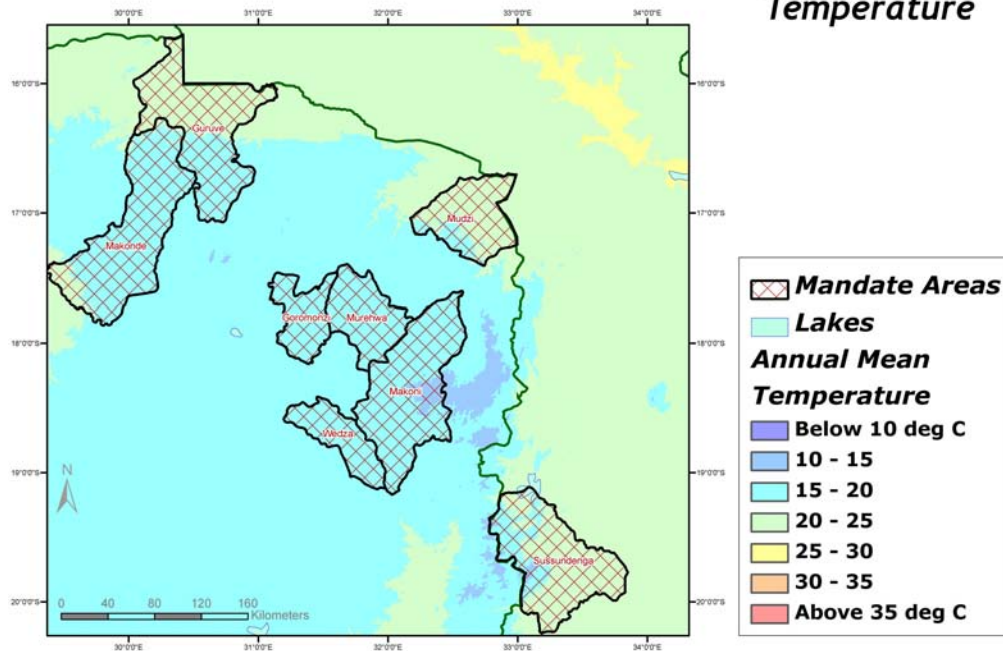
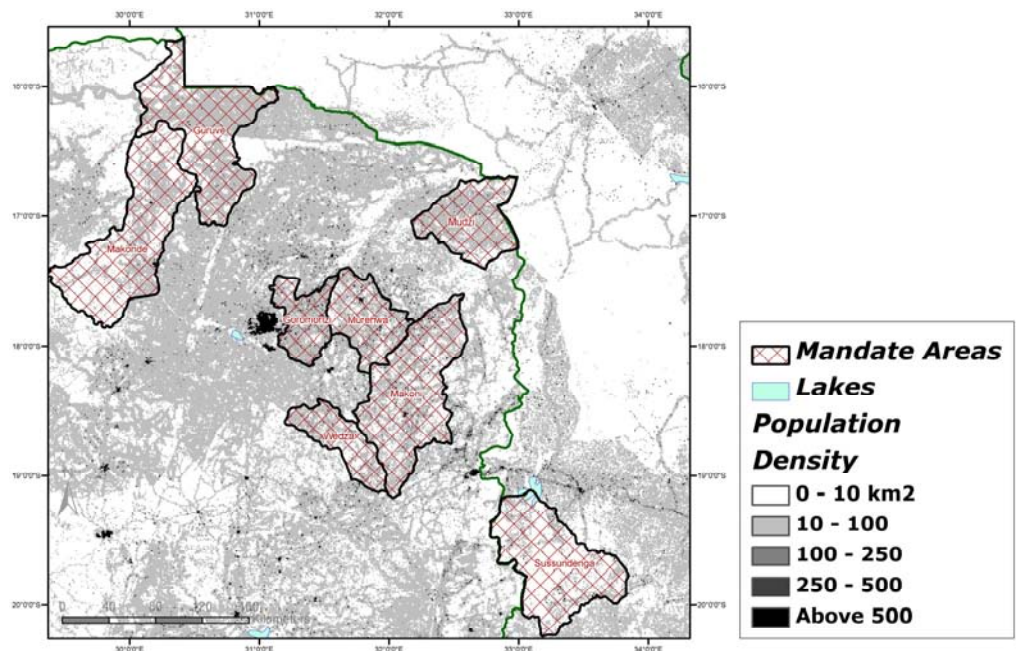**(b)** Zimbabwe & Mozambique Mandate Areas: Annual Rainfall
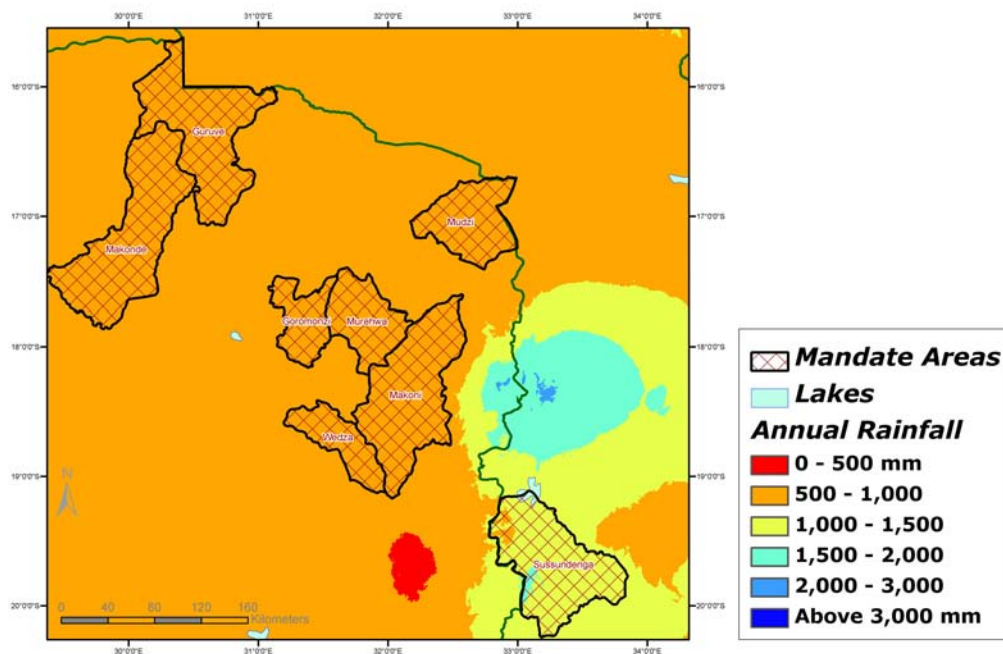
(c) **Zimbabwe & Mozambique Mandate Areas: Length of Growing Period**
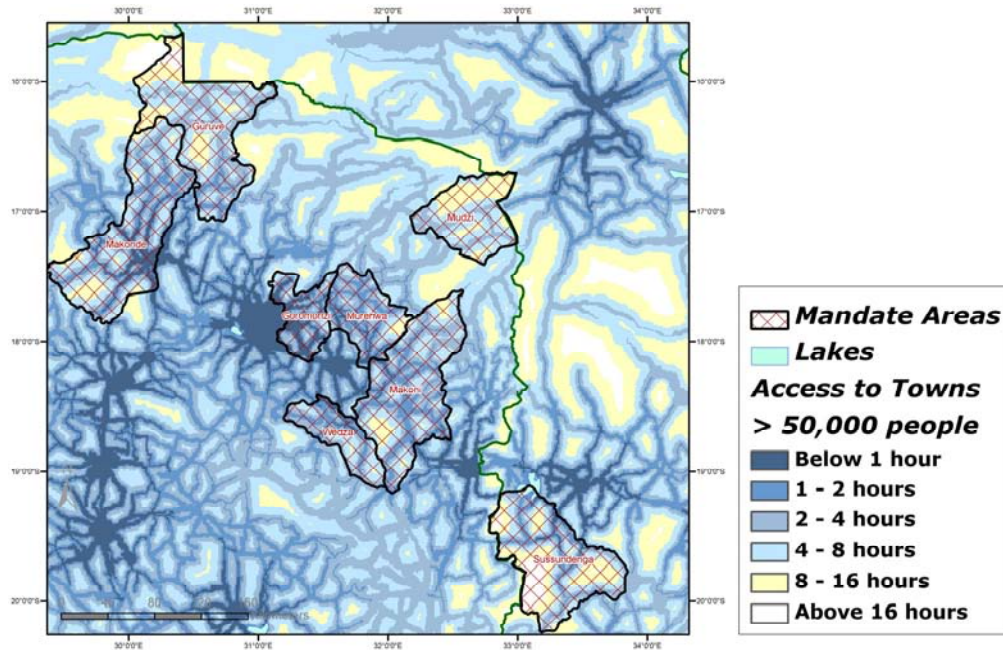

(d) **Zimbabwe & Mozambique Mandate Areas: Population Density**

(e) *Zimbabwe & Mozambique Mandate Areas: Accessibility*

Sources:
(a): WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean temperature. Available at
http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010).

(b): Source: WorldClim – Global Climate Data (v1.4), 30 arc-seconds, mean rainfall. Available at
http://biogeo.berkeley.edu/worldclim1_4 (accessed 24/03/2010)

(c): CIAT, 2010. Average Length of Growing Period. Derived from: Length of growing period (LGP)
zones of the world (FGGD), FAO, 2007. Available at
http://www.fao.org/geonetwork/srv/en/resources.get?id=14057&fname=Map4_2.zip&access =private
(accessed 24/03/2010). The FGGD LGP zone map is a global raster datalayer with a resolution of 5
arc-minutes. Each pixel contains a class value for the dominant LGP zone found in the pixel. The data
are from FAO and IIASA, 2000, Global agro-ecological zones, as reported in FAO and IIASA, 2007,
Mapping biophysical factors that influence agricultural production and rural vulnerability.

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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://bioval.jrc.ec.europa.eu/products/gam/ (accessed 24/03/2010).

4.4.3   Zimbabwe

The selected mandate areas and actions sites in Zimbabwe are Manicaland province (Makoni district), Mashonaland East province (Wedza, Murewa, Mudzi and Goromonzi districts), Mashonaland West province (Chegutu) and Mashonaland Central (Guruve). Sites are compared in Table 18 and Figure 7. Characteristics of natural regions in Zimbabwe are given in Table 19. The districts of Guruve and Mudzi are relatively dry and hot, and further away from urban centres than the other districts. Guruve and Mudzi are also the only two districts that fall under natural region IV, implying the region is primarily suitable for semi-extensive farming. The other districts fall under natural region II or III, implying the regions are suitable for (semi-)intensive arable farming. The district of Makoni is the only district including high altitude areas. Maize is a main commercial and staple crop throughout Zimbabwe. Groundnut and soybean are main legume crops. Tobacco is grown in some areas as a cash crop.

Table 18: Site characteristics in Zimbabwe. Experts: J. Rurinda, K. Giller, T. Mombeyarara, J. de Wolf

Indicators	Makoni	Wedza	Murehwa	Mudzi	Goromonzi	Chegutu	Guruve
Agro-ecological zone	Natural region IIb & III	Natural region IIb & III	Natural Region IIa & IIb	Natural Region IV	Natural Region IIa	Natural Region III	Natural Region IV
Population density (inhabitants per km^2)	30	23	104				
Main markets for outputs					Harare	Chegutu, Harare	Chinoyi, Harare
Access to urban markets (h)	4	3	2	4	1	2	4
Dominant soil types	Luvisols, Cambisols, Leptsols	Luvisols, Cambisols	Luvisols, lixisols	Ferric luvisols	Luvisols, lixisols	Ferric luvisols	Chromic luvisols, Lithosols
Annual rainfall (mm)	765±61	758±52	850	450-500	700-1050 (800)	500/600-800	450-650 (600)
Annual mean temperature (ºC)	17	18		23	18		26.5
Length growing period (d)	182	164	182		182		
Average altitude (masl)	1500-2000	900-1100	1100-1500	500-900	1300-1500	1100-1300	1500
Main crops	Maize, groundnuts	Maize, groundnuts, tobacco, vegetables	Maize, groundnuts		Maize, groundnuts	Maize, groundnuts	
Yields of cereals (kg ha^{-1})				0.5			
Main livestock species	Cattle, goats	Cattle, goats	Cattle, goats	Cattle, goats	Cattle, goats	Cattle, goats	
Main staple food	Maize	Maize	Maize	Maize	Maize	Maize	Maize

Table 19. Rainfall and farming characteristics of natural regions in Zimbabwe.

Natural Region	Annual rainfall	Farming systems
I	> 1000 mm, Rain in all months of the year, relatively low temperatures	Suitable for dairy farming forestry, tea, coffee, fruit, beef and maize production
II	700-1050 mm. Rainfall confined to summer	Suitable for intensive farming, based on maize, tobacco, cotton and livestock
III	500-800 mm. Relatively high temperatures and infrequent, heavy falls of rain, and subject to seasonal droughts and severe mid-season dry spells	Semi-intensive farming region. Suitable for livestock production, together with production of fodder crops and cash crops under good farm management
IV	450-650 mm. Rainfall subject to frequent seasonal droughts and severe dry spells during the rainy season	Semi-extensive region. Suitable for farm systems based on livestock and resistant fodder crops. Forestry, wildlife/tourism
V	< 450 mm. Very erratic rainfall. Northern low veldt may have more rain but the topography and soils are poor	Extensive farming region. Suitable for extensive cattle ranching. Zambezi Valley is infested with tsetse fly. Forestry, wildlife/tourism

4.5   A comparison across sites

Table 19 provides a comparison of some of the area indicators between the countries targeted by N2Africa. The three main impact zones where N2Africa works (East and Central Africa, West Africa and Southern Africa) are agro-ecologically distinct. In East and Central Africa, temperatures are relatively cool, rainfall is relatively high and the length of the growing period is long with two distinct growing seasons. East and Central Africa has a high variety of crops besides cereals and legumes, including bananas, tea, sweet potato, (Irish) potato and cassava. In West Africa, temperatures are relatively high and the single cropping season is used primarily to grow cereals and grain legumes. Southern Africa also has only a single growing season per year. The farming systems in southern Africa are dominated by maize. Also grain legumes, cassava, sweet potato and sometimes typical cash crops like tobacco and cotton are grown.

Grain legumes take a major place in the diets in all eight countries. In some places in East and Central Africa, beans can be the main staple food. In most other places, grain legumes are seen as a valuable addition to a primarily cereal-based diet. In all eight countries grain legumes are grown both as a food crop for the household as well as a commercial crop.

Population density and distance to a major urban centre (market access) are often linked, i.e. in regions with a high population density, the time required to reach an urban market is usually relatively low. High population densities can be found in western Kenya, part of Rwanda and northern Nigeria. In southern Africa, population densities are often low, with the exception of some regions in Malawi and Zimbabwe, and travel times to major urban centres are often high. Especially Mozambique is sparsely populated and farming tends to be very extensive in Mozambique. The length of the growing period and soil fertility is often but not always linked to high population densities. For instance, in Kano State in Nigeria, population densities are very high (>500 inhabitants per km^2) while the length of the growing season is about the shortest of all project areas and annual rainfall is low. The other extreme are certain regions of the DRC, which have a high rainfall, two growing periods a year, but low population densities. Fertiliser use, as far as data were available, greatly differed between countries. In DRC and Mozambique for instance, fertiliser use is nil or very low, while in Kenya and Ghana relatively high amounts of fertiliser are applied.

Table 19: Selected indicators to compare sites across eight countries.

	DRC	Rwanda	Kenya	Ghana	Nigeria	Malawi	Mozambique	Zimbabwe
Districts, regions where N2Africa works in the first growing season	Kalehe, Kabare, Walungu, Mwenga	Kamonyi, Busegera, Kayonza, Burera, Gakenke	Bungoma, Kakamega, Migori, Siaya, Kisumu	Northern, Upper East and Upper West	Kano State, Kaduna State	Salima, Ntcheu, Lilongwe, Mcjinji, Kasungu	Gurué, Mandimba, Angonia, Sussundenga, Mogovolas	Makoni, Murehwa, Wedza, Mudzi, Goromonzi, Chegutu, Makonde, Guruve,
Population density (inh km^{-2})	38-262	102-518	300-1200	7-231	37-587	128-151	13-40	23-40
Market access (h)	2-9	2.5-5	1-5	1-7	1-4	3-4	4-8	3-4
Farm size (ha)	0.3-1.2	0.2-0.7	0.6-2	0.4-5	0.5-1	0.5-1.5	0.5-3.5	
Main crops	Cassava, beans, banana, maize	Bananas, beans, cassava, maize, potato, sweet potatoes	Maize, millet, groundnut, tea, beans, cassava, sweet potato	Maize, rice, cowpea, yam	Maize, sorghum, millet, cowpea, groundnut, rice, vegetables	Maize, tobacco, beans, cotton, soybean	Maize, common bean, groundnut, cowpea, sweet potato	Maize, groundnut, tobacco, vegetables
Annual rainfall (mm)	1523-1828	842-1246	1364-1800	916-1040	714-1429	877-953	800-1800	765-857
Annual temperature (ºC)	17-20	16-21	20-22	27-28	24-27	21-23	21-22	17-18
Length of the growing period (d)	315-357	290-352	278-325	165-238	135-195	165	182-204	164-182
Soils	Ferrisol Ferralsol		Acrisols, Nitisols, Lixisols, Cambisols	Sandy loam, Clay loam, Vertisol	Alfisol	Lithosols	Clay loam, sandy loam, sandy clay loam	Luvisols Cambisols Leptsols
Fertiliser use	nil		Urea, SSP, NPK 10-60 kg ha^{-1}	NPK, SA, up to 250 kg ha^{-1}	8-10 kg ha^{-1}	NPKS, urea	Very low	NPK, urea
Livestock species	Goats, poultry, guinea pigs	Sheep and goats	Cattle, goats, poultry	Cattle, goat, sheep, pigs, donkeys	Cattle, goats, sheep, poultry, pigs	Cattle, goats, poultry	Chicken, goat, pork	Cattle and goats
Main staple food	Cassava, maize, sorghum, beans	Cassava, maize, potato, banana, beans	Maize, beans	Maize, millet, sorghum, cowpea, beans, rice, vegetables	Maize, sorghum, millet, cowpea, groundnut, rice,	Maize, beans	Maize, cassava, bean, sweet potato	Maize, groundnuts

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List of project reports

1. N2Africa Steering Committee Terms of Reference

2. Policy on advanced training grants

3. Rhizobia Strain Isolation and Characterisation Protocol

4. Detailed country-by-country access plan for P and other agro-minerals

5. Workshop Report: Training of Master Trainers on Legume and Inoculant Technologies (Kisumu Hotel, Kisumu, Kenya-24-28 May 2010)

6. Plans for interaction with the Tropical Legumes II project (TLII) and for seed increase on a country-by-country basis

7. Implementation Plan for collaboration between N2Africa and the Soil Health and Market Access Programs of the Alliance for a Green Revolution in Africa (AGRA) plan

8. General approaches and country specific dissemination plans

9. Selected soybeans, common beans, cowpeas and groundnuts varieties with proven high BNF potential and sufficient seed availability in target impact zones of N2Africa Project

10. Project launch and workshop report

11. Advancing technical skills in rhizobiology: training report

12. Characterisation of the impact zones and mandate areas in the N2Africa project

Partners involved in the N2Africa project

Diobass

Université Catholique de Bukavu

University of Zimbabwe

- Programme d'appui au developpement durable **PAD** (DRC)
- Service d'Accompagnement et de Renforcement des capacities d'Auto promotion de la Femme en sigle – **SARCAF** (DRC)