REPUBLIC OF RWANDA

MINISTRY OF AGRICULTURE AND ANIMAL RESOURCES

CROP ASSESSMENT – 2010A SEASON

FINAL REPORT

March 2010

1. Introduction

The Ministry of Agriculture and Animal Resources (MINAGRI), in collaboration with RADA, the National Institute of Statistics of Rwanda (NISR), FAO and WFP organizes regularily a crop assessment survey for each agricultural season. One of the objectives of this survey is to estimate the food balance and plan for food requirements within the next six months. Also, results from this exercise are used in the estimation of the gross domestic product (GDP) and the contribution of the sector in the national economy.

Data are collected by enumerators recruited by MINAGRI, under the supervision of staff from MINAGRI, RADA, NISR, FAO and WFP.

2. Sampling methodology.

The methodology used in the crop assessment exercise is the one used for the National Agriculture Survey (ENA 2008) organized by the National Institute of Statistics of Rwanda (NISR), in collaboration with the Ministry of Agriculture and Animal Resourses. The sample size for the crop assessment survey respresents 25% of the National Agriculture Survey. At the first stage, 210 primary sampling units (PSU) or enumeration areas (EA) have been selected using the simple random sampling methode and then 15 households (12 for interview and 3 households for replacement) per EA have been selected. In fact, 25% of housenols selected for the ENA have been covered by the crop assessment exercise, which represent 2,520 sample households.

The sampling frame of the ENA is described in Gashaka Jacques « Sampling frame and estimation procedures », Novembre 2007. The summary of the sampling methodology is presented in annex II.

3. Data collection methodology.

3.1. Area measurement

The shape of cultivated areas is not always of the regular form (triangle, rectangle…), but most of the fields under cultivation have rectangular shape (square or rectangle, others are triangular (triangle). We encounter also fiels that have irregular shapes, having 5 sides or abore. In one or other case, the area measurement has been done by triangulation method (splitting the plot in triangles or rectangles). Hence, the area of the plot is the total sum of the surface areas of the triangles (or rectangle, square) created in that plot.

3.2. Density estimation and crop areas.

It's common in Rwanda to have intercropping practice. In one parcel, it can be planted beans, sweet potato and sorghum. The question that arises is to estimate the area allocated to each of these crops, i.e, which area is allocated to a particular crop planted in that parcel in the absence of intercropping (one single crop in the parcel)?

The density of each crop in the parcel is roughly estimated and standardized by dividing the density of a particular crop by the sum of the densities of all crops (the standardized densities sum up to 100). The area for each crop is equal to the standardized density multiply by the area of the parcel. These densities are used to estimate the percentage of land allocated to each crop by district. These estimates are applied to the total area under cultivation by district to obtain the total land for each crop.

3.3. Estimation of Production.

Under each particular piece of land, the enumerator asks the head of household what quantity of each crop present in that parcel, to be harvested during season 2010A. The expected production includes the quantity harvested before the interview and the quantity to be harvested until february 2010.

The production can be expressed in differeent units of measurement (Kg, bag, basket, bucket, …). It is asked to the enumerator to convert theses units in Kg.

3.4. Data processing and analysis.

Data entry mask has been designed using CsPro (Census and Survey data Processing); while data editing is made in SPSS. Data editing included the checking of range, structure, and a selected set of checks for internal consistency. All errors detected during the editing procedure were corrected. Statistical tables have been prepared using SPSS. These tables were transferred to Excel spreadsheet for further calculations.

All crop and animal products were converted to their equivalent energy, proteins and lipids using the appropriate weights of each commodity. The population was estimated at mid seasonal time, March 31st, 2010. Assuming a daily adult requirement of 2,100 kcal/capita/day, 59 g of proteins and 40 g of lipids (source ENA/MINAGRI), the total energy was distributed among the Rwandan population for six months (181 days) calculated at March 31st, 2010.

Losses through cooking and post-harvest handling were estimated at 15% since most of the produce in Rwanda is consumed almost immediately.

Comparisons were made between production in 2009A and 2010A for different crops. The food balance sheet was then computed using the following formula:

1. Available food for human consumption=1+2+3
2. Amount available in stock=0 (non estimated)
3. Production (x 1000 MT)=Energy (Kcal/Capita/day)/equivalent Kcal for maize (i.e. 3225.32 Kcal/Kg) x 1000
4. Losses= -0.15 x crop production
5. Needs= 4
6. Consumption=2,100 x 181 days x estimated population/3,225.32/1000000
7. Balance/Deficit=1-5

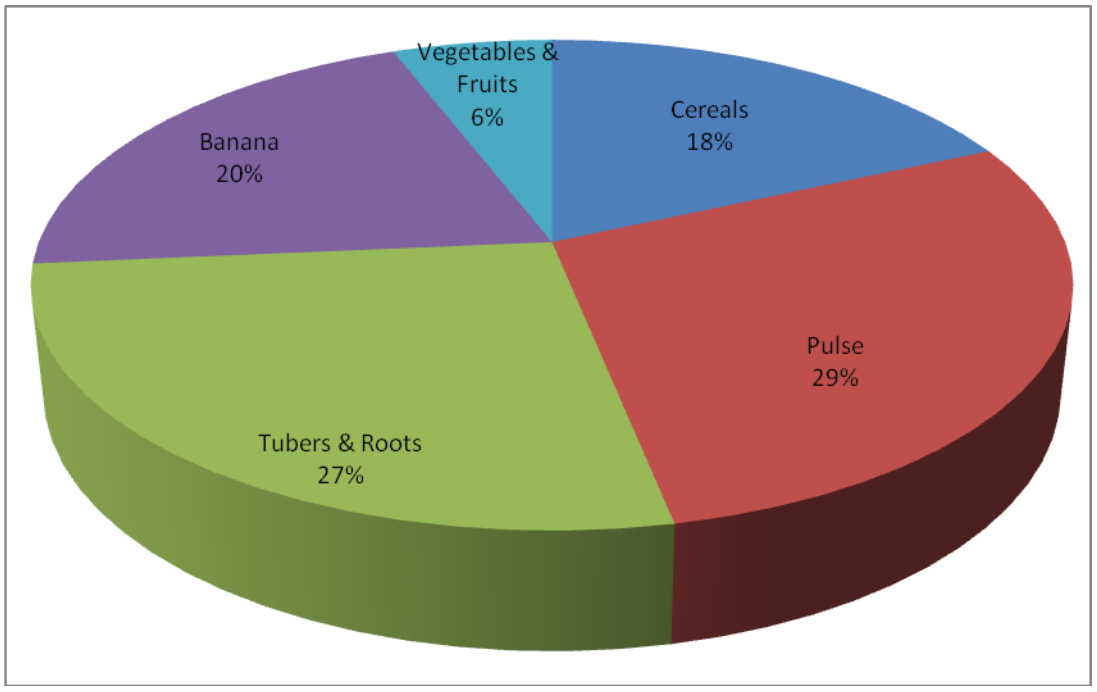
4. Key Results.

4.1. Area under crop.

The land area measured in the crop assessment exercise consists of the land under cultivation and of which the planted crops will be harvested until the end of February 2010.

Graph 1-1 shows that the share of land allocated to pulses and tubers in 2010A was estimated at 29% and 27% respectively. In 2009A, the land area under pulses stood at 30% while tubers and roots occupied 27% of the total land area.

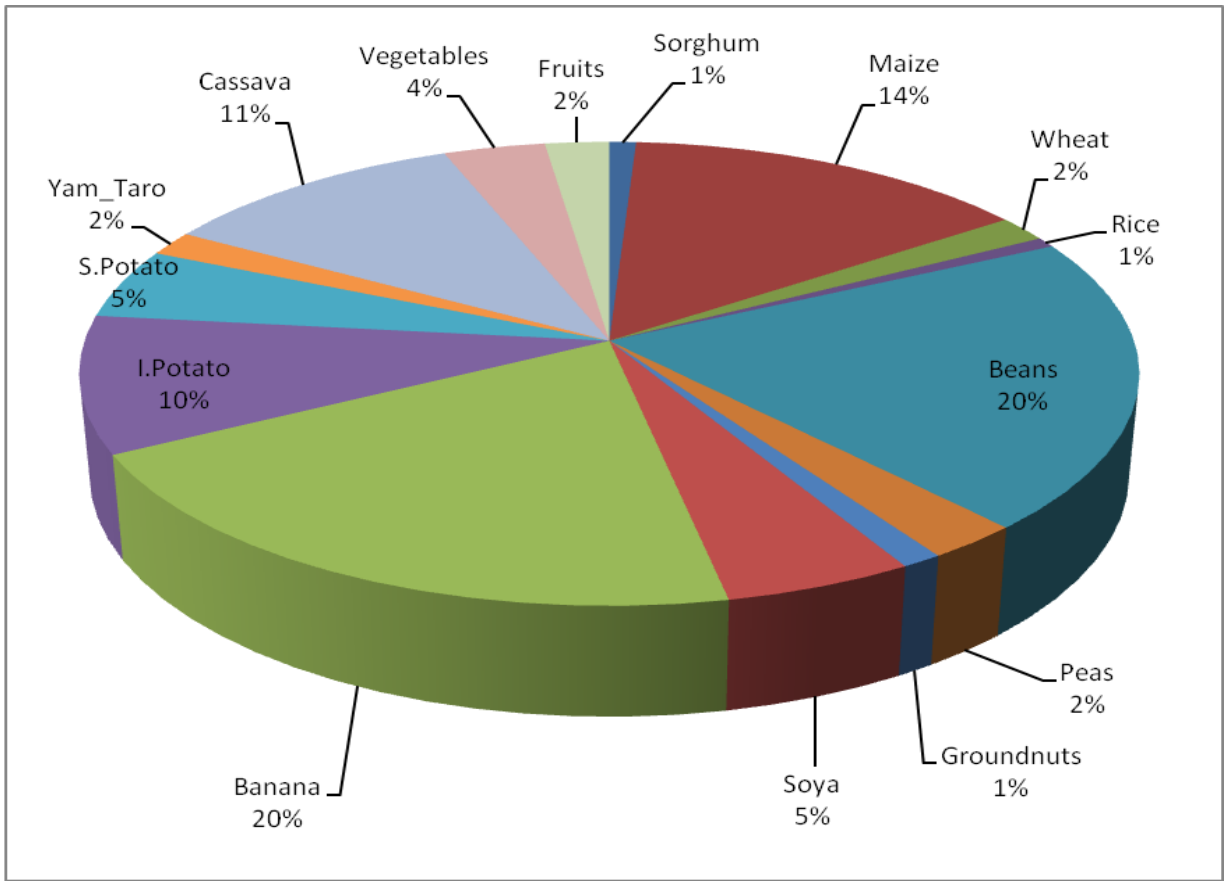
Graph 1-1: Share of land (%) by category of crop, 2010 A season



The remaining cultivated area in 2010 A was distributed as follows: banana (20%), cereals (18%) and vegatables (6%).

Graph 1-2 shows the share of land allocated to each individual crop. The share of land in 2010A for each individual crop is distributed as follows: beans (20%), banana (20%), Maize (14%), cassava (11%), Irish potato (10%). These crops totalize nearly three fourth of the land under crop (75%). The remaining crops occupy 25% of land in 2010A, the individual share ranging from 1% to 5%.

Graph 1-2: Share of land (%) by crop, 2010 A season.



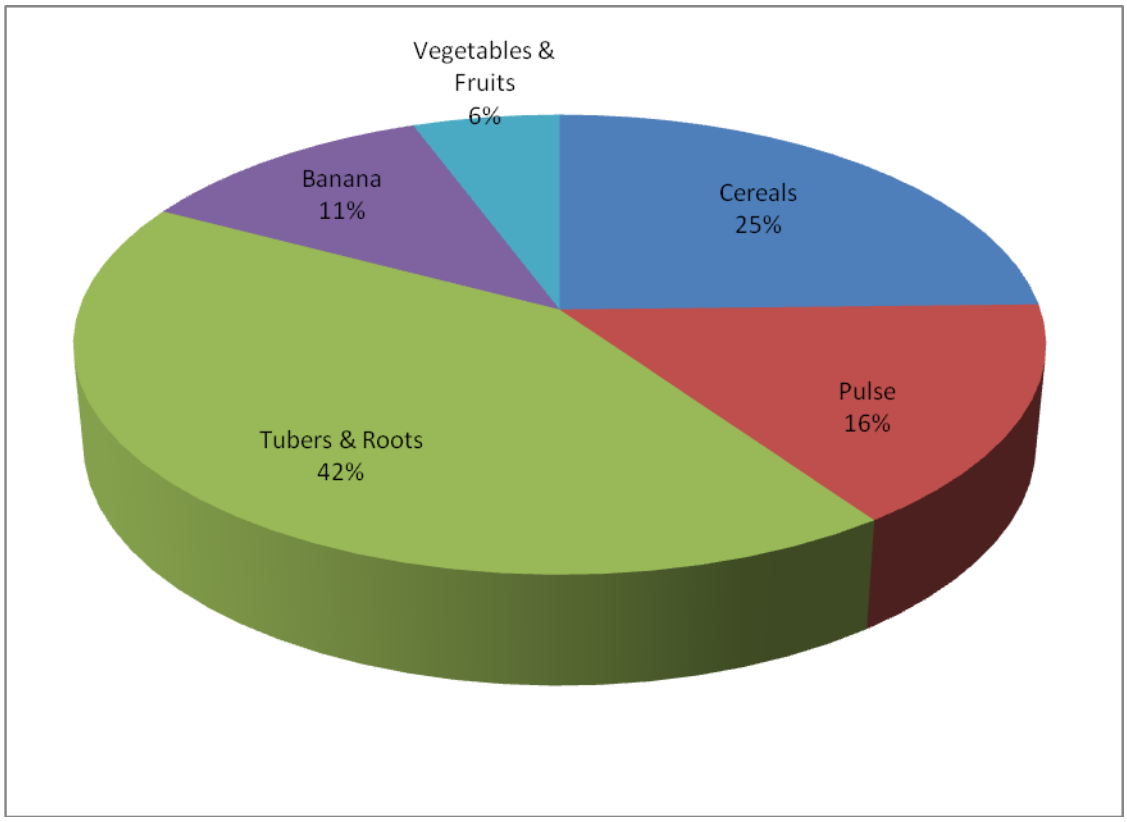
4.2. Agriculture production, 2010A.

The overall agricultural production of the season 2010A (in Cereal – equivalent) went up by 14% in comparison with the same season in 2009A. A remarkable increase is registered for and not limited to maize (47%), Irish potato (25%) and cassava (30%), whereas banana and sweet potatoes production declined by 11% and 3% respectively.

The share of crop production (in cer-equivalent) is distributed as follows (graph 1-3): tubers (42%), cereals (25%), pulses (16%), banana (11%) and vegetables/fruits (6%). The share of a crop is the ratio between the production (in quantity) of that particular crop and the total production.

The main crops in terms of production (in cer-equivalent) are: cassava (22%), maize (21%), beans (12%), banana (11%), Irish potato (12%) and sweet potato (7%). The share of crop in total production of the remaining crops culminates at 3%.

Graph 1-3: Share of crop production (%), season 2010A



The improvement of the yield for major crops has led to the increase of the production in 2010A. Yield for maize increased by 22% from 2,115 Kg in 2009A to 2,585 Kg in 2010 A. It's worthnoting that maize is a crop of interest in the Crop Intensification Programme (CIP). Quality seeds as well as chemical fertilizers have been distributed under the CIP.

Though all households are not covered by CIP, non beneficiaries of the CIP are improving agriculture practices (acquiring chemical fertilizers as well as improved seeds through markets).

In general, yield improved for pulses with the exception of soya (-6%). In comparision to 2009A, yield increased at the following rates: beans (3%), peas (22%) and groundnuts (8%).

In 2010A, yield for sweet potato increased by 32%, while yield for cassava, Irish potato and yam increased by 17%, 5% and 48% respectively.

Yield for banana fell by 10%, which led to the decline of 11% of banana production. Table 1-3 below shows the evolution of the area under crop, yield and production between 2009A and 2010A. Detailed tables are presented in annex I.

Table 1-3: Area under cultivation, yield and production, 2009A and 2010A.

Crops	Area under crop(ha)		Share of land by crop (in %)		Yield (Kg/Ha)			Production (MT)		
	2009A	2010A	2009A	2010A	2009A	2010A	Change in %	2009A	2010A	Change in %
Sorghum	13,551	8,054	2	1	1,489	1,512	2	20,178	12,173	-40
Maize	102,415	123,338	12	14	2,115	2,585	22	216,604	318,772	47
Wheat	17,566	15,441	2	2	2,181	2,077	-5	38,314	32,068	-16
Rice	6,565	6,047	1	1	4,715	5,236	11	48,353	31,660	-35
Beans	179,999	176,492	21	20	1,038	1,071	3	186,876	189,038	1
Peas	22,345	21,742	3	3	723	880	22	16,149	19,124	18
Groundnuts	10,533	9,408	1	1	565	612	8	5,950	5,758	-3
Soya	38,982	43,880	5	5	831	783	-6	32,410	34,344	6
Banana	176,755	175,822	21	20	9,340	8,388	-10	1,650,874	1,474,851	-11
I.Potato	69,352	82,425	8	10	11,854	12,495	5	822,092	1,029,887	25
S.Potato	57,731	42,232	7	5	5,753	7,617	32	332,126	321,698	-3
Yam_Taro	17,945	14,710	2	2	4,266	6,325	48	76,560	93,033	22
Cassava	83,514	93,397	10	11	9,793	11,413	17	817,837	1,065,901	30
Vegetables	31,924	30,661	4	4	10,084	10,782	7	321,917	330,568	3
Fruits	18,663	19,388	2	2	10,131	11,096	10	189,074	215,139	14

4.3. Qualitative assessment of the season 2010A.

During the crop assessment, qualitative questions have been asked on the behaviour of the season. As regard to beans and peas, nearly 40% of the respondents said that the rain came early, whilst for other crops, 50% to 64% of the respondents reported that the rain came on time. It's worthnoting that 32% to 49% said that the rain came too late. Nationwide, 51% of the respondents said that rain came on time against 44% who said it came late. The survey found that 25% to 34% of the respondents said that the rain was too much or not enough for cassava and sweet potatoes; while for other crops, 37% to 58% declared that the rain was too much or not enough.

Nearly 55% of the respondents reported that rain was enough, only one third said that it was too much.

Little or no damages resulting from the rainfall were recorded. More than 90% reported that the rain caused no or little damages. Also, a great proportion of the respondents (88% nationwide) said that crops have been attacked by insects or diseases in a very less extend.

A great percentage of the farmers don't use chemical fertilizers. Only 15% to 17% used chemical fertilizers on vegatables, Irish potatoes and maize. For other crops, the proportion of farmers using chemical fertilizers is less than 10%; instead, they use organic fertilizers.

A few number of farmers used improved seeds. The percentage of farmers that used improved seeds is distributed as follows: 21.4% for maize, 23.3% for vegatbles and 13.6% for cassava. For other crops, a maximum of 5% of farmers used improved seeds.

Finally, it was aked to farmers to compare the production of 2010 season A with that of season 2009 A. The table below shows that 82% of the respondents reported that the production of 2010 A was normal to good, in comparison to season 2009 A. This finding corroborates with the quantitative results of the survey, where the production of 2010 A was greater than that of 2009 A.

Table 1-4: Qualitative assessment of 2010 A season (numbers in % of respondents).

	Beans	Peas	Groundnuts	Soya	Maize	Cassava	Sweet potatoes	Irish potatoes	Vegetables	National average
Rainfall period										
On time	42.6	40.4	57.4	55.3	50.3	62.0	64.1	50.1	60.2	51
Early	7.8	10.7	2.3	2.3	2.0	1.7	3.5	3.1	3.3	5
Late	49.6	48.8	40.3	42.3	47.8	36.3	32.4	46.8	36.5	44
Quantity of rain										
Too much	44.0	37.6	7.9	32.1	27.1	14.9	25.4	40.9	30.0	33
Enough	41.7	45.7	62.5	57.4	61.7	74.6	69.0	45.7	66.5	55
Not enough	14.3	16.7	29.6	10.4	11.2	10.5	5.6	13.4	3.6	12
Damages										
Much damages	14.1	7.5	6.3	6.6	4.9	1.2	1.7	15.6	3.5	9
Little damages	32.5	36.4	15.5	15.4	14.3	13.5	10.7	26.3	16.6	23
No amage	53.4	56.1	78.3	78.1	80.7	85.3	87.6	58.2	79.9	68
Insects										
Yes	22.4	14.1	2.8	7.3	6.3	3.7	4.6	9.5	14.8	12
No	77.6	85.9	97.2	92.7	93.7	96.3	95.4	90.5	85.2	88
Diseases										
Yes	11.3	4.6	2.3	3.4	4.8	26.8	3.5	25.8	13.1	11
No	88.7	95.4	97.7	96.6	95.2	73.2	96.5	74.2	86.9	89
Chemical fertilizers										
Yes	6.3	9.2	0.5	1.9	16.9	2.2	0.6	16.0	14.9	8
No	93.7	90.8	99.5	98.1	83.1	97.8	99.4	84.0	85.1	92
Organic fertilizers										
Yes	69.4	62.0	35.0	72.0	64.8	49.6	40.1	71.6	88.4	63
No	30.6	38.0	65.0	28.0	35.2	50.4	59.9	28.4	11.6	37
Improved seeds										
Yes	4.0	2.1	1.4	2.1	21.4	13.6	0.8	5.0	23.3	8
No	96.0	97.9	98.6	97.9	78.6	86.4	99.2	95.0	76.7	92
Comparison with 2009A										
Good	52.7	43.6	55.2	57.0	51.1	56.0	45.9	40.0	52.6	51
Normal	24.8	31.9	26.7	26.9	30.3	34.9	43.5	36.6	36.0	31
Bad	22.4	24.5	18.1	16.1	18.6	9.1	10.6	23.4	11.5	18

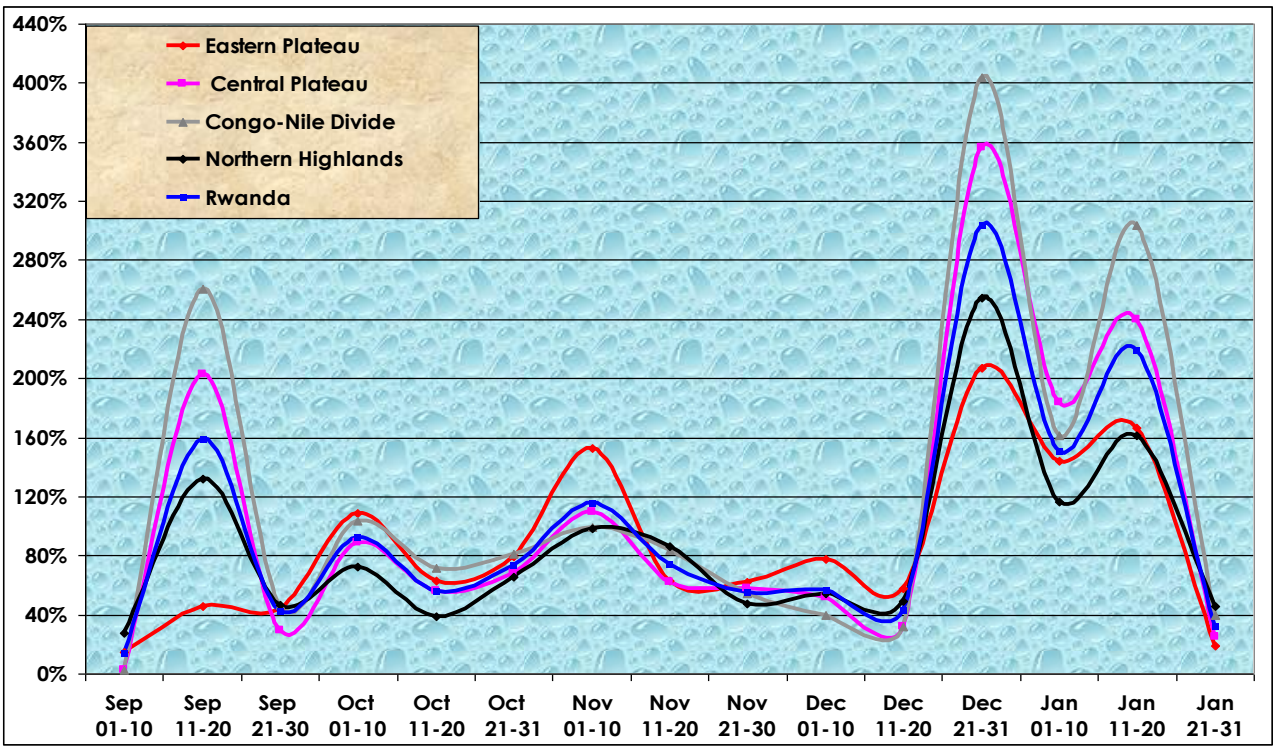
4.4. Rainfall situation, season 2010A.

The monthly bulletin produced by MINAGRI and FAO under the Operationalization of Harvest and Agricultural Markets Monitoring Project indicates that rains came early during the second decade of September 2009 for the Central plateau, the Congo Nile Divide and the Northern Highlands, but disappear two weeks later. In Eastern Plateau rains came late in the first decade of octocber 2009.

In the country as a whole, rains were very low (around 40% of the long term average) during the third decade of september. Beyond that period, rain was low but went upward during the first decade of November. Since then, rain went down until the second decade of December 2009 (graph 1-4 below), but increased promptly in the third decade of December. It reached 400% of the LT average in the Congo Nile Divide and nearly 300% of the LT average in the country as a whole. Nationwide, rainfall was still high (in comparison with the LT average) from the third decade of December until the second decade of January 2010.

The reduction in rainfall in December stressed crops in the drought prone areas of the Southern and Eastern Provinces, particularly beans and maize which were sowed late in October and early in November. In these regions, beans sowed in September have already been harvested. In the Western and Northern Provinces, the season has progressed as normal and the harvest can be expected to be good, except in some pockets where strong rains damaged sensitive crops, particularly beans.

Graph 1-4: decadal rainfall estimates as a percentage of the LT average by natural region, season 2010A.



Source: USGS data

4.5. Food Security

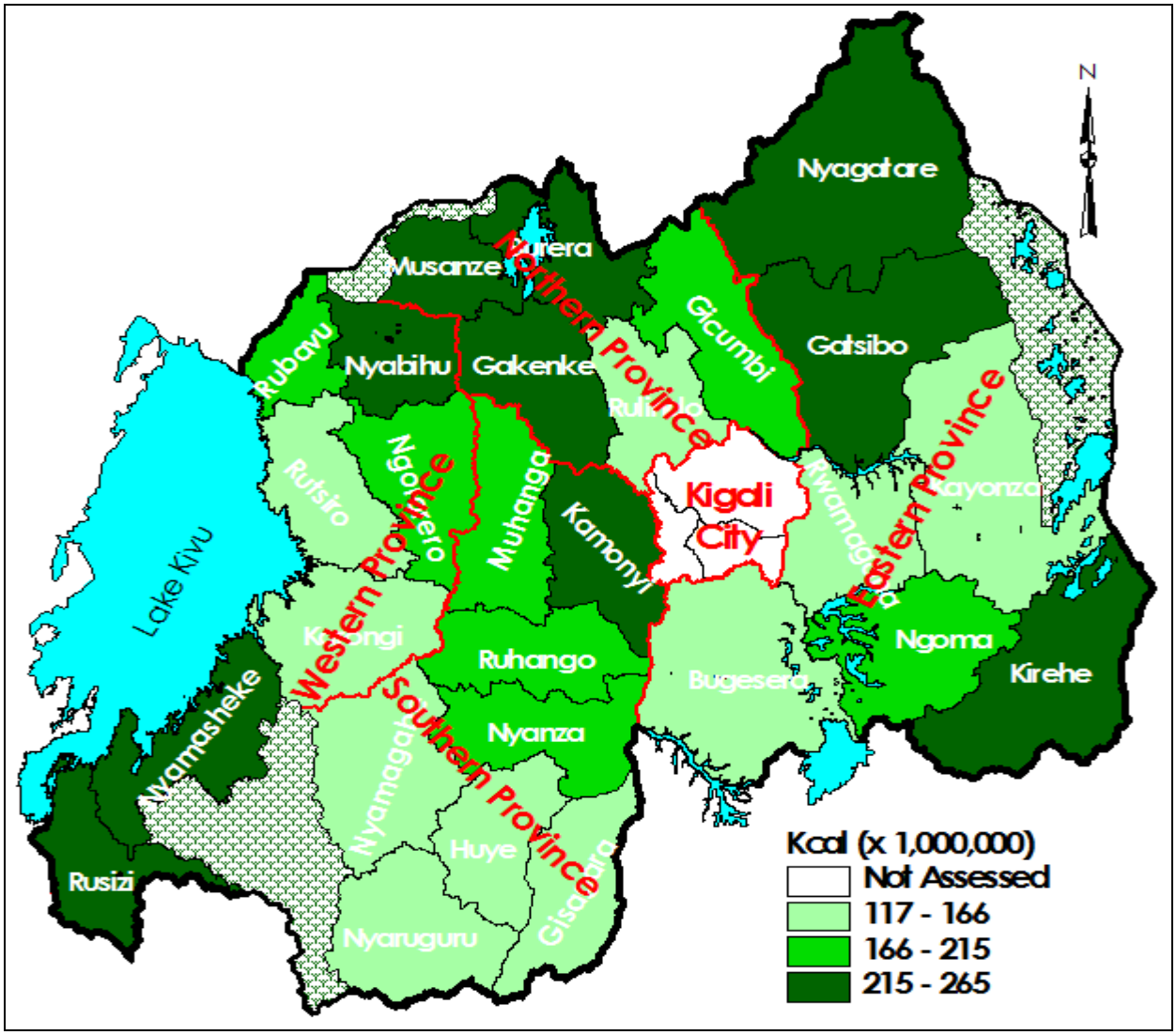
The national food security improved in 2010A. In all Provinces, carolific needs are covered at a minimum rate of 104% (Nyaruguru district) and a maximum of 204% in Kirehe district.

Table 1-5: Estimated energy availability in percent of the requirement (2100 kcal/person/day) from local food production in Rwanda by Province, Season 2010A.

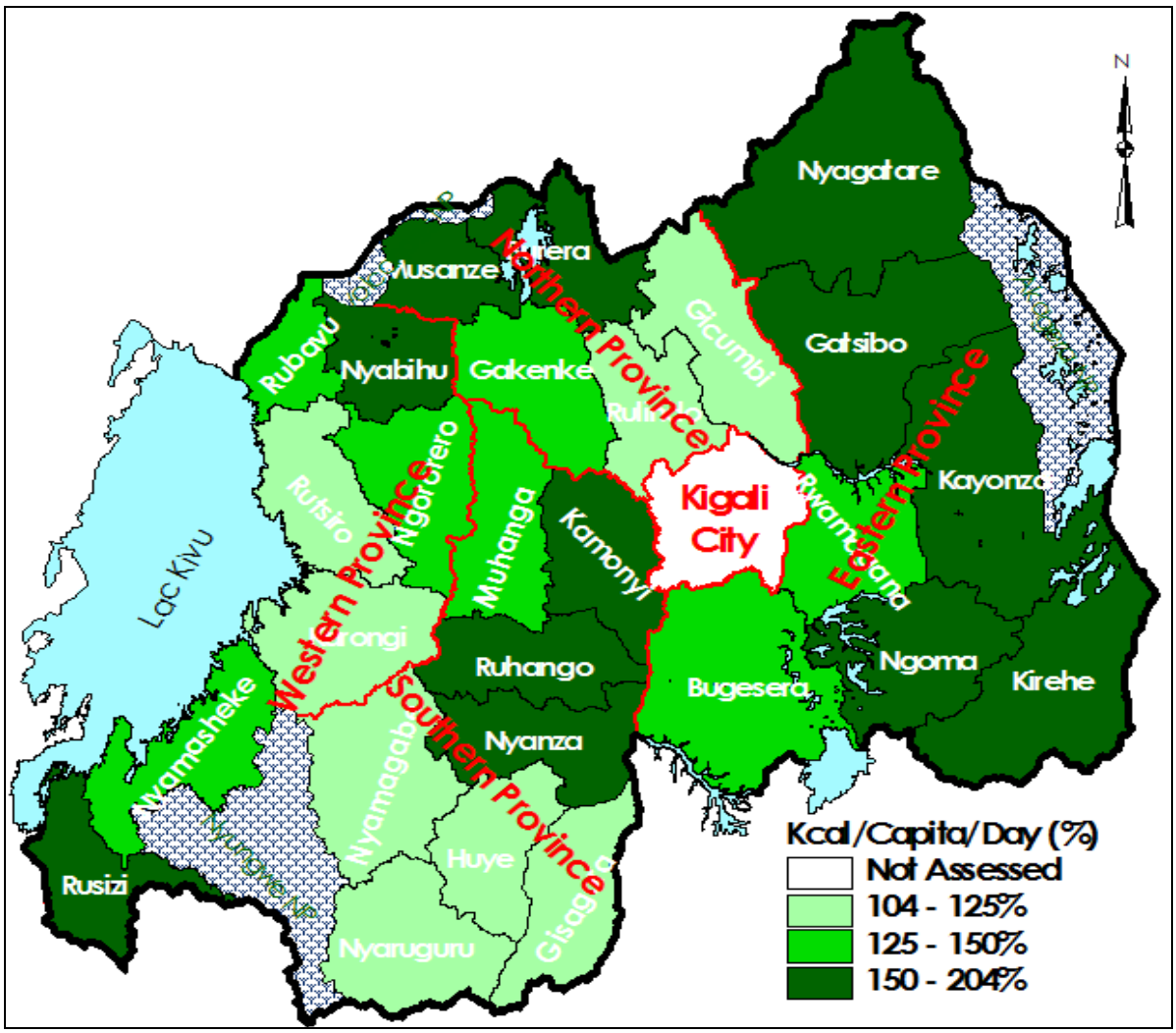
Province	Min	Max
South	104%	190%
West	109%	179%
North	108%	161%
East	126%	204%

The total and per capita production of energy is shown in figures 1-5 and 1-6. From these figures, we can see that some districts appear in light green area (figure 1-5) as total production of energy is concerned, while they shift to dark green area in terms of per capita production (the cases of Ruhango and Nyanza for example). The fact is that the population of the districts is taken in consideration in figure 1-6, while it's not in figure 1-5.

Graph 1-5: Total Crop and animal production in energy (Kcal) by district, season 2010A.



Graph 1-6: Energy coverage per person day in percent of recommended 2,100 Kcal/per/day, season 2010A.



The production in Kcal and lipids from livestock has slightly declined as indicated in table 1-6 below. The main explanation of this situation is that livestock is under reported. Also, where available, data from livestock are not disagregeted in local and exotic animals. Our estimates of livestock production are based on the number of herd, with respective weight for exotic and local animal production (in both meat and milk).

Table 1-6: Production in Kcal, proteins and lipids

	2009A	2010A	Change in % 2010A/09A
Kcal (1 000 000 000)	4,427	4,932	11.4%
Proteins (1 000 T.)	91	118	30.1%
Lipids (1 000 T.)	18	26	44.2%
Kcal from animals (1 000 000 000)	261	256	-1.8%
Proteins from animals (1 000 T.)	14	14	2.2%
Lipids from animals(1 000 T.)	19	19	-0.6%
Energie (Kcal/Capital/day)	2,646	2,751	4.0%
Protein (g/capital/day)	59	75	27.7%
Lipids (g/capita/day)	21	26	23.1%

N.B. : Adult humans require 2100 kcal/capital/day, 59 g of protéins and 40 g of lipids (source ENA/MINAGRI)

Crops and animals contributed differentelly to the production of energy, protein and lipids. Table 1-7 shows the contribution of major crops and animal in the production of energy: cassava (21%), maize (20%), beans, banana and Irish potato (11% each) and sweet potato (7%).The contribution of the remaining crops varies up to 3%. Animal production contributes to 5% of the total energy produced in 2010A.

In 2010A, the major contributors to protein production are beans (28%), maize (20%) Irish potato (9%), soya (8%) and animal (11%). These crops contributed to the production of 76% of the total production of protein.

Animal and maize productions are the main contributors of lipid with 43% and 26% respectively. Other contributors are soya (11%) and beans (6%). The remaining individual crops contribute up to 3% maximum on lipid production (Table 1-7).

Table 1-7: Contribution of crops and animal in energy, proteins and lipids (%)

	Energy	Protein	Lipids
Animal	5%	11%	43%
Sorghum	1%	1%	0%
Maize	20%	20%	26%
Wheat	2%	2%	1%
Rice	1%	1%	0%
Beans	11%	28%	6%
Peas	1%	3%	0%
Groundnuts	0%	1%	3%
Soya	2%	8%	11%
Banana	11%	4%	2%
Irish Potato	11%	9%	2%

Sweet Potato	7%	3%	1%
Yam & Taro	1%	1%	0%
Cassava	21%	4%	3%
Vegetables	3%	2%	0%
Fruits	2%	1%	0%

The national food balance sheet shows a surplus of 151 MT. Data on Imports, food aid and stock are not available and hence not included in this balance (Table 1-8).

Table 1-8: Rwanda Food Balance for 6 months from January to June 2010

	(*1000 MT)
I. AVAILABILITY =1+ 2+3	**1,379**
1. Crop production	1,529
2. Animal production	79
3. Losses (15%)	(229)
II. NEEDS = 4	**1,228**
4. Consumption	1,228
III. Balance/Deficit = I–II	**151**

5. Conclusion and recommendations.

Figures on production for the 2010A season show that there is a surplus of food in the country and food security is not threatened. Production (in cereal equivalent) has increased by 14% in 2010A in comparison to 2009A. The main cause of the increase of the production is the improvement of the yield, for the majority of the main crops.

The food balance includes production realized in 2010A. If the domestic production is consumed locally (which is not always the case), there is a surplus of 151 MT.

The Ministry of Agriculture has improved considerably the sampling and data collection methodologies for seasonal crop assessment. The sample is drawn from the National Agriculture Survey, carried out in 2008 by the National Institute of Statistics of Rwanda. The same sample of household is interviewed each season. Data collection methodology is outlined in annex II.

However, more improvements are needed in order to collect very reliable data. Data collection is made at the beginning of the season for area measurement and soil occupation (during 15 days) and another round occur before the end of the season, and mainly crop production is concerned. We also assume that time allocated to data collection is too short.

Also, data collectors are not sufficient, when we consider the size of a district and the dispersion of the enumeraion areas. Worse, supervision is assumed by one person for 2 districts.

Recommendations:

- Conduct a specific study on cassava in order to estimate the yield (production as a perennial product) by season;
- Conduct a study on production cost and harvest losses for the major food crops (cassava, maize, banana, wheat, Irish potato).
- Conduct a cross border trade survey;
- Conduct a variety research on rice with the aim at selecting varieties that are suitable for different regions;
- Need specific study on banana commodity chain in Rwanda;
- Focus on storage at household and community level;
- Carry out a continuous data collection for at least three years in order to have structural data on agricultural sector;
- Reinforce the supervision at district level (1 supervisor for 2 enumerators) and at central level by organizing regular visits to enumerators.

Annex I: Detailed tables

Cultivated area per District (Ha)

Crop	Huye	Gisagara	Nyamagabe	Nyaruguru	Ruhango	Nyanza	Kamonyi	Muhanga	Rusizi	Nyamasheke	Rutsiro	Karongi	Ngororero	Nyabihu	Ru
Sorghum								631		100			178	92	
Maize	2,020	1,566	3,297	2,050	2,331	1,515	2,514	1,344	8,575	4,764	3,109	3,456	4,055	7,928	5
Wheat			779								2,163	1,449	840	2,162	
Rice	490	743			188	207	294	117	1,123	42			25		
Beans	6,378	8,175	5,890	4,028	6,221	4,915	6,771	6,568	9,256	4,463	3,575	3,657	5,499	4,906	5
Peas	1,308	268	1,951	2,359	229	350	626	316	161	601	953	1,430	1,970	1,796	
Groundnuts	487	522			665	1,542	427	79	404						
Soya	1,995	2,407	2,223	1,541	1,816	1,780	2,392	2,376	3,418	3,301	1,861	1,529	1,646	2,196	3
Banana	6,217	6,024	4,234	3,544	6,591	3,881	5,891	8,074	7,993	8,732	7,963	10,482	7,054	3,243	3
Irish Potato	1,899	1,781	3,796	3,855	2,246	2,579	1,456	1,883	1,243	1,057	4,765	1,331	4,894	6,563	7
Sweet Potato	2,626	1,528	2,458	1,314	860	240	2,230	1,702	750	2,107	1,839	2,447	2,936	1,802	
Yam & Taro	319	103	309	820	283	64	746	1,898	428	574	1,142	93	1,574		
Cassava	5,125	5,140	2,378	2,726	7,408	5,122	7,571	4,932	4,288	5,447	1,057	5,682	3,349	254	
Vegetables	1,218	985	509	317	1,475	1,090	841	1,307	1,050	1,052	1,391	1,837	2,565	922	
Fruits	607	739	254	158	590	654	595	654	350	701	1,391	1,378	764	615	
Total cultivated area	**30,687**	**29,982**	**28,078**	**22,713**	**30,902**	**23,940**	**32,355**	**31,880**	**39,039**	**32,939**	**31,208**	**34,770**	**37,348**	**32,478**	**27**

Cultivated area per District (Ha) (Cont'd)

Crop	Gakenke	Musanze	Gicumbi	Burera	Rulindo	Bugesera	Rwamagana	Kayonza	Ngoma	Kirehe	Gatsibo	Nyagatare	Kigali City	Total
Sorghum	196			35		109					2,324	4,390		8,054
Maize	8,578	3,848	872	4,765	1,812	1,962	3,305	2,325	4,336	17,726	8,149	10,644	507	123,338
Wheat	1,607	1,039	1,487	2,560	795									15,441
Rice						319	420	60	320	647	356	572	124	6,047
Beans	4,723	4,989	6,720	6,466	6,140	9,117	7,480	9,078	11,142	8,151	5,782	6,604	4,433	176,492
Peas	228	17	2,224	853	817	138	80	499	319	154	1,234	89	774	21,742
Groundnuts	155		371		54	961	602	693	498	1,307	594		46	9,408
Soya	2,821	356	517	1,112	814	465	499	336	959	430	317	1,363	351	43,880
Banana	9,508	4,400	7,878	4,149	4,581	4,668	6,897	9,001	6,395	9,589	8,264	5,022	2,028	175,822
Irish Potato	4,066	6,998	8,747	7,899	1,909	601	705	869	1,046	517	1,770	325	504	82,425
Sweet Potato	3,039	336	1,918	1,900	2,168	961	979	1,981	1,535	405	665	387	521	42,232
Yam & Taro	304	1,071	1,738	65	1,197	230		11	639	102	650		351	14,710
Cassava	1,026	3,118	2,607	1,280	2,245	7,765	1,154	3,197	3,463	1,888	2,103	2,467	606	93,397
Vegetables	863	1,825	925	2,150	1,082	1,192	660	1,186	772	672	553	1,157	518	30,661
Fruits	863	1,825	617	1,302	883	477	440	593	515	420	316	868	273	19,388
Total cultivated area	**37,977**	**29,821**	**36,619**	**34,537**	**24,498**	**28,964**	**23,220**	**29,829**	**31,940**	**42,008**	**33,077**	**33,888**	**11,036**	**863,036**

Yield per District (kg/ha)

Crop	Huye	Gisagara	Nyamagabe	Nyaruguru	Ruhango	Nyanza	Kamonyi	Muhanga	Rusizi	Nyamasheke	Rutsiro	Karongi	Ngororero	Nyabihu	Rubavu
Sorghum								953		1,593			1,747	1,100	
Maize	2,686	2,069	2,987	3,600	3,037	2,656	3,092	3,157	3,572	3,320	1,531	1,892	2,420	2,519	2,416
Wheat			3,000								1,250	1,250	2,500	1,250	
Rice	5,000	4,050			5,500	4,100	6,000	5,000	7,000	4,000			4,000		
Beans	856	800	994	673	966	957	1,000	1,062	1,358	1,212	1,142	1,095	1,143	1,252	1,546
Peas	475	428	950	950	380	475	380	778	393	905	1,218	905	1,106	986	
Groundnuts	475	523			665	665	665	942	700						
Soya	850	700	792	771	884	660	893	795	924	951	800	750	772	700	670
Banana	4,000	4,000	3,500	3,500	4,716	4,610	5,500	7,000	11,238	14,388	4,809	5,500	5,994	7,320	8,038
Irish Potato	3,080	3,691	4,982	7,282	5,825	5,014	5,631	3,829	7,790	8,000	7,500	5,565	12,693	14,309	15,824
Sweet Potato	8,410	7,467	5,939	5,302	11,789	13,563	11,084	12,860	10,742	10,087	7,290	6,688	5,831	7,690	5,650
Yam & Taro	5,715	6,957	2,422	4,215	6,913	2,506	5,743	5,304	15,246	3,247	5,793	12,327	6,842		
Cassava	10,879	9,317	11,708	10,271	13,502	22,591	14,413	12,025	8,210	7,009	9,082	7,755	7,245	15,833	
Vegetables	8,499	9,489	9,103	7,541	5,986	12,373	12,964	9,632	10,126	11,892	15,313	12,351	7,534	11,000	15,275
Fruits	12,000	12,000	10,000	10,000	10,000	10,000	10,000	10,000	12,000	12,000	9,500	9,000	9,500	16,000	16,000

Yield per District (kg/ha) (Cont'd)

Crop	Gakenke	Musanze	Gicumbi	Burera	Rulindo	Bugesera	Rwamagana	Kayonza	Ngoma	Kirehe	Gatsibo	Nyagatare	Kigali City	Moyenne
Sorghum	1,227			1,100		800					1,650	1,549		1,512
Maize	2,237	3,281	2,192	2,973	2,091	2,000	2,828	2,000	2,850	2,000	2,750	2,515	2,316	2,585
Wheat	3,000	3,500	2,400	2,500	2,500									2,077
Rice						6,000	4,000	4,000	4,000	5,000	6,000	5,000	4,000	5,236
Beans	1,382	1,295	1,114	1,543	1,216	850	900	850	900	850	1,397	1,100	1,084	1,071
Peas	1,193	450	888	842	1,104	350	350	350	350	300	1,246	1,082	814	880
Groundnuts	836		926		1,053	500	500	500	500	500	910		938	612
Soya	705	600	887	601	588	809	717	733	688	715	779	837	787	783
Banana	6,207	5,743	11,500	7,500	8,649	4,867	9,856	15,850	14,999	12,131	12,000	9,945	7,257	8,388
Irish Potato	11,584	16,745	12,170	14,829	5,797	5,552	9,911	3,513	5,580	5,041	6,651	6,758	4,952	10,531
Sweet Potato	8,009	5,044	2,443	10,872	5,882	9,581	10,680	5,136	5,500	4,081	6,182	4,668	6,211	7,617
Yam & Taro	9,023	7,310	5,000	5,932	5,088	6,429		2,083	5,000	3,326	16,176		4,579	6,325
Cassava	14,274	5,000	11,195	4,500	11,817	10,164	17,478	8,771	18,000	10,876	12,891	12,418	12,345	11,413
Vegetables	8,543	13,783	9,500	17,252	9,359	15,000	8,742	2,776	10,000	11,000	13,472	10,000	6,746	10,782
Fruits	12,000	12,000	15,000	15,000	11,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	11,096

Production per District (MT)

Crop	Huye	Gisagara	Nyamagabe	Nyaruguru	Ruhango	Nyanza	Kamonyi	Muhanga	Rusizi	Nyamasheke	Rutsiro	Karongi	Ngororero	Nyabihu	Rubavu
Sorghum								601		159			310	101	
Maize	5,426	3,240	9,848	7,380	7,079	4,024	7,774	4,244	30,633	15,815	4,759	6,539	9,814	19,969	14,461
Wheat			2,336								2,704	1,811	2,100	2,703	
Rice	2,450	3,007			1,031	850	1,765	584	7,864	167			100		
Beans	5,463	6,540	5,857	2,711	6,011	4,702	6,771	6,976	12,573	5,407	4,084	4,003	6,285	6,141	8,294
Peas	621	115	1,853	2,241	87	166	238	246	63	543	1,161	1,294	2,178	1,770	
Groundnuts	231	273			442	1,026	284	74	283						
Soya	1,696	1,685	1,761	1,188	1,607	1,175	2,136	1,889	3,158	3,139	1,489	1,147	1,271	1,537	2,049
Banana	24,866	24,097	14,820	12,405	31,082	17,893	32,401	56,520	89,825	125,637	38,297	57,651	42,283	23,739	28,280
Irish Potato	5,848	6,573	18,914	28,075	13,083	12,933	8,201	7,211	9,685	8,455	35,741	7,405	62,116	140,859	168,955
Sweet Potato	22,083	11,409	14,597	6,968	10,133	3,255	24,717	21,884	8,054	21,252	13,407	16,362	17,122	13,855	3,386
Yam & Taro	1,823	718	747	3,455	1,959	161	4,283	10,068	6,532	1,864	6,613	1,152	10,768		
Cassava	55,753	47,892	27,843	28,004	100,014	115,714	109,119	59,305	35,201	38,184	9,597	44,063	24,264	4,020	
Vegetables	10,351	9,349	4,632	2,390	8,830	13,490	10,904	12,594	10,632	12,506	21,293	22,691	19,323	10,140	8,353
Fruits	7,278	8,867	2,544	1,585	5,901	6,542	5,953	6,537	4,200	8,413	13,210	12,401	7,258	9,833	8,750

Production per District (MT)

Crop	Gakenke	Musanze	Gicumbi	Burera	Rulindo	Bugesera	Rwamagana	Kayonza	Ngoma	Kirehe	Gatsibo	Nyagatare	Kigali City	Total
Sorghum	241			39		87					3,835	6,801		12,173
Maize	19,187	12,625	1,911	14,167	3,788	3,924	9,346	4,650	12,358	35,452	22,409	26,775	1,174	318,772
Wheat	4,820	3,638	3,569	6,401	1,988									32,068
Rice						1,914	1,681	241	1,280	3,234	2,137	2,860	497	31,660
Beans	6,527	6,460	7,482	9,978	7,468	7,749	6,732	7,716	10,028	6,928	8,079	7,264	4,806	189,038
Peas	272	8	1,974	719	902	48	28	175	112	46	1,538	97	630	19,124
Groundnuts	130		344		57	481	301	346	249	653	540		43	5,758
Soya	1,990	213	459	668	478	377	358	246	660	307	247	1,140	276	34,344
Banana	59,020	25,267	90,595	31,121	39,625	22,717	67,974	142,663	95,924	116,322	99,165	49,946	14,716	1,474,851
Irish Potato	47,102	175,780	106,447	117,143	11,069	3,339	6,988	3,054	5,839	2,608	11,772	2,198	2,494	1,029,887
Sweet Potato	24,343	1,694	4,685	20,655	12,754	9,210	10,454	10,174	8,441	1,653	4,113	1,805	3,235	321,698
Yam & Taro	2,743	7,826	8,690	383	6,090	1,477		22	3,194	340	10,520		1,607	93,033
Cassava	14,648	15,589	29,185	5,761	26,525	78,918	20,164	28,036	62,342	20,530	27,113	30,634	7,483	1,065,901
Vegetables	7,373	25,157	8,787	37,082	10,129	17,873	5,769	3,292	7,721	7,394	7,443	11,572	3,496	330,568
Fruits	10,357	21,903	9,249	19,532	9,716	4,290	3,960	5,336	4,633	3,781	2,842	7,811	2,460	215,139

Production in Kcal, protéins and lipids

	Huye	Gisagara	Nyamagabe	Nyarugur u	Ruhango	Nyanza	Kamonyi	Muhanga	Rusizi	Nyamashe ke	Rutsiro	Karongi	Ngororero	Nyabihu	Rubavu
Kcal (1 000 000 000)	151.0	126.5	133.3	105.3	192.0	183.0	225.3	173.8	258.1	209.4	127.0	155.0	186.7	221.4	199.9
Proteins (1 000 T.)	3.2	3.0	3.8	2.7	3.5	2.9	4.1	3.7	7.3	4.8	3.4	3.2	4.8	6.2	5.8
Lipids (1 000 T.)	0.7	0.6	0.9	0.6	0.9	0.8	1.0	0.7	2.0	1.3	0.6	0.7	0.9	1.3	1.1
Kcal from animals (1 000 000 000)	6.9	4.5	10.6	11.5	12.6	7.0	12.0	10.5	6.5	9.1	10.5	6.1	11.2	8.8	7.6
Proteins from animals (1 000 T.)	0.4	0.2	0.6	0.6	0.7	0.4	0.6	0.6	0.4	0.5	0.6	0.4	0.6	0.5	0.4
Lipids from animals(1 000 T.)	0.5	0.4	0.8	0.8	0.9	0.5	0.9	0.8	0.5	0.7	0.7	0.5	0.8	0.6	0.5
Energie (Kcal/Capital/day)	**2,607**	**2,213**	**2,253**	**2,188**	**3,651**	**3,700**	**3,982**	**2,813**	**3,497**	**2,948**	**2,282**	**2,532**	**3,074**	**3,762**	**3,109**
Protein (g/capital/day)	60	54	69	62	74	64	80	65	101	72	66	56	84	108	93
Lipids (g/capita/day)	21	17	27	27	32	26	33	24	32	27	23	18	26	31	25

N.B. : Adult humans require 2100 kcal/capital/day, 59 g of protéins and 40 g of lipids (source ENA/MINAGRI)

Production in Kcal, protéins and lipids (Cont'd)

	Gakenke	Musanze	Gicumbi	Burera	Rulindo	Bugesera	Rwamagana	Kayonza	Ngoma	Kirehe	Gatsibo	Nyagatare	Kigali City	Rwanda
Kcal (1 000 000 000)	206.5	230.2	194.7	235.4	122.8	156.2	122.6	142.5	198.0	218.6	209.8	201.7	44.9	4,931.7
Proteins (1 000 T.)	5.5	5.6	4.7	6.5	3.2	3.0	3.0	3.0	4.4	5.4	5.2	5.2	1.5	118.4
Lipids (1 000 T.)	1.4	0.9	0.6	1.1	0.5	0.6	0.7	0.6	0.9	1.8	1.3	1.4	0.2	26.0
Kcal from animals (1 000 000 000)	10.7	7.2	14.4	7.2	7.3	4.8	12.6	9.5	5.1	6.0	13.0	22.1	1.2	256.3
Proteins from animals (1 000 T.)	0.6	0.4	0.8	0.4	0.4	0.3	0.7	0.6	0.3	0.4	0.7	1.3	0.1	14.3
Lipids from animals(1 000 T.)	0.8	0.5	1.0	0.5	0.5	0.3	0.9	0.7	0.4	0.4	0.9	1.6	0.1	18.9
Energie (Kcal/Capital/day)	**2,959**	**3,391**	**2,549**	**3,317**	**2,269**	**2,647**	**2,689**	**3,177**	**3,788**	**4,293**	**3,447**	**3,849**	**222**	**2,751**
Protein (g/capital/day)	82	85	67	94	63	54	73	76	87	110	93	112	8	75
Lipids (g/capita/day)	30	20	20	21	18	15	31	26	25	42	35	52	1	26

N.B. : Adult humans require 2100 kcal/capital/day, 59 g of protéins and 40 g of lipids (source ENA/MINAGRI)

Annex II: Methodology.

1.1. Sampling methodology

1.1.1. Target population

The target population for the crop assessment survey is commposed of all rural and urban households where there exist strong agricultural activities.

1.1.2. Stratification

A stratified two-stage sample design has been used for the ENA. The sampling frame was stratified by Province (City of Kigali), urban and rural. The urban strata consisted of Kigali-City and other urban, while the rural part of each province was treated as a separate stratum. Data are representative at District level.

1.1.3. Sample selection procedure.

Within each stratum, the sample enumeration areas were selected systematically with probability proportional to size (PPS), where the measure of size for each enumeration area was based on the number of households from the sampling frame. Within each enumeration area, 12 households have been selected with simple random sampling, meaning that all households had the same probability to be selected.

1.1.4. Estimation procedure

In order for the sample estimates from a particular survey to be representative of the population, it is necessary to multiply the data by a sampling weight, or expansion factor. The basic weight for each sample household would be equal to the inverse of its probability of selection (calculated by multiplying the probabilities at each sampling stage).

1.2. Estimation of area under cultivation.

1.2.1. Area measurement

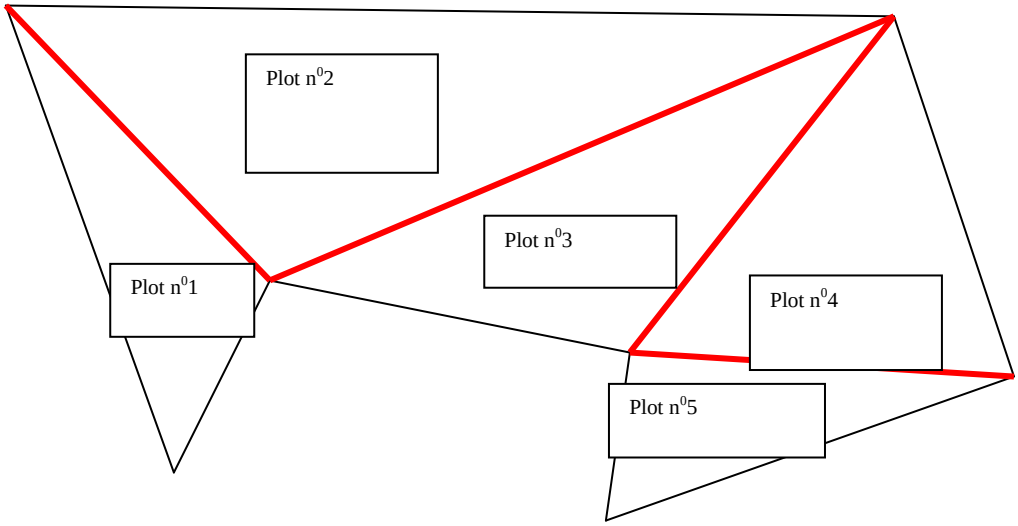
The shape of cultivated areas is not always of the regular form (triangle, rectangle…), but most of the fields under cultivation have rectangular shape (square or rectangle), others are triangular (triangle). We encounter also fiels that have irregular shape, having 5 sides or abore. In one or other case, the area measurement has been simplified as follows:

a) **Field of rectangular shape**: area is obtained by multiplying the length and the width.

b) **Triangular fields.** The enumerator measures the length of the base side and that of the height, and the area is equal to the base multiply by the height divide by 2.

c) **Fields of irregular shape.** In this case, a field of such shape has been divided into several plots of regular shape, in order to facilitate the calculation of the area of the entire field, as shown in the following figure.

Example : A field of irregular shape with 7 sides.



The perimeter of the above fiel is shown by the thin black lines. The field is not a rectangle, nor a triangle, neither of a known geometric form. In this case, area measurement has been done using procedure described in b, since the fiel dis composed of triangle. The total area of the fiels is the sum of the areas of the triangles that constitute the field. One or more plots were randomly selected for the purpose of estimating the yield.