

CHAPTER 3: LAND USE AND AGRICULTURE

Overview of the agriculture sector

The agricultural sector has been given a high priority in the government's planning for development. The current national thrust is for the sector to move from subsistence to commercial mode of production. This strategy aims to increase household incomes and lead to a 50 per cent reduction in poverty over twenty years (ROR 2008). With its projected contribution to economic growth, modernisation of agriculture is seen as one of the six pillars of Vision 2020 along with sustainable land-use management and basic infrastructure (ROR 2000). Agriculture is also explicitly recognised in the EDPRS as one of the four priority sectors that will both stimulate economic expansion and make the greatest contribution to poverty reduction (ROR 2007). The other sectors are health, education and road maintenance

By 2020, agriculture is envisaged to contribute 33 per cent to GDP whereas industry, including agro-processing, is expected to grow from current levels of 14 per cent to 26 per cent of GDP (ROR 2000). The key national and agricultural sector-related targets presented in the Vision 2020 document, are listed in table 1.

Table 1: Selected national and agriculture-related goals in Vision 2020

Indicator	2000	2010	2020
Population (million)	7.7	10.1	12.71
GDP/capita (constant 2000 US\$)	220.0	400.0	900
Poverty (per cent)	64.0	40.0	30
Agricultural GDP growth (per cent)	9.0	8.0	6
Agriculture as per cent of GDP	45.0	47.0	33
Agricultural as per cent total population	90.0	75.0	50
Land under 'modernised' agric (per cent)	3.0	20.0	50
Fertiliser application (kg/ha/annum)	0.5	8.0	15
per cent banks' portfolio to agric. sector	1.0	15.0	20
Soil erosion protection (per cent total land)	20.0	80.0	90
Coffee exports (tonnes)	19,000.0	44,160.0	<i>n.a.</i>
per cent of coffee production fully washed (2001)	1.0	63.0	<i>n.a.</i>
Coffee export earnings (US\$ m) (2002)	22.0	*117.1	<i>n.a.</i>
Tea export earnings (US\$ m) (2003)	26.8	91.0	<i>n.a.</i>
Agricultural exports	<i>n.a.</i>	<i>n.a.</i>	<i>5-10 times yr 2000 value</i>

*The Rwanda Investment and Export Promotion Agency (RIEPA) projects coffee export earnings to reach US\$85 million in 2008, from a base of US\$38 million in 2005, largely on the basis of improved quality or greater proportion of specialty coffee in the total exports (RIEPA 2006).

Source: MINECOFIN 2003 in ROR 2008

The agriculture sector which currently contributes significantly to national GDP (32.6 per cent) has of recent experienced remarkable growth as the 5-year trends in table 2 illustrate. Food production has increased as a result of the expansion of maize and wheat farming. There was also a rebound in cassava yields following depressed production in 2006 and 2007 due to the cassava mosaic epidemic. The Crop Intensification Programme and improved crop diseases prevention and treatment measures in 2007 and 2008 have, in the main, been

responsible for growth in food and export crops production. This places the sector in a good position to achieve its EDPRS targets.

Table 2: Trends in Sector Performance and GDP Growth Estimates (2004-2008)

GDP	2004	2005	2006	2007	2008*	5 Yr Average
	(%)					
Agriculture	0.1	4.8	1.1	0.7	15.0	4.3
Food crops	-1.8	6.4	0.02	1.8	16.4	4.6
Export crops	58.2	-24.3	29.8	-33.1	20.3	8.8
Livestock	2.7	2.7	2.7	2.7	2.7	2.7
Fisheries	2.6	2.6	2.6	2.6	2.7	2.6
Forestry	2.6	2.6	2.6	2.6	2.7	2.6
Total GDP growth	5.3	7.2	7.3	7.9	11.2	7.2
Agriculture as per cent of GDP	34.9	34.2	32.2	30.0	31.0	32.6

*Data for 2008 is a projection as agreed with IMF.

Source: MINECOFIN 2009

The state of land use and agricultural development in Rwanda

Arable land

Rwanda is a small country with an area of 26,336 km². The total arable land is about 1.4 million hectares, which is 52 per cent of the total surface area of the country. However the actual area cultivated has exceeded 1.6 million ha in recent years. Another 0.47 million ha is under permanent pasture, so well over 70 per cent of the country's total land surface is exploited for agriculture (ROR 2008).

Rwanda has about 165,000 ha of marshlands of which 93,754 ha (57 per cent) have been cultivated. However, only 5,000 ha have been developed and can be cultivated throughout the year while the rest are arbitrarily cultivated by peasants grouped in organizations or by cooperatives without any technical study (ROR 2008).

Land use

Land use is largely influenced by a number of factors, the main ones being climate, socio-economic (culture and population dynamics) and government policies.

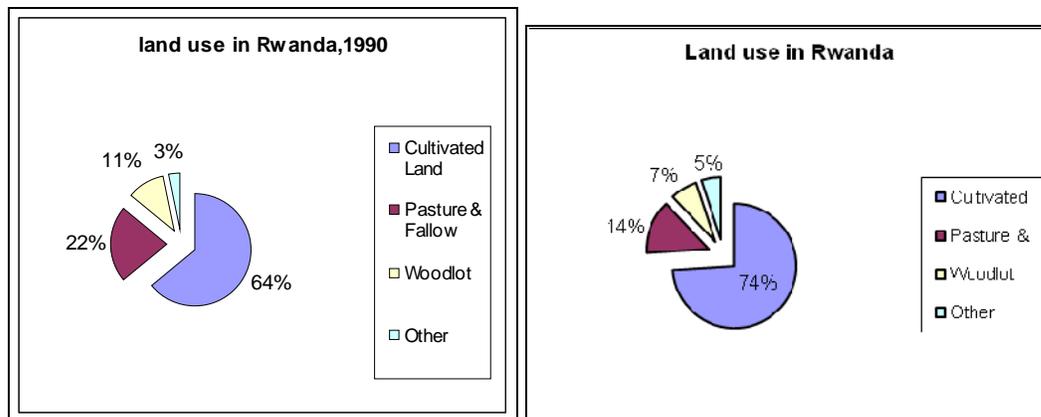
Figure 1 shows the land use in Rwanda in 1990 and 2002. Cultivated land increased from 782,500 to 899,133 ha or from 64 per cent to 74 per cent in absolute terms between 1984 and 2002 (Mpyisi *et.al.* 2003). This increase occurred at the expense of pasture, fallow and woodlots. The share of pasture and fallow decreased from 22 per cent in 1990 to 14 per cent in 2002 and woodlots decreased from 11 per cent in 1990 to 7 per cent in 2002. These trends persist today and this implies that the land is being farmed intensively with no fallow at all.

Land used for agriculture in Nyabihu district



Photo credit: REMA

Figure 1: Land Use in Rwanda 1990 and 2002



Source: Mpyisi *et.al.* 2003

Land reform

The Vision 2020 and the medium term strategy (the EDPRS) have focused on land administration and land use management as key areas for the land reform process that will support sustainable development. These efforts have come up against significant challenges such as population pressure in both urban and rural areas which have led to land degradation. Presently, there are efforts to develop a national land use master plan which will subsequently be translated into local plans to guide zoning for activities including agriculture, urbanization, resettlement, public infrastructures, and biodiversity conservation.

The realization of these efforts will likely provide appropriate interventions for land degradation which will lead to enhanced agricultural productivity. Additionally, the appropriate location of activities informed by land suitability assessments will ensure that resettlement patterns, public infrastructure and the overall urbanization process provides the right kind of interventions for urban environment issues in particular and proper national planning targeted at promoting environmental management in support of sustainable development.

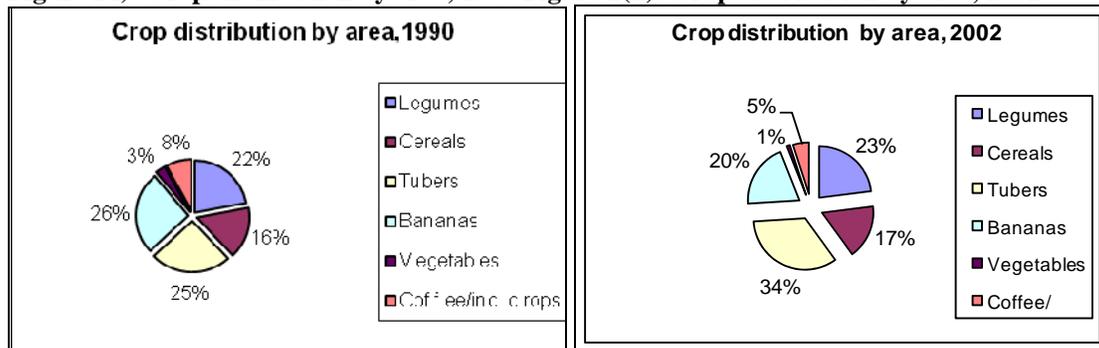
Changes in crop distribution

Besides the change in land use and cultivated area, there have been changes in terms of crop distribution by area occupied. The changes in cropping pattern have implications on the environment in the areas concerned. For instance, areas where bananas and coffee were replaced with tubers such as cassava are likely to become susceptible to soil erosion because of loss of cover. Figure 2 shows some of the changes in crop distribution.

The area occupied by legumes and cereals remained fairly constant over the period 1990-2002 (although there was some increase in absolute terms). However, the area under tubers increased significantly from 25 to 33 per cent of total farmland over the same period. Many areas have experienced gains of over 100 per cent in Irish potatoes, for instance Butare and Gikongoro provinces. The traditional epicenter of Irish potato production, Ruhengeri, lost about 50 per cent of its production during the same period. The increase in cassava production was dramatic in Gikongoro where it showed a ten-fold gain, while the eastern zone (Gitarama, and Kibuye) more than doubled their output.

The area under bananas has dropped from 26 to 23 per cent of cultivated land between 1990 and 2002. Kibuye was the only part of the country with increased banana production. The reduction was most dramatic in the Kigali Rural province, where output fell by 91 per cent. The areas surrounding Kigali Rural also experienced substantial declines. Good rains and greater attention from farmers is having a positive effect on banana production in areas of decline. Upward trends in banana will likely continue as many farmers rely heavily on them as part of their cropping system.

Figure 2 i): Crop distribution by area, 1990 Figure 2(ii): Crop distribution by area, 2002



Source: FSRP/MINAGRI 2003 – allocation of land holdings

Growing bananas on the hillsides



Photo credit: REMA

Agricultural production

Production of food and cash crops increased considerably between 2000 and 2005. The increase in production can partly be explained by expansion of cultivated area or by improved yields. This has been part of the sector strategy to ensure food security, income generation and poverty reduction. Livestock rearing has also been encouraged as an important category for income generation and nutrition for farm and non-farm families. Increasing production can come at the expense of further limiting the available land for agriculture, especially in light of the aggressive efforts to intensify agriculture. Improved methods of environment management will be required to ensure that agricultural practice is sustainable.

Food crops hold a very dominant position in Rwandan agriculture. However, since 1990 the largest percentage increases in area sown, by a large margin, have been fruit and vegetables (increasing more than fourfold), followed by Irish potatoes and wheat (increasing almost threefold) (ROR 2008). Table 3 shows the area harvested under principal crops up to 2007.

Table 3: Area harvested of principal crops, 1990 and 1997-2007

Crop/ Year	1990	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Sorghum	133,421	108,894	114,639	129,261	174,195	165,444	171,608	179,991	179,307	196,732	170,298	159,670
Maize	98,522	76,481	71,212	72,673	89,053	105,560	104,628	103,100	106,976	109,400	114,836	140,141
Wheat	9,313	6,275	5,700	5,172	10,043	10,748	12,046	0,727	22,191	24,157	22,972	27,161
Rice	6,816	3,233	4,144	4,919	4,266	5,090	6,423	7,666	12,167	13,922	14,033	15,037

Crop/ Year	1990	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cereals	248,07 2	194,88 3	195,69 5	212,02 5	277,55 7	286,84 2	294,70 5	311,48 4	320,64 1	344,21 1	322,13 9	342,00 9
Beans	262,56 3	238,52 5	234,92 3	228,21 5	333,20 5	343,96 6	358,00 2	356,89 9	319,34 9	313,01 9	356,38 1	355,72 5
Peas	45,896	33,562	28,750	26,796	29,993	32,125	31,228	34,752	32,175	34,796	31,141	36,545
Groundnuts	9,365	3,459	7,045	7,397	13,463	14,767	15,900	16,823	18,884	16,011	16,197	19,488
Soybeans	26,867	13,756	17,858	19,073	29,543	29,555	31,289	36,067	36,707	42,119	42,364	55,423
Pulses, oilseeds	344,69 1	289,30 2	288,57 6	281,48 1	406,20 4	420,41 3	436,41 8	444,54 1	407,11 5	405,94 5	446,08 2	467,18 1
Irish potatoes	42,055	42,000	28,264	29,770	108,98 3	117,40 3	124,97 2	134,03 4	133,41 8	135,62 2	139,75 0	114,16 4
Sweet potatoes	175,89 3	149,34 2	148,85 8	179,94 1	174,66 3	197,72 7	195,37 0	147,29 0	163,06 9	148,52 6	138,72 5	146,76 3
Colocas e, yams	52,137	42,914	46,158	49,049	21,320	25,669	25,334	27,158	27,098	26,537	25,251	31,722
Cassava	131,76 8	82,188	76,314	118,49 2	120,46 3	136,23 8	130,45 7	134,38 6	133,87 5	115,69 4	118,86 0	143,22 5
Roots & tubers	401,85 3	316,44 4	299,59 4	377,25 2	425,42 9	477,03 7	476,13 4	442,86 9	457,46 0	426,37 9	422,58 6	435,87 4
Bananas , plantains	400,57 0	349,90 6	405,26 4	410,32 3	360,47 0	363,24 9	358,86 3	358,41 8	363,38 3	361,25 1	366,29 6	351,95 8
Fruit/ vegetables	18,374	n.a.	19,310	20,889	41,692	44,042	47,420	58,225	48,160	81,777	84,830	83,959
Total above	1,413,5 60	1,150,5 35	1,213,7 83	1,301,9 70	1,511,3 52	1,591,5 83	1,613,5 40	1,615,5 38	1,596,7 59	1,619,5 63	1,641,9 33	1,680,9 81
Coffee										33,000	38,559	
Tea						9,786	9,572	9,588	9,542	11,750	12,306	
Pyrethrum						2,385	2,665	3,191	3,394	3,191		

Sources: Compiled from statistics available from MINAGRI, MINECOFIN, OCIR Café and OCIR Thé.

There has been increased production in major export crops between 2001 and 2005 and this trend is continuing. The tea sector has experienced strong recovery from last year's stagnation, with production increasing by 3.6 per cent. Furthermore, the price achieved per kg sold rose by 21.8 per cent, indicating that efforts by the Public Office in Charge of Tea (OCIR-Thé) to increase the quality of tea grown is beginning to produce results. This strategy should continue to inform OCIR-Thé's work in 2009 (MINAGRI 2009).

The production of coffee increased 16 per cent from 16.0 to 18.6 MT between 2000 and 2005 with 2004 the peak year of production at 28.7 MT. In 2005, although production of coffee fell 35 per cent, its quality improved. Standard coffee rose from 19.2 to 45 per cent between 2000 and 2005, ordinary coffee decreased from 74.4 per cent in 2000 to 49 per cent in 2005 and the share of fully washed coffee increased from 0.1 per cent to 6 per cent over the same period. Following a downturn in coffee production in 2007 (as a consequence of the cyclical nature of coffee production as well as the uprooting of certain varieties), 2008 shows a substantial recovery in production (over 33 per cent compared to 2007). Production levels are not yet as high as they were in 2006, but as production is of increasingly high quality this has partly made up for the reduction in volume produced. This policy direction is reflected in the average price received for Rwanda's coffees, which has increased by 10 per cent since 2007 and 21 per cent since 2006 (MINAGRI 2009).

Production of pyrethrum fell by 24 per cent. Horticulture production (flowers, fruits and vegetables) increased by 2,737 per cent with exports averaging 59 tonnes per week, mainly for regional markets. Export volumes from high value horticulture for international markets remain significantly lower, around 2.5 tonnes per week.

Livestock numbers have increased by 60 per cent over the PRSP1 period, (2001-2005) reaching pre-1990 levels in 2003/2004. During that period cattle increased by 43 per cent, goats 67 per cent, sheep 195 per cent, pigs 93 per cent, poultry 44 per cent and rabbits 67 per cent. These increases were due to improvements in quality and disease control. The number of poultry declined due to bird flu (table 4).

The increase in cattle numbers has contributed to a significant increase in milk production and subsequent increase in average consumption of milk per capita from 6.8 l/year in 1999 to 20 l/year in 2007 (MINAGRI 2008). Although production of livestock products has increased, demand still outstrips supply, especially for milk and eggs, which contributes to food insecurity (lipid and protein intake). Hides and skins production increased 60 per cent.

Table 4: Trends in livestock and livestock products, 2000-2007

	2000	2001	2002	2003	2004	2005	2006	2007
Livestock ('000 head)								
Cattle	755	814	960	992	1,007	1,077	1,122	1,147
Goats	757	917	920	1,271	1,264	2,664	2,688	2,738
Sheep	233	267	301	372	687	690	695	704
Pigs	177	197	208	212	327	456	527	571
Poultry	2,043	1,278	1,056	2,432	2,482	2,109	1,776	1,868
Rabbits	339	495	489	498	520	427	418	423
Livestock products (mt)								
Milk	57,853	63,484	97,981	112,463	121,417	135,141	146,840	158,764
Meat	22,807	25,608	35,748	39,126	48,681	49,861	52,226	54,780
Fish	6,996	7,308	7,612	8,144	8,126	8,180	9,267	9,655
Eggs	1,471	920	1,015	2,432	2,452	2,452	2,236	1,620
Honey	n.a.	760	819	908	1,029	1,671	1,676	n.a.

Source: ROR 2008

Agriculture and National Economic Development

The agricultural sector is very important to the economy of Rwanda. The agriculture sector grew at an average of 9.5 per cent over the 1996 to 2000 period; however this growth declined to an average of 4.8 per cent annual growth in 2001-2006 that was just half the growth registered in the previous 5-year period (ROR 2007). The agricultural sector contribution to the overall GDP growth for 2007 was 6.3 per cent. The slow growth of the sector in 2001-2006 is explained by the corresponding modest growth of 3.5 per cent for food crops and 1.9 per cent for export crops over the period 2002-2005 due to bad weather. Agricultural production in 2008 was generally impressive at 14.8 per cent. There were also increases in food and export crop production of 16.4 and 13.5 per cent respectively. This served as a major input towards national growth levels of 8.5 per cent (MINAGRI 2009).

In 2001, the contribution of the agricultural sector to GDP was about 46 per cent in real terms and it accounted for 80 per cent of exports. It was thus the main national source of foreign currency and survival for the population (ROR 2004). In 2003, the share of the sector declined to 43 per cent of GDP and by 2006 was 36.4 per cent of GDP compared to 43 per cent of the service sector.

Despite the decline in share of GDP, agriculture still remains important (ROR 2007). It provides employment for 86.3 per cent of the country's working population (NISR *et.al.*

2008), with about 80 per cent of adults working in agriculture as the main occupation (NISR *et.al.* 2008). However, in the urban areas, the figure is much lower. For instance those working in agricultural-based sector in Kigali are only 15 per cent (NISR *et.al.* 2008).

Currently, the agricultural sector contributes about 30 per cent to Rwanda's growth and as such has positioned itself as a sector key to national development and is crucial to achieving the goals set out in the EDPRS and Vision 2020.

Key environmental issues associated with the agricultural sector

The main issues putting pressure on agricultural productivity include high population density on the limited land resource. This has led to land fragmentation and reduction of farm sizes, continued intensive cultivation of land with no fallow and soil erosion, over cultivation without restoration of soil nutrients, weak extension and research services and increased vulnerability to climatic shocks like drought or heavy rains. The use of fertilizers and agricultural chemicals has polluted water; and agricultural activities and general mismanagement of the wetlands have further degraded and destroyed them.

Population pressure

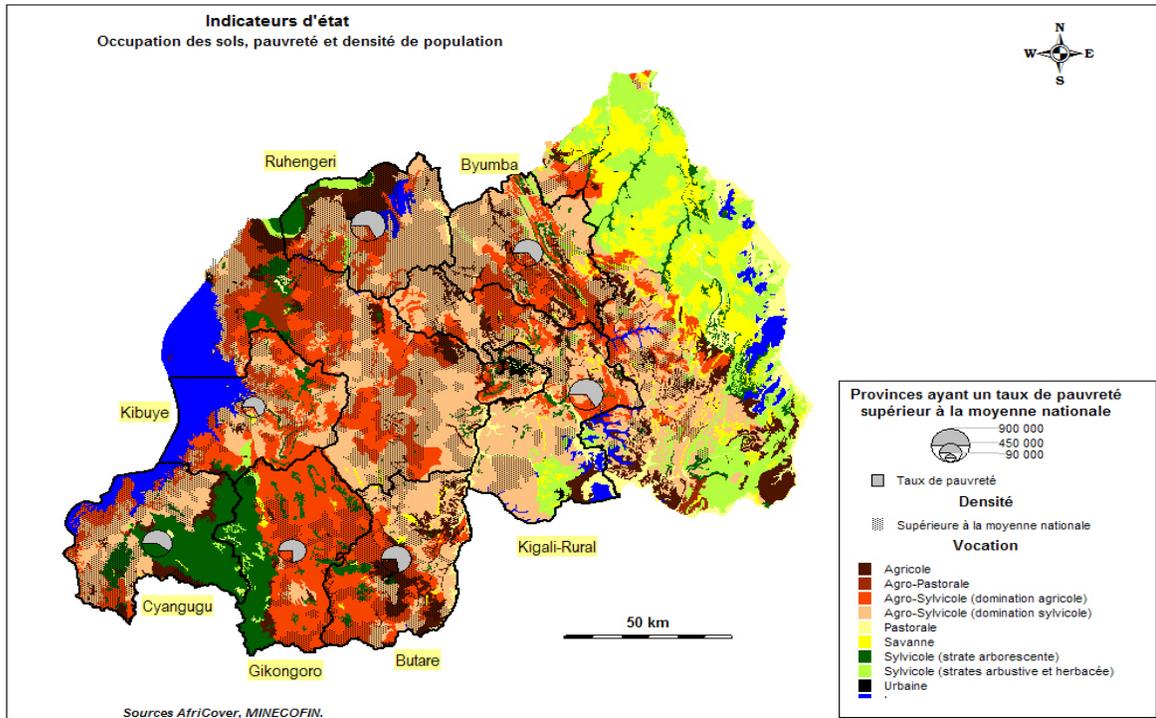
High population density has fuelled a shortage of arable land, led to decreasing farm size, shortage of arable land and the adoption of intensive agricultural practices on land with declining soil fertility. As a result of land shortages, even the most fragile areas are not spared. For instance the ecologically sensitive areas of Ruhengeri, Gisenyi have the highest population densities (see figure 3). This has increased pressure on the ecosystems resulting in the current degraded state (loss of biodiversity; over-cultivation; soil erosion; declining productivity) and more poverty. In the southern parts (Gikongoro and Butare), the main poverty-environment issue is soil erosion and soil infertility, largely due to over cultivation, use of inappropriate technology and lack of external inputs. In the pastoral and agro-pastoral rangelands of the east, population pressure is not as high but water shortages (for both humans and livestock), drought and overstocking are the main concerns, often leading to encroachment into the protected areas (Akagera National Park).

The cattle grazing areas of Umutara are prone to bush fires, treading and overgrazing. Overgrazing has been a big problem in the drier Umutara region, particularly soon after the genocide of 1994. Most returning refugees who settled in the region had large herds of cattle and overgrazing and accompanying soil erosion was a problem due to the limited carrying capacity of the dry region. The number of cattle in Umutara region in 1995 was estimated at about 800,000 head. The government has developed policies and created awareness on improved livestock keeping, including gradual substitution of the local breeds, a reduction in numbers through substitution with improved breeds, improvement of pastures and the zero-grazing system.

Overgrazing and bush fires have been the greatest culprit for reduction of biodiversity as they result in the extermination of the most grazed species as well as pyrophilic (fire-resistant) species with low bromalytic (nutritive) such as *Eragrostics*, *Sporobolus* and *Digitalia* (Twagiramungu 2006). In this respect, the One Cow per Family (*Gira Inka*) programme has been effective in promoting improved cow breeds among Rwandans not only to improve nutrition and income through milk production and sales, but also to provide organic manure to improve crop production. This system has been extended to other animals such as goats,

which are expected to significantly reduce overgrazing and related environmental degradation problems.

Figure 3: Land Use and Land Cover, Poverty Incidences and Population Density –
TYPESSETTER there is a land cover map on the cd which could replace this one



Source: REMA 2006

National and regional availability of land

Generally landholdings are very small with more than 60 per cent of households cultivating less than 0.7 ha, 50 per cent cultivating less than 0.5 ha, and more than 25 per cent cultivating less than 0.2 ha (ROR 2008). This constraint is aggravated by the fact that most farms have multiple, scattered plots, many of them tiny. The small size of farms emanates from high population pressure on a small land area. Moreover, cultural and inheritance patterns of dividing land among sons has also aggravated the situation (ROR 2007).

There are regional disparities in the availability of arable land. The largest average farm sizes are in Umutara averaging 1.14 ha and the lowest average sizes are in Cyangugu with 0.34 ha. The small farm sizes mean that the majority of rural populations cannot produce enough food. Without the adoption of better farming methods like terracing and contour ridges to stop soil erosion, agriculture will continue to be unsustainable. To address this issue, Vision 2020 requires that the use of national space is organised based on an overall land-use plan. Table 5 shows the average land holdings per household by province in 2006.

Table 5: Distribution of land size per household by province 2006

PROVINCES	Average land size per household (ha)	Total land (ha)
Kigali Ville and Kigali Ngari	0.69	127 076

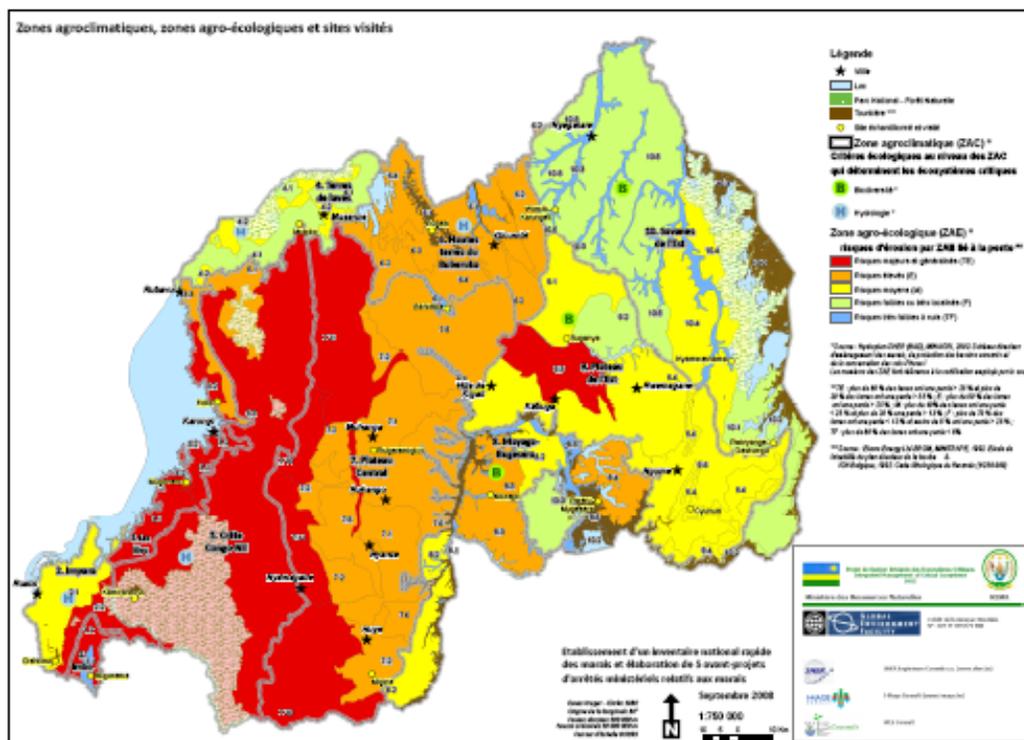
Gitarama	1.09	178 284
Butare	0.36	33 455
Gikongoro	0.41	41 564
Cyangugu	0.34	38 935
Kibuye	0.68	58 250
Gisenyi	0.56	94 791
Ruhengeri	0.54	101 111
Byumba	1.04	153 400
Umutara	1.14	96 122
Kibungo	0.95	139 875
Rwanda	0.72	1 062 861

Source: NISR and MINAGRI 2007

Soil erosion

Agriculture practiced on the slopes of hills and mountains, coupled with deforestation has caused extensive land degradation and soil erosion. About 40 per cent of Rwanda's land is classified by the FAO as having a very high erosion risk with about 37 per cent requiring soil retention measures before cultivation. Only 23.4 per cent of the country's lands are not prone to erosion (ROR 2008).

Figure 4: Agro-climatic zones and risk of soil erosion



Map production: REMA

Although, it is generally agreed that slopes of more than 5 per cent need erosion control measures, the reality is that most cultivation is carried out on steep slopes without any recommended soil control measures (ROR 2007). Indeed it is not unusual to find crops grown on steep slopes of up to and above 55 per cent. Only 31.2 per cent of the agricultural land area is equipped with anti-erosion techniques. About 36.5 per cent of the country has

protective grass strips. The provinces of Butare and Gikongoro have the most of these - 70.5 and 65.3 per cent respectively. This is mainly due to the efforts of non-governmental organisations such as Food for Work, World Vision, Catholic Relief Services (CRS) and Care International. Areas with least land protection were found in the former provinces of Cyangugu (77.1 per cent), Umutara (66.7 per cent) and Kibungo (51.2 per cent) (Kelly *et.al.* 2001). Table 6 shows classification of soils according to the risk of being eroded due to the slope.

Soil erosion has compromised ecosystem integrity, eroded riverbanks and led to nutrient loading of water bodies. It has also led to reduced soil fertility in the acid-soil mountainous areas resulting in lowered agricultural yields. The impact of reduced productivity of arable land through the constant loss of top soil and nutrients is already evident at all levels in Rwanda. For instance up to 80 per cent of households in hilly areas such as Ruhengeri are already experiencing a decline in productivity related to soil erosion (Musahara 2006). Overall the country is estimated to be losing 1.4 million tonnes of soil per year. This is equivalent to a decline in the country's capacity to feed 40,000 people per year.

Most of the soil lost through erosion ends up in the stream network and marshlands (Musahara 2006). This is evident in the siltation of the various rivers and associated wetlands. Research shows that the Nyabarongo river system carries 51 kg/second of soil at Nyabarongo-Kigali, 44 kg/s at Nyabarongo-Kanzenze and 26 kg/s at Akagera-Rusumo (ROR 2008).

Domestic and industrial energy demands have also indirectly contributed to soil erosion. Much of the country's energy requirements are met by crop residues as well as fuel wood. The use of crop residues limits the extent to which they can be used to conserve soil moisture and fertility. Deforestation on the other hand leads to extensive soil erosion and in some instances floods and landslides.

Table 6: Classification of soils according to the risk of being eroded due to the slope

Risk class	Very high	High	Average	Low	Very low
Surface (ha)	357.529	436.563	763.005	340.376	136.625
per cent of soils	17.6	21.5	37.5	16.7	6.7

Source: REMA 2006

Siltation is evident from the brown colour of many of Rwanda's rivers and streams



Photo credit: REMA

Soil nutrient replacement

Before the war and genocide in 1994, about 95 per cent of farmers used organic manure on 70 per cent of cultivated area. The post-war figures for use of organic matter (primarily manure) shows a decline compared to pre-war figures. Organic manure is currently used by only 69 per cent of farms on 59 per cent of cultivated area compared with 95 per cent and 70 per cent before the war. There has been little change in the use of inorganic fertilizers. Nine per cent of farmers used pesticides on 5 per cent of cultivated land during the 2000A season. The numbers for fertilizers and lime, show that 5 per cent of farms applied fertilizers to 3 per cent of the cultivated area. These numbers are slightly lower than those for 1991 (7 per cent of farms and 5 per cent of area), however, the standard deviations for both the pre- and post-war data sets are very large and there is no statistically significant difference in fertilizer use between the two periods (Kelly *et.al.* 2001). Table 7 shows the use of inputs on cultivated land in 1991 and 2000.

Table 7: Input use and investments on cultivated land: 1991A vs. 2000A

Type of Investment	Farms using inputs (%)	Cultivated area (%)	Specified input covered	
	1991A	2000A	1991A	2000A
Chemical fertilizer/lime	7	5	5	3
Pesticides	NA	9	NA	5
Organic manure	95	69	70	59

Adapted from (Kelly *et.al.* 2001)

The use of fertilizer is likely to increase in future as the government has taken a policy decision to subsidize it and improve distribution through the use of private sector. In 2007 about 21,600 tonnes of mineral fertilizers were ordered and 13,260 tonnes were received and distributed. About 4,200 tonnes of mineral fertilizers were distributed under crops intensification program (MINAGRI 2008).

Climate-related threats

Climate-related shocks like drought and flooding are becoming more regular. The poor are particularly vulnerable to these shocks. The eastern and south eastern regions (Umutara, Kibungo, Bugesera and Mayaga) are most affected by prolonged drought while the northern and western regions (Ruhengeri, Gisenyi, Gikongoro and Byumba) experience abundant rainfall that usually causes erosion, flooding and landslides (Twagiramungu 2006). These extreme climate events have adverse environmental impacts on agricultural productivity. For instance, the 2008A and 2008B harvests were both negatively affected by serious droughts that came in at the beginning of the planting season. The droughts destroyed just-planted seeds and in some instances delayed planting so that crops became vulnerable to dry spells late in the season in ways that affected overall productivity (MINAGRI 2009).

Flooded farmland in Gishwati



Photo credit: REMA

Addressing the threats to agriculture

Agriculture is recognised in the EDPRS as one of the priority sectors that will both stimulate economic expansion and make the greatest contribution to poverty reduction and food security. However, as demonstrated in the discussion above, a number of factors are threatening these efforts. The government has put in place a number of strategies to address these threats. These are discussed below.

Soil erosion and nutrient loss control

The government is aggressively pursuing measures for soil erosion control. These measures include terracing, increasing soil cover and integrated management approaches such as agro-forestry and zero-grazing. There have been increases in the area under radical terracing.

However, small scale farmers lack the capacity to respond to the control of soil erosion because the anti-erosion measures are expensive. Some of the achievements are highlighted in box 1.

The intensive agricultural policy is geared towards increasing the use of mineral and organic fertilizers, pesticides and selected seeds. As part of the strategy to reduce soil nutrient loss, the government is currently subsidising fertilizers. However, since the misuse of agro-chemical products have harmful consequences on human and ecosystem health, the policy has to be accompanied with training on the control and management of the negative impact of agro-chemicals.

Box 1: Achievements in protection of soil

According to the March 2009 Joint Sector Review for the Agriculture sector, the area under agriculture (both traditional and commercial farming) underwent protection measures and progress was noted in the following areas:

- Area of land protected against soil erosion: 45 per cent (2008) to 50 per cent (2009)
- Area of marshland developed for agricultural use: 12,000 ha (2008) to 14,000 ha (2009)
- Arable land irrigated increases from 1 per cent (approx. 15,000 ha) to 1.6 per cent (approx. 24,000 ha)
- Irrigated hillside area increases from 130 ha in 2006 to 1,100 ha in 2012 using upland irrigation measures
- Proportion of farming households using improved farm methods: chemical fertilizer use increases from 15 per cent (2008) to 18 per cent (2009); organic fertilizer use increases from 10 per cent (2008) to 13 per cent (2009)
- Percentage of livestock in intensive systems increases from 30 per cent (2008) to 38 per cent (2009).

Source: [MINAGRI 2009](#)

Radical terracing on steep slopes in Rwanda



Photo credit: REMA

Expanding arable land through irrigation

There is potential for arable land expansion through the use of irrigation. The EDPRS aims to increase the area of hillside agricultural land under irrigation from a baseline of 130 ha in 2006 to 1,101 ha in year 2012. This has implications for environmental management and thus creates urgent need to develop technical expertise within the agriculture and environment sectors to ensure that Strategic Environmental Assessments (SEA) and Environmental Impact Assessments (EIA) are incorporated into the crop intensification programme to guarantee that adequate soil and water management measures are undertaken.

At present, Rwanda does not have irrigation-related environment problems like salinisation and concomitant loss of land for cultivation. However, there are some problems, albeit not serious, related to use of agro-chemicals, such as fertilizers in the sugar and tea industry. Table 8 shows the modes of farming based on rain-fed, irrigated and drainage farming according to the old provinces.

Table 8: Rain-fed agriculture, irrigated and drainage farming

Provinces	Rainfall		Irrigation		Drainage		Not Declared	
Kigali Ville and Kigali Ngari	120 322	96.3	1479	1.7	5274	1.9	0.0	0.0
Gitarama	173 013	90.1	135	1.9	5136	8.0	0.0	0.0
Butare	32 701	97.2	0	0.0	754	2.8	0.0	0.0
Gikongoro	40 995	97.3	369	1.6	199	1.1	0.0	0.0
Cyangugu	37 892	95.1	744	3.7	299	1.2	0.0	0.0

Kibuye	56 560	95.8	53	0.6	1460	3.3	176.8	0.3
Gisenyi	94 175	97.1	0	0.0	616	2.9	0.0	0.0
Ruhengeri	99 884	99.4	1125	0.2	102	0.4	0.0	0.0
Byumba	152 810	98.2	413	1.0	177	0.8	0.0	0.0
Umutara	95 641	97.3	210	0.8	270	1.9	0.0	0.0
Kibungo	139 763	99.2	96	0.5	17	0.3	0.0	0.0
Rwanda	1 043 756	97.0	4624	1.0	14304	2.0	176.8	0.0

Source: NISR and MINAGRI 2007

Strengthening policy implementation

Land resources are governed by law No. 11/82 (1982). This law however was not based on the land policy and is thus not comprehensive enough to deal with all land issues. Further, the implementation of both is currently done in a piecemeal manner with inadequate supporting resources.

Both the policy and law have the potential to address some of the issues like land fragmentation, farm size and land tenure. For instance they both provide the opportunity for land to be privately owned ensuring long-term land security that guarantees economic benefits through sale of land or using it as collateral for bank loans. Equally, an efficient land administration system is needed that is easily accessible at the local level for land transactions. Land administration and land use management along with land consolidation will continue to facilitate growth in agricultural productivity, investment in land especially for women and environmental management in support of sustainable development. The security of long-term tenure rights is important for encouraging soil conservation practices and other on-farm investments, as well as providing an inheritable asset for future generations.

Implementation of SEA at policy and strategic levels and EIA particularly for exploitation of wetlands for agricultural purposes, hill side irrigation and integrated water resources management measures will all provide scope for sustainable development with overall benefits to national environmental protection. Integration of SEA into policy and strategic planning for the agriculture sector will need to be followed by action planning facilitated by an effective coordination mechanism involving both agriculture and environment sectors through existing mechanisms such as the rural cluster. Successful implementation will also require technical services and actions to be disseminated through extension services, a sector of the economy that is yet to grow to levels where it will have impact both for enhanced agriculture production and environment management.

The environment action plan (1996), national strategy for biodiversity (2000), national environment policy (2003) and the environmental law (2005) provide important tools to deal with environment management for sustainable development and agricultural development in particular. The environment law outlines major principles of management and protection, deals with the management and use of agriculture land, governs issues of imports and exports of animals and plants and provides for mandatory environment assessment for development projects and has provisions related to the protection of wetlands and other critical ecosystems.

Agricultural policies and laws and strategies, particularly those that are supportive of value adding to agricultural practices including agro-processing will continue to be rationalized in the foreseeable future. Extension services need to be strengthened and extension-research linkages tailored to solving the farmers' problems. The on-going review of agricultural organizations with the objective of decentralization, offers the opportunity to improve

management, effectiveness and to bring extension and research to the farm level. The Agricultural Sector Wide Approach (SWAP) should encourage a more integrated approach to the sectoral programmes.

Improving population control and farming methods

The current population control methods continue to have inadequate impact and population pressure on land continues. There is also little concerted effort to create off farm employment. The current EDPRS flagships focus on improving policy on privatization and job creation which is likely to enhance off-farm options with overall benefits for environmental management.

The long term programme for soil and water conservation and degradation continues, but is yet to yield measurable results. There exist opportunities for effective adoption of the conservation measures that contribute to sustainable agriculture. The annual agricultural report for 2007 shows an increase in the area under radical terracing between 2006 and 2007 due to the introduction of IMIHIGO which provided an opportunity to enhance improved farming methods through use of terraces and improved agro-forestry practices capable of renewing and regenerating the soil. This has not only increased the area protected against erosion but also the land under cultivation.

Developing the marshes

The development plan for MINAGRI (1987-1997) regarded marshes as being important for agricultural production. The 1987 Bill on the development of marshlands promoted the development of marshes as a method for safeguarding the environment. It also recommended undertaking an environmental impacts study in accordance with the decision of the Ministry responsible for environment. The study was never done and consequently there has been mismanagement of the marshlands leading to a number of them drying and thus being unsuitable for agriculture.

The national environmental strategy and the National Environment Plan of 1991 then advocated for a compromise between the need to safeguard and the necessity to develop areas. It was necessary to harmonize the actions, establish a classification of marshes between areas requiring protection, areas requiring development and reserved areas, reduce to the minimum disruptive effects of developmental activities (through EIA) and controlling the use of chemical inputs in the marshes and on the slopes. In line with this, the Ministry of Agriculture has, since 1997, minimised the procedures for the distribution of plots in the marshes. Further, REMA has recently undertaken a wetland inventory which categories wetlands for conservation and other developments (REMA 2008).

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