BOTSWANA ENVIRONMENT STATISTICS 2012

STATISTICS BOTSWANA

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PREFACE

Statistics Botswana through the Environment Statistics Unit presents the third edition of Botswana's Environment Statistics Report. The report includes the latest available statistics and trends analysis in climate, land, water, wildlife, forests, natural disasters, mining and agriculture. Data used in this report are secondary and were drawn from various departments and organisations.

Like its predecessors, the Framework for Development of Environmental Statistics (FDES) developed by the United Nations Statistical Division was used in preparing this report. The indicators developed in this report would be useful to measure progress towards sustainable development and to entrench environmental sustainability in development programmes and projects. Needless to say, new threats to the environment caused by climate change, call for action which must be well-informed by facts and figures.

Last but not least, I would like to thank all data providers that worked cooperatively with the Environment Statistics Unit in the production of this report, and encourage their continued support as we strive to contribute to an environmentally friendly development path.

Thank you.

Anna Majelantle
Statistician General
September 2013

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EXECUTIVE SUMMARY

The purpose of the 2012 Botswana Environment Statistics Report is to present and discuss the current status and trends of natural resources in relations to human use, under selected themes; climate, land, water resources, wildlife, forests, natural disasters, mining and agriculture. The United Nations Framework for the Development of Environment Statistics (UNFDES) guided the production of this report.

The report reveals that the rainfall season in Botswana, is from November to March, though sometimes rains do come before November and even after March. Botswana's rainfall patterns indicate a high variability of rainfall both spatially and temporally. During the 10-year period, from 2002/03 to 2011/12, rainfall was highest in 2005/06 over Shakawe and lowest in 2006/07 in Tshabong. Coldest temperatures were recorded in Tshabong, while Maun realised the hottest temperatures.

There are three main categories of land tenure in Botswana, namely; Communal, Freehold and State Land. Communal land dominates, constituting 54.8 percent of the total land area, followed by State land with 41.8 percent and Freehold at 3.4 percent. Significant changes took place in Communal land and State land major tenure systems, during the period 1981 to 2007.

Currently there are eight (8) major dams in the country with a total storage capacity of 1,016.8 Million cubic meters. Botswana experienced the largest water abstraction in the years 2009/10, 2008/09 and 2010/11. The capital city Gaborone had the highest total annual treated water production while Palapye stood at the bottom. There has not been any change in the amount of water supplied daily, from the developed available groundwater resources since 2008, except for Masama well field.

For major villages, the general trend over the years is that both production and consumption were on the increase until the year 2009 where almost all the major villages experienced a decline. The decline in production is attributable to the Water Sector Reform Programme by the Water Utilities Corporation (WUC). Water consumption patterns vary between the cities/ towns. Water tariffs for domestic and business consumers in all cities/towns remained stagnant between the year 2008/09 and 2009/10 except in Sowa Town. The tariffs in cities are higher than those in towns because of high standard infrastructures and the increasing population size.

Water demand was on the increase in all cities/towns and districts in the period under review. Regular water quality-microbiology testing shows that almost all centres had total coliforms which fall within the WUC recommended maximum limit. The chemical tests on the other hand showed that the highest average Lead content was recorded in Francistown. Generally the content of all other chemicals was below the WUC maximum allowable limit.

The estimated national number of problem animal incidents increased by approximately 16 percent between 2009 and 2010 but decreased by about 9 percent between 2010 and 2011. The species mostly involved in the incidents are Leopard, Elephant, Lion and Wild Dog in that order. In Botswana compensation is paid for damage made by animals which are deemed to be dangerous for humans to protect themselves against. The largest amount of compensation was paid for damages by Lion and Leopard, while the highest number of human casualties was recorded in Ngamiland. Leopard, kudu, lion, buffalo and elephant had the highest mortality incidences due to human wildlife conflict. In all the districts, single game license is the one that generates most revenue. Wildlife poaching in Botswana is at two levels; commercial and subsistence. Comparisons show that elephant was the most poached species in the three years under review; particularly in Chobe District in the year 2011.

Botswana's forests are endowed with natural resources that people and ecosystems depend on. The forest cover stood at about 11,346 square kilometres in 2011, and it experienced a decline, from 23.6 percent in 1990 to 19.7 percent in 2010. Reasons for deforestation include fuel wood harvesting and land clearing for human settlements. One of the main pressures on forests in Botswana is wild fires. On average, about 37 percent of the country's total forest reserves area experienced burning due to wild fires annually, for the years 2008, 2010 and 2011.

Floods and Drought are the natural disasters that often affect daily human lives in Botswana. During the year 2010, floods accounted for most of the displacement of people, affecting 10 villages and a total of 168 households in those villages. Storm winds are also a threat in Botswana, and during January 2010, in Maun village alone, they left 89 people from 37 households' vulnerable and needing relief aid.

Botswana declares drought years after assessments are carried out countrywide through the annual Drought and Food Security Assessments. The Drought and Food Security Outlook for the year 2012 recommended that the country be declared drought-stricken. The report concluded that for the period October 2011 to March 2012, the country received inadequate rainfall. Water, rangelands and wildlife conditions were generally better for 2009/10 than the subsequent 2010/11 and 2011/12. Rangelands and water conditions have an effect on the livestock conditions. Comparing livestock mortality for the years 2010 through 2012, it is clear that the most affected were cattle and horses.

In Botswana, the major minerals mined are diamond, coal, copper &nickel, soda ash, salt and gold. In 2007 the mining sector's value addition to the GDP dropped from 18,113.7 million Pula to 10,760.6 million Pula in 2011. Debswana diamonds production which generates more than half of the country's revenue, has been on the increase since 2002 and suddenly plummeted in 2009 because of the World economic meltdown.

1. CLIMATE

Botswana is a semi-arid to arid country. This is because rainfall is scarce and unreliable; and temperatures are hot leading to high evapo-transpiration rates. Summer and winter are two predominant seasons in the country. Summer season is traditionally from November to January and it is characterized by very high temperatures and high rainfall, while winter season is from May to July and it is generally very cold and dry. In between summer and winter there are transitional seasons of spring, which is from August to October; and autumn which is from February to April. Spring is characterized by high temperatures but dry conditions and is a transitional period from winter to summer, while autumn is slightly hot with some rain. It is like an extension of summer season but with less temperature and rainfall and it ushers in the winter season.

1.1 Rainfall

With the aforesaid, rainfall season is therefore, from November to March, but due to effects of climate change; this is sometimes not the case as rains can come way before November or even after March. Traditionally the months of May to August are dry although recently, there also seems to be a shift as rains do continue until May or June. Some rain (although little) fell in June and July in the year 2011/12 as evidenced in Table 1.1a. The same table shows that the highest rainfall in the year 2011/12 was recorded in December (762.2mm) which falls within the summer season. Figure 1.1a depicts the rainfall in this period.

Still on Table 1.1a the highest rainfall was recorded in Kasane with 569.9mm followed by Shakawe with 485.8mm, both areas being situated in the north of the country. Most of the stations recorded rainfall of over 200mm, with the lowest recorded at Tshane followed by Tshabong both in the southern part of the country. These scenarios are depicted in Figure 1.1b.

Table 1.1a Monthly Rainfall (mm) by Location 2011-13

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Ghanzi	0	0	0	0	8.3	72	39.3	73.4	37.6	45	0	0	235.1
Mahalapye	1.4	0	0	10.7	76.4	67.7	31	9.3	16.7	1.5	0	0	214.7
Tshabong	0	0	0	0	6.9	46.7	27.2	65.6	43.4	13.7	0	9.9	213.4
Maun	0	0	0	0	86.5	171	70.5	62.9	15.4	0	0	0	406.3
Gaborone	0.6	0	0	23	17.7	108	82.9	43.1	24.7	1.4	0	0	280.7
Tshane	0	0	0	0	0.2	47.9	37.9	69.3	52.2	4.4	0	0	211.9
Shakawe	0	0	0	0.7	86.5	78.9	141.7	127.4	50.6	0	0	0	485.8
Kasane	0	0	0	7.4	52.5	170	126.4	164.5	49.1	0	0	0	569.9
Total	**2**	**0**	**0**	**21.1**	**335**	**762.2**	**556.9**	**615.5**	**289.7**	**25.5**	**0**	**9.9**	**2617.8**

Note: Monthly total rainfall covers the stated stations only
Source: Department of Meteorological Services

Figure 1.1a Total Monthly Rainfall (mm): 2011/12

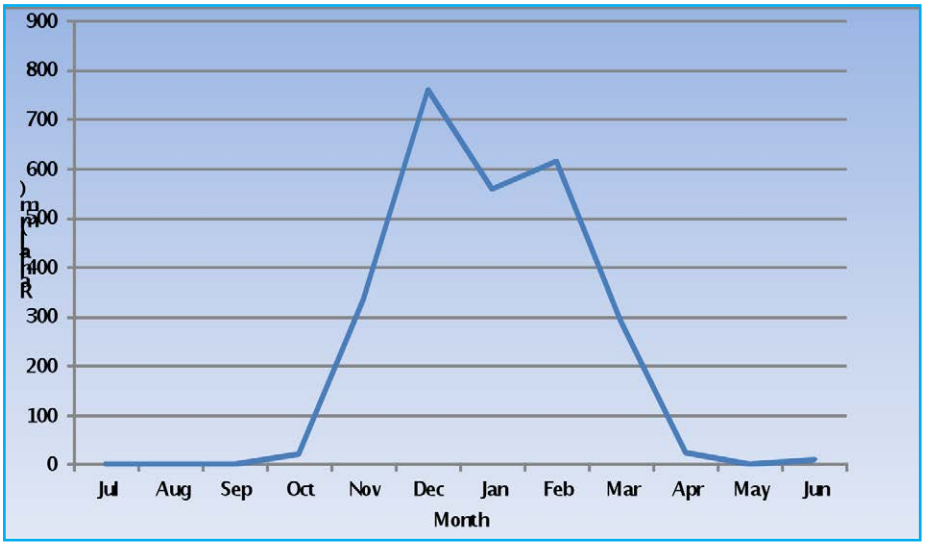


Figure 1.1b Annual Rainfall by Location: 2011/12

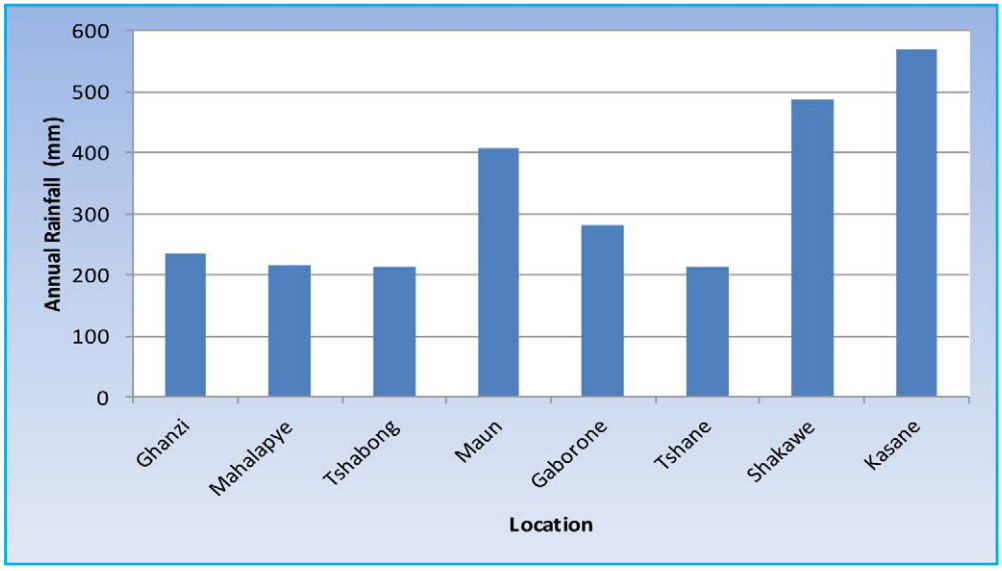


Table 1.1b depicts annual rainfall for different locations over a 10-year period from 2002/03 to 2011/12. Rainfall was highest in 2005/06 with 1,041 millimetres over Shakawe in the north and lowest in 2006/07 with only 122.7 millimetres in Tshabong south of the country.

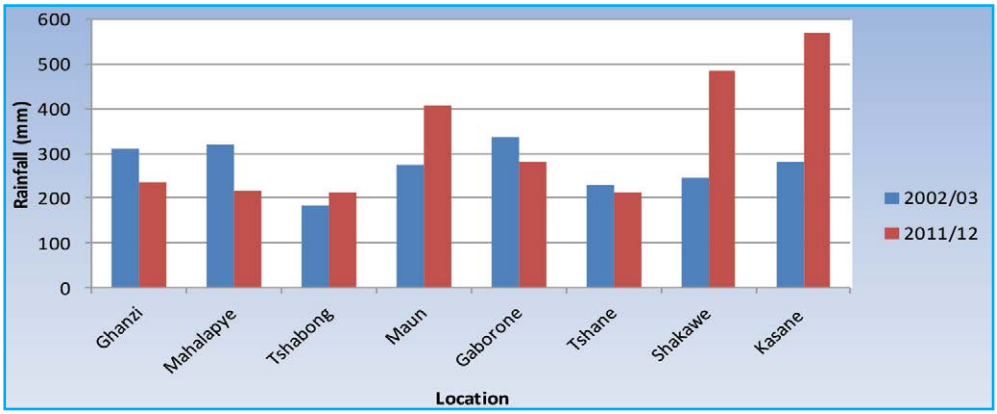
It is noted that the year 2002/03 recorded very low rainfall compared to other years in most locations. For the northern towns and villages of Maun, Shakawe and Kasane, rainfall for 2011/12 far exceeded that of 2002/03. The same year is one of the recorded drought years in Botswana (see Natural Disasters chapter). The reverse is true for the southern towns and villages. Figure 1.1b illustrates the comparison of rainfall recorded over the two years.

Table 1.1b: Total Annual Rainfall (mm) by Location: 2002-2012

	Ghanzi	Mahalapye	Tshabong	F/town	Maun	Gaborone	Tshane	Shakawe	Kasane
Elevation (m)	1131	1005	960	968	945	983	1118	1030	960
2002/03	309.9	318.8	184.4	248.9	273.3	336.2	228.4	245.7	279.6
2003/04	555.6	493	170.5	647.9	523.9	451.6	210.3	596	845.2
2004/05	331.9	463.9	252.1	482.5	326.7	310.2	282.3	287.8	506.9
2005/06	735.7	571.5	329.2	467	684.4	613.2	776.7	1,041	838.7
2006/07	304.8	297.1	122.7	417.9	283.4	145.2	145.5	452.5	562.8
2007/08	597.1	677.2	304.3	480.7	506.4	707.1	298	725.9	895.9
2008/09	477.2	671.5	356.6	565.5	388.4	493.6	363	475.5	722.9
2009/10	664.9	503.9	482.6	478.4	748.8	717.4	383	559.4	488.4
2010/11	596	366.2	413	543.7	627.9	531.6	415.9	493	416.3
2011/12	235.1	214.7	213.4	n/a	406.3	280.7	211.9	485.8	569.9

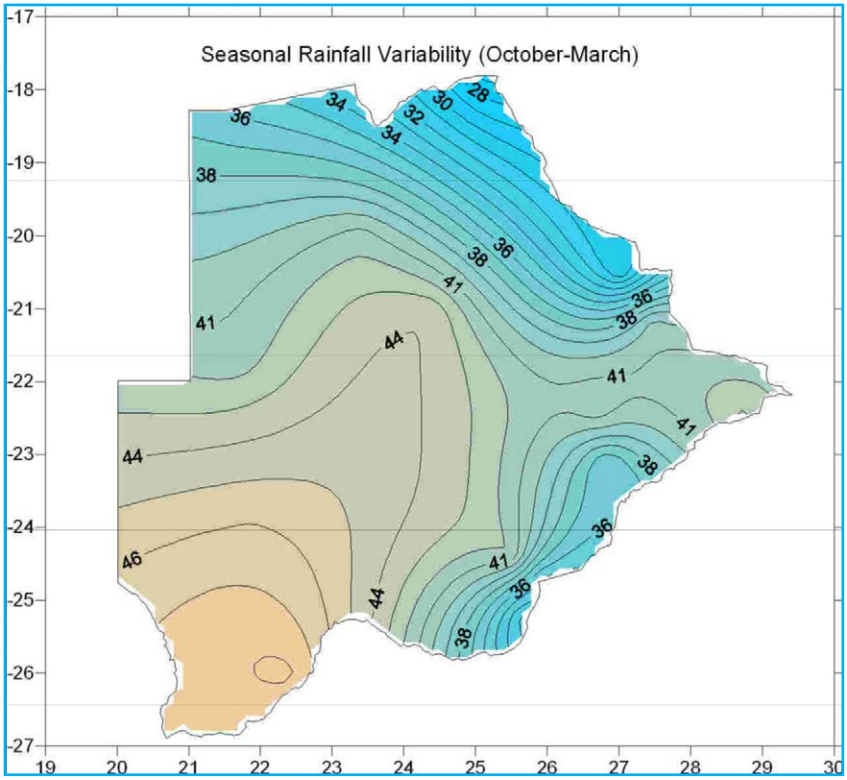
Source: Department of Meteorological Services

Figure 1.1c Total Annual Rainfall (mm) by Location: 2002/03 and 2011/12



The depicted rainfall patterns indicate the high variability of rainfall both spatially and between seasons. This is further shown in Figure 1.1c which illustrates percentage variability of seasonal rainfall. The percentage variability or coefficient of variability (CV) is a measure of the average extent (expressed as a percentage of the mean seasonal rainfall) to which the yearly rainfall varies from the mean during the rainy season.

Figure 1.1d Percentage Seasonal Rainfall Variability (October-March)



Source: Department of Meteorological Services

1.2 Temperature

As pointed out in the introduction, temperatures fluctuate between extremes in summer (when it is very hot) and winter (when it is extremely cold). According to Table 1.2a the highest maximum temperature in the year 2011/12 was in October at 360C over Maun.On the other hand the lowest maximum temperature was recorded in Tshane and Tshabong in the south of the country with 20.60C and 20.80C respectively in July.

Likewise Table 1.2b shows that the lowest minimum temperature was recorded in Tshabong at 0.40C in July while the highest minimum temperature was in Maun at 21.90C in November. These temperature patterns further accentuate the variability of climate both in space and in time. These are graphically illustrated on Figures 1.2a and 1.2b.

Table 1.2a Mean Monthly Maximum Temperature by Location (2011/12)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual Av.
Ghanzi	22.3	26.8	32.4	34	34	31.7	33.8	30.9	31.3	29.7	28.6	24.4	30.0
Shakawe	25	28.7	33.9	35.4	34.3	30.5	31.4	30.4	31.6	30.5	29.2	26.3	30.6
Maun	24.5	28.8	34.2	36	35.9	31.7	33.1	31.4	32.7	31.4	30	26.2	31.3
F/town	23	26.4	31.9	33.5	33.1	29.3	32.7	33.7	32.6	28.2	28	24.6	29.8
Gaborone	20.9	24.9	30.6	32	32.5	30.3	32.2	33	31.6	27.5	26.7	22.4	28.7
Mahalapye	21.5	24.6	30.8	32.2	31.8	28.8	32.3	32.2	32.2	28.5	27.3	23.4	28.8
Tshabong	20.8	25.4	30.6	31.5	33.6	33.8	35.8	32.8	32.7	27.8	27.3	21.1	29.4
Tshane	20.6	25.1	30.9	32.2	33.6	32.7	34.1	31.9	31.1	28.4	27.5	22.7	29.2

Source: Department of Meteorological Services

Table 1.2b Mean Monthly Minimum Temperature by Location (2011/12)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual Av.
Ghanzi	2.9	7	11.2	15.1	18.3	19.5	19.9	19.2	17.2	13.4	8.8	4.9	13.1
Shakawe	3.2	6.3	11	16.2	19.8	20.4	19.5	19.5	17.9	12.4	6.6	5.1	13.2
Maun	7.4	10.8	15.8	19.8	21.9	20.5	20.7	20.3	18.9	14.9	12.1	9	16.0
Ftown	3.9	7.1	12.2	16.9	19.7	18.8	18.8	19.2	16.7	10.6	7.1	4.3	12.9
Gaborone	1.6	4.6	10.5	15.1	17.9	18.3	18.3	20.1	17.1	11.9	7.4	3.8	12.2
Mahalapye	3.9	7.1	11	15	17.8	17.2	17.4	18.6	16.8	11.9	8.1	5.1	12.5
Tshabong	0.4	4.2	9.3	12.8	14.7	18.8	20.4	19.2	17.2	11.3	7.1	3	11.5
Tshane	2.4	6.3	11.4	14.6	16.9	19.2	20	19.6	17.4	12.5	8.3	3.7	12.7

Source: Department of Meteorological Services

Figure 1.2a Mean Monthly Maximum Temperature by Location (2011/12)

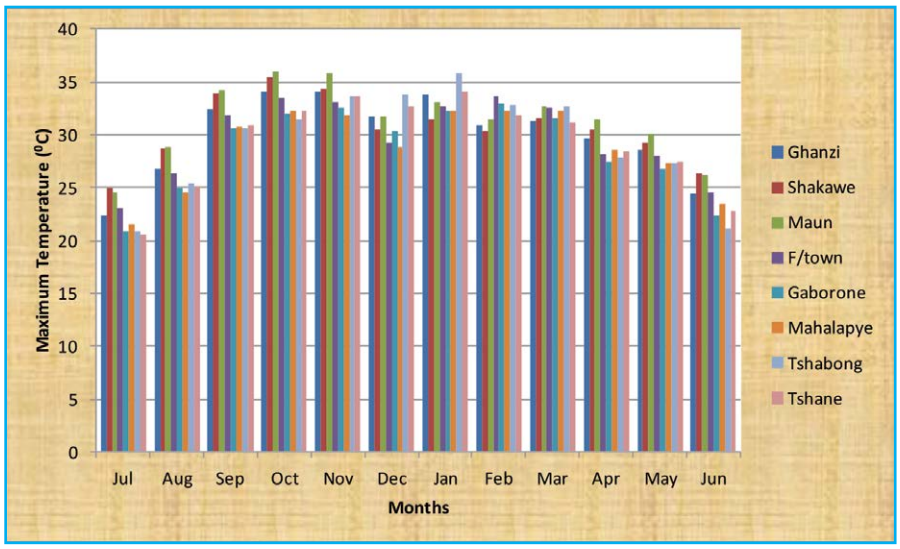
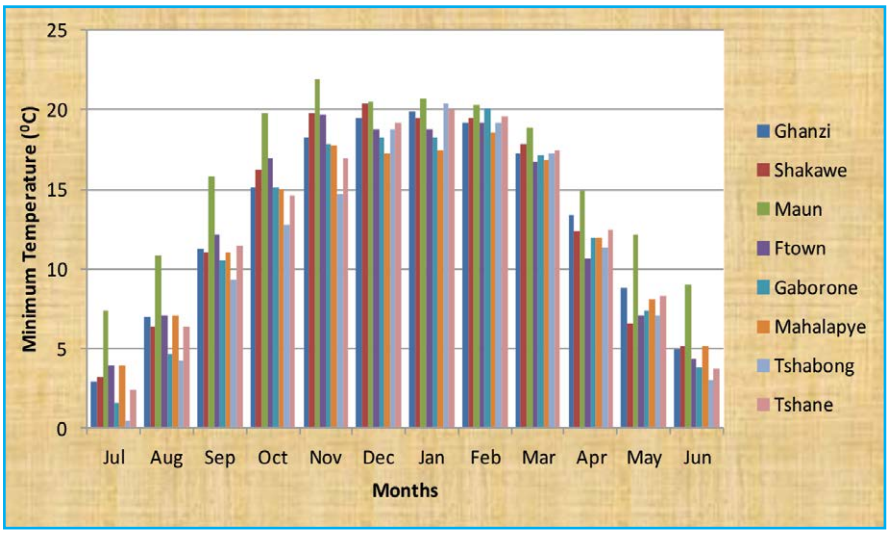


Figure 1.2b Mean Monthly Minimum Temperature by Location (2011/12)



Over the period from 1980/81 to 2011/12, it is indicated that annual average temperatures were generally around 300C for all stations (Table 1.2c). Exceptions are however noted in the year 1999/2000 in Gaborone and Mahalapye when temperature of 26.30C and 26.9 0C was recorded respectively.

On the other hand annual average minimum temperatures were between 110C and 160C in this period. Outliers of around 100C are found in Tshabong in several years and Maun at 170C in 2002/03 (Table 1.2d).

Table 1.2c Annual Average Maximum Temperature by Location (1980/81-2011/12)

	Ghanzi	Shakawe	Maun	F/town	SSKA	Mahalapye	Tshabong	Tshane
1980/81	29.3	29.3	29.5	27.3	n/a	27.1	29.1	28.8
1981/82	30.4	30.6	31.8	29.3	n/a	28.6	28.9	29.3
1982/83	30.8	30.8	31.9	29.6	n/a	29.3	29.7	30.0
1983/84	30.3	30.4	31.5	29.1	n/a	28.6	29.2	29.6
1984/85	30.5	30.5	31.2	28.5	n/a	28.2	29.6	29.9
1985/86	29.9	30.1	30.6	28.9	29.3	28.4	29.6	29.7
1986/87	30.9	31.2	31.9	30.5	29.7	29.1	29.5	30.1
1987/88	29.7	30.6	31.6	28.2	28.1	27.5	28.3	28.6
1988/89	29.1	29.8	30.1	28.5	27.7	27.6	n/a	28.4
1989/90	30.3	31.1	31.4	29.2	28.6	28.7	30.6	29.5
1990/91	29.8	31.2	30.4	29.0	28.7	28.4	29.2	29.1
1991/92	30.7	31.4	31.8	30.6	29.9	29.8	30.1	30.0
1992/93	30.0	30.7	31.1	29.4	29.1	28.7	29.5	29.3
1993/94	29.9	30.8	31.0	29.0	28.3	28.1	29.5	29.1
1994/95	30.6	31.4	31.7	28.7	28.6	27.8	30.0	29.7
1995/96	30.0	31.7	31.3	28.4	27.9	27.9	29.3	28.8
1996/97	29.6	31.0	31.2	28.7	27.6	28.3	28.3	28.9
1997/98	31.2	31.8	31.5	29.4	29.2	29.8	30.5	30.9
1998/99	30.8	31.2	31.6	28.7	28.8	28.7	30.2	30.0
1999/00	28.5	30.0	30.0	27.3	26.8	26.9	28.8	28.2
2000/01	30.1	30.5	30.9	28.2	27.8	28.3	29.6	29.1
2001/02	30.6	31.3	31.7	29.7	27.8	29.0	29.3	29.5
2002/03	31.0	31.5	32.1	29.5	29.3	29.5	30.0	30.1
2003/04	29.8	30.2	31.0	28.4	28.1	27.8	29.7	29.5
2004/05	30.8	31.7	32.2	30.1	29.1	29.3	29.6	29.6
2005/06	29.2	30.1	30.5	28.8	28.2	28.3	28.8	28.5
2006/07	30.0	30.8	31.6	29.3	29.1	29.6	29.9	29.3
2007/08	29.6	30.4	30.7	28.3	27.4	27.7	29.7	29.1
2008/09	29.9	30.8	30.9	29.1	28.1	28.6	29.1	29.7
2009/10	29.3	30.3	30.5	28.9	27.1	28.2	28.7	28.9
2010/11	29.1	30.6	30.8	29.1	27.8	28.0	29.3	28.6
2011/12	30.0	30.6	31.3	29.8	28.7	28.8	29.4	29.2

Source: Department of Meteorological Services

Table 1.2d Annual Average Minimum Temperature by Location (1980/81-2011/12)

	Ghanzi	Shakawe	Maun	F/town	Gaborone	Mahalapye	Tshabong	Tshane
1980/81	11.9	14.6	14.5	12.3	n/a	12.4	11.1	12.2
1981/82	12.3	15.2	14.9	12.9	n/a	13.2	11.0	12.8
1982/83	13.0	15.8	15.8	14.2	n/a	14.7	11.2	13.2
1983/84	12.7	15.3	14.3	14.0	n/a	14.1	10.6	11.1
1984/85	12.5	15.2	15.9	12.6	n/a	14.2	10.6	12.8
1985/86	13.5	14.9	15.7	13.5	14.5	14.7	11.6	13.2
1986/87	14.1	15.6	16.1	14.2	14.5	14.7	11.9	n/a
1987/88	13.6	15.9	16.0	13.7	13.6	14.2	11.3	n/a
1988/89	12.6	15.1	15.2	12.9	12.4	13.4	n/a	12.3
1989/90	13.2	15.1	15.3	13.9	12.5	13.7	12.5	13.1
1990/91	13.0	16.4	15.3	13.4	13.2	13.8	11.0	12.9
1991/92	13.1	14.0	15.5	15.0	13.4	14.9	10.4	13.3
1992/93	13.3	n/a	15.8	13.7	13.8	14.7	10.7	13.3
1993/94	13.2	13.4	15.7	13.7	13.4	14.6	10.5	14.4
1994/95	13.5	14.2	16.3	13.4	13.3	14.2	11.4	14.6
1995/96	13.3	14.8	16.1	13.0	13.0	14.0	11.4	13.4
1996/97	13.2	14.3	15.4	13.3	12.3	13.5	10.3	12.0
1997/98	13.9	15.1	16.5	13.5	12.7	14.3	11.4	13.2
1998/99	14.1	14.9	16.6	13.7	13.4	14.6	12.0	14.0
1999/00	13.4	15.1	15.9	13.3	13.0	13.9	11.7	13.0
2000/01	13.2	14.3	16.0	12.8	13.1	13.4	12.0	13.3
2001/02	12.9	14.7	16.6	13.5	12.4	14.1	11.3	13.5
2002/03	13.0	15.3	17.0	14.2	13.2	14.8	11.7	14.2
2003/04	13.4	14.4	16.4	13.7	13.2	14.3	12.0	13.9
2004/05	14.2	14.8	16.4	14.2	13.5	14.6	11.3	13.9
2005/06	13.5	14.3	15.9	13.9	13.3	14.3	11.7	13.2
2006/07	12.9	13.5	15.8	13.5	13.4	14.3	12.0	13.1
2007/08	13.0	12.9	15.3	13.0	12.8	13.3	12.2	13.0
2008/09	14.2	14.0	16.3	13.5	12.7	14.1	13.1	13.9
2009/10	14.3	14.8	16.5	14.1	12.8	14.3	12.8	13.9
2010/11	13.7	14.1	16.5	13.8	13.5	13.9	12.9	13.6
2011/12	13.1	13.2	16.0	12.9	12.2	12.5	11.5	12.7

Source: Department of Meteorological Services

In the period from 1980/81 to 2011/12 the mean monthly temperature was lowest in Tshabong in June and highest in Maun, in October. Likewise the lowest mean monthly minimum temperature was in Tshabong in July and highest in Maun in November. Tables 1.2e and 1.2f depict this scenario.

From these accounts, it is reflected that Tshabong which is located in the southern part of the country is colder compared to other locations while Maun, which is located in the northern part, is hotter than other locations.

Table 1.2eLong Term Mean Monthly Maximum Temperature by Location (1980/81-2011/12)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Ghanzi	24.0	27.3	31.5	33.4	33.7	33.5	32.9	32.3	31.3	29.5	27.1	24.3
Shakawe	25.9	29.4	33.3	34.9	33.9	32.6	31.7	31.2	31.1	30.4	28.6	26.1
Maun	25.7	29.1	33.1	35.0	34.2	33.1	32.8	32.6	32.3	31.1	28.8	26.1
F/town	23.5	26.7	30.4	31.9	31.9	31.2	31.4	30.9	30.5	28.6	26.5	24.1
Gaborone	22.4	25.6	29.4	31.3	31.5	31.6	31.9	31.4	30.3	27.7	25.2	22.4
Mahalapye	22.7	25.8	29.4	31.0	31.3	31.2	31.8	31.4	30.2	28.0	25.7	23.0
Tshabong	22.2	24.9	29.0	31.6	33.2	34.5	34.8	33.9	32.2	28.8	25.7	22.1
Tshane	22.7	25.7	29.7	32.1	33.0	33.7	33.5	32.8	31.5	28.8	25.8	22.8

Source: Department of Meteorological Services

Table 1.2f Long Term Mean Monthly Minimum Temperature by Location (1980/81-2011/12)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Ghanzi	4.4	7.4	11.8	16.3	18.1	19.1	19.4	18.7	17.2	13.6	8.7	4.8
Shakawe	5.9	8.6	13.0	17.5	19.4	19.8	19.9	19.6	19.1	15.5	10.5	6.7
Maun	7.9	10.9	15.7	19.5	20.6	20.4	20.3	19.9	19.1	16.0	11.7	8.4
Ftown	5.0	7.9	12.7	17.1	18.4	18.9	19.1	18.5	17.5	13.8	8.7	5.5
Gaborone	4.0	7.3	12.0	16.2	17.8	18.8	19.4	19.0	17.5	13.5	8.2	4.6
Mahalapye	5.6	8.6	13.1	16.7	18.5	19.0	19.6	19.4	17.8	14.2	9.5	6.3
Tshabong	1.0	4.1	8.8	13.8	16.1	18.3	19.6	19.2	16.8	12.1	6.2	1.8
Tshane	4.2	7.0	11.3	15.7	17.8	19.2	19.9	19.4	17.6	13.7	8.8	4.5

Source: Department of Meteorological Services

Table 1.2g Mean Annual Deviation from Average of Maximum and Minimum Temperatures: 1970/71-2010/11

Years	Deviation from Mean maximum	Deviation from Mean minimum
1970/71	0.3	0.6
1971/72	-1.3	-1.5
1972/73	1.1	0.1
1973/74	-2.7	-1.7
1974/75	-1.5	-1.6
1975/76	-1.6	-1.2
1976/77	-0.7	-1.3
1977/78	-1.1	-0.9
1978/79	0.5	-0.2
1979/80	-0.3	-0.7
1980/81	-1.2	-1.6
1981/82	0.5	-1
1982/83	1.2	1
1983/84	0.4	-0.7
1984/85	0.4	-0.2
1985/86	0.1	0.7
1986/87	1.5	2.3
1987/88	-0.4	1.2
1988/89	-0.8	0.2
1989/90	0.5	0.9
1990/91	0.4	0.7
1991/92	1.5	0.7
1992/93	0.4	0
1993/94	0.3	0
1994/95	0.6	0.8
1995/96	0	0.5
1996/97	0.3	-0.7
1997/98	1.9	1.2
1998/99	0.7	1.5
1999/00	-1.2	0.5
2000/01	0	0.2
2001/02	1.1	0.6
2002/03	1.4	1.6
2003/04	0	0.9
2004/05	1.1	1.5
2005/06	-0.2	0.9
2006/07	0.4	0.4
2007/8	-0.3	-0.4
2008/9	0.3	1.2
2009/10	-0.2	1.5
2010/2011	-0.2	1.4

Source: Department of Meteorological Services

Table 1.2g shows mean annual deviation from average of maximum and minimum temperatures for Botswana, from 1970/71 to 2010/11, which is further illustrated in Figures 1.2d and 1.2e.

Figure 1.2d shows the deviation from average maximum temperature for the period 1970/71 to 2010/11. It indicates increase in frequency of above average maximum temperature from 1981/82. The deviation from average minimum temperature is as in Figure 1.2e. The graph depicts an increase in frequency of above average minimum temperature from 1982/83 to 2010/11, a similar trend as in mean maximum temperature.

Figure 1.2d Mean Maximum Temperature Deviation (1970-2011)

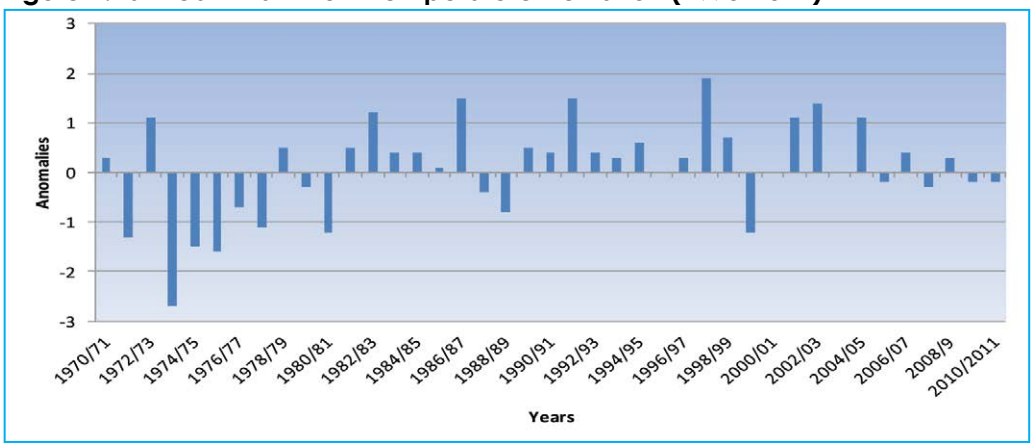
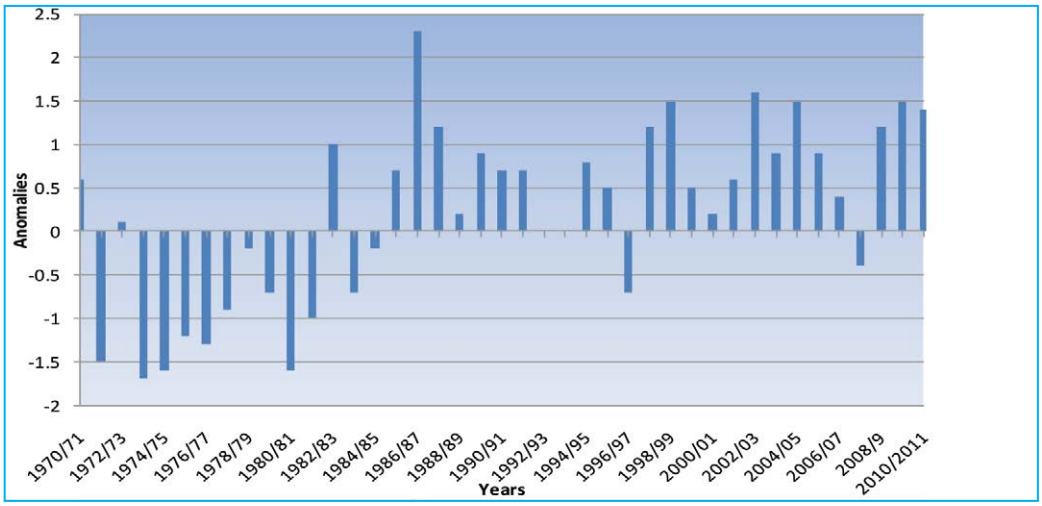


Figure 1.2e Mean Minimum Temperature Deviation (1970-2011)



1.3 Effects of Climate

The most outstanding consequence of climate in Botswana is its detrimental effects on the agricultural sector, this is particularly so because arable farming is mainly rain-fed. In addition, most livestock holders keep their cattle communally. The effect is borne from the fact that rainfall is inadequate and unreliable, also with high temperatures. The conditions are not conducive to good agricultural production. This has an obvious impact on livelihoods particularly in rural areas. Agricultural production in the country is discussed under Chapter Eight (8) of this publication.

Climate also has a bearing on human health as each season is associated with certain illnesses such as heat strokes during summer. Associated with it is the issue of extreme weather which often cause damage to property and are even a danger to human beings themselves. The most common extreme weather episodes are drought, when rain is too

little and temperatures are too harsh for any production of food, as well as floods when rains pour in short spells of time thereby curtailing any food production. With these climatic disasters come associated diseases. More discussion on natural disasters is covered under Chapter Six (6) of this publication.

These and other effects are exacerbated by the process of climate change as the frequency and severity of extreme weather events are increased. Furthermore with the onset of climate change, usual patterns of weather are disturbed such that rainy seasons do not come when they are expected, thus impacting on all production systems.

2. LAND

2.1 Introduction

In any discussion of the environment, land is a central feature because it provides the basis for plants, animals and ecosystems to operate. It underlies human infrastructure such as buildings and roads and, perhaps, most importantly, areas of land delineate the space in which humans live (UNSD, 2011).

Botswana is a land-locked country, with a total area of 581,730 square kilometres and mean altitude of approximately 1,000 metres above sea level. The Land is generally flat with gentle undulations. More than half of the total area of Botswana is communal land (pasture, arable and residential areas, lease ranches and Tribal Grazing Land Policy Ranches).

With four agro-ecological zones (hardveld, sandveld, lacustrine and alluvial) the country has different vegetation cover; the northern region is rich in vegetation while the western and southern regions have scarce vegetation.

The purpose of this chapter is to discuss Botswana Land Cover, Land Use and Land-Use Change (LULUC), but due to data gaps only the 2012 land cover statistics were used, though it covers only Ngamiland and Chobe Districts. Furthermore, national land use statistics for the year 2007 are also presented.

2.2 Land Use and Land Cover

The terms "land cover" and "land use" are often confused. Land cover is "the observed physical and biological cover of the earth's land, as vegetation or man-made features." In contrast, land use is "the total of arrangements, activities, and inputs that people undertake in a certain land cover type" (IPCC, 2000).

2.2.1 Land Cover

Botswana's has seventeen land cover classes which are in aligned to the internationally recognized land cover classes, refer to Table 2.2.1a extracted from Food and Agriculture Organisation (2000). Land cover statistics presented are only for Chobe and Ngamiland Districts for the year 2012. According to the Department of Surveys and Mapping, work is on-going with regards to the production of land cover maps for the rest of the remaining districts hence the extraction of the area of each land cover class from the shape files. Table 2.2.1b presents area of each land cover class and percentage cover for Chobe District in 2012. It is evident from the table that Open Low Shrub land had the highest percentage share of the total area of the district with 30.61 percent (662,358 hectares) followed by Bare Low Herbaceous with 19.09 percent (413,065 hectares) then Open Savannah/Woodland with 12 percent (259,740 hectares). The rest of the land cover classes contributed less than percent each to the total area of Chobe District (Figure 2.2.1a).Figure 2.2.1c gives the same information in a map.

Table 2.2.1c and Figure 2.2.1b show the area of each land cover class and percentage cover for Ngamiland District in 2012. Just like in Chobe District, Open Low Shrub land area had the highest percentage share of Ngamiland district (57.6 percent). Second and third after Open Low Shrub land class's share was Open Savannah/Woodland and Sparse/ Scattered Savannah with 10.4 percent (1,330,593 hectares) and 6.5 percent (837,515 hectares) respectively.

Table 2.2.1a:Land Cover Classification

LEVEL I CLASSESS	LEVEL II CLASSES	
Water	11	Open Water
	12	Perennial Ice/Snow
	21	Low Intensity Residential
	22	High Intensity Residential
	23	Commercial/Industrial/Transportation
Barren	31	Bare Rock/Sand/Clay
	32	Quarries/Strip Mines/Gravel Pits
	33	Transitional
Forest Upland	41	Deciduous Forest
	42	Evergreen Forest
	43	Mixed Forest
Shrub land	51	Shrub land
Non-Natural Woody	61	Orchards/Vineyards/Other
Herbaceous Upland Natural/Semi-natural Vegetation	71	Grasslands/Herbaceous
Herbaceous Planted/Cultivated	81	Pasture/Hay
	82	Row Crops
	83	Small Grains
	85	Urban/Recreational Grasses
Wetlands	91	Woody Wetlands
	92	Emergent Herbaceous Wetlands

Source: FAO, 2000

Table 2.2.1b: Chobe Land Cover Classes by Area and Percentage Cover, 2012

Land cover Class No.	Land cover Class	Area (ha)	% Cover
1	Dense Savannah/Forest	89,928.48	4.16
2	Open Savannah/Woodland	259,740.80	12
3	Dense Low Shrub land	186,701.96	8.63
4	Open Low Shrub land	662,357.76	30.61
5	Sparse/Scattered Savannah	130,299.68	6.02
6	Bare Low Herbaceous	413,065.04	19.09
7	Swamp Vegetation	25,331.32	1.17
8	Natural Bare	99,586.08	4.6
9	Pans	132,094.32	6.11
10	Cultivated Areas	29,623.12	1.37
11	Built up areas	862.12	0.04
12	Mine	155.52	0.01
13	Non Natural Bare	3,446.56	0.16
14	Water Bodies	20,338.36	0.94
15	Sand Dunes	464.36	0.02
16	Rocky Outcrops	387	0.02
17	Burnt/Cloud	109,280.48	5.05
Total		**2,163,662.96**	100

Source: Department of Surveys and Mapping

Figure 2.2.1a: Percentage Distribution of Land Cover by Class, 2012 (Chobe)

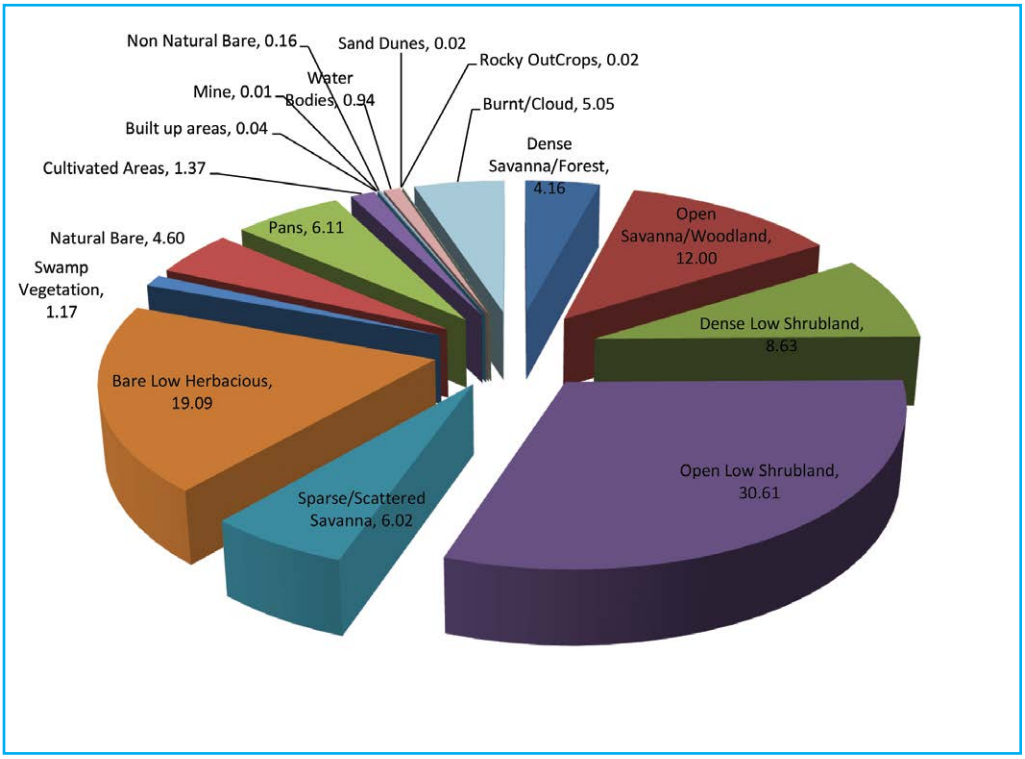
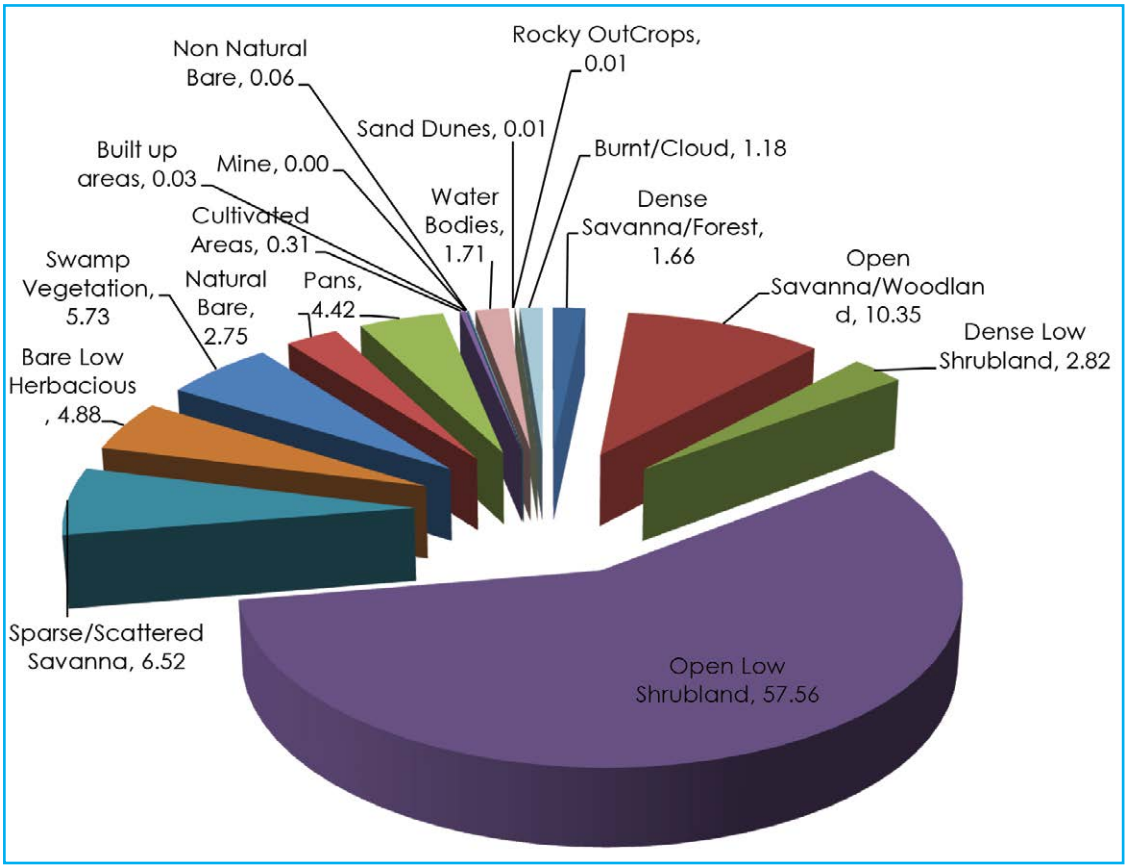


Table 2.2.1c: Ngamiland Land Cover Classes by Area and Percentage Cover, 2012

Land cover Class No.	Land cover Class	Area (ha)	% Cover
1	Dense Savannah/Forest	213,407.08	1.66
2	Open Savannah/Woodland	1,330,593.36	10.35
3	Dense Low Shrub land	362,580.60	2.82
4	Open Low Shrub land	7,399,021.28	57.56
5	Sparse/Scattered Savannah	837,515.00	6.52
6	Bare Low Herbaceous	627,028.28	4.88
7	Swamp Vegetation	735,988.16	5.73
8	Natural Bare	353,636.08	2.75
9	Pans	568,689.20	4.42
10	Cultivated Areas	39,432.72	0.31
11	Built up areas	4,310.56	0.03
12	Mine	106.76	0
13	Non Natural Bare	7,690.36	0.06
14	Water Bodies	219,819.48	1.71
15	Sand Dunes	1,343.24	0.01
16	Rocky Outcrops	885.24	0.01
17	Burnt/Cloud	151,455.20	1.18
Total		**12,853,502.60**	100

Source: Department of Surveys and Mapping

Figure 2.2.1b: Percentage Distribution of Land Cover by Class, 2012 (Ngamiland)



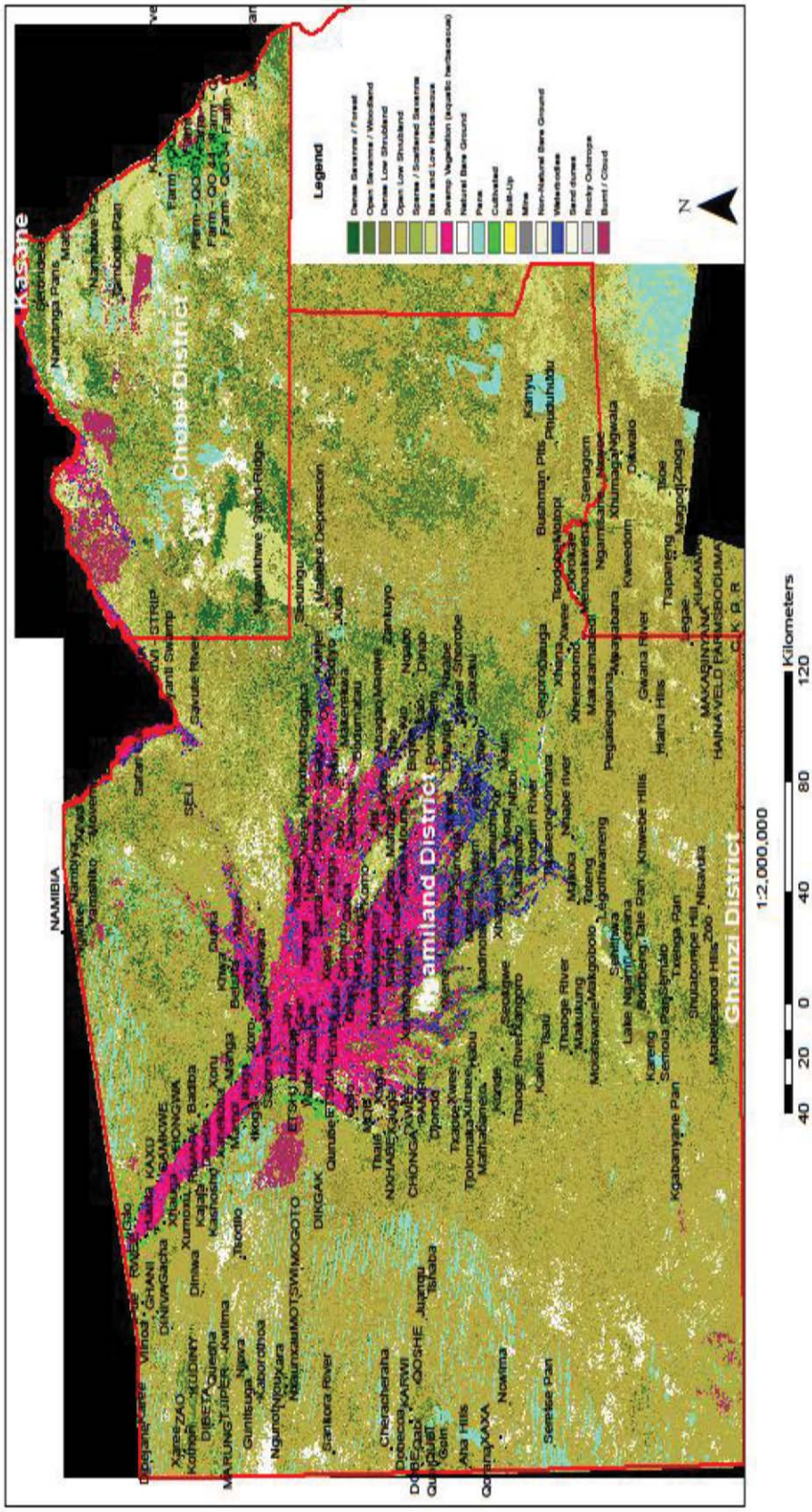


Figure 2.2.1c: Land Cover Map of Chobe and Ngamiland Districts, 2012

2.2.2 Land Use

Land tenure is the relationship, whether legally or customarily defined, among people, as individuals or groups, with respect to land. According to FAO, Land tenure is an institution, i.e., rules invented by societies to regulate behaviour and they define how access is granted to rights to use, control, and transfer land, as well as associated responsibilities and restraints. In simple terms, land tenure systems determine who can use what resources for how long, and under what conditions.

National categories of land use differ, but many have been harmonized under the influence of FAO's periodical World Census of Agriculture (Table 2.2.2a) including that of Botswana. There are three main categories of land tenure in Botswana, namely; communal, freehold and state Land. Table 2.2.2b reveals that land tenure in Botswana is dominated by communal land, constituting 54.8 percent (318, 997 square kilometres) of the total land area, followed by state land with 41.8 percent (243, 304 square kilometres). Freehold land stood at the bottom with 3.4 percent (19, 429 square kilometres). About 79.0 percent of the communal land is used for pasture, arable and residential areas. Figure 2.2.2a illustrates the location of Botswana's main land tenure categories and their respective sub-categories.

Table 2.2.2a: Land-use Categories recognized in FAO's World Census of Agriculture

In Sequence of Increasing Intensity of Use:

(a) Deserts (barren land and waste land)

(b) Non-Forest Wooded Lands (scrubland; may include national parks and wilderness recreational areas)

(c) Wetlands, Non-Forest (marshes)

(d) Land under Forest (natural forests and most non-managed woodlands)

(e) Land under Forestry/Silviculture

(f) Land under Shifting Cultivation (temporarily abandoned land that is not part of a holding)

(g)Land under Agroforestry(permanent use of land at holding level, but with mixed crop growing, animal herding, and tree utilization)

(h) Land with Temporary Fallow (resting for a period of time, less than 5 years, before it is planted again with annual crops)

(i) Land under Permanent Meadows and Pastures [used for herbaceous forage crops that are either managed/cultivated (pastures) or growing wild (grazing land); trees and shrubs may be present or grown purposely, but foraging is the most important use of the area; grazed woodlands]

(j) Land under Temporary Meadows and Pastures(cultivated temporarily, for less than 5 years, for herbaceous forage crops, mowing, or pasturing, in alternation with arable cropping)

(k) Land under Permanent Crops (perennials; cultivated with long-term crops that do not have to be replanted for several years after each harvest; harvested components are not timber but fruits, latex, and other products that do not significantly harm the growth of the planted trees or shrubs: orchards, vineyards, rubber and oil palm plantations, coffee, tea, sisal, etc.)

(l) Land under Temporary Crops (annuals; cultivated with crops with a growing cycle of under 1 year, which must be newly sown or planted for further production after harvesting; not only small grain crops such as beets, wheat, and soy bean but also bi-annuals that are destroyed at harvesting, such as cassava, yams, and sugarcane; bananas are transitional to the permanent crops category)

(m) Land under Temporary Crops Requiring Wetland Conditions [wet-foot crops such as irrigated rice and jute (dry-foot crops with intermittent irrigation included in other categories)]

(n)Land under Protective Cover (greenhouses and other urban or peri-urban intensive use, formal or informal; vegetable growing, home gardening, residential parks, golf courses, etc.)

(o) Land under Residential/Industrial/Transportation Facilities

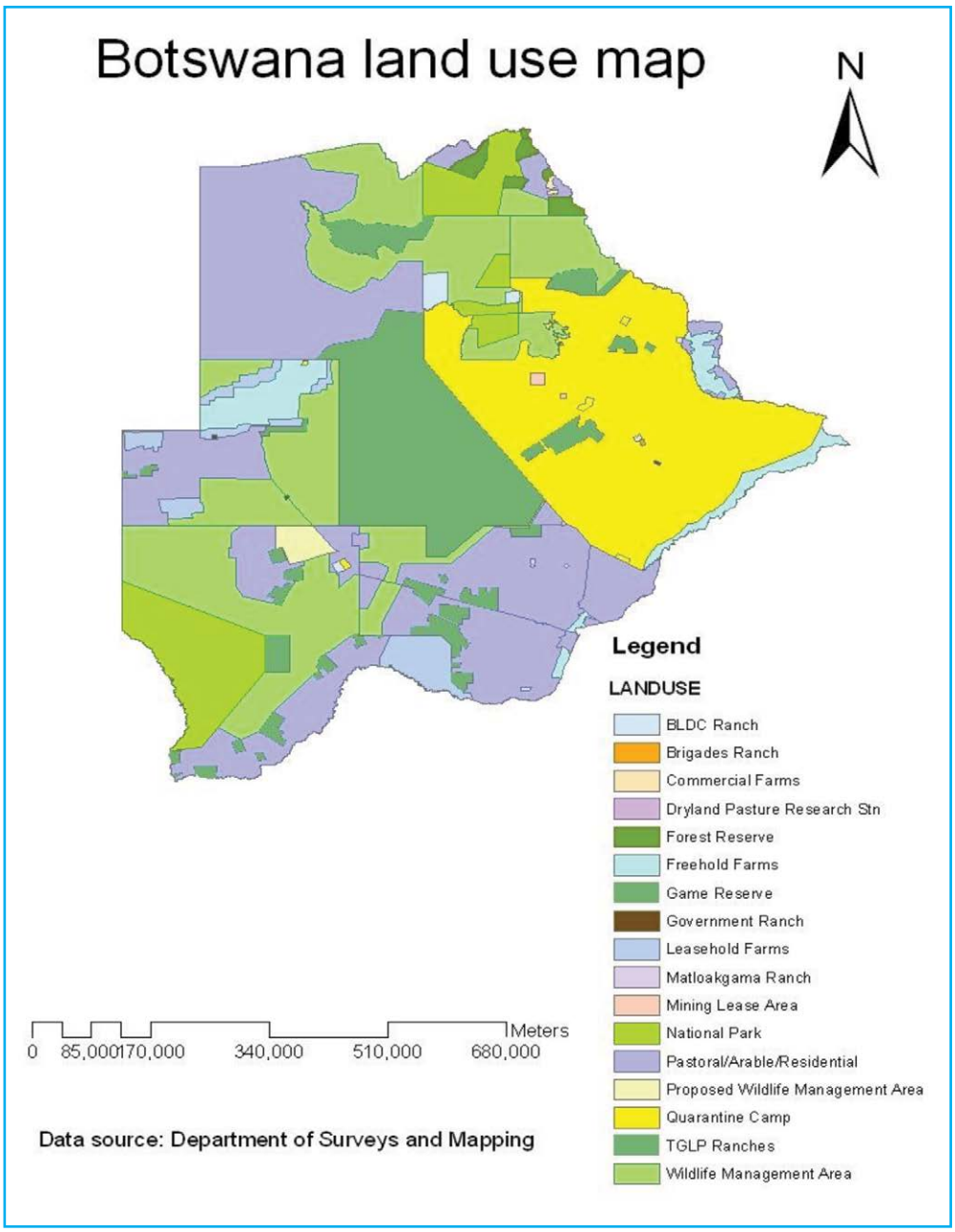
Source: IPCC, 2000 (http://www.ipcc.ch/ipccreports/sres/land_use/index.php?idp=45)

Table 2.2.2b: Botswana Land Tenure, 2007

Use/Tenure:	Land (square kilometres)	Percentage of Total
Communal Land		
Pasture, Arable and Residential areas	253,223	43.5
Tribal Grazing Land Policy Ranches	24,292	4.2
Lease ranches	13,090	2.3
NADP (fencing component)	28,392	4.8
Sub-total	318,997	54.8
Freehold Land		
Freehold farms	19,109	3.3
Arable blocks	320	0.1
Sub-total	19,429	3.4
State Land		
National Parks	45,900	7.9
Game Reserves	60,558	10.4
Forest Reserves	4,555	0.8
Wildlife Management Areas	128,574	22.1
Quarantine and Botswana Livestock		
Development Corporation (BLDC) Ranches	3,717	0.6
Sub-total	243,304	41.8
Total Land	**581,730**	**100**

Source: 2007 Botswana Land Use Map, Cartographic Section, Ministry of Agriculture

Figure 2.2.2a: Land Use Map of Botswana, 2007



2.2.3 Changes in Land Use at National Level

Table 2.2.3c and Figure 2.2.3b show the shares of total land under the three major land uses changed during the period 1981 to 2007. Significant changes took place in communal land and state land major tenure systems. Communal land's share of the total area dropped from 77.8 percent in 1981 to 54.8 percent in 2007, and during this drastic decline state land's share increased from 18.8 percent in 1981 to 41.8 percent in 2007. According to CSO (2006), this was a result of the re-allocation of part of the communal land to state land as well as the creation of Wildlife Management Areas (WMA) which never existed in 1981 but had a share of 23.0 percent of the national land area by 1995 and the gazetting of additional Forest Reserves during the same period.

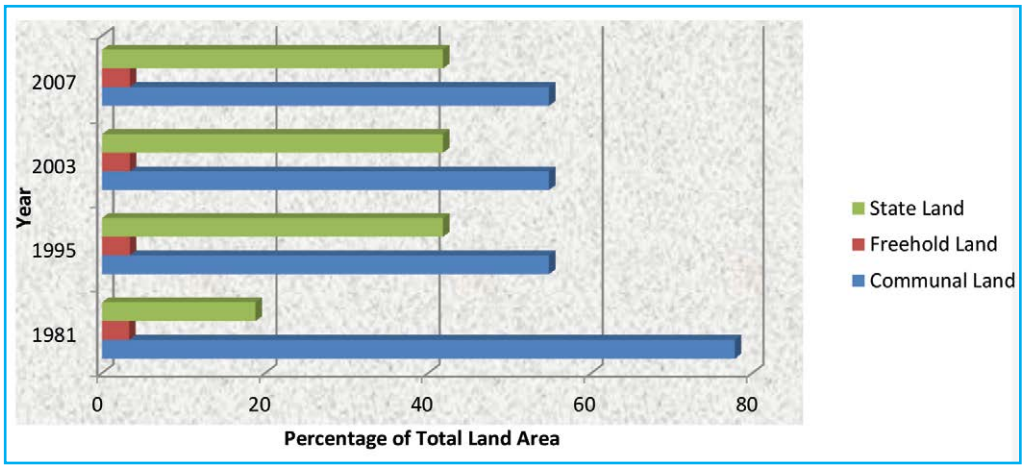
Table 2.2.3c further reveals that the share of total land area that fell under the three Land tenure systems remained the same from 1995 to 2007. For example, total Communal land area remained 318,997 square kilometres (54.8 percent) during the 1995-2007 period despite the introduction of the National Agricultural Development Policy (NADP) in some districts; this is a fencing component which still falls within the Communal Land Category.

Table 2.2.3c: National Land Use Change (Km^2), 1981-2007

	1981		1995		2003		2007	
Land use/Tenure	Land Area Square Kilometers	Percentage of Total Land Area	Land Area Square Kilometers	Percentage of Total Land Area	Land Area Square Kilometers	Percentage of Total Land Area	Land Area Square Kilometers	Percentage of Total Land Area
Communal Land								
Pastr/arab/resi(1)	415,315	71.4	281,615	48.4	259,278	44.6	253,223	43.5
TGLP ranches(2)	24,292	4.2	24,292	4.2	24,292	4.2	24,292	4.2
Lease ranches	13,090	2.3	13,090	2.3	13,090	2.3	13,090	2.3
NADP (fencing component)	-	-	-	-	22,337	3.8	6,055	1.0
Sub-Total	452,697	77.8	318,997	54.8	318,997	54.8	318,997	54.8
Freehold Land								
Freehold farms	19,429	3.3	19,109	3.3	19,109	3.3	19,109	3.3
Arable blocks	-	-	320	0.1	320	0.1	320	0.1
Sub-total	19,429	3.3	19,429	3.4	19,429	3.4	19,429	3.4
State Land								
National Parks	37,815	6.5	37,815	6.5	37,815	6.5	37,815	6.5
Game Reserves	63,517	10.9	63,517	10.9	63,517	10.9	63,517	10.9
Forest Reserves	4,555	0.8	4,555	0.8	4,555	0.8	4,555	0.8
Wildlife Management Areas (WMA)	-	-	133,700	23.0	133,700	23.0	133,700	23.0
Quarantine & Botswana Livestock Development Corporation ranches (QBLDC)	3,717	0.6	3,717	0.6	3,717	0.6	3,717	0.6
Sub-total	109,604	18.8	243,304	41.8	243,304	41.8	243,304	41.8
Total Land	**581,730**	**100.0**	**581,730**	**100.0**	**581,730**	**100.0**	**581,730**	**100.0**

Source: Central Statistics Office, 2006

Figure 2.2.3b: Percentage Change of National Land Use, 1981-2007



2.2.4 Pressure on Land and Land Resources

In Botswana just like in most of the sub-Saharan countries pressure on land and land resources results from Economic (because the economy of the country is largely influenced by physical geographical attributes, e.g. mining of mineral resources) and Socio–political factors (land resources exploitation is largely influenced by the country's Socio–political structure). Population growth further exacerbates the already existing pressure.

Consistent pressure on land can result in land degradation, that is, a land situation that constitutes the reduction or loss of the biological or economic productivity of rain-fed cropland, irrigated cropland, or range, pasture, forest or woodlands resulting from natural processes (CSO, 2006). Issues of concern under land use and tenure in Botswana are mismanagement of grazing land particularly in communal areas, unwarranted change of limited fertile arable land to other uses and land use conflicts (The National Settlement Policy's Final Report, 1998; CSO, 2006). The report further explains these issues as thus:

• Lack of institutionalised regulatory measures to control and ensure proper use of communal grazing land, as Tribal Grazing Land Policy (TGLP) and freehold ranch owners who have exclusive rights to their ranches continue to let their animals into the communal areas, only to return them to their ranches when pasture is denuded in the communal areas.

• Overstocking which is a result of increase of livestock beyond the carrying capacity of the land, leading to degradation of the environment and a reduced quality of livestock.

• Sub-division and change of use of arable land and development of such land for other purposes, especially in and around the fast growing towns.

• The encroachment of settlements onto agricultural and wildlife areas, through the allocation of land outside the existing settlement's water works boundary. This practice which stems from individuals who prefer to exercise their constitutional right of settling where they wish, leads to sprawling and land use conflicts.

• Lack of land use zoning plans and non-adherence to them in some districts where they exist, resulted in improper and un-optimal use of land.

The State of Environment Review Report (2002) stated the following examples, among others, concerning issues of land use conflict;

> *"…conflicts at the rural-urban interface usually take the form of competition between urban land uses and non-urban land uses…most well-known is the development of Phakalane Township to the north of Gaborone. To the south of Gaborone, a substantial part of the Forest Hill Farm has been converted into residential estates of Kgale View area…"*

Botswana is also facing Urban Environmental Pollution and Dereliction problems. According to SOER (2002), rapid urbanization is mostly accompanied by environmental problems that adversely impact upon land use and land resources and these include pollution and dereliction that emerge from the various city building and industrialization processes. Furthermore, land pollution results mainly from poor waste disposal and management, and these impacts arise from the extraction of building materials such as sand, gravel, poles and grass and from the dumping of building rubble at the rural–urban interface. The increase in borrow pits and rubble dumping sites show the extent of land dereliction around urban areas of Botswana.

3. WATER RESOURCES

"Water-related problems have been recognised as the most immediate and serious threats to humankind."

(Dr. Klaus Töpfer, United Nations Under-Secretary General)

3.1 Introduction

This section of the report presents water resources information in Botswana through the following sub-sections: water use, sources of water, statistics on surface and ground water, water consumption, production/abstraction, losses, tariffs, quality, water related pressures/ impacts and responses, and water accounts.

Water is an essential resource for life. It is indispensable to the world's economy and the role it plays in the climate regulation cycle and climate change cannot be under estimated. Water resources management and protection, among others, is one of the basis of natural resources protection. While the world strives to manage and protect water resources of fresh and salt water ecosystems, and of the water we consume, it is faced with challenges of rapid urbanization, population growth, pollution, unsustainable use, hence the problem of water shortage. According to UNECA (2000), many African countries with a population of nearly 200 million people, are facing serious water shortages and by the year 2025, it is estimated that nearly 230 million Africans will be facing water scarcity, and 460 million will live in water-stressed countries.

In Botswana water resources are limited, and they are generated within the basins of the Okavango, Zambezi, Limpopo, and Orange Rivers. Being a semi-desert country, Botswana relies mainly on ground water supply. Groundwater accounts for about 66 percent of the country's water supplies. High evaporation rates and low/variable rainfall exacerbates the already existing problem of water scarcity. According to Botswana's State of the Environment Report (2002), rainfall in Botswana is erratic and varies greatly with time. Furthermore, prolonged periods of drought are interspersed with wet years, and annual average evaporation rate at 2000 mm is way in excess of the rainfall, which averages about 450 mm.

3.1.1 Water Sector Reforms Programme

The Water Sector Reforms Programme which commenced during the 2009/10 reporting period involved the takeover of potable water service delivery and wastewater management services to villages by Water Utilities Corporation (WUC). In the past, potable water delivery to big villages was offered by the Department of Water Affairs nationally and services to smaller villages and settlements as well as waste water management, by respective District Councils. To manage the reforms better, WUC divided the country into sixteen management centres, Lobatse, Gaborone, Mochudi, Kanye, Molepolole, Tshabong, Ghanzi, Mahalapye, Serowe, Palapye, Letlhakane, Selibe Phikwe, Francistown, Masunga, Maun, and Kasane. Bringing the WUC services closer to the customer in line with the Corporation's shift towards emphasizing customer service in its operations, is the reason why the country was divided into the afore-mentioned management centres. To effectively manage the takeover, the programme was divided into seven phases, with the programme scheduled to be completed in 2014. The programme is ahead of schedule as only one district, Ngamiland is remaining to be taken over, with its takeover scheduled for 2013. This programme will result in the programme completion in 2013, a year ahead of the initially planned 2014. As a result of the Water Sector Reform the Corporation's customer base rose from 144,000 in 2011 to just over 222,000 in 2012 (WUC, 2012).

3.2 Sources of Water

There are two main sources of water in Botswana, being ground water and surface water resources.

3.2.1 Surface water resources

Surface water resources: is water that is sourced from either rivers, dams, or any other surface sources. Due to the current water sector reform, Water Utilities Corporation (WUC) is now responsible for the supply of water to the rest of country. Like mentioned earlier, almost all of Botswana urban areas are supplied from dams. A large proportion of the population resides in urban areas because of increased urbanization. The 2011 population and housing census preliminary results reveal that the percentage of population share for cities and towns stood at 22 percent second to Central District, which still commands the biggest percentage share of the population, at 28 percent.
Surface water resources are very limited with annual run-off depth estimated at 1.2 mm when averaged over the whole country (Botswana's State of the Environment Report 2002). The Okavango and Chobe Rivers are the only two perennial rivers found in Botswana, and are both located in the north. All the remaining rivers are ephemeral. To take stock of water quantities in rivers, mean annual run-off are estimated. It is stated in the Botswana's State of the Environment Report (2002) that,

> *"…runoff in the country is very low, seasonal and varies greatly from year to year in accordance with the erratic rainfall. Areas of the highest runoff are in eastern Botswana, covering the Makgadikgadi and Limpopo river basins, where there are ephemeral rivers that flow on average 10 to 70 days a year during the rainy season."*

Presented in Table 3.2a is the estimated mean annual run-off for the drainage basins in Botswana. The river with the highest estimated mean annual run-off was Shashe with 270 Million cubic metres followed by Motloutse averaging 125 Million cubic metres per year then Notwane with 85 Million cubic metres, and all these rivers are ephemeral. The perennial rivers- Chobe and Okavango are the only two with the largest volume of surface water in Botswana, though they originate from Angola.

Table 3.2a: Estimated mean annual runoff for the drainage basins

River Basin	Area (Km²)	Estimated Mean Annual RUNOFF
Limpopo Drainage Basin		
Shashe	11,340	270
Motloutse	18,310	125
Lotsane	15,790	70
Mahalapye	5,740	40
Bonwapitse	11,000	15
Notwane	17,620	85
Makgadikgadi Drainage Basin		
Mosopye & Mosetse	9,500	55
Nata	6,500	45
Orange River Basin		
Molopo	7,100	No data

Source: Department of Water Affairs, 1998; State Of Environment Report, 2002

3.2.1.1 Water Storage

3.2.1.1.1 Dams

Surface water is stored in large dams in Botswana and they supply industry and urban areas. Table 3.2b and Figure 3.2a show the storage capacity of dams and their spatial location in Botswana for the period 2009-2012. Currently there are 8 major dams in the country with a total storage capacity of 1,016.8 Million cubic meters. These are Gaborone, Bokaa, Nnywane, Shashe, Letsibogo, Ntimbale, Dikgatlhong, and Lotsane dams. Before the coming into existence of Dikgatlhong dam in 2012 with a storage capacity 400 Million cubic meters, Gaborone dam has always been the largest dam with a capacity of 141.1 Million cubic meters followed by Letsibogo dam with 100 Million cubic meters then Shashe with 85 Million cubic metres. Nnywane dam stood at the bottom with 2.3 Million cubic meters, it is for this reason that the dam is used as a backup supply for Lobatse apart from Gaborone dam. Though Dikgatlhong dam has the largest storage capacity it does not supply any area as yet since pipelines are under construction in order to supply the neighbouring areas (Table 3.2c).

On the other hand, Letsibogo dam represents the largest dam in Botswana as far as the annual reservoir yield is concerned. According to Water Utilities Corporation; CSO (2009), the entire catchments of Letsibogo dam are within Botswana and have an area of around 57,000 Km2 with an estimated mean annual yield of 24 Million cubic meters. Moreover, the development of Letsibogo dam and the proposed lower Shashe dam (now Dikgatlhong dam) formed part of the largest engineering project ever undertaken in Botswana, namely the North South Carrier Water Project (NSCW).

Table 3.2b: Storage Capacity of Large Dams in Botswana ('000 000 m³): 2009-2012

Name of Dam	Capacity (MCM)	Location
Gaborone	141.4	Gaborone (South East)
Bokaa	18.5	Bokaa (Kgatleng)
Nnywane	2.3	Lobatse (South East)
Shashe	85	Shashe (North East)
Letsibogo	100	Mmadinare (Central)
Molatedi*	201	RSA
Ntimbale	26.5	Tutume (North East)
Dikgatlhong	400	Mmadinare (East)
Lotsane	40	Palapye (Central)

NB* Although Molatedi Dam is in South Africa, it supplies water in Botswana
Source: Water Utilities Corporation

Figure 3.2a: Percentage Carrying Capacities of Dams in Botswana

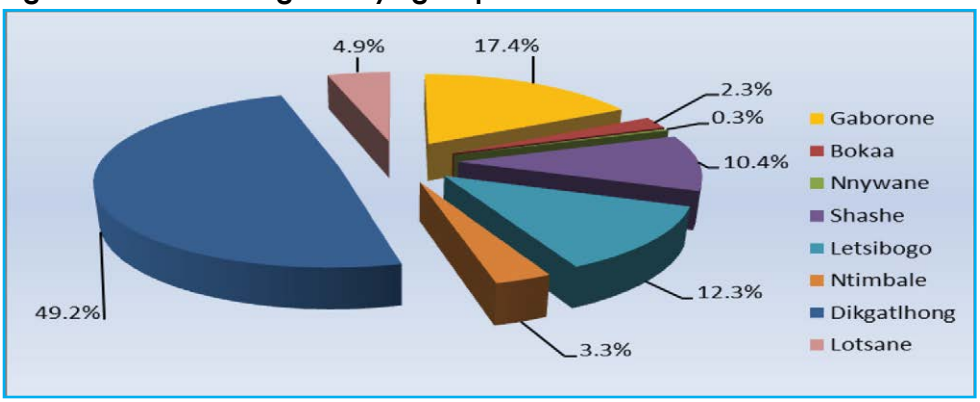


Table 3.2c: Area Supplied by Dams & Percentage Contribution to the Area Supplied: 2012/13

Dam	Areas supplied	Percentage contribution to area supplied
Gaborone	Greater Gaborone	56
Molatedi	Greater Gaborone	16 at full allocation
		8 at Half allocation
Bokaa	Greater Gaborone	25
Nnywane	Lobatse	10
Letsibogo	Greater Gaborone	36
	S/Phikwe, BCL & Mma dinare	100
	Mahalapye & Palapye	100
Shashe	Greater Francistown	100
Ntimbale	North East & Tutume District	50 (the other 50 from Maitengwe well field)
Dikgatlhong	-	-
Lotsane	-	-

Note: dash (-) means that no area is supplied
Source: Water Utilities Corporation

It is evident from Table 3.2d and Figure 3.2b that during the 2001-2011 period, Letsibogo dam (in 2005, 2007, 2009 and 2011) and Shashe dam (in 2001, 2005, 2007 and 2011) were over 80 percent full each only four times, followed by Nnywane dam which was over 80 percent full three times (in 2001, 2005 and 2007). Gaborone dam was the lowest, experiencing over 80 percent full capacity only in 2001.

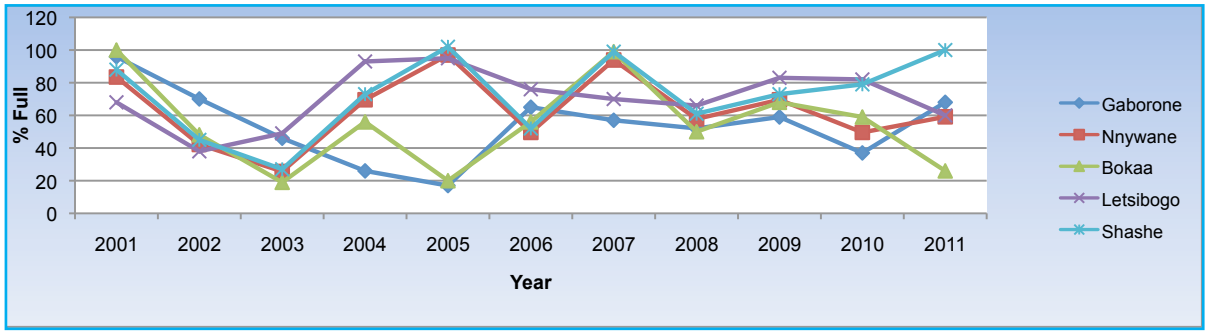
However, in terms of the total amount of water collected during the period under review Gaborone dam stood on top with 838.45 Million cubic meters, followed by Letsibogo dam with 780.00 Million cubic meters, then Shashe dam with 695.13 Million cubic meters. Nnywane dam came last with a total amount of 16.04 Million cubic meters since it has the smallest storage capacity compared to all the dams under discussion. It is only until the end of the year 2012 that Gaborone dam came second to Dikgatlhong dam in terms of the storage capacity that is why it stood on top of other dams as far as the total amount of water collected during the period 2001-2011 is concerned.

Table: 3.2d: Water Levels & Percentage Full for Selected Dams('000 000 Cubic meters):2001-2011

Year	Gaborone Level	% Full	Nnywane Level	% Full	Bokaa Level	% Full	Letsibogo Level	% Full	Shashe Level	% Full
2001	135.61	95.91	1.92	83.48	18.5	100	68	68	76.56	90.07
2002	99.06	70.06	0.97	42.17	8.95	48.38	38	38	39.15	46.06
2003	65.04	46	0.59	25.65	3.53	19.08	49	49	23.49	27.64
2004	36.76	26	1.6	69.57	10.42	56.32	93	93	63.51	74.72
2005	24.04	17	2.23	96.96	3.72	20.11	95	95	88.74	104.4
2006	91.91	65	1.14	49.57	10.42	56.32	76	76	45.24	53.22
2007	80.6	57	2.16	93.91	18.41	99.51	70	70	86.13	101.33
2008	73.53	52	1.33	57.83	9.3	50.27	66	66	53.07	62.44
2009	83.43	59	1.6	69.57	12.65	68.38	83	83	63.51	74.72
2010	52.32	37	1.14	49.57	10.97	59.3	82	82	68.73	80.86
2011	96.15	68	1.36	59.13	4.84	26.16	60	60	87	102.35

Note: Dam storage values were the December values for that year.
Source: Water Utilities Corporation

Figure 3.2b: Water Levels for Selected Dams (% Full), 2001-2011



Derived from Table 3.2d

3.2.1.2 Water Abstraction from WUC Dams

The removal of water from any source is referred to as water abstraction. In the case of Botswana, surface water is abstracted from dams. There are considerable differences in the amounts of freshwater abstracted within each dam, in part reflecting the resources available.

Table 3.2e shows total annual water abstraction from WUC dams for the period 2003/4 to 2010/11. On average, Gaborone dam experienced the highest average annual water abstraction with a value of about 21.24 Million cubic meters per year, followed by Shashe dam with an average of 13.94 Million cubic meters per year, then Letsibogo with 11.53 Million cubic meters per year. Nnywane dam had the least average annual water abstraction of about 0.57 Million cubic meters per year. These results are influenced by the storage capacity of the dams; Gaborone dam had the largest storage capacity and Nnywane dam had the lowest capacity. Botswana experienced the largest water abstraction in the years 2009/10, 2008/09 and 2010/11 with total yearly abstraction of 63.3 Million cubic meters, 63.1 Million cubic meters and 57.6 Million cubic meters, respectively.

Table 3.2e: Total Annual Water Abstraction from WUC Dams (Mm^3)

Year	Gaborone	Nnywane	Letsibogo	Shashe	Bokaa	Ntimbale
2003-2004	23	0.7	18.6	9.1	1.9	
2004-2005	17.8	0.5	11.1	12.9	1.2	
2005-2006	8	0.7	16.6	13.4	2.4	
2006-2007	18.7	0.9	13.1	14.6	3.8	
2007- 2008	22.3	0.8	3.2	14.4	5.3	
2008-2009	26.35	0.29	12.02	16.29	8.1	
2009-2010	26.4	0.46	11.03	17.31	6.9	1.2
2010-2011	27.4	0.21	6.59	13.53	7.7	2.18

Note: Ntimbale dam was functional since 2009/10 to date
Source: Water Utilities Corporation

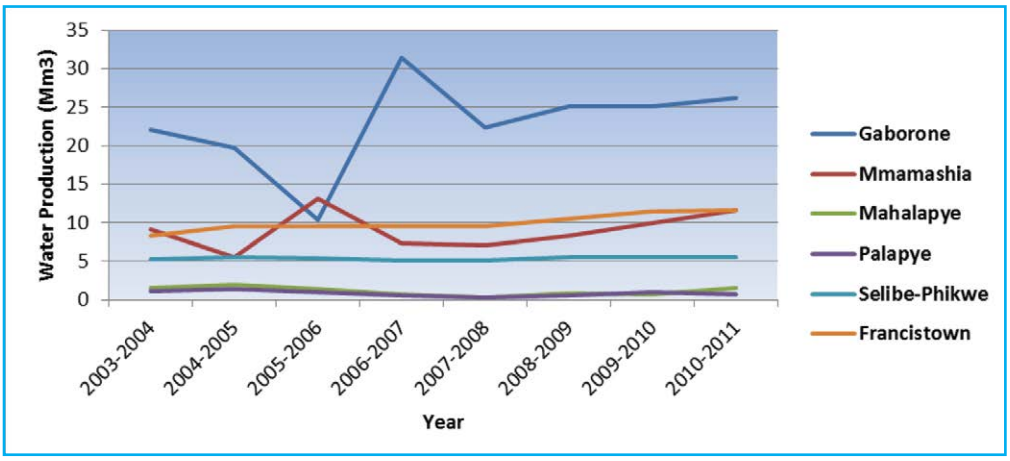
Table 3.2f and Figure 3.2cpresent the total amount of water produced from different treatment plants from 2003 to 2010. The table shows that Gaborone had the highest total annual treated water production (182.6 Million cubic meters) while Palapye stood at the bottom with 6.9 Million cubic meters. The afore-mentioned treatment plants draw their water from different dams across the country. According to CSO (2009), 'Mahalapye and Palapye fall in the North South Carrier Scheme and comprise of a 360 km long pipeline, water treatment plants and associated pump stations. Gaborone treatment plant gets its water from Gaborone dam and Molatedi dam which pours directly into Gaborone Dam; Mmamashia plant abstracts water from Letsibogo and Bokaa Dams, while Mahalapye, Palapye and Selibe-Phikwe treatment plants are supplied by Letsibogo Dam. Shashe Dam supplies Francistown, Shashe village and Selibe Phikwe water works.'

Table 3.2f: Annual Treated Water Productionby Treatment Plant (Mm^3)

Year	Gaborone	Mmamashia	Mahalapye	Palapye	Selibe-Phikwe	F/town
2003/04	22.03	9.14	1.5	1.21	5.3	8.3
2004/05	19.77	5.58	1.99	1.47	5.6	9.6
2005/06	10.42	13.14	1.46	1.03	5.4	9.5
2006/07	31.5	7.28	0.73	0.53	5.2	9.5
2007/08	22.4	7	0.32	0.34	5.2	9.6
2008/09	25.1	8.3	0.84	0.6	5.5	10.57
2009/10	25.1	9.9	0.71	0.98	5.5	11.51
2010/11	26.24	11.64	1.55	0.74	5.5	11.67

Source: Water Utilities Corporation

Figure 3.2c: Annual treated water production Mm, 2003-2010



3.2.2 Groundwater resources

Groundwater resources are the main source of fresh/potable water in Botswana. Groundwater, which accounts for about 66 percent of the country's water supplies, is limited. Groundwater occurs in geological formation known as aquifers. Botswana National Atlas defines aquifers as the geological formation that may either be a consolidated rock or unconsolidated pile of sediments that contain sufficient saturated permeable material to yield significant quantities of water wells and springs.

Aquifers are classified according to the types of bedrock and water transmissive voids. According to Botswana's State of the Environment Report 2002, aquifers in Botswana can be divided into four types of classes: fractured, fractured porous, porous and karstified fractured. Table 3.2g presents the type of bedrock constituting the four aquifer types. Recharging of aquifers range from over 40 mm/year in the extreme north to practically zero in the central and western parts of Botswana (National Water Master Plan review, 2005).

Table 3.2g: Type of Aquifers in Botswana

Aquifer Type	% of Botswana	Aquifer or Area	Size (Km²)
	27	Archaen Basement	61,000
		Ventersdorp Supergroup	
		Transvaal Supergroup	21,000
		Waterberg Supergroup	28,000
		Olifantshoek Supergroup	400
		Damara Supergroup	34,000
Fractured		Karoo basalt	6,000
	37	Ntane Sandstone	138,000
		Ecca Sandstone	67,001
Fractured Porous		Mea Arkose	6,000
	35	Sand Rivers	
		Alluvium	40
Porous		Kalahari Beds	201,000
Karstified fractured	1	Dolomites in Transvaal Supergroup at Ramotswa, Lobatse, Kanye, Moshaneng, Sekoma, Molopo	

Source: Botswana National Water Master Plan, Vol. 5; State Of Environment Report, 2002

3.2.2.1 Well fields in Botswana

Like mentioned earlier an aquifer is an underground layer of water-bearing penetrable rock from which groundwater can be mined. Water in aquifers can come to the surface naturally through a spring and it can be discharged into lakes and streams. Furthermore, water from an aquifer can also be extracted through drilling of a well. An area containing one or more wells that produce usable quantities of water is referred to as a well field.

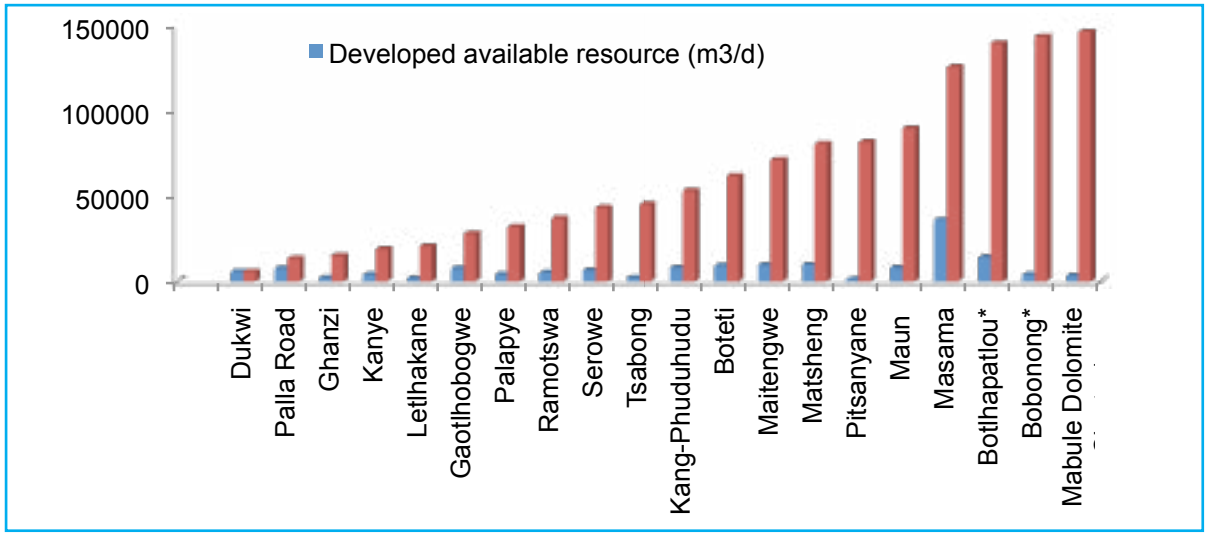
Table 3.2h presents developed water resources from different well fields in Botswana. The table also shows the total amount of ground-water currently available country-wide together with the cumulative totals. There has not been any change in the amount of water supplied daily from the developed available resources since 2008, except for Masama well field with an increase of 75.9 percent from 20, 480 cubic meters per day in 2008 to 36,016 cubic meters per day in 2011. Furthermore, Figure 3.2d shows that high water yield is expected from Masama well field with 36, 016 cubic meters per day followed by Botlhapatlou with expected yield of 14,000 cubic meters per day then Matsheng well field with expected yield of 9,600 cubic meters per day.

Table 3.2h: Availability of Groundwater in Botswana, 2009-2011

Well field	Developed available resource (m^3/d)	Cumulative Resources developed (m^3/d)	Sustainable Resource (Mm^3/yr.)
Dukwi	5,700	5,700	0.039
Palla Road	7,500	13,200	1.46
Ghanzi	1,850	15,050	0.68
Kanye	3,950	19,000	1.44
Letlhakane	1,500	20,500	0.06
Gaotlhobogwe	7,500	28,000	5.84
Palapye	4,000	32,000	1.64
Ramotswa	5,000	37,000	1.83
Serowe	6,200	43,200	1.28
Tshabong	2,000	45,200	0.73
Kang-Phuduhudu	7,860	53,060	3.27
Boteti	8,950	62,010	1.96
Maitengwe	9,400	71,410	3.43
Matsheng	9,600	81,010	3.52
Pitsanyane	1,000	82,010	0.37
Maun	8,000	90,010	10.07
Masama	36,016	126,026	7.3
Botlhapatlou*	14,000	140,026	-
Bobonong*	3,800	143,826	-
Mabule Dolomite Cluster*	3,000	146,826	-

NB: m^3/d refers to Cubic Meters per Day
Mm^3/yr. refers to Million cubic meters per year
*** Expected yield per day**
Source: Water Utilities Corporation

Figure 3.2d: Cumulative Water Resources Developed (m³/day) by Well field, 2009-2011
NB: m³/d refers to Cubic Meters per Day



*** Expected yield per day**

Derived from Table 3.2h

3.3 Water Production, Consumption and Losses

This sub-section presents statistics on water production, consumption and losses specifically for cities/towns, major villages and mining areas in Botswana. Due to the Water Sector Reforms Programme which commenced during the 2009/10 period, the reporting period 2010/11 was affected the most by the transformation, and this resulted in lack of proper data documentation, hence data gaps during the same year.

3.3.1 Water Consumption in towns

Table 3.3a to 3.3h and Figure 3.3a show water consumption patterns for cities/towns. Like in the 2008 Water Statistics Report, the 'Sales' column in the afore-mentioned tables does not show the tariffs for the different towns, instead the totals for the towns are given for every year. Water consumption patterns vary between the cities/towns. During the 1999-2011periods, Gaborone had the highest consumption followed by Selibe Phikwe and Francistown (Table 3.3a). Gaborone had the highest consumption compared to other cities/towns because it has the largest population size and more commercial and industrial activities. Although Selibe Phikwe has a lesser population compared to Francistown, it comes second in water consumption to Gaborone and this is mainly due to activities at the BCL mine.

3.3.1.1 Water Consumption per Capita in Cities and Towns

Water consumption per capita is the quantity of water supplied over the population supplied over a specific period in time. It indicates pressure that human consumption patterns exert on water resources. Per capita consumption of drinking water has been fluctuating since 1999 with the highest increase of around 50 percent experienced from the year 2008 (0.233 cubic meters/day) to 2009 (0.351 cubic meters/day). Consumption in urban areas has been dropping since 2009; this is solely because of the loss of bulk sales to Government as a result of the reforms (Table 3.3b & Figure 3.3a). Rapid urbanization, population growth, unsustainable use and climatic differences could be the contributing factors to these fluctuations.

Presented in Table 3.3c is the per capita water consumption in cities/towns. Selibe Phikwe has the highest per capita consumption of water when compared with other towns/cities. According to 2008 Water Statistics report, BCL mine in Selibe Phikwe consumed large quantities of potable water and the town has high water usage in the domestic sub sector. The high water usage in the domestic sector is influenced by low tariffs on the bulk of the water that is supplied by WUC. On the other hand, BCL mine has subsidized water for its workers, hence higher per capita water consumption.

Table 3.3a: Water Consumption in (Kl) and sales collected from users, 1999-2011

Year	Gaborone	Francistown	Lobatse	Jwaneng	Selibe Phikwe	Sowa Town	North South Currier	Total in ('000) Kl	Sales in Pula
1999	20,061,032	4,098,653	1,684,635	1,045,225	4,420,634	337,067	-	31,647,246	133,164,012
2000	21,307,303	5,374,931	2,432,899	2,404,847	5,889,339	479,107	-	37,888,426	232,887,628
2001	23,975,888	8,132,476	3,032,608	1,829,462	10,174,466	673,001	-	47,817,901	387,204,438
2002	23,672,759	6,109,033	1,948,531	1,317,769	5,873,312	456,258	814,753	40,192,415	326,631,106
2003	23,977,709	6,759,856	2,589,689	1,594,425	9,054,474	536,518	2,732,679	47,245,350	430,247,650
2004	24,529,020	7,185,879	2,607,674	1,686,921	8,681,348	463,493	3,338,843	48,493,178	501,353,260
2005	19,643,169	7,715,038	2,168,350	1,635,758	9,305,079	501,959	2,538,200	43,507,553	405,119,463
2006	20,669,603	8,419,012	2,282,253	1,543,636	8,594,176	517,717	1,585,078	43,611,475	421,029,698
2007	23,973,239	8,566,130	2,656,014	1,736,555	8,906,098	441,988	1,007,200	47,287,224	466,665,882
2008	25,657,363	9,269,496	2,968,719	1,578,607	9,348,311	501,895	968,300	50,292,691	502,441,939
2009	27,327,387	11,206,669	3,209,521	1,635,828	8,823,678	495,626	1,352,200	54,050,909	546,839,988
2010	22,250,821	11,382,211	3,415,344	1,764,663	9,612,447	468,034	22,250,821	49,123,230	461,016,289
2011	17,936,012	7,520,276	2,838,899	1,741,135	8,479,270	509,124	-	39,026,727	335,083,639

Note: - means data not available
Source: Water Utilities Corporation

Table 3.3b: Water Consumption for All Towns in Kl and Sales Collected From Users, 1999-2011

Year	Total in ('000) Kl	Sales in Pula	Sales per Kilolitre	Projected Population	Per Capita Consumption (kl/day)
1999	**26,372,110**	**133,164,012**	**5.05**	**409,230**	**0.177**
2000	37,888,426	232,887,628	6.15	427,236	0.243
2001	47,817,901	387,204,438	8.1	446,878	0.297
2002	40,192,415	326,631,106	8.13	465,646	0.227
2003	47,245,350	430,247,650	9.11	485,204	0.267
2004	48,493,178	501,353,260	10.34	505,582	0.263
2005	43,507,553	405,119,463	9.31	526,817	0.226
2006	43,611,475	421,029,698	9.65	548,267	0.218
2007	47,287,224	466,665,882	9.87	569,101	0.228
2008	50,292,691	502,441,939	9.99	590,727	0.233
2009	54,050,909	546,839,988	10.12	421,856	0.351
2010	49,123,230	461,016,289	9.03	439,097	0.311
2011	39,026,727	335,083,639	9.03	447,430	0.242

Source: Water Utilities Corporation

Figure 3.3a: Water Consumption per Capita for All Towns, 1999-2011

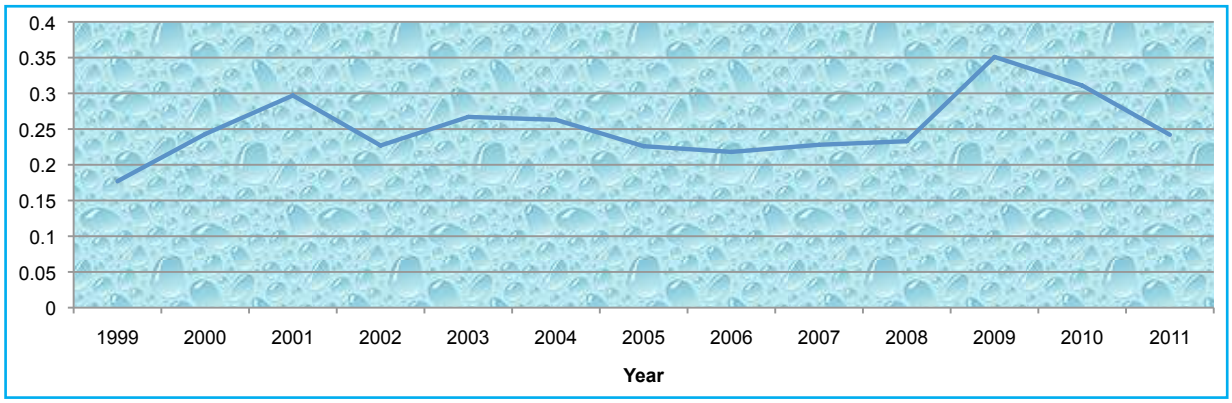


Table 3.3c: Water Consumption per capita in Towns (m^3/d)(1998 – 2011)

Year	Gaborone	Francistown	Lobatse	Jwaneng	Selibe-Phikwe
1998	0.247	0.151	0.192	0.246	0.323
1999	0.175	0.115	0.148	0.175	0.252
2000	0.386	0.149	0.208	0.386	0.329
2001	0.288	0.208	0.252	0.288	0.539
2002	0.192	0.151	0.159	192	0.312
2003	0.225	0.159	0.205	0.225	0.471
2004	0.227	0.162	0.203	0.227	0.441
2005	0.211	0.167	0.164	0.211	0.463
2006	0.192	0.175	0.17	0.192	0.416
2007	0.208	0.17	0.192	0.208	0.422
2008	0.184	0.178	0.211	0.184	0.433
2009	0.335	0.317	0.289	0.264	0.474
2010	0.267	0.315	0.304	0.28	0.511
2011	0.211	0.204	0.25	0.272	0.446

Source: Water Utilities Corporation

3.3.2 Water Consumption in major villages

Tables 3.3d to 3.3g and Figures 3.3b to 3.3r show water production, consumption and losses for individual major villages. The general trend over the years is that both production and consumption were on the increase until the year 2009 where almost all the major villages experienced a decline. The decline in production is attributable to the Water Sector Reform Programme by the Water Utilities Corporation. Mogoditshane has been consistently higher in water production and consumption as compared to other major villages, Tshabong realised the lowest.

It is evident from the tables and figures that losses were slightly low in Mogoditshane in 1999 with 3.0 percent, Ghanzi with 5.0 percent in 2005, then Mogoditshane again with 7.0 percent each for the years 2000 and 2001 respectively.

High water losses exceeding consumption were experienced in Serowe recording about 62 percent in 2004. Large population sizes coupled with high growth, among others, can influence the just mentioned results. According to the 2011 Population and Housing Census, Serowe Central District still commands the biggest percentage share of the population, at 28 percent; this is a drop of 2 percentage points over the 2001 figure. The same scenario was experienced in Ramotswa from 2000 to 2003 and 2006 respectively, with losses of more than 40 percent each.

There is only one incident where consumption exceeded production that is in Molepolole in 2007 with 1,592,827 cubic meters of production and 1,866,237 cubic meters of consumption. This is attributable to the fact that during the 2007/08 period Molepolole recorded the highest percentage of water loss (46 percent) that the village never experienced before.

Table 3.3d: Water Production in Major Villages (m^3): 1999-2011

Villages	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Kanye	1,657,291	2,187,351	2,381,510	2,568,447	2,662,739	2,904,969	2,762,456	3,317,585	2,919,454	2,804,674	2,950,825	3,272,920	3,435,468
Ramotswa	1,287,890	1,414,015	1,362,367	1,559,617	1,483,556	1,344,002	1,275,156	1,610,900	1,713,900	1,708,700	1,115,000	2,538,400	2,512,952
Maun	1,218,520	1,157,234	1,610,332	1,295,582	1,188,079	1,435,451	1,682,822	1,697,088	2,135,624	2,063,698	2,049,482	1,957,093	-
Tlokweng	1,367,845	1,338,680	1,538,932	1,608,990	1,721,059	1,593,460	1,151,740	1,523,160	1,619,960	1,715,590	-	2,199,110	2,355,860
Tsabong	224,245	289,508	284,748	280,786	320,498	343,266	380,672	348,905	385,051	392,515	422,292	388,752	391,324
Moshupa	336,063	345,872	386,240	466,551	496,096	539,560	458,793	539,650	523,950	476,120	501,100	544,890	-
Tonota	701,715	779,191	889,464	971,525	867,792	1,001,592	929,608	942,606	995,564	1,039,654	794,090	-	1,373,733
Ghanzi	363,381	481,852	496,137	531,681	596,695	601,643	533,126	586,146	602,235	618,930	620,716	643,998	865,211
Mahala-pye	2,031,558	1,871,462	1,950,003	2,152,691	2,182,230	2,172,161	2,203,623	2,305,873	2,438,675	2,378,526	1,695,393	-	2,940,279
Palapye	1,098,006	1,168,767	1,328,934	1,402,109	1,330,101	1,492,069	1,315,525	1,379,232	1,207,100	1,291,424	876,943	-	2,264,660
Kasane	604,343	614,750	662,069	619,794	639,725	752,275	862,220	916,840	1,052,257	1,182,760	798,935	-	1,497,683
Mochudi	1,111,861	1,229,400	1,331,558	1,675,594	1,812,310	1,949,026	1,610,411	1,836,933	1,833,636	2,014,056	1,247,537	2,241,473	2,388,375
Molepolole	1,509,807	1,701,137	1,960,554	2,160,437	2,147,724	2,519,631	2,501,041	2,672,986	1,592,827	2,469,416	2,818,526	2,561,597	2,413,865
Serowe	1,306,311	1,466,165	1,612,092	1,707,837	1,987,130	2,266,422	2,405,806	2,585,802	2,391,128	2,474,217	2,461,244	1,960,764	2,412,142
Thamaga	338,551	428,537	428,537	460,789	512,795	486,308	550,968	621,320	750,921	703,230	615,536	536,736	-
Letlhakane	426,999	440,900	490,588	535,453	555,219	594,511	580,188	648,864	668,447	781,996	711,942	655,258	681,459
Mogodit-shane	2,578,354	2,807,003	2,992,678	2,999,841	3,179,371	3,179,844	3,219,685	3,244,685	3,191,000	3,438,903	-	4,459,200	4,125,291
Total	**18,162,740**	**19,721,824**	**21,706,743**	**22,997,724**	**23,683,119**	**25,176,190**	**24,423,840**	**26,778,575**	**26,021,729**	**27,554,409**	**19,679,561**	**23,960,191**	**29, 658, 302**

Note: Dash means no data available
Source: Water Utilities Corporation

Table 3.3e: Water Consumption in Major Villages (m³): 1999-2011

Villages	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Kanye	1,003,560	1,606,587	1,687,783	1,864,072	1,614,093	1,813,722	1,581,445	1,895,692	1,634,626	1,562,229	1,852,712	2,016,961	1,869,569
Ramotswa	759,507	670,336	643,349	750,890	631,636	954,068	942,884	310,883	962,244	919,938	610,056	-	1,374,023
Maun	980,972	908,380	1,124,519	970,020	948,483	1,065,138	1,181,793	1,305,158	1,657,445	1,538,880	1,604,812	1,565,571	-
Tlokweng	1,100,702	1,149,080	1,090,678	1,221,293	1,436,306	1,192,356	931,422	1,169,138	1,259,986	1,251,403	-		2,031,504
Tsabong	185,730	221,960	218,687	232,421	250,969	260,821	277,436	249,570	229,061	231,590	299,022	248,191	278,112
Moshupa	262,766	249,663	277,157	332,407	316,391	319,310	311,505	393,952	345,059	333,208	367,781	362,584	-
Tonota	600,332	638,294	748,189	838,638	768,868	823,000	781,621	843,563	824,438	826,377	566,309		827,742
Ghanzi	289,298	396,035	458,043	408,604	432,246	521,676	508,950	526,813	526,148	523,220	520,926	508,065	606,025
Mahalapye	1,453,765	1,341,124	1,593,636	1,513,492	1,708,877	1,794,003	1,725,982	1,794,011	1,679,606	1,660,727	1,123,555		1,681,082
Palapye	1,006,158	858,149	1,017,968	1,040,322	1,031,515	1,063,193	978,418	1,005,579	984,128	1,040,904	723,400		1,465,621
Kasane	489,206	495,282	539,933	536,101	551,662	669,824	584,968	604,249	847,675	948,324	691,163		932,785
Mochudi	940,230	1,047,943	1,152,689	1,436,692	1,466,006	1,495,320	1,349,522	1,522,301	1,533,575	1,648,890	952,825		1,695,746
Molepolole	1,113,144	1,127,229	1,072,241	1,471,880	1,566,305	1,638,659	1,827,218	1,904,696	1,866,237	1,734,872	1,936,482	1,553,678	1,505,164
Serowe	991,800	1,108,774	1,404,451	1,330,606	1,099,942	869,277	1,334,792	1,527,471	1,506,812	1,515,487	1,629,687	1,397,887	1,720,833
Thamaga	247,229	290,893	326,915	354,821	354,821	431,791	445,819	579,689	540,063	552,032	506,627	368,620	-
Letlhakane	356,069	401,457	448,154	478,864	523,414	543,393	516,972	565,263	565,263	681,236	616,914	557,325	582,023
Mogoditshane	2,493,733	2,599,537	2,605,017	2,609,277	2,795,915	2,702,596	2,662,468	2,590,842	2,590,842	2,751,224	-	-	2,921,602
Total	**14,274,201**	**15,110,723**	**16,409,409**	**17,390,400**	**17,497,449**	**18,158,147**	**17,943,215**	**18,788,870**	**19,553,208**	**19,720,541**	**14,002,271**	**8, 578, 882**	**19, 491, 831**

Note: Dash= No data available
Source: Water Utilities Corporation

Table 3.3f: Water Losses in Major Villages (m^3): 1999-2011

VILLAGE	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Kanye	653,731	580,764	693,727	704,375	1,048,646	1,091,247	1,181,011	1,421,893	349,373	1,242,445	1,098,113	1,255,959	1,477,251
Ramotswa	528,383	743,679	719,018	808,727	851,920	389,934	332,272	721,850	751,656	788,762	504,944	-	1,055,440
Maun	237,548	248,854	485,813	325,562	239,596	370,313	501,029	391,930	478,179	524,818	444,670	367,007	-
Tlokweng	267,143	189,600	448,254	387,697	284,753	401,104	220,318	354,022	359,974	464,187	-	-	306,262
Tshabong	38,515	67,548	66,061	48,365	69,529	82,445	103,236	99,335	155,990	160,925	123,270	-	121,310
Moshupa	73,297	96,209	109,083	134,144	179,705	220,250	147,288	145,698	178,891	142,912	133,319	182,306	-
Tonota	101,383	140,897	141,275	132,887	98,924	178,592	147,987	99,043	171,126	213,277	227,781	-	494,544
Ghanzi	74,083	85,817	38,094	123,083	164,449	79,967	24,176	59,333	76,086	95,710	99,790	68,256	259,563
Mahalapye	577,793	530,338	364,367	639,199	473,353	378,158	477,641	511,862	759,069	717,799	571,838	-	1,205,514
Palapye	91,848	310,618	310,966	361,787	298,586	428,876	337,107	373,653	222,972	250,520	153,543	-	792,631
Kasane	115,137	119,468	122,136	83,693	88,063	82,451	277,252	312,591	204,582	234,436	102,190	-	389,398
Mochudi	171,631	181,457	178,869	238,902	346,304	453,706	260,889	314,632	300,061	365,166	294,712	-	692,629
Molepolole	396,663	573,908	888,313	688,557	581,419	880,972	673,823	768,290	726,590	734,544	882,044	1,007,919	700,021
Serowe	314,511	357,391	207,641	377,231	887,188	1,397,145	1,071,014	1,058,331	884,316	958,730	831,557	562,877	651,278
Thamaga	91,322	137,644	101,622	105,968	157,974	54,517	105,149	118,823	210,858	151,198	108,909	168,116	-
Letlhakane	70,930	39,443	42,434	56,589	31,805	51,118	63,216	69,175	103,184	100,760	95,028	97,933	102,219
Mogoditshane	84,621	207,467	387,661	390,564	383,456	477,248	557,217	552,121	600,158	687,679	-	-	1,196,334

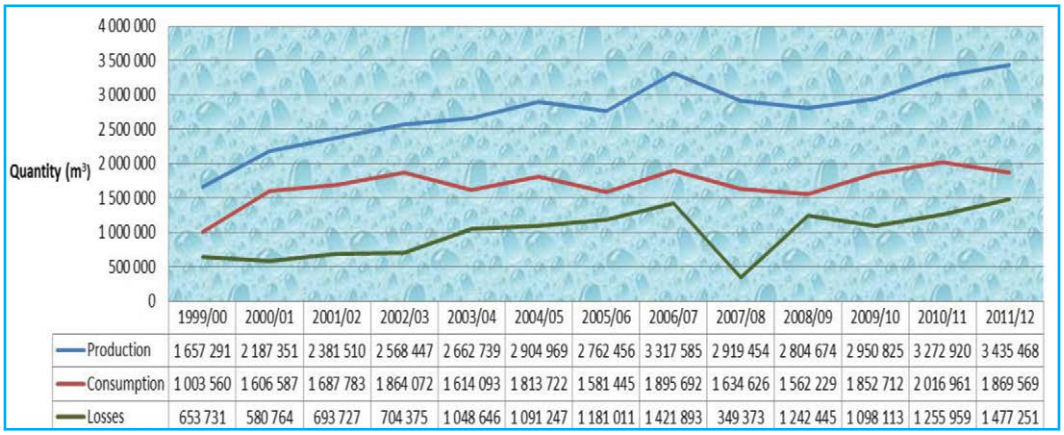
Note: Dash means no data available
Source: Water Utilities Corporation

Table 3.3g: Percentages of Water Losses for Each Major Villages (m^3): 1999-2011

Villages	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Kanye	40	27	29	27	39	38	43	43	12	44	37	38	43
Ramotswa	41	53	53	52	57	29	26	45	44	46	45	-	42
Maun	20	22	30	25	20	26	30	23	22	25	22	20	-
Tlokweng	20	14	29	24	17	25	19	23	22	27	-	-	13
Tshabong	17	23	23	17	22	24	27	29	41	41	29	36	31
Moshupa	22	28	28	29	36	41	32	27	34	30	27	34	-
Tonota	15	18	16	14	11	18	16	11	17	21	29	-	36
Ghanzi	20	18	8	23	28	13	5	10	13	16	16	11	30
Mahalapye	28	28	19	30	22	17	22	22	31	30	34	-	41
Palapye	8	27	23	26	23	29	26	27	19	19	18	-	35
Kasane	19	19	19	14	14	11	32	34	19	20	13	-	26
Mochudi	15	15	13	14	19	23	16	14	16	18	24	-	29
Molepolole	26	34	45	32	27	35	27	29	46	30	31	39	29
Serowe	24	24	13	22	45	62	45	41	37	39	34	29	27
Thamaga	27	32	24	23	31	11	19	19	28	22	18	31	-
Letlhakane	17	9	9	11	10	9	11	10	15	13	13	15	15
Mogoditshane	3	7	7	13	12	15	17	17	19	20	-	-	29

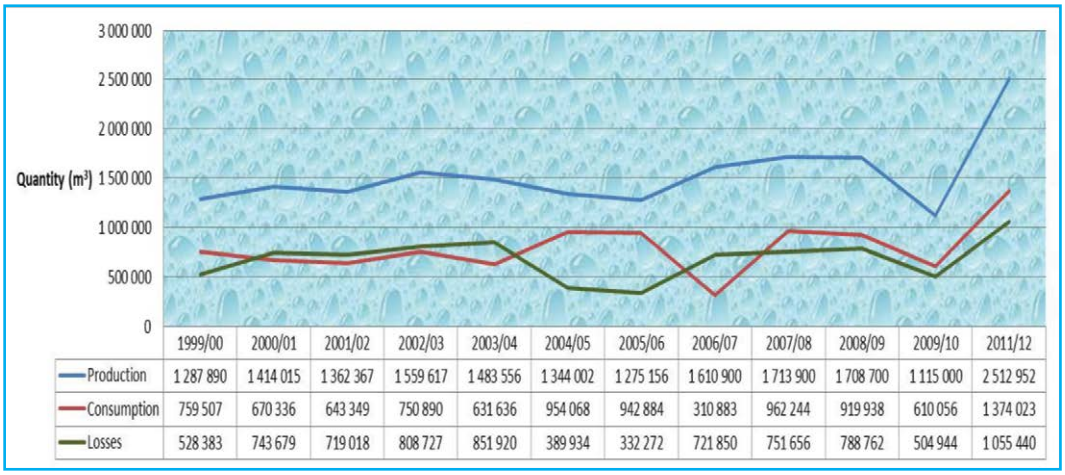
Note: Dash means no data available
Source: Water Utilities Corporation

Figure 3.3b: Kanye Water Production, Consumption & Losses, 1999-2011 (m^3)



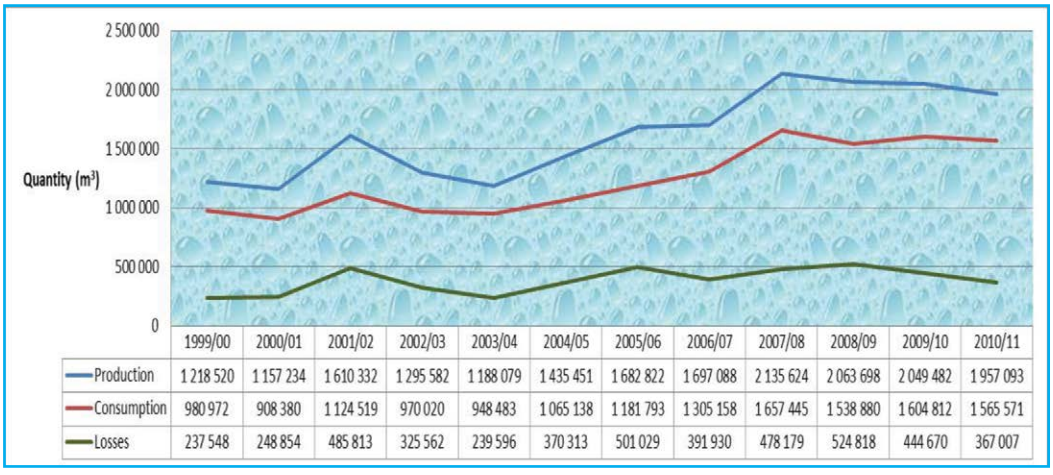
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Production	1 657 291	2 187 351	2 381 510	2 568 447	2 662 739	2 904 969	2 762 456	3 317 585	2 919 454	2 804 674	2 950 825	3 272 920	3 435 468
Consumption	1 003 560	1 606 587	1 687 783	1 864 072	1 614 093	1 813 722	1 581 445	1 895 692	1 634 626	1 562 229	1 852 712	2 016 961	1 869 569
Losses	653 731	580 764	693 727	704 375	1 048 646	1 091 247	1 181 011	1 421 893	349 373	1 242 445	1 098 113	1 255 959	1 477 251

Figure 3.3c: Ramotswa Water Production, Consumption & Losses, 1999-2011 (m^3)



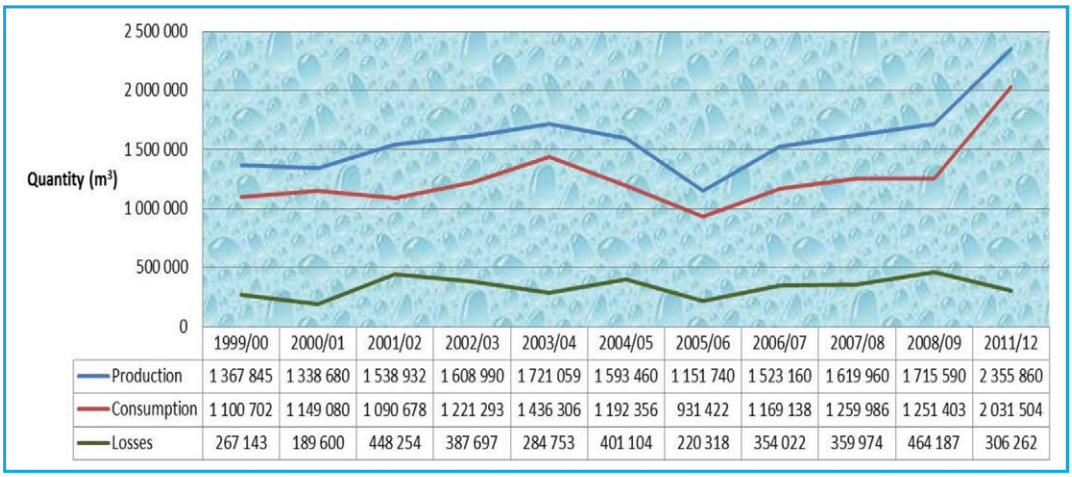
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2011/12
Production	1 287 890	1 414 015	1 362 367	1 559 617	1 483 556	1 344 002	1 275 156	1 610 900	1 713 900	1 708 700	1 115 000	2 512 952
Consumption	759 507	670 336	643 349	750 890	631 636	954 068	942 884	310 883	962 244	919 938	610 056	1 374 023
Losses	528 383	743 679	719 018	808 727	851 920	389 934	332 272	721 850	751 656	788 762	504 944	1 055 440

Figure 3.3d: Maun Water Production, Consumption & Losses, 1999-2011 (m^3)



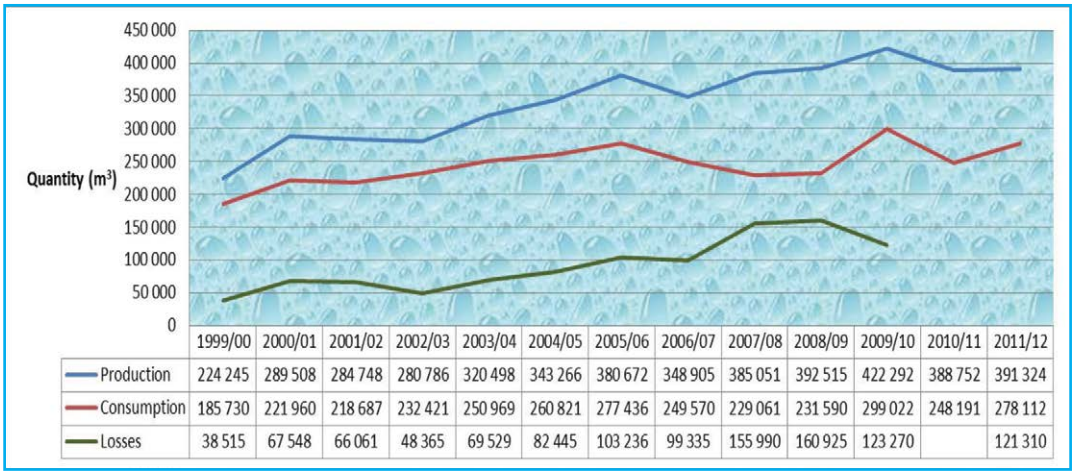
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Production	1 218 520	1 157 234	1 610 332	1 295 582	1 188 079	1 435 451	1 682 822	1 697 088	2 135 624	2 063 698	2 049 482	1 957 093
Consumption	980 972	908 380	1 124 519	970 020	948 483	1 065 138	1 181 793	1 305 158	1 657 445	1 538 880	1 604 812	1 565 571
Losses	237 548	248 854	485 813	325 562	239 596	370 313	501 029	391 930	478 179	524 818	444 670	367 007

Figure 3.3e: Tlokweng Water Production, Consumption & Losses, 1999-2011 (m³)



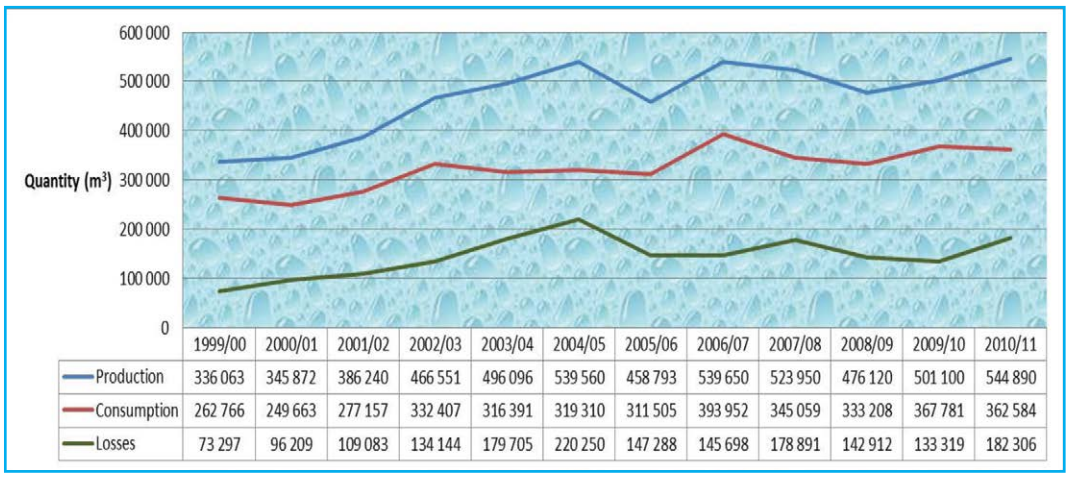
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2011/12
Production	1 367 845	1 338 680	1 538 932	1 608 990	1 721 059	1 593 460	1 151 740	1 523 160	1 619 960	1 715 590	2 355 860
Consumption	1 100 702	1 149 080	1 090 678	1 221 293	1 436 306	1 192 356	931 422	1 169 138	1 259 986	1 251 403	2 031 504
Losses	267 143	189 600	448 254	387 697	284 753	401 104	220 318	354 022	359 974	464 187	306 262

Figure 3.3f: Tshabong Water Production, Consumption & Losses, 1999-2011 (m³)



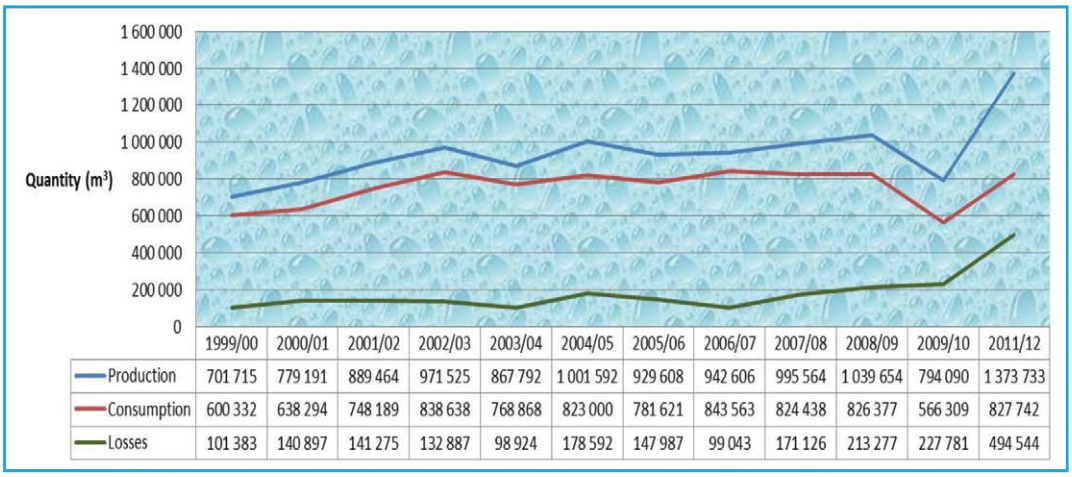
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Production	224 245	289 508	284 748	280 786	320 498	343 266	380 672	348 905	385 051	392 515	422 292	388 752	391 324
Consumption	185 730	221 960	218 687	232 421	250 969	260 821	277 436	249 570	229 061	231 590	299 022	248 191	278 112
Losses	38 515	67 548	66 061	48 365	69 529	82 445	103 236	99 335	155 990	160 925	123 270		121 310

Figure 3.3g: Moshupa Water Production, Consumption & Losses, 1999-2011 (m³)



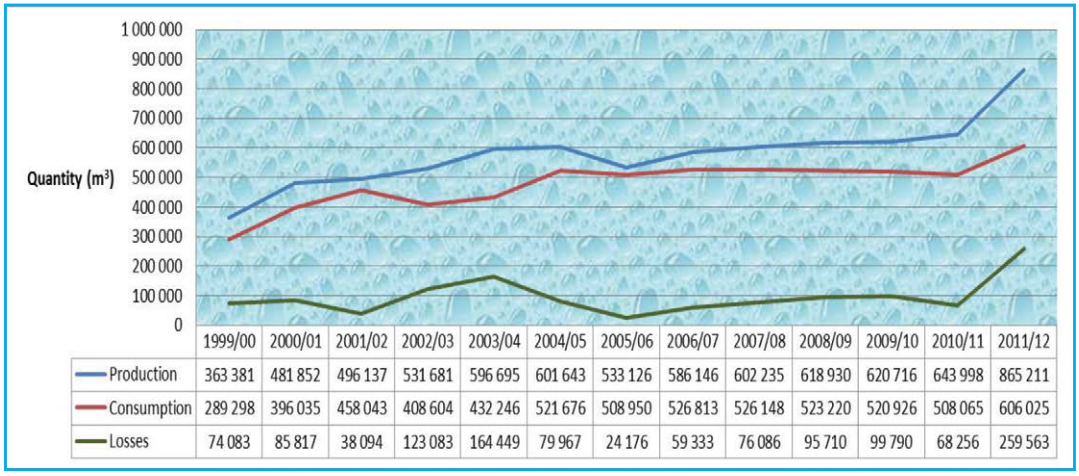
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Production	336 063	345 872	386 240	466 551	496 096	539 560	458 793	539 650	523 950	476 120	501 100	544 890
Consumption	262 766	249 663	277 157	332 407	316 391	319 310	311 505	393 952	345 059	333 208	367 781	362 584
Losses	73 297	96 209	109 083	134 144	179 705	220 250	147 288	145 698	178 891	142 912	133 319	182 306

Figure 3.3h: Tonota Water Production, Consumption & Losses, 1999-2011 (m^3)



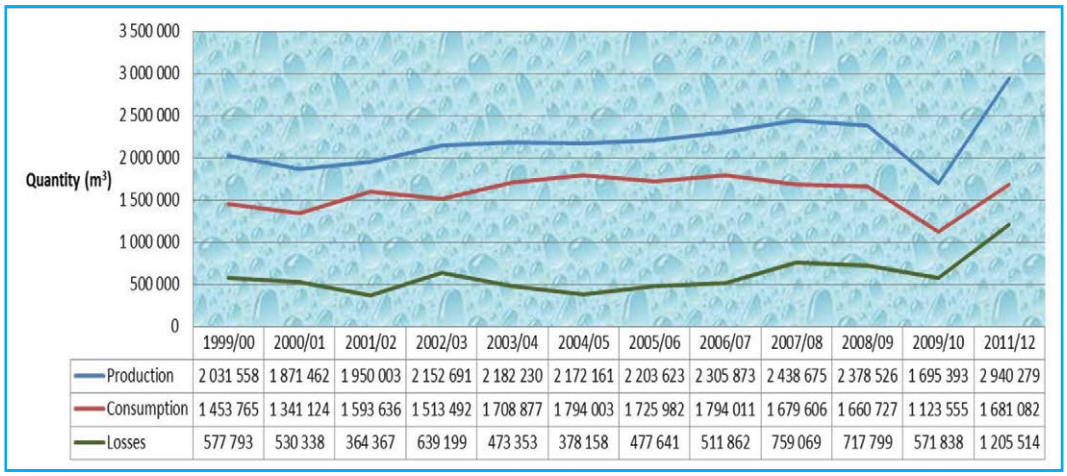
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2011/12
Production	701 715	779 191	889 464	971 525	867 792	1 001 592	929 608	942 606	995 564	1 039 654	794 090	1 373 733
Consumption	600 332	638 294	748 189	838 638	768 868	823 000	781 621	843 563	824 438	826 377	566 309	827 742
Losses	101 383	140 897	141 275	132 887	98 924	178 592	147 987	99 043	171 126	213 277	227 781	494 544

Figure 3.3i: Ghanzi Water Production, Consumption & Losses, 1999-2011 (m^3)



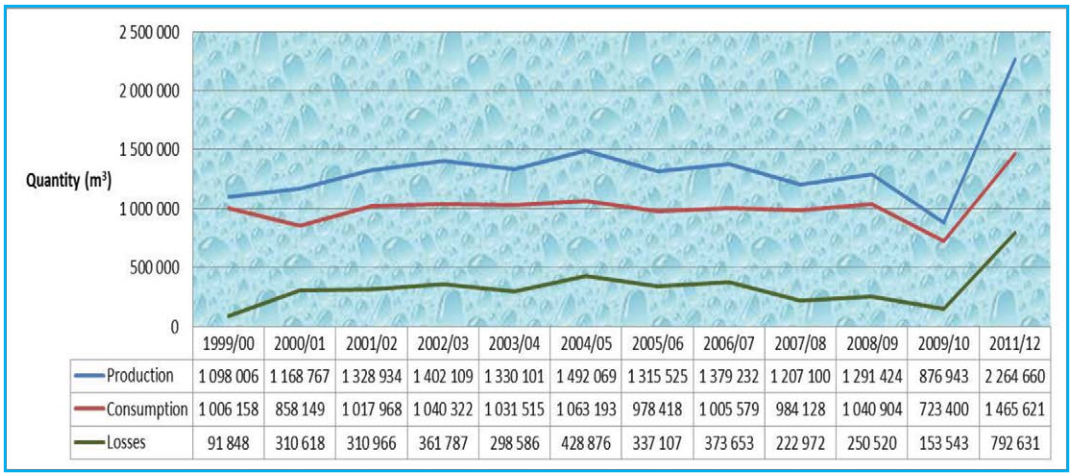
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Production	363 381	481 852	496 137	531 681	596 695	601 643	533 126	586 146	602 235	618 930	620 716	643 998	865 211
Consumption	289 298	396 035	458 043	408 604	432 246	521 676	508 950	526 813	526 148	523 220	520 926	508 065	606 025
Losses	74 083	85 817	38 094	123 083	164 449	79 967	24 176	59 333	76 086	95 710	99 790	68 256	259 563

Figure 3.3j: Mahalapye Water Production, Consumption & Losses, 1999-2011 (m^3)



	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2011/12
Production	2 031 558	1 871 462	1 950 003	2 152 691	2 182 230	2 172 161	2 203 623	2 305 873	2 438 675	2 378 526	1 695 393	2 940 279
Consumption	1 453 765	1 341 124	1 593 636	1 513 492	1 708 877	1 794 003	1 725 982	1 794 011	1 679 606	1 660 727	1 123 555	1 681 082
Losses	577 793	530 338	364 367	639 199	473 353	378 158	477 641	511 862	759 069	717 799	571 838	1 205 514

Figure 3.3k: Palapye Water Production, Consumption & Losses, 1999-2011 (m^3)

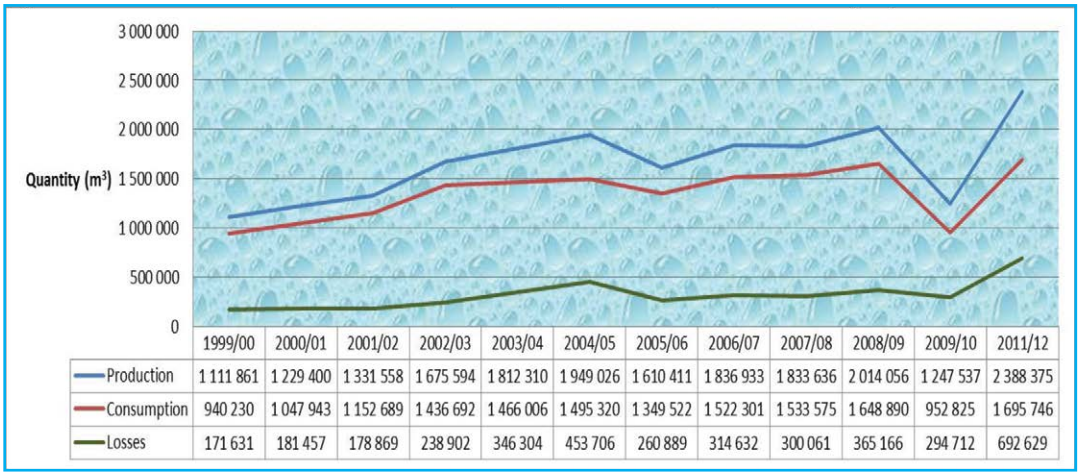


	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2011/12
Production	1 098 006	1 168 767	1 328 934	1 402 109	1 330 101	1 492 069	1 315 525	1 379 232	1 207 100	1 291 424	876 943	2 264 660
Consumption	1 006 158	858 149	1 017 968	1 040 322	1 031 515	1 063 193	978 418	1 005 579	984 128	1 040 904	723 400	1 465 621
Losses	91 848	310 618	310 966	361 787	298 586	428 876	337 107	373 653	222 972	250 520	153 543	792 631

Figure 3.3l: Kasane Water Production, Consumption & Losses, 1999-2011 (m^3)

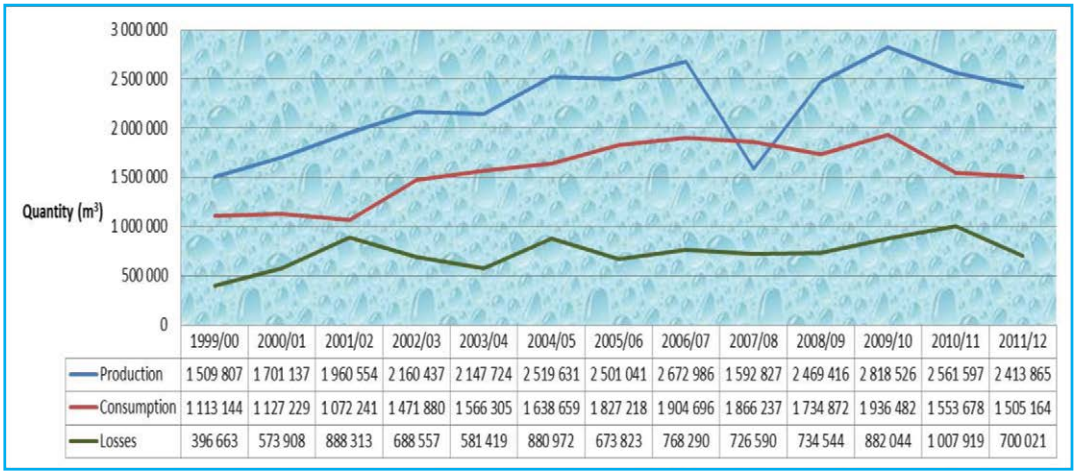
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2011/12
Production	604 343	614 750	662 069	619 794	639 725	752 275	862 220	916 840	1 052 257	1 182 760	798 935	1 497 683
Consumption	489 206	495 282	539 933	536 101	551 662	669 824	584 968	604 249	847 675	948 324	691 163	932 785
Losses	115 137	119 468	122 136	83 693	88 063	82 451	277 252	312 591	204 582	234 436	102 190	389 398

Figure 3.3m: Mochudi Water Production, Consumption & Losses, 1999-2011 (m^3)



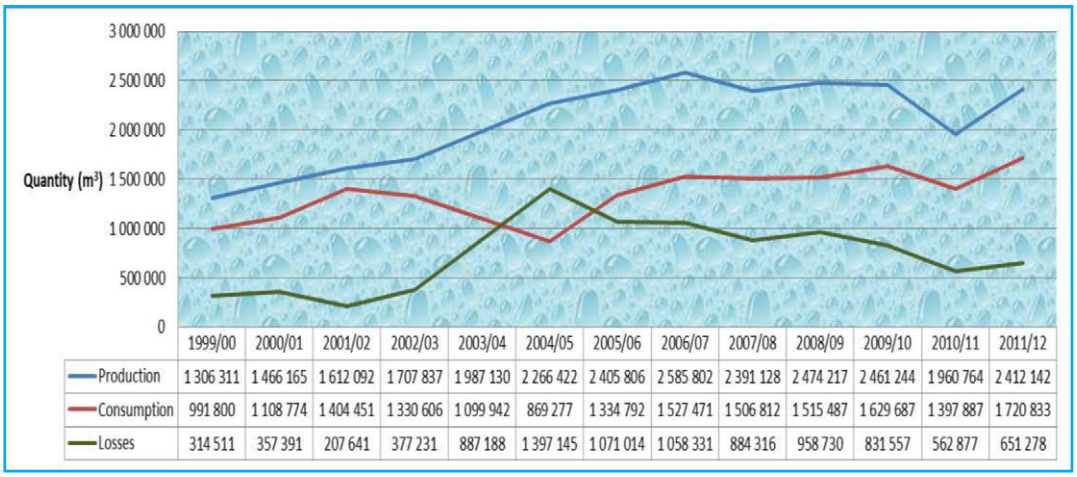
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2011/12
Production	1 111 861	1 229 400	1 331 558	1 675 594	1 812 310	1 949 026	1 610 411	1 836 933	1 833 636	2 014 056	1 247 537	2 388 375
Consumption	940 230	1 047 943	1 152 689	1 436 692	1 466 006	1 495 320	1 349 522	1 522 301	1 533 575	1 648 890	952 825	1 695 746
Losses	171 631	181 457	178 869	238 902	346 304	453 706	260 889	314 632	300 061	365 166	294 712	692 629

Figure 3.3n: Molepolole Water Production, Consumption & Losses, 1999-2011 (m³)



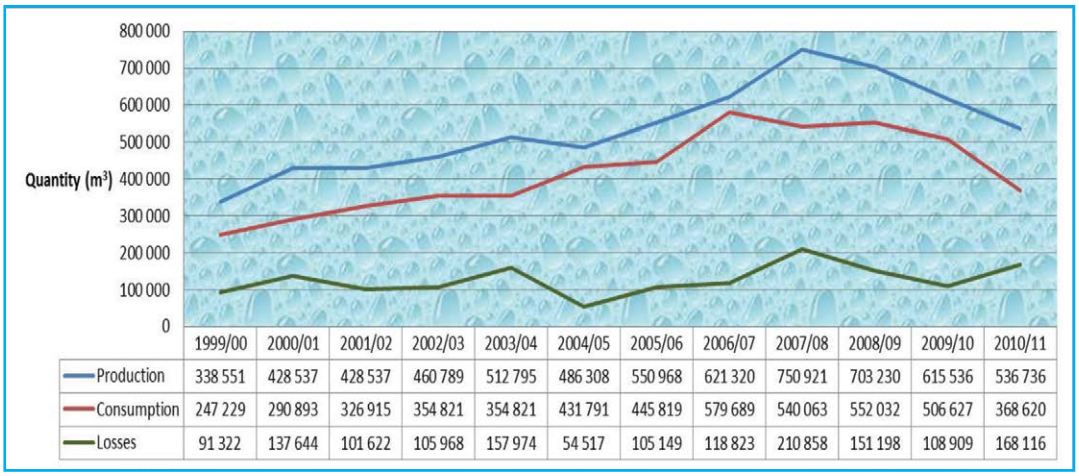
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Production	1 509 807	1 701 137	1 960 554	2 160 437	2 147 724	2 519 631	2 501 041	2 672 986	1 592 827	2 469 416	2 818 526	2 561 597	2 413 865
Consumption	1 113 144	1 127 229	1 072 241	1 471 880	1 566 305	1 638 659	1 827 218	1 904 696	1 866 237	1 734 872	1 936 482	1 553 678	1 505 164
Losses	396 663	573 908	888 313	688 557	581 419	880 972	673 823	768 290	726 590	734 544	882 044	1 007 919	700 021

Figure 3.3o: Serowe Water Production, Consumption & Losses, 1999-2011 (m³)



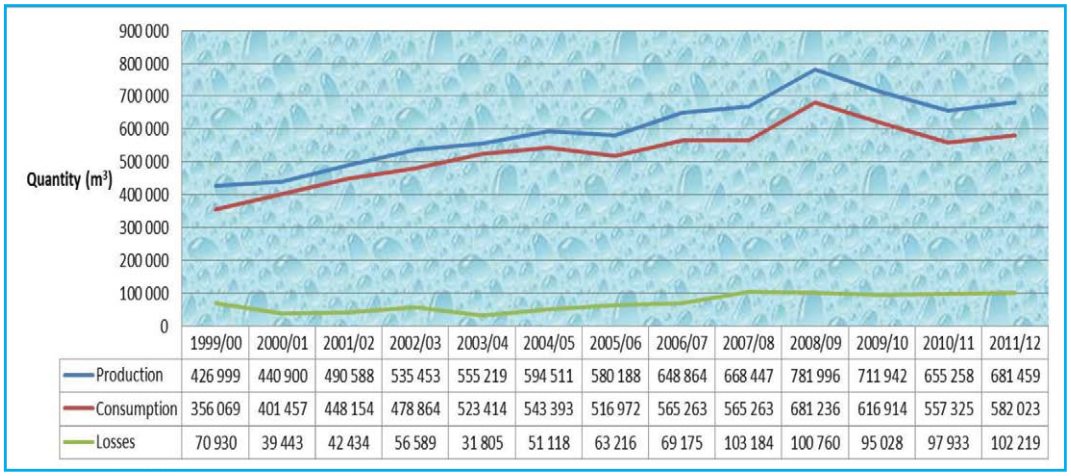
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Production	1 306 311	1 466 165	1 612 092	1 707 837	1 987 130	2 266 422	2 405 806	2 585 802	2 391 128	2 474 217	2 461 244	1 960 764	2 412 142
Consumption	991 800	1 108 774	1 404 451	1 330 606	1 099 942	869 277	1 334 792	1 527 471	1 506 812	1 515 487	1 629 687	1 397 887	1 720 833
Losses	314 511	357 391	207 641	377 231	887 188	1 397 145	1 071 014	1 058 331	884 316	958 730	831 557	562 877	651 278

Figure 3.3p: Thamaga Water Production, Consumption & Losses, 1999-2011 (m³)



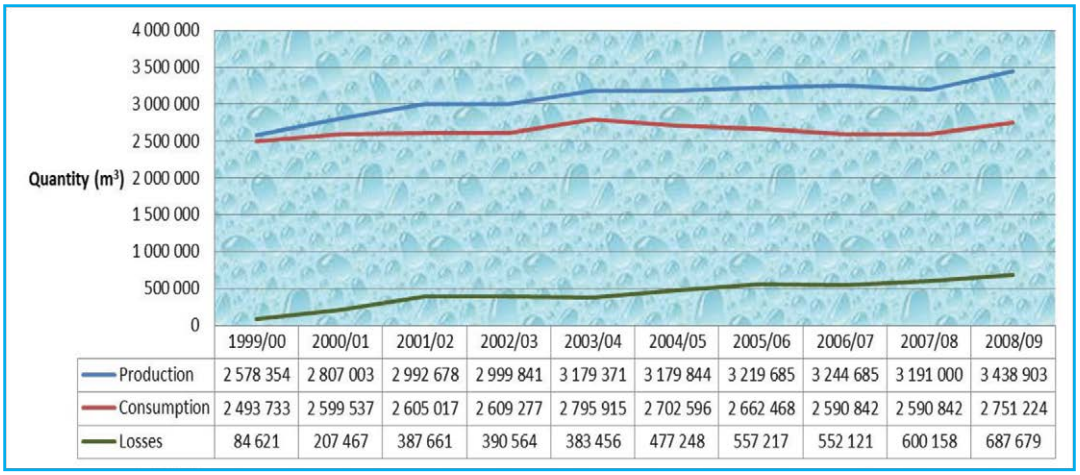
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Production	338 551	428 537	428 537	460 789	512 795	486 308	550 968	621 320	750 921	703 230	615 536	536 736
Consumption	247 229	290 893	326 915	354 821	354 821	431 791	445 819	579 689	540 063	552 032	506 627	368 620
Losses	91 322	137 644	101 622	105 968	157 974	54 517	105 149	118 823	210 858	151 198	108 909	168 116

Figure 3.3q: Letlhakane Water Production, Consumption & Losses, 1999-2011 (m^3)



	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Production	426 999	440 900	490 588	535 453	555 219	594 511	580 188	648 864	668 447	781 996	711 942	655 258	681 459
Consumption	356 069	401 457	448 154	478 864	523 414	543 393	516 972	565 263	565 263	681 236	616 914	557 325	582 023
Losses	70 930	39 443	42 434	56 589	31 805	51 118	63 216	69 175	103 184	100 760	95 028	97 933	102 219

Figure 3.3r: Mogoditshane Water Production, Consumption & Losses, 1999-2011 (m^3)



	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Production	2 578 354	2 807 003	2 992 678	2 999 841	3 179 371	3 179 844	3 219 685	3 244 685	3 191 000	3 438 903
Consumption	2 493 733	2 599 537	2 605 017	2 609 277	2 795 915	2 702 596	2 662 468	2 590 842	2 590 842	2 751 224
Losses	84 621	207 467	387 661	390 564	383 456	477 248	557 217	552 121	600 158	687 679

3.3.3 Water Consumption by Sector

It is important to quantify water use because it gives a baseline for the amount of water the people need, pressures put on water resources and impacts of water management decisions and activities on the people. Measuring water use patterns is crucial when reviewing the present and past practices and it influences best management practices, for example increased water tariffs where there is high unsustainable water use can reduce water misuse. In Botswana water consumption has been categorized as follows: commercial, industrial, domestic, and institutional.

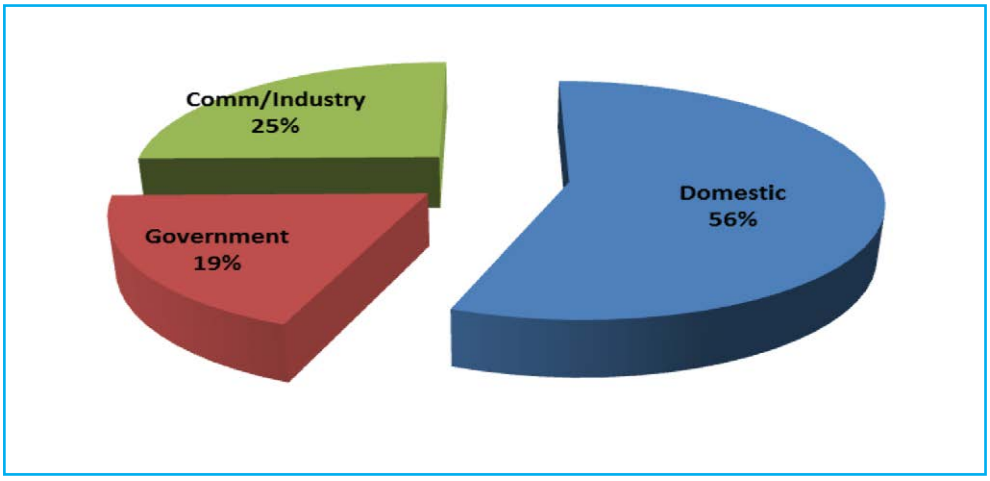
Table 3.3h shows the total potable water sales categorized by activities from 2006 to 2010. The total potable water sales were on the increase from 2006 to 2008 and suddenly dropped between 2008 and 2009, from 56.837 Million cubic meters to 35.493 Million cubic meters. During the review period, Gaborone had the highest w ater sales for all sectors followed by Francistown then Selibe Phikwe. Furthermore, Domestic registered the highest total water sales with total of 154.204 Million cubic meters, followed by Commercial/Industrial with 69.611 Million cubic meters and finally Government with 52.038 Million cubic meters. Figure 3.3s illustrates the percentage distribution of water sales by activity for the period 2006-2010. No data was available for Lobatse, Sowa, and Orapa.

Table 3.3h: Potable Water Sales in Thousand Cubic Meters by Activities, 2006/07-2010/11

	2006/07	2007/08	2008/2009	2009/10	2010/11
(a) Gaborone					
Domestic	15,934,006	17,769,913	19,124,916	20,493,273	21,565,458
Government	4,769,145	5,178,806	5,439,513	5,791,288	5,881,231
Comm/Industrial	7,232,617	8,166,780	8,948,061	9,122,835	9,219,836
Total	**27,935,768**	**31,115,499**	**33,512,490**	**35,407,396**	**36,666,525**
(b) Selebi Phikwe Division					
Domestic	3,930,550	4,208,318	4,268,527	4,342,741	4,558,822
Government	1,569,599	1,593,392	1,526,357	1,449,562	1,422,988
Comm/Industrial	2,949,170	3,009,305	3,055,832	3,158,683	3,090,019,
Total	**8,449,319**	**8,811,015**	**8,850,716**	**8,950,986**	**9,071,829**
(c)Francistown					
Domestic	4,760,375	5,184,505	5,712,179	6,158,022	6,513,527
Government	2,928,972	3,063,131	3,288,890	3,496,935	3,529,715
Comm/Industrial	2,494,126	2,541,502	2,597,186	2,751,930	2,622,714
Total	**10,183,473**	**10,789,138**	**11,598,255**	**12,406,887**	**12,665,956**
(d) Jwaneng					
Domestic	2,254,521	2,406,808	2,374,175	2,432,005,	2,643,555
Government	195,136	190,073	157,897	151,076	168,708
Comm/Industrial	324,788	334,828	325,769	352,326	403,238
Total	**2,774,445**	**2,931,709**	**2,857,841**	**2,935,407**	**3,215,501**
(e) North South Carrier					
Government			17,561	85,386	143,181
(f) Total Potable Water Supply	49,343,005	53,647,361	56,836,863	59,786,062	61,762,992

Note: North South Carrier started selling water in the year 2008/09
Source: Water Utilities Corporation

Figure 3.3s: Percentage distribution of water sales by activity, 2006-2010



Derived from Table 3.3h

3.3.4 Waste Water

WUC took over wastewater management services from the various Local Authorities under the Water Sector Reforms Programme in February 2011. The wastewater management takeover was reconciled with the potable water service delivery and these were taken over at the same time in a particular area. Partnerships were entered into with leaders in the industry regionally and internationally so that they could assist WUC build capacity. Operationally the Corporation encountered a lot of challenges stemming from the inadequate capacity of wastewater treatment plants and mechanical failures due to improper use of the sewage network. During the 2011/12 review period, several incidents of illegal dumping of prohibited substances down the network were reported. Furthermore, scores of vehicle tyres, rocks and other hazardous materials were disposed-off down the sewage network and caused major blockages and damage to the network (WUC, 2012).

The Corporation found an alternative source of water to supplement the dwindling available water sources in Botswana; that is to recycle wastewater. The decision was arrived at in 2005 and since then the project has not been implemented. During the 2011/12 review period, there was some significant progress made towards implementing the project and the initial project to build a recycling plant was at tender evaluation stage.

3.3.5 Water Tariffs

The Government of Botswana gets some revenue from water production and supply. WUC which is a parastatal, controls water tariffs both in urban and rural places. The Corporation proposes water tariffs which are reviewed and approved by the Minister of Minerals, Energy and Water Resources. In Botswana water tariffs are divided into two: Water tariffs for Domestic and Business Consumers and Water Tariffs for Government, City, Town and District Councils. Each category has 5 tariff bands.

Water tariffs for domestic and business consumers in all cities/towns remained stagnant from the year 2008/09 to 2009/10 except in Sowa Town where tariff bands 3 to 5 were on the decrease. For example, under tariff band 3 which fall within the range 16-25 cubic metres per month of consumption decreased from 540 Thebe per cubic metre in 2008/2009 to 330 Thebe per cubic metre in 2009/10. From 2009/10 to 2010/11 there was a significant increase in almost all the five tariff bands. Under Band 4 where consumption per month is above 25 cubic meters, Gaborone had the highest tariff with 1,130 Thebe per cubic metre both in 2008/09 and 2009/10, and increased to 1,270 Thebe per cubic meter in 2010/11. The tariffs in cities are higher than those in towns because of high standard infrastructures and increasing population size. CSO (2009) further asserts that, Gaborone is partially supplied by Letsibogo Dam which is situated about 400 Km from Gaborone and this might contribute to the high tariffs in the city. Water tariffs for Government, City, Town and District Councils also experienced almost the same changes as for domestic and business consumers (Tables 3.3i - 3.3j& Figures 3.3t – 3.3u).

Table 3.3i: Water Tariffs for Domestic and Business Consumers, 2008/09 – 2010/11

Tariff Band	Consumption per month (cubic metres)	2008/09*					2009/10*					2010/11*				
		Gab/Lob	Jwaneng	F/Town	S/Phikwe	Sowa	Gab/Lob	Jwaneng	F/Town	S/Phikwe	Sowa	Gab/Lob	Jwaneng	F/Town	S/Phikwe	Sowa
1	0-10	210	165	240	165	165	210	165	240	165	165	235	185	270	185	185
2	Nov-15	640	330	575	265	375	640	330	575	265	375	720	370	645	300	420
3	16-25	815	430	840	330	540	815	430	840	540	330	915	485	945	370	605
4	Above 25	1,130	495	940	430	600	1,130	495	940	600	430	1,270	555	1,055	485	675
5	Raw water (untreated)	330	-	200	235	-	330	-	200	-	235	370	-	225	265	-
	Raw water Botash' BCL	-	-	-	90	185	-	-		190	90	-	-	-	105	215

***Tariff given in Thebe per cubic metre**
Dash: No Data
Source: Water Utilities Corporation

Figure 3.3t: Water Tariffs for Domestic and Business Consumers, 2008/09 – 2010/11

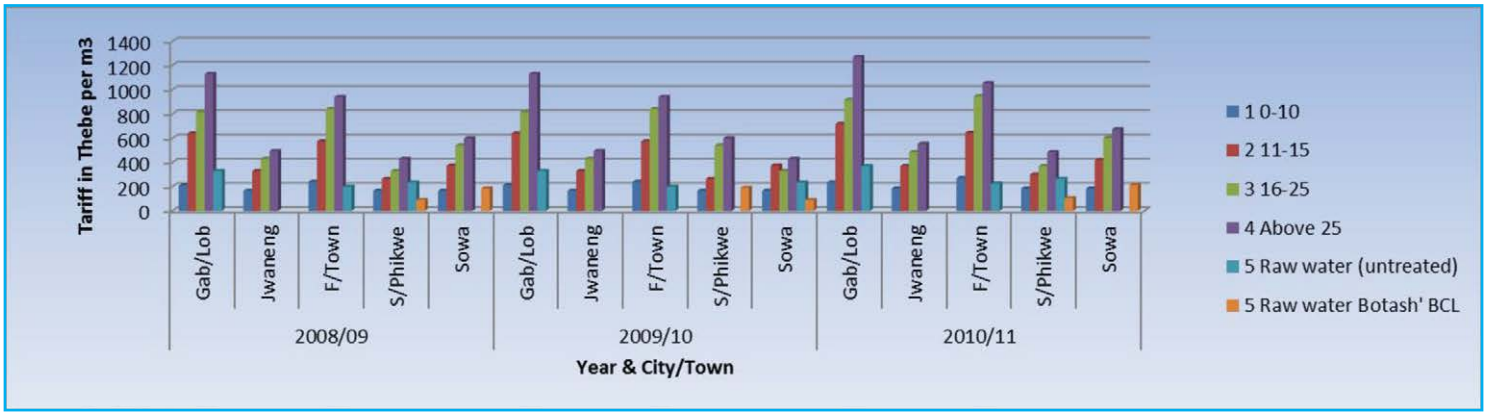
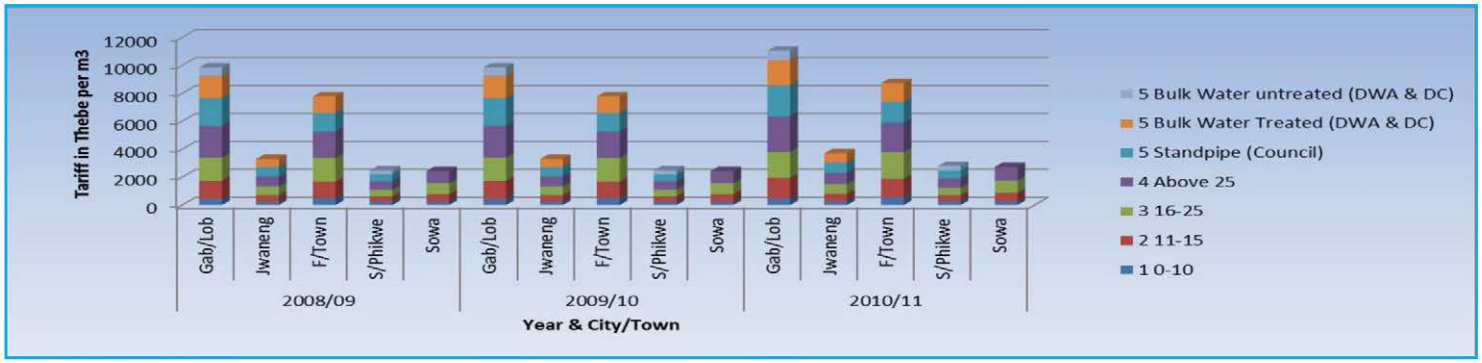


Table 3.3j: Water Tariffs for Government, City, Town and District Councils, 2008/09 – 2010/11

Tariff Band	Consumption per month (cubic metres)	2008/09*					2009/10*					2010/11*				
		Gab/Lob	Jwaneng	F/Town	S/Phikwe	Sowa	Gab/Lob	Jwaneng	F/Town	S/Phikwe	Sowa	Gab/Lob	Jwaneng	F/Town	S/Phik-we	Sowa
1	0-10	440	240	500	240	240	440	240	500	240	240	495	270	560	270	270
2	Nov-15	1,295	475	1,175	385	540	1,295	475	1,175	385	540	1,450	535	1,320	435	605
3	16-25	1,660	620	1,695	475	785	1,660	620	1,695	475	785	1,860	695	1,900	535	880
4	Above 25	2,270	725	1,890	595	870	2,270	725	1,890	595	870	2,545	815	2,120	670	975
5	Standpipe (Council)	1,985	650	1,330	505	-	1,985	650	1,330	505	-	2,225	730	1,490	570	-
	Bulk Water Treated (DWA & DC)	1,610	585	1,190	-	-	1,610	585	1,190	-	-	1,805	655	1,335	-	-
	Bulk Water untreated (DWA & DC)	590	-	-	280	-	590	-	-	280	-	665	-	-	315	-

*** Tariff given in Thebe per cubic metre**
Source: Water Utilities Corporation

Figure 3.3u: Water Tariffs for Government, City, Town and District Councils, 2008/09 – 2010/11



3.3.6 Water Demand

Botswana Government introduced a completely new water demand model, and it was developed for the National Water Master Plan Review Vol. 5 (NWMPR). The model uses the population forecasts from the 2001 Population and Housing Census. The population forecasts for 57 villages and towns formed the basis of the demand forecasts. Moreover, the domestic demand, which include house connection, yard/standpipe was then calculated. According to the NWMPR;

> *"…new demand model provides a further enhancement with the capability of examining the impact of changes in tariffs for each category, regional development and commercial and industrial expansion… tariffs and the demand were adjusted to reflect actual demand for 2004 for each of the categories. Domestic demand figures were combined with estimates of demands in institutions, industry and commerce; and mining…the aggregate of all the individual demand sectors, together with the losses, provides an annual aggregated village or town water demand model capable of being manipulated according to the options or scenarios proposed for the next 30 years…"*

Tables 3.3k to 3.3l were extracted from the NWMPR and were developed through the model which is captured briefly in the introduction of this section. The tables are accompanied by their respective figures (Figures 3.3v and 3.3w). Included in the tables are, water demand projections for cities/towns, districts and sub-districts. Water demand was on the increase in all cities/towns and districts.

In the urban centres, Gaborone had the highest water demand from the year 2006 to 2011, followed by Francistown then Selibe Phikwe. This result explain why Gaborone' water consumption and tariffs are high compared to other urban centres (refer to sections 1.31 & 1.3.4). With regards to sub-districts, high water demand was projected for Kweneng East, followed by Serowe/Palapye (Table 3.3l & Figure 3.3w).

Table3.3k: Water Demand Projections for Cities and Towns based on 2001 Population and Housing Census Statistics, 2006-2011 (m^3)

URBAN CENTRES	District	Sub-District	2006	2007	2008	2009	2010	2011
Gaborone	South East	South East	25,307,796	26,317,369	2,736,660	28,340,520	29,363,172	30,276,621
Francistown	North East	North East	8,870,296	9,166,805	9,471,855	9,785,669	10,108,530	10,422,082
Lobatse	South East	South East	3,438,761	3,544,440	3,653,165	3,765,018	3,880,114	4,062,561
Selibe-Phikwe	Central	Central Bobonong	6,882,240	7,129,193	7,378,425	7,630,876	7,866,990	8,125,180
Orapa	Central	Central Boteti	793,272	813,738	834,783	855,497	857,513	858,773
Jwaneng	Southern	Southern	263,181	271,629	280,330	289,290	298,519	299,760
Sowa	Central	Sowa	263,181	271,629	280,330	289,290	298,519	299,760
Total			**45 818 727**	**47 514 803**	**24,635,548**	**50,956,160**	**52,673,357**	**54,344,737**

Source: NWMPR Vol. 5; Water Utilities Corporation

Figure 3.3v: Water Demand Projections for Cities and Towns based on 2001 Population and Housing Census Statistics, 2006-2011 (m^3)

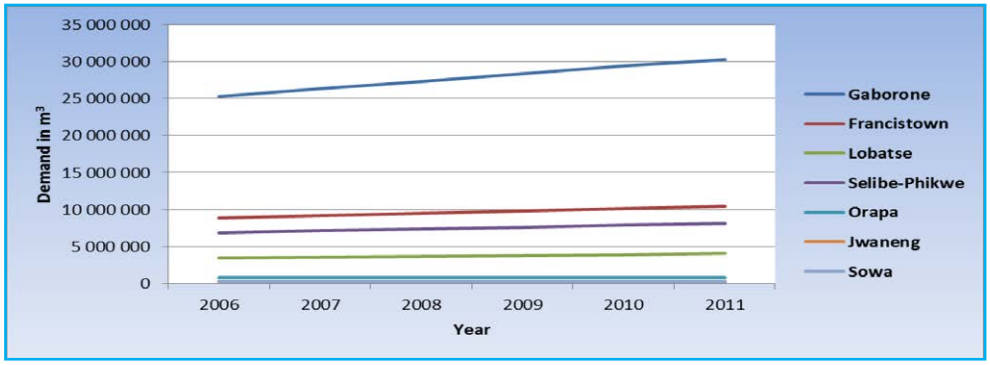
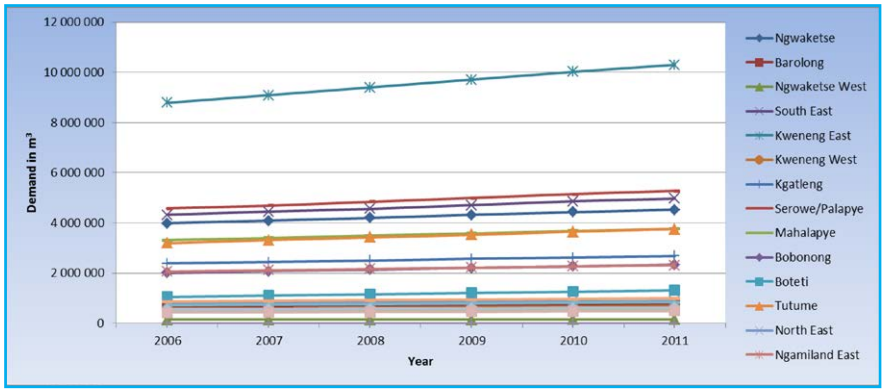


Table 3.3l: Water Demand Projections (m_3)based on 2001 Population and Housing Census Statistics by District & Sub-District, 2006-2011

District	Sub-District	2006	2007	2008	2009	2010	2011
Southern	Ngwaketse	3,980,041	4,087,616	4,198,096	4,311,161	4,427,213	4,524,472
	Barolong	675,776	692,184	709,037	726,299	744,029	758,963
	Ngwaketse West	136,824	140,730	144,738	148,818	152,991	156,362
South East	South East	4,322,606	4,442,306	4,565,672	4,708,226	4,855,009	4,979,467
Kweneng	Kweneng East	8,782,839	9,082,283	9,389,664	9,702,358	10,022,274	10,297,463
	Kweneng West	578,932	598,930	619,540	640,756	662,600	681,543
Kgatleng	Kgatleng	2,382,151	2,439,698	2,498,901	2,559,697	2,622,167	2,678,292
Central	Serowe/Palapye	4,572,842	4,694,094	4,840,150	4,989,360	5,141,957	5,271,568
	Mahalapye	3,310,416	3,399,114	3,490,339	3,584,026	3,680,324	3,767,191
	Bobonong	2,008,053	2,071,854	2,137,341	2,203,658	2,271,376	2,330,092
	Boteti	1,053,799	1,103,169	1,154,740	1,208,285	1,263,803	1,314,400
	Tutume	3,198,638	3,309,999	3,423,047	3,537,488	3,653,660	3,750,361
North East	North East	807,519	824,006	841,135	858,889	877,344	892,785
Ngamiland	Ngamiland East	2,062,897	2,111,803	2,161,914	2,213,231	2,265,825	2,308,792
	Ngamiland West	493,432	507,441	521,932	536,911	552,455	564,564
	Ngamiland Delta	5,463	5,462	5,462	5,461	5,461	5,462
Chobe	Chobe	716,430	741,973	768,004	794,514	821,562	844,748
Ghanzi	Ghanzi	860,761	885,700	911,413	937,611	964,415	988,459
Kgalagadi	Kgalagadi South	558,686	571,173	584,065	597,372	611,111	623,154
	Kgalagadi North	432,470	443,141	454,071	465,243	476,686	486,555
SUB TOTAL (Districts)		**40 940 575**	**42,152,676**	**43,419,261**	**44,729,364**	**46,072,262**	**47,224,693**
Total Botswana Demand		**86 759 302**	**89,667,479**	**68,054,809**	**95,685,524**	**98,745,619**	**101,569,430**

Source: National Water Master Plan Review Vol. 5; Water Utilities Corporation

Figure 3.3w: Water Demand Projections(m3) based on 2001 Population and Housing Census Statistics by Sub-District, 2006-2011



3.4 Water in Mining Sector

Presented in this section are water sources, consumption, abstraction, quality and waste water treatment for the mining sector in Botswana. Because of data gaps not all the thematic areas listed here will be captured during the discussion.

3.4.1 Jwaneng Mines

Table 3.4a and Figure 3.4ashow water consumption in Jwaneng mines. Table 3.4a reveals that quantity of potable water increased from 1.944 Million cubic meters in 2009 to 2.09 Million cubic meters in 2011. The mine plants consumed more water compared to that used in the Township, Game Park and mine domestic (Table 3.4b &Figure 3.4b). The total water pumped from the well fields is channelled through mine reservoir for consumption by users. Statistics on water abstraction from the well fields were not available. The Mine Treatment Plant used more water from the reservoir during 2009-2011 period, seconded by the Township (Table 3.4c). Both Jwaneng mine and WUC supply the Township with water. Data on water quality could not be accessed and this hampers the quality of reporting.

Table 3.4a: Water Consumption 2009-2011 (cubic metres)

Months	2009		2010		2011	
	Potable	Raw Water	Potable	Raw Water	Potable	Raw Water
January	189,801	291,857	152,811	518,230	167,474	410,834
February	185,224	26,855	167,569	673,966	179,244	435,690
March	144,191	11,173	158,559	477,617	177,011	376,574
April	159,949	27,354	158,404	418,088	191,662	393,395
May	160,227	306,416	157,172	444,601	176,126	389,848
June	158,131	599,852	149,952	407,377	176,605	405,632
July	145,226	579,201	162,607	459,681	173,363	377,049
August	147,312	475,290	157,533	529,148	150,390	564,092
September	167,808	669,775	176,628	680,319	171,143	563,420
October	154,836	734,158	181,927	372,484	172,140	223,601
November	177,693	504,077	198,048	544,582	197,076	450,909
December	153,892	603,074	177,636	436,951	162,217	413,800
Total	**1,944,290**	**4,829,082**	**1,998,846**	**5,963,044**	**2,094,451**	**4,995,845**

Source: Jwaneng Mine

Figure 3.4a: Water Quantity in cubic metres 2009-2011

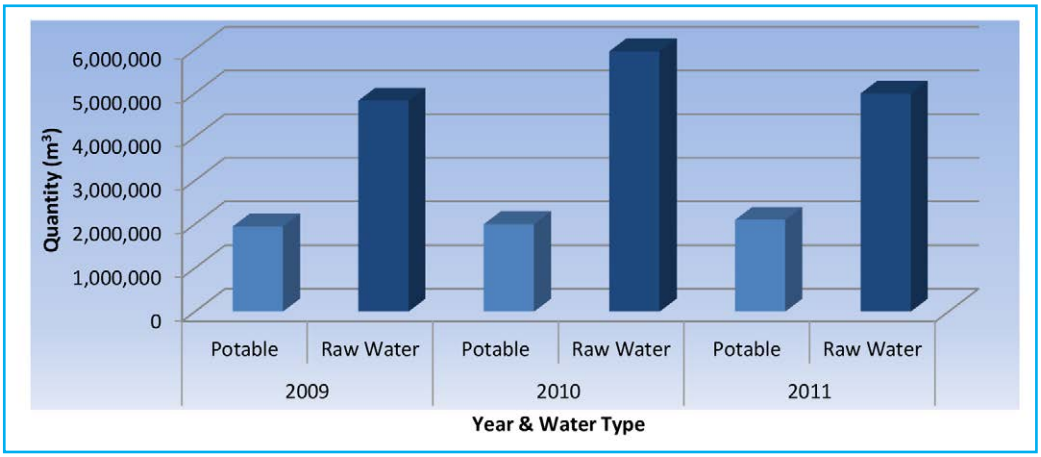


Table 3.4b: Water Consumption by Sector/User(cubic metres): 2009-2011

Sector/User	2009	2010	2011
Township	1,859,794	1,876,925	1,957,062
Game Park	32,721	58,885	55,723
Plants	4,719,566	5,842,180	4,891,507
Mine domestic	84,496	121,921	137,389

Source: Jwaneng Mine

Figure 3.4b: Water Consumption by sector/user(cubic metres): 2009-2011

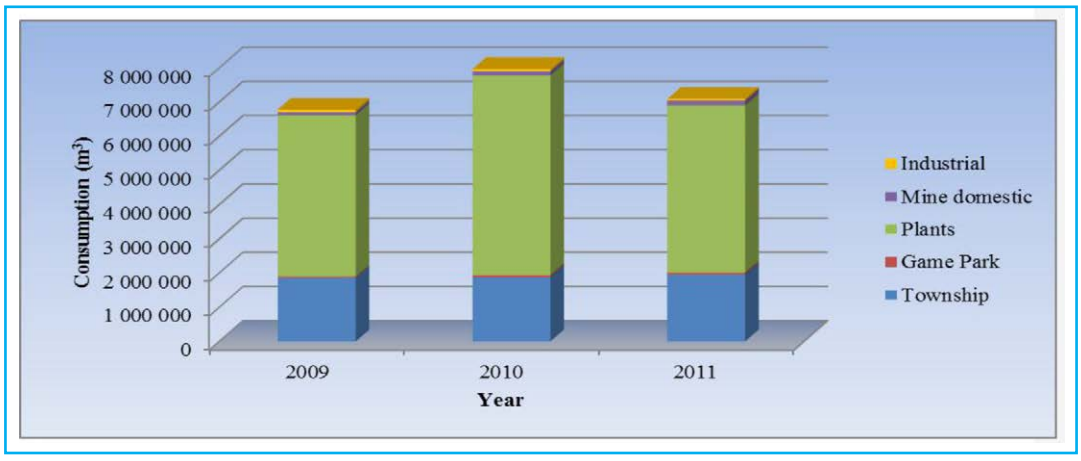


Table 3.4c: Water Consumption (cubic meters) from the Mines' reservoir by activity 2009-2011

Activity	2009	2010	2011
MTP	3,435,962	4,906,021	3,898,864
BSP and Aquarium	191,987	341,007	206,255
Recrush -	1,091,617	595,152	786,388
Township (W.U.C)	1,859,794	1,876,925	1,957,062
Industrial -	76,795	61,979	48,615
Domestic -	84,496	121,921	137,389
Miscellaneous -	32,721	58,885	55,723
Total Water Consumed	**6,773,372**	**7,961,890**	**7,090,296**

Source: Jwaneng Mines

3.4.2 BCL Mine

WUC supplies both potable and raw water to the BCL mine. Raw water is supplied from Shashe dam and is used mainly for smelter furnaces cooling, gland cooling in plant equipment and occasionally as top up to granulation at the smelter; whereas potable water is supplied from Selibe Phikwe water treatment plant and used for human consumption and also on various operations like demineralization for the boiler. Table 3.4d shows the supply of water to Selibe Phikwe BCL Mine from 2009 to 2011. It is evident from the table that the supply of potable water which is regarded as safe drinking water increased from a total annual figure of 997,651 cubic meters in 2009 to 1,256,720 cubic meters in 2010 and slightly dropped to 1,193,441 cubic meters in 2011.

Waste water production was on the increase during the 2009-2011period. There are two types of waste water in the BCL mine even though the data is not disaggregated as per those types, they include; fissure water and tailings water. Fissure water is pumped from the mine and is estimated at 10-12 Ml/d. About 50 percent is re-used either for cooling drilling machines or in the milling process at the Concentrator. Other portions of fissure water are used for smelter granulation and the remaining excess water is treated at the Nickel Removal Plant for irrigation. On the other hand tailings water is from the concentrator process and not suitable for release into the environment as a result they are contained in the mine premises. The water is recycled and used again in the concentrator process.

Table 3.4d: BCL Water Consumption and wastewater production (cubic meters)

Month	2009			2010			2011		
	Raw water	Waste Water	Potable water	Raw water	Waste Water	Potable water	Raw water	Waste Water	Potable water
January	90,024	392,088	69,606	477,133	191,208	104,225	174,840	279,000	87,864
February	333,312	241,920	110,158	367,270	223,776	103,634	102,144	87,360	119,280
March	329,592	286,440	77,070	390,620	191,952	124,737	286,440	107,136	117,400
April	234,000	102,960	92,103	286,420	259,920	105,790	373,680	244,080	116,891
May	295,368	136,152	61,266	336,580	117,552	96,699	335,544	235,104	94,732
June	280,080	211,680	49,596	319,720	124,560	99,029	304,560	246,960	84,517
July	305,784	211,680	98,739	366,920	218,736	87,629	162,192	238,824	107,385
August	297,600	200,136	49,182	264,250	164,424	59,093	191,208	161,448	53,730
September	334,080	157,680	85,499	304,560	199,440	110,422	269,280	180,720	41,771
October	320,664	142,104	86,270	271,560	248,496	148,437	357,120	317,688	138,106
November	231,840	200,880	97,347	269,280	277,200	74,271	237,600	293,040	115,491
December	345,960	166,656	120,815	280,488	251,472	142,754	124,248	235,848	116,274
Total	**3,398,304**	**2,450,376**	**997,651**	**3,934,801**	**2,468,736**	**1,256,720**	**2,918,856**	**2,627,208**	**1,193,441**

Source: BCL

3.4.3 BOTASH Mine

Botswana Ash (BOTASH) mine supplies three types of ground water and these are classified as Brine, Brackish and Potable water. Brine water refers to water containing large amounts of salt, whereas Brackish water is water with a level of salinity between freshwater and seawater. Water that is safe for consumption is referred to as potable water.

3.4.3.1 Brine supply

Resource estimates cover a wide range of values owing to the uncertainty in respect of the model input parameters in particular recharge and storage values. The adopted base case scenario was low recharge and low storage which results in a conservative resource estimate. With a brine abstraction of 2500 m3/hr the predicted mine life is between 20 - 60 years. The model further predicts that dilution of the brine will occur as a result of downward migration of fresh water through the upper confining layer (Water Management Consultants, 1998 - 2008; and Groundwater Resources; National Water Master Plan Review Final Report-volume 4, 2006).

3.4.3.2 Brackish water supply - Dukwi Well field

Based on Leif Carlsson's Resource modeling audit report [Department of Water Affairs, 2005], BOTASH production water boreholes [Z8690 and Z6504/Z8691] are sustainable up to 2020 [12 years] and possibly beyond at a pumping rate of 1,700 cubic meters per day. The average pumping rate over the past 13 years is 1,622 cubic meters per day.

3.4.3.3 Potable water supply - Dukwi Well field

Sustainable abstraction for the Dukwi Well field is estimated to be 3,900 cubic meters per day. Currently it is estimated abstraction could be around 6,600 cubic meters per day, consisting of 1,200 cubic meters per day, 1,700 cubic meters per day and 3,700 cubic meters per day abstracted from Chidumela, Botash and the Dukwi boreholes respectively. Current abstraction is above sustainable limits, however the model shows that predicted water levels will not reach top of screen (water intake) by 2020, put another way, pumping at these high rates can be supported up to at least 2020.

Statistics on the supply of brine, brackish and potable water is presented in Tables 3.4e – 3.4g. Generally abstraction of brine water was on the increase except for a slight decrease recorded in the year 2000 and 2006 as well as between the years 2008 and 2010 (Figure3.4c). Brackish water abstraction on the other hand fluctuated between the years under consideration (Table 3.4f). The supply of potable water was generally on the decrease except for a slight increase which was recorded between 2004 and 2005, with potable water supply of 287,942cubic meters and 334,951 cubic meters respectively (Table 3.4g).

Table 3.4e: Yearly Well Brine Abstraction/Production (Million cubic meters), 1998-2011

Unit (Mm^3)	Year										
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total	**17.3**	**17.03**	**16.2**	**17.64**	**18.82**	**19.21**	**19.22**	**19.51**	**18.79**	**21.01**	**21.28**

Source: Botash Mine

Figure 3.4c: Yearly Well Brine Abstraction/Production in Million (cubic meters), 1998-2011

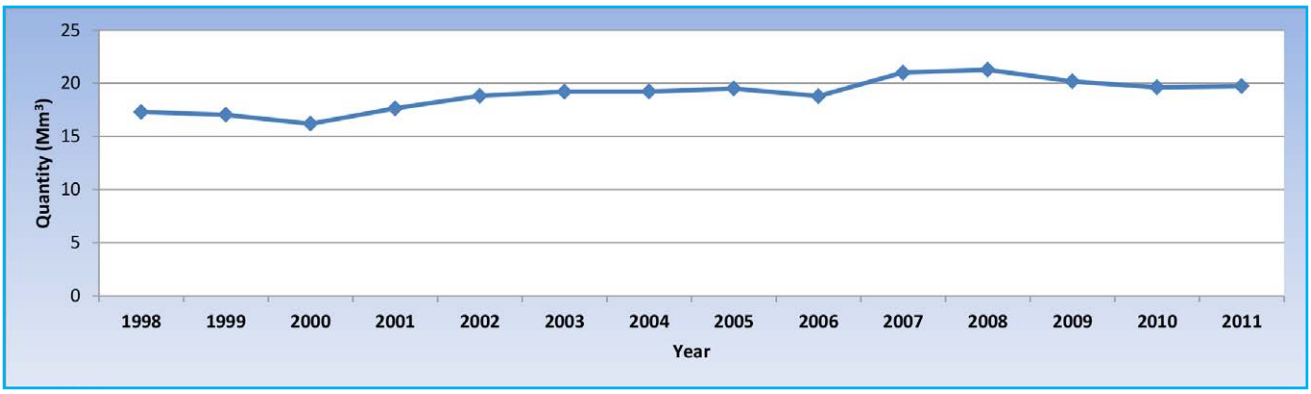


Table 3.4f: Monthly Brackish Water Abstraction/Production in cubic meters, 1998-2011

	Year													
Month	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Jan	52,402	50,520	35,990	55,140	51,432	53,568	45,070	51,623	52,107	53,652	51,336	50,892	49,320	47,237
Feb	38,790	51,260	49,728	45,920	46,670	36,288	48,003	49,233	47,152	46,185	48,720	46,375	44,791	42,040
Mar	57,460	32,980	54,312	46,404	53,224	51,336	52,698	48,320	50,948	35,809	52,824	48,080	50,907	44,800
Apr	51,430	37,920	53,280	40,201	51,120	50,400	52,139	32,176	47,142	49,680	48,960	50,830	40,149	33,985
May	45,670	50,830	52,824	45,345	54,732	53,568	53,265	48,591	44,379	52,080	50,592	31,151	50,973	48,585
Jun	45,980	51,150	55,380	50,080	50,257	49,680	50,686	51,050	50,340	48,240	48,960	47,252	48,563	44,818
Jul	45,460	57,200	44,140	52,790	50,586	44,897	51,389	53,367	52,693	50,592	52,080	51,142	48,476	44,573
Aug	40,400	53,400	43,180	52,903	49,104	43,371	52,583	51,766	52,491	50,592	51,779	50,843	48,801	48,720
Sep	52,490	59,400	57,250	50,845	51,120	46,913	43,285	52,525	53,045	50,400	47,567	49,504	47,986	46,535
Oct	48,470	45,330	56,544	51,222	50,416	50,388	47,799	53,147	52,596	47,616	49,101	49,704	49,694	49,895
Nov	46,230	58,160	53,350	52,227	52,330	45,652	46,992	51,233	52,559	50,400	48,334	49,480	47,160	47,480
Dec	46,400	57,870	53,750	48,751	53,568	42,942	50,750	52,769	51,486	52,080	49,946	50,910	48,743	47,230
Total	**571,182**	**606,020**	**609,728**	**591,828**	**614,559**	**569,003**	**594,659**	**595,800**	**606,938**	**587,326**	**600,199**	**576,163**	**575,563**	**545,898**

Source: Botash Mine

Figure 3.4d: Yearly Brackish Water Abstraction/Production in cubic meters, 1998-2011

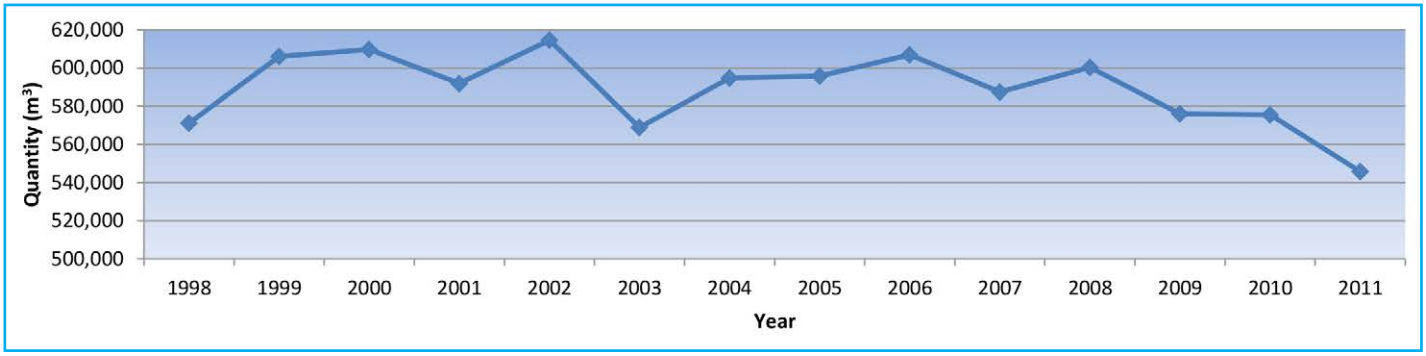
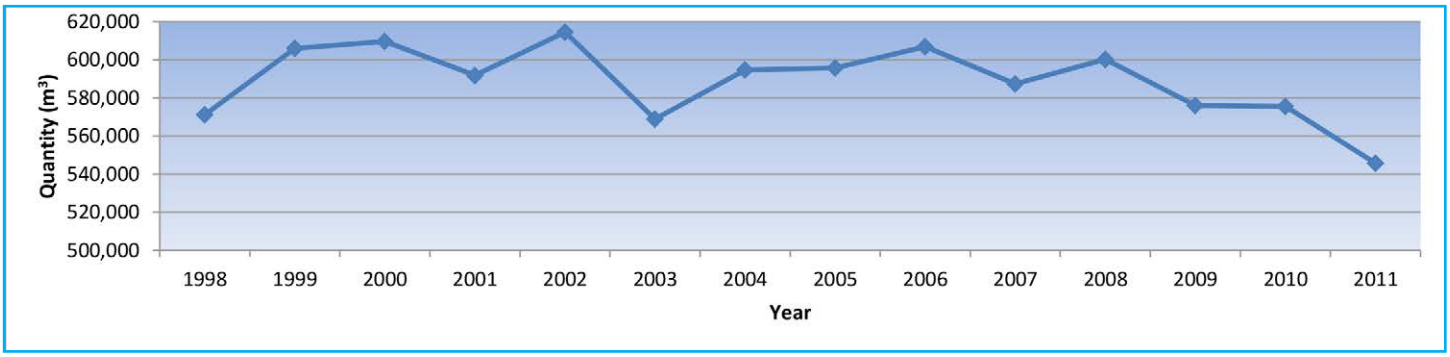


Table 3.4g: Monthly Potable Water Supplyin cubic meters, 2000-2011

Month	Year										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Jan	32,442	31,096	30,778	21,190	25,062	28,272	28,272	28,272	26,793	18,432	27,355
Feb	24,923	29,829	22,862	20,556	22,809	20,160	21,504	18,096	24,975	22,382	23,038
Mar	33,017	32,707	28,753	20,150	29,308	22,320	14,136	23,064	20,476	17,432	21,483
Apr	26,376	29,694	26,595	21,233	22,969	21,600	23,040	17,112	23,781	23,055	18,635
May	28,703	32,817	25,914	21,855	33,821	21,576	20,088	20,832	15,713	19,199	24,899
Jun	24,762	29,245	28,956	23,196	29,498	21,600	19,440	20,160	21,014	19,319	19,587
Jul	30,129	29,462	22,828	25,158	30,079	27,528	18,600	18,600	24,185	18,522	23,815
Aug	25,450	26,464	23,499	31,621	28,932	22,320	19,344	19,231	24,918	20,029	22,780
Sep	28,245	24,765	26,743	25,005	28,170	23,040	18,720	22,648	24,868	17,642	23,545
Oct	25,977	29,657	27,791	24,984	29,163	22,320	17,856	22,624	29,486	21,882	25,075
Nov	26,936	28,955	26,278	25,481	29,449	18,720	23,760	22,568	26,731	24,198	25,430
Dec	29,669	29,186	19,113	27,513	25,691	26,040	19,344	23,553	30,197	23,494	27,276
Total	**336,629**	**353,877**	**310,110**	**287,942**	**334,951**	**275,496**	**244,104**	**256,760**	**293,137**	**245,586**	**282,918**

Source: Botash Mine

Figure 3.4e: Yearly Potable Water Supplyin cubic meters, 2000-2011



3.4.3.4 Compliance to water quality standards

Brine is the raw material fed to the Botash mine plant to extract salt and soda ash. It is not used as drinking water and does not meet drinking water specification.

Brackish water is used for industrial purposes and not as drinking water. The quality of the water falls within Class III as defined by the BOS 32:2000 Drinking Water Quality specification (Botswana Bureau of Standards).

Potable water is supplied by Water Utilities Corporation.

Table 3.4h reveals that almost all properties of both brackish and potable water falls within the WUC maximum allowable limit, except the 'Total dissolved solids, ppm,' which recorded 2,100 mg/l and 1,350 mg/l for brackish and potable water respectively. The WUC maximum allowable limit is 1,000 mg/l and the recommended maximum limit is 500 mg/l.

Table 3.4h: Typical Analysis of Brackish and Potable Water, 2011

Properties	Brackish water	Potable water	WUC Maximum Allowable
pH	7.6	7.6	5.5-9.0
Total hardness, as $CaCO_3$, ppm	440	400	1,000
Ca hardness, ppm	340	310	1,000
Conductivity (µS/cm)	3,080	2,060	
Total dissolved solids, ppm	2,100	1,350	1,000
Suspended solids, ppm	60		25
P. alkalinity as $CaCO_3$			
M. alkalinity, as $CaCO_3$, ppm	603	472	
Sodium, as Na ppm	508	285	200
Chloride, as Cl- ppm	563	349	600
Nitrate, as NO_3-ppm			3
Sulphates,as SO_4^{2-}ppm	80		400
Fluoride, as F	10		
Silica, as SIO_2 ppm	71	80	
Iron (total)			0.7

Note: blanks = no data
Source: Botash Mine

3.4.3.5 Waste Water Treatment Facilities

The waste water treatment facility available at Botash mine is the sewage treatment facility. The facility is a five pond system consisting of an anaerobic pond and four oxidation ponds in series and is designed to treat waste generated by 500 people at 150l/head/day. Currently treated waste water from this facility is allowed to evaporate and is not re-used.

3.4.3.6 Waste Water Generation and Discharge

Brackish water is for process and fire protection use and is not recoverable. About 20 percent of potable water is used for human consumption and the rest is treated in the demineralization plant to produce high quality boiler feed make-up water. Waste water generated during demineralization is reused to convey fly ash from the boilers to a dam.

3.4.4 Morupule Colliery

Morupule Colliery is currently supplied by five boreholes. Water from Botswana Power Corporation (BPC) also supplements water that is sourced from the boreholes. The Mine is connected to the North South Carrier, since 2009; a 17 Km pipeline through Palapye. Tables 3.4i and 3.4j show the amount of water pumped and supplied to Morupule.

The supply from the boreholes fluctuated during the years under consideration, the reason being that some of the boreholes were dysfunctional. Only No. 5A Borehole was operational during the entire period though it doesn't supply much of the water (Table 3.4i and Figure 3.4f).

On average the mine Village consumes more water with a yearly consumption of 27,918.8 Kilo litres (Table 3.4j).

Table 3.4i: Morupule Colliery Water Supply, 2002-2011 (Kl)

Source	Government Number	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
No. 1 Borehole	BH 2461	9,411	9,462	8,362	4,970	5,741	2,385	0	0	0	43,307
No. 5B Borehole	BH 1691	2,001	5,845	288	0	0	0	0	0	0	8,134
No. 5A Borehole	BH 2344	8,377	7,431	5,199	647	1,486	4,482	7,413	2,429	21	38,601
No. 5C1 Borehole	BH 4775 (Relieve Borehole)	-	-	31,264	29,441	25,291	26,198	29,871	21,914	33,101	200,800
No. 5C2 Borehole	BH 4775	-	-	16,039	15,590	11,220	14,611	14,303	11,513	20,321	105,829
Total Borehole Supply		**21,791**	**24,741**	**63,156**	**52,653**	**45,744**	**49,683**	**53,595**	**37,865**	**55,453**	**398,682**
North/South Carrier Supply									2,411	7,829	10,240
B.P.C. Supply		50,198	26,581	16,204	14,097	7,479	12,252	25,274	30,362	16,656	199,103
Total Available		**71,989**	**51,322**	**79,360**	**66,750**	**53,223**	**61,935**	**78,869**	**70,638**	**79,938**	**608,025**

Note: Dash= No Data
Source: Morupule Colliery

Figure 3.4f: Morupule Colliery Water Supply from boreholes, 2002-2011 (Kl)

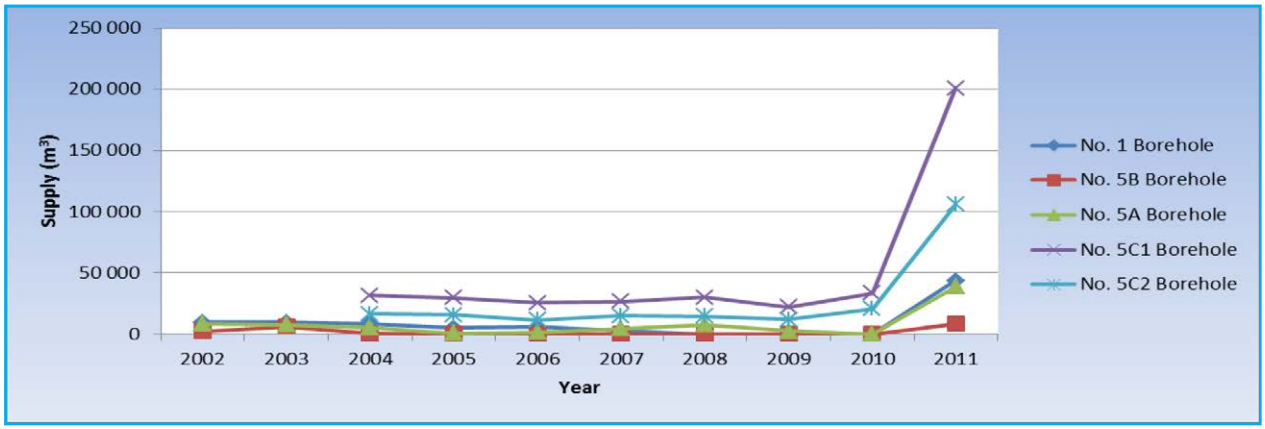


Table 3.4j: Morupule Colliery Internal Water Consumption, 2002-2011 (Kl)

Internal Consumption (kl)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Mine Village	23,038	22,617	25,691	32,650	26,920	31,723	34,900	27,132	25,992	28,525
Mine Surface (Offices & W/ Shops)	16,913	18,763	18,210	15,283	13,504	14,952	17,003	16,089	17,467	18,571
Raw water transfer or U/G	25,476	25,791	28,924	25,189	11,384	13,520	21,631	12,494	18,480	7,113
Wash Plant							2,869	10,355	13,127	12,402
Crushing & Screening									848	215
Garage									444	285
Game park									1,540	2,408
Total Consumption	**65,427**	**67,171**	**72,825**	**73,122**	**51,808**	**60,195**	**76,403**	**66,070**	**77,898**	**69,519**

Note: Dash= Consumption by some internal users had not yet started
Source: Water Utilities Corporation

3.5 Water Quality

Water quality is the chemical, physical, and biological characteristics of water with regards to its suitability for particular use. In Botswana, the Botswana Bureau of Standard (BOBS) is the organization that is solely responsible for setting drinking water quality standards, guidelines and amendments. Its standards are aligned with World Health Organization guidelines (Table 3.5a). The guidelines for drinking water quality are used as the basis for regulation and standard setting to ensure the safety of drinking water. Water sources are monitored on a regular basis to assess its quality.

There are various variables monitored by the Water Utilities Corporation and Department of Water Affairs to measure water quality. According to the BOS 32:2000, the water quality standards are classified in three categories: Class 1- Ideal, Class 2- Acceptable and Class 3- Maximum allowable standard of water quality. The common water quality parameters important in drinking water, wastewater, and natural water are as follows: alkalinity, ammonia, carbon dioxide, chlorine, nitrates and nitrites, oxygen- dissolved in water, pH, phosphates, temperature and turbidity.

Table 3.5a: Specifications for Drinking Water Quality

VARIABLES (in mg/l where applicable)		WHO Guideline Values	WUC Recommended Maximum Limit	WUC Maximum Allowable
Physical Requirements				
Turbidity	NTU	5	0.5	1
Colour	TCU	15	15	20
Taste & Odour		unobjectionable	unobjectionable	unobjectionable
Chemical Requirements				
Chlorine Residual	CL_2	0.6	0.3	1
pH value		6.0 - 9.0	6.5 - 8.5	5.5 - 9.0
Total Dissolved Solids	TDS	500	500	1000
Total Hardness (as $CaCO_3$)		20 - 200	500	1000
Sulphate	SO_4	250	250	400
Calcium	Ca	75	75	200
Nitrite	NO_2	3	3	3
Phosphorous	PO_4	0.3	0.3	0.3
Chloride	CL	250	250	600
Sodium	Na	200	200	200
Magnesium	Mg	100	100	150
Iron	Fe	0.3	0.3	0.7
Manganese	Mn	0.1	0.1	0.4
Ammonium	NH_4	1.5	1.5	2
Aluminium	Al	0.2	0.2	0.2
Copper	Cu	1	1	1.5
Zinc	Zn	5	5	1.5
Toxic Substances				
Nitrate	NO_3	45	45	45
Fluoride	F	0.7 - 1.5	1	1.5
Lead	Pb	0.05	0.05	0.1
Cadmium	Cd	0.05	0.01	0.05
Cyanide	CN	0.01	0.01	0.2
Microbiological Variables				
Faecal Coliforms / 100 ml		0	0	0
Total Coliforms / 100 ml		0	10	50 - 150
Organic Constituents				
Phenols		0.01	0.002 – 0.01	0.3
Total Organic Carbon	TOC	8	8	8
Trihalomethanes	THM	100	100	100
Total Pesticides		0.001	0.001	0.001
Poly Aromatic Hydrocarbons		0.001	0.001	0.001
Disinfection by-products		0.6 - 1	0 – 0.5	5
Toluene		0.02 – 0.2	0.02 – 0.2	0.2
Chlorophyll A		0 - 5	0 – 0.5	5

Source: Water Utilities Corporation Water Quality Standards and Botswana Bureau of Standards

3.5.1 Testing Potable and Raw Water in Towns/Cities and some Major Villages

3.5.1.1 Microbiology and chemical contents tests

Drinking water is routinely tested for the presence of indicator organisms, Total coliforms, E. coli, streptococci and chemical contents as follows;

The tests for both microbiology and chemical contents are done once every week for small towns that is Sowa, Lobatse, and Jwaneng and twice a week for bigger towns and cities namely Gaborone, Francistown and Selibe-Phikwe. Testing is also done daily at the plants.

On average the corporation tests about 3500 to 4000 microbiological and chemical samples from its distribution network and another 1500 to 2000 from the plants annually, which translates to between 6 to 11 times the minimum requirement of the BOS 32: 2000 (National Drinking Water Standard).

Results of indicator organisms, total coli forms, E. coli and streptococci for 2011/12 are shown in Tables 3.5b. The table reveals that Gaborone had the highest microbiology percentage compliance of 97 percent followed by Letlhakane with 86 percent then Kanye with 80 percent, while Tshabong stood at the bottom with microbiology percentage compliance of 39 percent. Almost all centers had total coliforms which fall within the WUC recommended maximum limit of 0-10 total coliforms/100ml and maximum allowable of 50-150 total coliforms/100ml.

According to WUC standards, this is a good sign because high faecal coliform counts creates a greater chance that pathogenic organisms are also present in the water and a person using such water stands a chance of getting sick from swallowing disease-causing organisms, or from pathogens entering the body through cuts in skin, the nose, mouth, or the ears. Research done elsewhere, University of Carolina in the US reveals that diseases and illnesses such as typhoid fever, hepatitis, gastroenteritis, dysentery, and ear infections can be contracted in waters with high faecal coliform counts

(www.unc.edu/~shashi/TablePages/totalfecalcoliforms.html).

The chemical tests are shown in Table 3.5c. In this narrative more emphasis is put on the toxic substances (Nitrate, Fluoride, Lead and Cadmium) by virtue of being poisonous. The table reveals that on average fluoride (F) and Nitrate (NO3) content was below the WUC maximum allowable limit in all the centers during 2009-2011. Lead (Pb) and Cadmium on the other hand averaged above the WUC maximum allowable limit in all the centers. The highest average Lead content was recorded in Francistown (3.29 µg/L) which is above the WUC maximum allowable limit of 0.10 micro gram per liter (µg/L). Generally the content of all other chemicals was below the WUC maximum allowable limit.

Table 3.5b: Microbiology Percentage Compliance for the year (April 2011 to March 2012) for the Various Management Centres

Determinants	Units	Acceptable limit	MICROBIOLOGY PERCENTAGE COMPLIANCE PER MANAGEMENT CENTRE													
			F/twn	Gaborone	Gantsi	Kanye	Kasane	Letlhakane	Lobatse	Mahalapye	Masunga	Mochudi	Molepolole	Palapye	S/Phikwe	Serowe	Tshabong
Total coliforms	Count / 100 ml	Not detected	68	97	79	89	50	86	53	43	79	58	48	55	45	53	39
Escherichia coli	Count / 100 ml	Not detected	92	99	81	80	-	86	74	81	97	82	75	92	94	83	70
Thermotolerant (faecal) coliforms	Count / 100 ml	Not detected	86	99	-	80	62	-	73	76	100	81	73	83	-	88	56
Faecal streptococci	Count / 100 ml	Not detected	92	99	83	85	80	86	70	77	82	68	65	92	92	80	60
ATTAINED PERCENTAGE COMPLIANCE			68%	97%	79%	80%	50%	86%	53%	43%	79%	58%	48%	55%	45%	53%	39%

Note: The attained percentage compliance for the management centers is the lowest achieved compliance as the acceptable limit for all parameters is zero tolerance; hence an average is NOT used to come up with the percentage compliance (Water Utilities Corporation).
Source: Water Utilities Corporation

Table 3.5c: Chemical Tests Results for Francistown, Gaborone, S/Phikwe, Jwaneng & Sowa: 2009-2011

Chemical	Francistown			Gaborone		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Alkalinity as $CaCO_3$, mg/L	76.77	73.54	80.78	108.16	88.65	134.48
Aluminium Al/ µg/L	46	0.21	306	8.16	ND	18.2
Bromide Br mg/L	ND	ND	ND	0.042	ND	0.21
Cadmium Cd, µg/L	1.88	ND	9.4	2.28	ND	8.8
Calcium Ca, mg/L	14	74	159	21.28	18.44	23.59
Calcium Hardness as $CaCO_3$, mg/L	44.35	38.19	49.3	55.85	17.74	97.39
Chloride, Cl, mg/L	3.91	3.63	4.51	10.55	8.79	12.05
Chromium Cr, µg/L	2.04	ND	9.32	1.23	ND	7.3
Cobalt Co, µg/L	1	ND	0.59	0.002	ND	0.008
Conductivity µS/cm	125.7	120.1	169.5	250.5	220	281
Copper Cu, µg/L	55.4	13.02	77	7.92	ND	23.75
Fluoride, F mg/L	0.08	ND	0.13	0.48	0.39	0.52
Iron Fe, mg/L	17.2	47.07	213	5.3	ND	12.3
Lead Ph, µg/L	3.29	ND	6.5	0.82	ND	1.88
Magnesium Mg, mg/L	5.67	4.53	7.6	10.2	4.06	13.11
Manganese Mn, mg/L	3.2	ND	14.59	2.35	ND	4.44
Nickel Ni, µg/L	2.41	ND	4.45	0.82	ND	1.74
Nitrate NO3, mg/L	0.16	ND	0.53	0.7	ND	2.31
pH	8.31	7.5	8.6	0.38	0.29	0.52
Potassium K, mg/L	3.1	ND	4.7	6.6	5.1	10.53
Sodium Na, mg/L	4.76	4	5.6	12.25	7.12	18.19
Sulphate SO_4, mg/L	1.22	0.53	1.9	3.94	4.2	4.96
TDS	123.1	80.6	139	162.5	140	182
Temperature,Celcius,	25.7	22.6	28.1	25.3	2025	26.92
Total Hardness as $CaCO_3$, mg/L	63.7	57.62	66.33	91.64	69.59	134.86
Turbidity NTU	0.585	0.412	0.912	0.38	0.355	0.762
Zinc Zn, µg/L	30.4	7.2	38.7	4.04	ND	15.2

Table 3.5c: Chemical Tests Results for Francistown, Gaborone, S/Phikwe, Jwaneng & Sowa: 2009-2011 Continued

Chemical	Lobatse			Selebi Phikwe		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Alkalinity as $CaCO_3$, mg/L						
Aluminium Al, µg/L	11.92	6.17	17.93	16	0.64	31.5
Bromide Br mg/L	0.03	ND	0.09	ND	ND	ND
Cadmium Cd, µg/L	1.8	ND	8.6	1.01	ND	3.04
Calcium Ca, mg/L	20.5	16.79	25.05	17.73	17.32	18.5
Calcium Hardness as $CaCO_3$, mg/L	41.39	34.65	47.07	51.41	51.4	87.27
Chloride, Cl mg/L	10.24	8.17	12.32	4.82	4.76	4.87
Chromium Cr, µg/L	1.2	0.007	7.2	ND	ND	0.001
Cobalt Co, µg/L	0.001	ND	0.008	0.19	ND	0.57
Conductivity uS/cm	180	208	257	150.3	133	167
Copper Cu, µg/L	11.59	ND	26.81	18.5	15.85	39.66
Fluoride, F mg/L	0.61	0.22	0.54	0.18	0.15	0.23
Iron Fe, mg/L	18.18	15.83	32.8	15.39	1.31	24.21
Lead Pb, µg/L	1.96	ND	9.1	1.74	ND	5.22
Nickel Ni, µg/L	0.99	ND	2.01	2.22	1.23	3.4
Magnesium Mg, mg/L	10.16	1.41	11.35	3.97	3.38	4.32
Manganese Mn, mg/L	2.63	ND	11.04	0.86	ND	2.59
Nitrate NO_3, mg/L	0.308	0.27	0.714	1.17	0.79	2
pH	7.83	7.51	8.16	7.42	7.11	7.7
Potassium K, mg/L	6.6	4.57	10.12	4.76	3.4	6.26
Sodium Na, mg/L	10.53	8.86	14.21	2.77	2.6	3.12
Sulphate SO_4, mg/L	4.31	2.85	5.08	1.69	0.63	2.57
TDS	146.25	135.1	186.4	97.5	86.4	108
Temperature,Celcius,	19.8	17.4	25.3	27.1	21.4	32.6
Total Hardness as $CaCO_3$, mg/L	96.62	95.31	98.47	68.62	54.78	75.9
Turbidity NTU	0.526	0.495	0.983	0.92	0.54	1.98
Zinc Zn, µg/L	4.09	ND	35.03	39.85	34.52	48.5

Table 3.5c: Chemical Tests Results for Francistown, Gaborone, S/Phikwe, Jwaneng & Sowa: 2009-2011 Continued

Chemical	Sowa			Jwaneng		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Alkalinity as $CaCO_3$, mg/L	339.59	284.71	424.63	353.59	316.24	435.42
Aluminium L, µg/L	28.5	45	95	ND	ND	ND
Bromide Br mg/L	0.39	ND	0.975	ND	ND	ND
Cadmium Cd, µg/L	ND	ND	ND	0.002	ND	1.5
Calcium Ca, mg/L	151.8	136.3	167.3	111.3	100	116
Calcium Hardness as $CaCO_3$, mg/L	80.12	60	108	98.26	89.21	166.5
Chloride, Cl, mg/L	205	202	209	69.78	60.1	80.6
Chromium Cr, µg/L	ND	ND	ND	ND	ND	ND
Cobalt Co, µg/L	ND	ND	ND	0.01	0.04	0.08
Conductivity uS/cm	1457	1394	1485	799	715	901
Copper Cu, µg/L	249.4	219	279	2.52	1.05	2.94
Fluoride, F mg/L	0.94	0.91	1.05	0.43	0.23	0.845
Iron Fe, mg/L	112.55	32.1	193.2	0.32	0.18	0.68
Magnesium Mg, mg/L	46.9	47.2	47.51	31.48	24.7	48.6
Manganese Mn, mg/L	45.4	ND	90.9	0.81	0.21	1.05
Nickel Ni, µg/L	2.22	1.52	2.92	0.8	0.73	1.64
Nitrate NO_3, mg/L	2	ND	6	10.86	6.33	12.3
pH	7.54	7.35	7.92	7.26	7.1	7.7
Potassium K, mg/L	5.12	4.92	5.13	9.1	5.94	12.27
Sodium Na, mg/L	254	246	255	62	59.13	71.25
Sulphate SO_4, mg/L	120.4	24.6	235	11.97	9	13.97
TDS	945	906.1	965.2	519.35	462.13	645.1
Temperature,Celcius,	25.3	24.1.9	30.5	21.4	17.3	28.9
Total Hardness as $CaCO_3$, mg/L	281.37	190	588	295.87	229	366.1
Turbidity NTU	0.25	0.18	0.32	0.3	0.19	0.54
Zinc Zn, µg/L	7.91	3.08	12.74	0.008	0.51	1.06

Note: ND= No data available
Source: Water Utilities Corporation

3.6 Pressure on Water Resources and Responses

This section discusses pressures on water resources. The interplay of both humankind's actions and naturally occurring events exert pressure on water resources. According to UNESCO (2006), climate change and natural variability in the distribution and occurrence of water are the natural driving forces that complicate the sustainable development of our water resources.

Due to fact that secondary data is used to compile this report it is difficult to establish cause and effect relationship between indicators/variables. Therefore literature review is used in this section instead. Some of the common driving forces affecting water resources include:

- population growth, particularly in water-short regions,
- major demographic changes as people move from rural to urban environments,
- higher demands for food security and socio-economic well-being,
- increased competition between users and usages,
- pollution from industrial, municipal and agricultural sources.

Botswana's population size has been on the increase since the first population and housing census till the latest 2011 population and housing census though there is an indication that the population increases at diminishing growth rates. CSO (2011) reveals that, 'annual population growth rate between 2001 and 2011 is 1.9 percent.' Furthermore, the preliminary result of the 2011 Population and housing census put the population of Botswana at 2.38 million as compared with 1.68 million in 2001. Literature elsewhere (UNESCO, 2006), asserts that population growth, particularly in water-short regions put pressure on water resources. High water consumption is more pronounced in Gaborone and the catchment areas, and so is the high population growth rate. High population growth rates in Kweneng and South East Districts have been observed, due largely to very high growth rates of villages within the proximity of Gaborone.

Water pollution also worsens the already existing problem of water scarcity. According to State of Environmental Report (2002), over-exploitation, pollution and aquatic weeds are the main threats to water resources. The sources of pollution are industrial and domestic effluent from settlements, human waste from pit latrines and waste disposal on the dam catchment areas and shallow aquifers.

WUC (2012) reports that, during the 2011/12 review period, several incidents of illegal dumping of prohibited substances down the network were reported. Moreover, fifteen 200 liter-drums of oil were siphoned from the sewage network in Nkoyaphiri. Whereas, scores of vehicle tyres, rocks and other material that is not supposed to be disposed-off down the sewage network caused major blockage and damage to the network.

As a response to the problem of pollution WUC embarked on a public education and awareness campaign. Letters were written and site visits made to some areas in Gaborone that have connected their storm water drainage systems to the sewage network resulting in overloading. Furthermore, the Corporation drafted a Trade Effluent Agreement and all industries discharging effluent into the WUC sewer lines will be required to sign it and remain compliant.

Over-exploitation of water is also a pressing issue in Botswana. Percentage of water loss in the country is slightly high (refer to section 1.3). WUC (2012) also reports that, during the 2011/12 review period most major villages constantly recorded above average water losses primarily due to a combination of factors including dilapidated networks, unmetered standpipes, inefficient meters and physical losses. In responding to the afore-mentioned problem the WUC developed and implemented a strategic framework for water losses management so as to better understand and remedy the situation. The Corporation's initiative towards an effective water losses reduction programme includes a project whose implementation will continue into the 2013/14 period. The strategic initiatives are as follows:

- A Water Meter Replacement Programme. This will eliminate under-registering billing meters which contribute immensely to water losses

- Determination of an Economic Level of Leakage Control to effectively set practical targets

- Timely response to and repair of bust pipes.

The Corporation further assures that once the implementation of the above mentioned strategic initiatives is complete, the challenges of meeting the Millennium Development Goals, especially the goal of providing access to potable water for most Batswana, will be addressed to a large extent.

Just like any other transformation process, the Water Sector Reforms Programme took place in the face of challenges. Water delivery service was troubled with disruptions attributed to a wide range of factors including the localized pipe bursts, vandalism of infrastructure, borehole breakdowns and interruption to the NSCI. To deal with these challenges the Corporation came up with planned emergency projects (Table 3.6a).

Dating as far back as 2004, WUC and Department of Water Affairs came up with initiatives which addressed issues that affected water resources. These included penalties and an increase in water charges, an effort meant to discourage the population from wasting water (CSO, 2009).

The Government of Botswana has introduced two main legal instruments as interventionist strategies to address the water resources issues, which are Water Act of 1968 and Waterworks Act of 1962 and other legislation which are related to water resources such as Aquatic Weeds Control Act Cap 34:04, and Public Health Act Cap 63:01, among others.

Table 3.6a: Planned Emergency Projects

Intervention	Benefits	Timeline
The acceleration of the development of a framework for groundwater monitoring and reporting. Due diligence on drought impact on groundwater resources at area level and implementation of mitigation measures.	To enhance the sustainability of groundwater supplies.	Sep-12
The procurement and installation of backup generators countrywide.	This will ensure continuous availability of power even during load-shedding.	Dec-12
Rehabilitation of the Palapye Well field.	This will augment supply to Mahalapye and surrounding areas to reserve the Letsibogo Dam for the Greater Gaborone area.	Dec-12
The Ramotswa Well field has significant amounts of water which have not been exploited due to the fact that the well field is contaminated. WUC is currently working on building a treatment plant to treat the water for potable use.	This will take pleasure off the Gaborone Dam. Plans to build the treatment plant will continue.	Aug-12
The erection of new water tanks and repair of damaged ones across the country.	The increased capacity of tanks will ensure the availability of water for longer periods during water supply interruptions.	Sep-12
The installation of telemetry and chlorination infrastructure countrywide.	WUC will be able to monitor water levels remotely, promoting efficiency and the curbing of water losses from overflowing tanks. Chlorination will be done for all areas to ensure the availability of potable water.	Oct-12
The equipping of boreholes in Molepolole, Bobonong and other areas.	This will augment supply to the relevant areas.	Oct-13
Procurement of water bowsers.	This will increase the amount of water that can be bowsed to communities during water supply interruptions.	Oct-14
Construction of package treatment plants.	Increased capacity of plants treating water to potable standards.	Apr-13

Source: Water Utilities Corporation, 2012

4. WILDLIFE

4.1 Introduction

Wildlife is one of the country's attractive natural resources. It also serves as a cornerstone of Botswana's tourism industry and contributes to rural livelihoods. Government has thus demonstrated commitment to conserving this precious resource through various measures. Vision 2016 underscores the importance of environmental protection and sustainable development particularly focusing on development of the rural economy; hence conservation of natural resources including wildlife is advocated for by government.

To demonstrate this, Government passed a Community Based Natural Resource Management (CBNRM) Policy in 2007 formulated to help communities to manage and benefit from natural resources in their areas. As stated in the tenth National Development Plan (NDP 10) there were 150 villages involving 135,000 people having Community Based Organisations (CBOs) by 2006. The CBOs generated revenue to the amount of P16.3 million by 2006; most of the CBOs are wildlife based.

To further demonstrate Government commitment to conservation of wildlife, 17 percent of land is reserved as national parks and game reserves and 20 percent as Wildlife Management Areas (WMAs). National parks and game reserves are no hunting protected areas set up for conservation of wildlife. WMAs act as buffer zones between pastoral/arable/residential areas and protected areas. This helps to lessen contact between wild animals and people thereby reducing human wildlife conflict. Human-wildlife conflict is discussed in more detail in the next section. They also provide a safe wildlife corridor between protected areas, for instance the passageway between Central Kalahari Game Reserve and Kalahari Trans-Frontier Park; supporting the natural migration patterns of the animals. Furthermore, WMAs facilitate the participation of communities in resource conservation and management through CBNRM.

Together with neighbouring countries, Botswana has further illustrated her commitment to the conservation of wildlife by signing the Protocol on Wildlife Conservation and Law Enforcement in 1999 and ratifying it at the end of 2003. The Protocol binds the Member States to **"promote the conservation of the shared wildlife resources through the establishment of trans-frontier conservation areas"** (SADC, 2012). Trans-frontier conservation area is an ecological area straddling two or more countries for purposes of joint management of wildlife resources by countries. In that respect, the Kalahari Trans-frontier Park was established between Botswana and South Africa; plans are underway to set up the Kavango Zambezi (KAZA) Conservation Area between Angola, Botswana, Namibia, Zambia and Zimbabwe. Government of Botswana does wildlife management and conservation through Department of Wildlife and National Parks which is guided by the Wildlife Conservation and National Parks Act of 1986. This chapter looks at various issues pertaining to wildlife management and challenges thereof.

4.2 Human Wildlife Conflict

The increasing population of wild animals and people and the resultant competition for space and food brings about negative interactions between human beings and wildlife hence the phenomenon human-wildlife conflict. As aptly put by FAO Forestry Paper (2009)1"The main cause of human-wildlife conflict worldwide is the competition between growing human populations and wildlife for the same declining living spaces and resources. The transformation of forests, savannah and other ecosystems into agrarian areas or urban agglomerates as a consequence of the increasing demand for land, food production,

energy and raw materials, has led to a dramatic decrease in wildlife habitats" (Pg 14). In pursuance of development, people have expanded agricultural and other activities to marginal areas thus encroaching and fragmenting hitherto wildlife habitats. Paths have been opened in areas that were once the preserve of wildlife thus increasing contact between people and wildlife.

The animals damage people's property and are a menace to their lives. In response, people kill the animals in a bid to protect themselves thus defeating conservation efforts. The animals involved in these conflicts are termed problem animals and their incidents are recorded to see the trend of the conflict.

In combating the conflict, Department of Wildlife and National Parks (DWNP) provides water for wildlife inside protected areas as another conservation measure especially during drought years. The department has also fenced some of the protected areas in an effort to separate wild animals from people and thus reduce human wildlife conflict.

4.2.1 Trends in Problem Animal Incidences

Table 4.2a shows that the estimated national number of problem animal incidents was highest in the year 2010 in the three year period from 2009 to 2011. They increased by approximately 16 percent between 2009 and 2010 but decreased by about 9 percent between 2010 and 2011. This is illustrated in Figure 4.2a. The species mostly involved in the incidents are Leopard, Elephant, Lion and Wild Dog in that order.

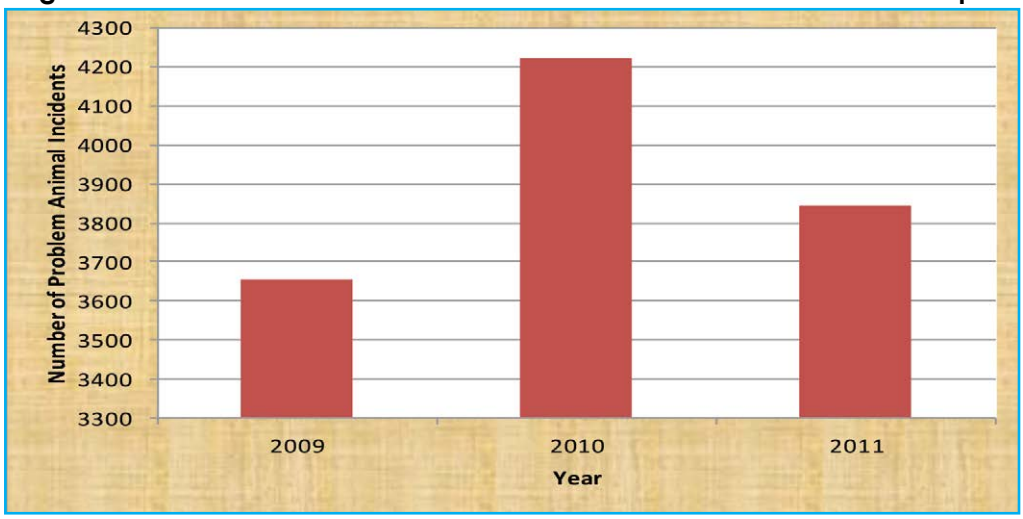
It is indicated on Table A1 in the Appendix that elephant incidents were highest in 2010 and Ngamiland District accounted for most of the incidents, and that the incidents were absent in all other areas outside the elephant range (Kgalagadi, Kgatleng, Kweneng and Southern Districts). The district (Ngamiland) also had the highest lion incidences in 2009 compared to other districts. Lion incidences were absent in Kgatleng and Southern Districts in all the three years. Leopard incidents were highest in 2010 in Central District. On the other hand wild dog incidences were highest in 2010 and Ghanzi District accounted for most of the incidents; whilst Kgatleng recorded none.

Table 4.2a National Problem Animal Incidents by Species (2009-2011)

Species	2009	2010	2011	Total
Baboon	19	74	48	141
Birds	1	4	2	7
Black b-jackal	0	6	4	10
Brown Hyaena	3	23	20	46
Buffalo	1	135	1	137
Caracal	1	65	1	67
Cheetah	168	55	53	276
Crocodile	11	76	57	144
Duiker	0	26	21	47
Elephant	756	1,000	887	2,643
Francolin	0	0	2	2
Ground Squirrel	1	0	0	1
Guinea fowl	0	17	12	29
Hippopotamus	66	111	94	271
Honey badger	0	1	2	3
Hyaena (unknown)	50	68	37	155
Impala	3	0	0	3
Jackal(unknown)	8	8	7	23
Kudu	138	245	271	654
Leopard	986	1,011	807	2,804
Lion	805	575	531	1,911
Monitor lizard	2	0	0	2
Monkey	0	5	5	10
Pied crows	0	0	2	2
Porcupine	18	27	28	73
Rock rabbit	0	1	1	2
Side-striped jackal	0	1	0	1
Snakes	27	70	75	172
Spotted hyaena	5	10	11	26
Spring hare	0	7	2	9
Steenbok	0	18	22	40
Warthog	100	7	191	298
Wild dog	485	576	649	1,710
Total	**3,654**	**4,222**	**3,843**	**11,719**

Source: Department of Wildlife and National Parks

Figure 4.2a Estimated Number of Problem Animal Incidents for Selected Species



4.2.2 Compensation for Problem Animal Incidents

Compensation is paid to people whose property has been damaged by problem animals as a way of reducing consequences of the damage and encouraging tolerance for the animals. However compensation has not shown to reduce conflict as it only addresses symptoms and not root causes of conflict (FAO Forestry Paper, 2009).

In Botswana compensation is paid for damage made by nine animals which are deemed to be dangerous for humans to protect themselves against. These are Buffalo, Cheetah, Crocodile, Elephant, Hippopotamus, Lion, Leopard, Rhinoceros and Wild dog. These species are also cited in to FAO Forestry Paper (2009) which says "...the larger herbivores (elephants, buffalo and hippopotamus), large mammalian carnivores (lions, leopards, cheetahs, spotted hyenas and wild dogs), and crocodiles are traditionally seen as the animals representing the greatest threat to humans and responsible for the majority of human-wildlife conflicts"(Pg 1).

Table 4.2b shows the number of reports due to these animals which attract compensation from 2009 to 2011 and the amount of compensation paid for the damages. The table indicates that the largest amount of compensation was paid for damages by Lion (P1, 576,776.50) followed by Leopard (P835, 267.10). Central District paid the highest compensation in the three years as illustrated on Table 4.2c. This scenario is again depicted on Figure 4.2b.

Table 4.2b National Problem Animal Reports and Amount of Compensation (2009-2011)

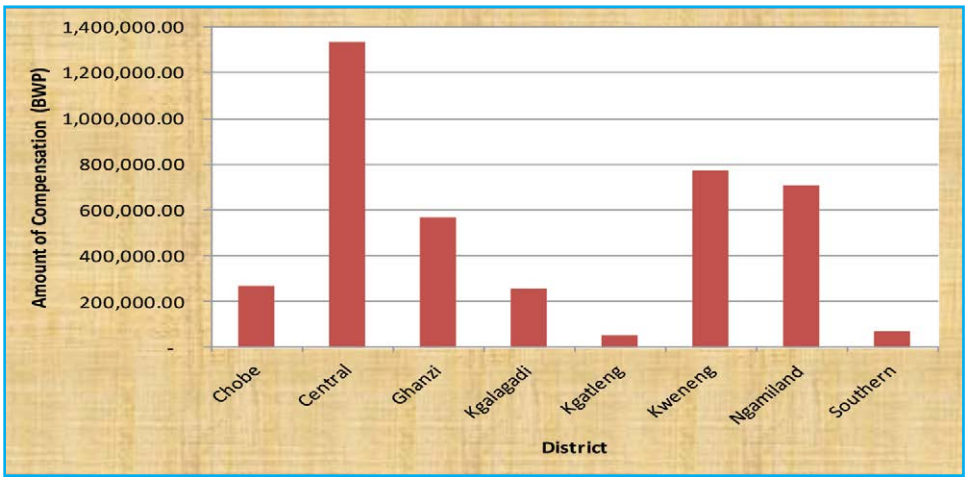
Species	Number of Reports	Amount Paid (BwP)
Lion	2,625	1,576,776.50
Leopard	2,904	835,267.10
Wild dog	1,038	742,419.00
Cheetah	228	77,463.00
Buffalo	2	1,330.98
Elephant	2,816	645,938.88
Hippo	252	72,201.90
Crocodile	212	78,054.35
Rhino	0	0.00
Total	**10,077**	**4,029,451.71**

Source: Department of Wildlife and National Parks

Table 4.2c Number of Reports and Amount of Compensation by Species and District (2009-2011)

Species	Ghanzi		Kgalagadi		Ngamiland		Kweneng		Kgatleng		Central		Southern		Chobe	
	No of Reports	Amount Paid (BWP)	No of Re-ports	Amount Paid (BWP)	No of Reports	Amount Paid (BWP)	No of Reports	Amount Paid (BWP)	No of Reports	Amount Paid (BWP)	No of Reports	Amount Paid (BWP)	No of Reports	Amount Paid (BWP)	No of Reports	Amount Paid (BWP)
Lion	102	85,855.00	64	61,922.50	1,174	165,915.00	360	351,395.50		0.00	801	787,628.50	0	0	124	124, 060.00
Leopard	277	80,920.00	134	59,834.60	512	31,365.00	484	203,927.50	110	43,260.00	1,196	349,570.00	155	57,675.00	36	8, 715.00
Wild dog	633	388,745.00	136	128,956.50	0	0.00	212	193,276.50	4	2,100.00	47	24,738.50	2	1,452.50	4	3, 150.00
Cheetah	63	14,175.00	14	8,102.00	0	0.00	46	20,707.50	14	4,275.00	55	17,416.00	35	12,630.00	1	157.50
Buffalo	0	0.00	0	0.00	1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	1, 330.98
Elephant	13	0.00	0	0.00	1,226	403,074.75	0	0.00	0	0.00	1,312	121,636.40	0	0.00	265	121, 227.73
Hippo	0	0.00	0	0.00	200	45,538.50	0	0.00	1	1,192.00	5	16,470.75	0	0.00	46	9, 000.65
Crocodile	0	0.00	0	0.00	160	61,816.85	0	0.00	3	665.00	48	14,522.50	0	0.00	1	1,050.00
Rhino	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**1,088**	**569,695.00**	**348**	**258,815.60**	**3,273**	**707,710.10**	**1,102**	**769,307.00**	**132**	**51,492.00**	**3464**	**1,331,982.65**	**192**	**71,757.50**	**478**	**268,691.86**

Figure 4.2b Amount of Compensation (BWP) by District: 2009-2011



4.2.3 Impact of Human Wildlife Conflict

Most of human wildlife conflict takes place at rural areas; therefore the vulnerability related to majority of subsistence farmers is quite significant. This has implications on food security as problem animals destroy crop fields and kill livestock. The conflicts are more pronounced during drought periods, when wild animals enter human settlements in search of water.

The compensation paid out for damages is not a replacement but a small token to encourage tolerance for damage. Compensation is also not addressing the causes of human wildlife conflict. It should be noted that it is difficult to control some of the problems especially the predators as they kill at night.

Although less common than field raids and livestock killing, human deaths and injuries incurred from attacks by problem animals are most distressing. Human casualties in Ghanzi, Ngamiland and Central Districts due to problem animals for the period 2008 to 2011 are depicted on Table 4.2d. The highest number of casualties was recorded in Ngamiland with 74 percent of all casualties (29 casualties) in the period under review; probably because it is the largest district with the highest number of wild animals. The species mostly involved across the districts is leopard. The incidents occurred commonly in December with 49 percent of the incidents (19 incidents). Other districts did not report on the occurrences.

Table 4.2d National Human Casualties Involving Problem Animals by District (2008-2011)

	Ghanzi				Ngamiland								Central					
Month		2009		2011		2008		2009		2010		2011		2008		2010		2011
	Number	Species	Number	Species	Number	Species	Number	Species	Number	Species	Number	Species	Number	Species	Number	Species	Number	Species
January	1	Leopard	0		0		3	Ele, Lio	0		0		0		0		0	
February	0		0		0		0		0		0		0		0		0	
March	0		0		0		0		1	Elephant	1	Elephant	0		0		0	
April	0		0		0		0		0		0		1	BBJ	0		0	
May	0		0		0		1	Elephant	0		2	Ele, Lio	0		0		0	
June	0		0		0		0		0		0		0		0		0	
July	0		0		0		2	Elephant	1	Lion	0		0		0		0	
August	0		1	Lion	0		0		0		0		0		0		1	Leopard
September	0		0		0		0		0		0		0		1	Leopard	0	
October	0		0		0		0		0		1	Crocodile	0		0		0	
November	0		0		0		0		0		0		0		3	Leopard	0	
December	0		2	Leopard	4	Ele, Lio	2	Lio, Ele	6	Ele, Lio, Leo,Croc	5	Cro, Ele, Lio ,Hip	0		0		0	
Total	**1**		**3**		**4**		**8**		**8**		**9**		**1**		**4**		**1**	

Source: Department of Wildlife and National Parks

4.3 Mortality

Human-wildlife conflict sometimes results in mortalities of wildlife as farmers protect themselves or when Wildlife Officers control them in a bid to reduce conflict. Other times mortality is caused by factors such as poaching, road accidents, drought, disease and natural causes.

Table 4.3a indicates national mortality incidences due to different factors. Leopard, kudu, lion, buffalo and elephant had the highest mortality incidences due to human wildlife conflict (as indicated on Table A2 in the Appendix). Mortality due to problem animal control made up about 60 percent of all deaths.

Table 4.3a further shows an abnormally high number of mortality cases for crocodile in 2011. This was caused by floods which occurred in Ngamiland in 2011. They swept away lots of crocodiles from a crocodile farm into agricultural and residential areas posing threat to people and livestock, most of the crocodiles were killed as problem animal control measure.

4.3a National Wildlife Mortality Incident, 2009-2011

Species	2009	2010	2011
B/hyena	1	1	1
Baboon	1	7	5
Bat eared fox	0	8	7
Black-backed Jackal	2	1	0
Buffalo	14	32	38
Bushbuck	0	1	2
Cheetah	3	2	7
Crocodile	0	3	50
Eland	3	2	0
Elephants	18	29	47
Gemsbok	4	0	0
Giraffe	0	2	1
Hartebeest	4	3	4
Hippo	1	5	3
Hyena (unknown)	3	4	5
Impala	5	12	8
Jackal	6	8	0
Kudu	17	50	65
Leopard	42	50	69
Lion	36	30	43
Puff Adder	3	4	5
Python	4	9	14
Snake	3	3	7
Steenbok	5	8	5
Tsessebe	5	9	0
Warthog	1	7	6
Waterbuck	0	2	2
Wildebeest	0	4	0
Wild dog	0	2	0
Zebra	1	3	4

Source: Department of Wildlife and National Parks

4.4 Hunting Licenses and Quotas

Department of Wildlife and National Parks (DWNP) manage hunting of wildlife for conservation of the species through among other things, issuance of hunting licenses for consumptive use of the resource. The hunting licenses are issued based on hunting quotas determined by wildlife population dynamics.

4.4.1 Licenses

There are four types of hunting licenses in Botswana namely; Bird license, Small Game license, Single Game license, and Special Game license. Bird licenses are issued at a fee of 25 Pula per year for citizens, whereas non-citizens pay 750 Pula per year, 300 Pula per month or 150 Pula per week. Small Game licenses are issued to citizens only at a fee of 75 Pula per specified hunting season. Single Game licenses are issued to both citizens and non- citizens through a raffle system. Each species has a particular hunting fee which differs for citizens and non-citizens. A list of licensing fees for Single Game licenses is contained in the Appendix as Table A3.

Table 4.4a - 4.4g presents sale of different licenses and government trophy in the country. In all the districts, single game license is the one that generates most revenue. Ngamiland District made the highest amount of revenue from sale of permits, licenses and government trophy. This is most probably because of the high number of single game licenses and the high value species sold in the district.

Table 4.4a Number of Licenses Issued and Amount of Revenue Accrued for Central District (2009-2011)

Year	Bird	Single Game	Small Game	CHA	Lost hunting	Sale of	Sale of	Revenue accrued
	License	Licenses	Licenses	permit	card	Game Meat	Govt trophy	(BWP)
2009	2,349	171	42	261	59	15,675.70	6,285.00	428,080.70
2010	1,774	196	47	221	40	13,136.75	10,282.00	697,823.75
2011	2,390	149	56	235	69	23,040.00	3,126.00	889,066.00
Total	**6,513**	**516**	**145**	**717**	**168**	**51,852.45**	**19,693.00**	**2,014,970.45**

Table 4.4b Number of Licenses Issued and Amount of Revenue Accrued for Chobe District (2011)

Years	Bird Licenses		Single Game Licenses		Total Revenue
	Number	Amount	Number	Amount	BWP
2011	309	13,745	81	907,100	920,845

Table 4.4c Number of Licenses Issued and Amount of Revenue Accrued for Ghanzi District (2009-2011)

Year	Bird License	Single Game License	*Special game licenses	Hunting Cards	Revenue Accrued
2009	122	7	44	8	P87,915.00
2010	205	10	30	3	P196,364.00
2011	115	7	37	9	P101,577.20
Totals	**432**	**24**	**97**	**20**	**P385,856.20**

Table 4.4d Number of Licenses Issued for Kweneng District (2009-2011)

Year	Bird License	Small Game License	Single Game License	*Special
2009	333	19	10	13
2010	330	16	5	13
2011	401	4	2	9
Total	**1064**	**39**	**17**	**35**

Table 4.4e Number of Licenses Issued for Kgatleng District (2009-2011)

Year	Bird License	Fish	Other		
			Hunting cards	Sale of game meat	Trophy dealers
2009	204		5	5	
2010	223	4	55		2
2011	238	4	6	1	5
Total	**665**	**8**	**66**	**6**	**7**

Table 4.4f Number of Licenses Issued and Amount of Revenue Accrued for Ngamiland (2010)

	Bird	Trophy Dealer	Professional Guide	Hunter, Assistant & Trainee	Gov. Trophy	Fishing permit	Export, Import & Re-Export	CITES export & Import	Small Game	CHA permit	Lost hunting Card	Single Game	CITES stationary	TOTAL
Number Issued	823	4	64	20	28	157	110	6	5	253	26	211	12	1,719
Revenue Accrued (BWP)	33,570.00	2,450.00	17,950.00	10,100.00	3,091.00	65,890.00	22,705.00	102,815.00	375	67,540.00	620	4,589,800.00	3,296.00	4,920 202.00

Table 4.4g Number of Licenses Issued and Amount of Revenue Accrued for Southern District (2009-2011)

Year	Bird License	Single Game License	Lost Hunting Cards	Sale of Game Meat	Government Trophy	CHA Permit	Revenue Accrued
2009	169	Nil	Nil	Nil	Nil	Nil	4,225.00
2010	302	Nil	5	Nil	4,995.00	2	12,645.00
2011	292	2	16	4,771.05	8,694.00	Nil	24,085.05
Total	**763**	**2**	**21**	**4,771.05**	**13,689.00**	**2**	**40,955.05**

4.4.2 Hunting Quotas

DWNP uses a quota system to effect issuance of hunting licenses. Quotas are based on the population and annual percentage change of species population which is obtained from aerial surveys undertaken by the department. Apart from generating revenue for communities and the State, issuance of a hunting quota also acts as a check/control measure on animal populations. Quota system is used to restrict number of animals hunted (Eyes on Africa; Travel and Safaris, 2013).
The country is sub-divided into administrative land blocks called Controlled Hunting Areas (CHAs), where hunting quota is annually allocated.

4.4.2.1 Community Managed Areas

Some of the CHAs are community managed, where communities adjacent to the CHA organize themselves into Community Based Organisations (CBOs). The CBOs can then use the hunting areas to manage and utilize the wildlife resources in the areas. This is done to uphold a rural development strategy on Community Based Natural Resource Management (CBNRM). As pointed out by Eyes on Africa; Travel and Safaris (2009) it is assumed that communities are more inclined to conserve natural resources around them if they get economic value from the resources. The benefit of CBNRM is thus achieved rural economic development on one hand and conservation of natural resources on the other.

Concession Areas

Other CHAs may be leased by the private sector in which case the private sector tenders for lease of CHA for commercial use. Commercial use of CHAs generate revenue to the state in the form of rental to land boards, resource royalty to government, sales tax, income tax and Training levy on accommodation resorts among others.

4.4.2.2 Citizen Hunting Areas

Some CHAs are reserved for individual citizen hunting; these are called Citizen Hunting Areas.

Hunting quotas are therefore allocated according to the type of CHA. Table 4.4h indicates the total number of animals in the quota for the years 2009 -2011. The table shows that the quota was highest in the year 2009 and declines over the years. The species with the highest numbers in the quota were elephant, impala, steenbok and duiker. It is further noted that elephant quota increased threefold due to the high and ever increasing elephant population that exacerbates human-elephant conflict. Increasing the quota is one of the measures taken to reduce human-elephant conflict. On the other hand lion was not included in the quota as the species population was low and decreasing.

Table 4.4h Botswana All Wildlife Hunting Quotas (2009-2011)

Species	2009	2010	2011	Total
Baboon	144	118	102	364
Buffalo	151	100	79	330
Cat, Wild	19	0	0	19
Crocodile	10	0	0	10
Duiker	361	245	226	832
Eland	30	19	13	62
Elephant	353	378	350	1,081
Gemsbok	209	66	43	318
Hare, Cape	90	32	32	154
Hare, Scrub	90	32	32	154
Hartbeest	28	22	15	65
Hyena_ Spotted	45	14	12	71
Impala	746	430	302	1,478
Jackal	48	15	10	73
Kudu	251	115	124	490
Lechwe	184	58	25	267
Leopard	24	5	4	33
Lion	0	0	0	0
Monkey, Vervet	28	15	15	58
Ostrich	347	168	147	662
Porcupine	36	14	14	64
Side striped Jackal	2	2	1	5
Springbok	148	69	72	289
Steenbok	604	324	235	1,163
Tsessebe	190	40	0	230
Warthog	217	70	51	338
Wildebeest, blue	141	48	32	221
Zebra	135	48	47	230
Total	**4,631**	**2,447**	**1,983**	**9,061**

Source: Department of Wildlife and National Parks

The majority of the quota allocated was in Concession Areas in 2009 while in 2010 and 2011 quota was highest in Community Managed Areas and (Table 4.4i-4.4k). A breakdown of the quota allocation by district is found in the Appendix as Tables A4, A5 and A6.

Table 4.4i Botswana All Community Managed Areas Hunting Quotas (2009-2011)

Species	2009	2010	2011	Total
Baboon	35	35	19	89
Buffalo	43	57	36	136
Cat, Wild	0	0	0	0
Crocodile	3	0	0	3
Duiker	146	97	78	321
Eland	17	14	9	40
Elephant	141	179	151	471
Gemsbok	180	46	23	249
Hare, Cape	0	0	0	0
Hare, Scrub	0	0	0	0
Hartbeest	28	22	15	65
Hyena_ Spotted	20	11	9	40
Impala	192	190	62	444
Jackal	20	15	7	42
Kudu	77	46	37	160
Lechwe	50	46	13	109
Leopard	12	5	4	21
Lion	0	0	0	0
Monkey, Vervet	0	0	0	0
Ostrich	184	88	67	339
Porcupine	6	6	6	18
Side striped Jackal	2	2	1	5
Springbok	84	39	42	165
Steenbok	232	168	79	479
Tsessebe	31	26	0	57
Warthog	45	39	20	104
Wildebeest, blue	29	23	9	61
Zebra	18	18	17	53
Total	**1,595**	**1,172**	**704**	**3,471**

Source: Department of Wildlife and National Parks

Table 4.4j Botswana All Concession Areas Wildlife Hunting Quotas (2009-2011)

	Central			Ngamiland			Chobe		
Species	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**
Baboon	21	21	21	49	24	24	7	7	7
Buffalo	8	13	13	98	26	26	2	4	4
Cat, Wild	3	0	0	15	0	0	1	0	0
Crocodile	0	0	0	7	0	0	0	0	0
Duiker	21	12	12	49	16	16	0	0	0
Eland	4	1	0	7	3	3	2	1	1
Elephant	38	58	58	134	82	82	16	22	22
Gemsbok	6	5	5	6	3	3	1	2	2
Hare, Cape	15	15	15	70	12	12	5	5	5
Hare, Scrub	15	15	15	70	12	12	5	5	5
Hyena_ Spotted	3	1	1	13	0	0	1	0	0
Impala	7	13	13	294	28	28	3	5	5
Jackal	9	0	0	16	0	3	3	0	0
Kudu	9	6	6	58	15	15	2	2	2
Lechwe	0	0	0	134	12	12	0	0	0
Leopard	3	0	0	8	0	0	1	0	0
Lion	0	0	0	0	0	0	0	0	0
Monkey, Vervet	4	4	4	22	9	9	2	2	2
Ostrich	15	6	6	20	3	3	0	0	0
Porcupine	6	3	3	22	4	4	2	1	1
Springbok	3	3	3	6	5	5	0	0	0
Steenbok	45	21	21	125	35	35	9	5	5
Tsessebe	0	0	0	151	10	0	0	0	0
Warthog	4	4	4	111	13	13	2	2	2
Wildebeest, blue	4	3	3	84	9	9	2	2	2
Zebra	8	6	6	95	15	15	2	2	2
Total	**251**	**210**	**209**	**1,664**	**336**	**329**	**68**	**67**	**67**

Source: Department of Wildlife and National Parks

Table 4.4k Botswana All Citizen Wildlife Hunting Quotas (2009-2011)

Species	2009	2010	2011	Total
Baboon	32	31	31	94
Buffalo	0	0	0	0
Cat, Wild	0	0	0	0
Crocodile	0	0	0	0
Duiker	145	120	120	385
Eland	0	0	0	0
Elephant	24	37	37	98
Gemsbok	16	10	10	36
Hare, Cape	0	0	0	0
Hare, Scrub	0	0	0	0
Hartbeest	0	0	0	0
Hyena_ Spotted	8	2	2	12
Impala	250	194	194	638
Jackal	0	0	0	0
Kudu	105	46	64	215
Lechwe	0	0	0	0
Leopard	0	0	0	0
Lion	0	0	0	0
Monkey, Vervet	0	0	0	0
Ostrich	128	71	71	270
Porcupine	0	0	0	0
Side striped Jackal	0	0	0	0
Springbok	55	22	22	99
Steenbok	193	95	95	383
Tsessebe	8	4	0	12
Warthog	55	12	12	79
Wildebeest, blue	22	11	9	42
Zebra	12	7	7	26
Total	**1,053**	**662**	**674**	**2,389**

Source: Department of Wildlife and National Parks

4.5 Poaching

Poaching is the illegal hunting, killing or capturing of animal species. It involves killing of wildlife without a license, killing outside hunting season, and killing using prohibited weapons. It is the "illegal taking of wildlife, in violation of local, state, federal or international law. Activities that are considered poaching include killing an animal out of season, without a license, with a prohibited weapon, or in a prohibited manner" (Environment.about.com; 2013).

If left unchecked poaching contributes to the extinction of animal species and loss of biodiversity. It is a threat to food security of rural communities especially where Community Based Natural Resources Management is practiced. It also hurts the tourism industry, thereby impacting on national economy.

Wildlife poaching in Botswana is at two levels; commercial and subsistence. The former is usually international in nature and involves high value species like rhino, lion and elephant while the latter is borne out of a quest to subsist. Department of Wildlife and National Parks (DWNP) through Anti-Poaching Unit are responsible for fighting and controlling this scourge. However, statistics show that even with this effort, poaching is still taking place.

4.5.1 Poaching Incidences

Incidences of poaching for all districts except Central District in the period 2009 to 2011 are indicated on Tables 4.5a – Table 4.5g. Comparison among the districts shows that elephant was the most poached species in the three years under review; particularly in Chobe District in the year 2011. Ngamiland also recorded a sizable number of elephant poaching in the period.

In Kgalagadi Gemsbok and Eland were the most poached species while in Kgatleng the commonly poached species was Impala; and the numbers were increasing throughout the period.

Table 4.5a Poaching Statistics – Chobe (2009-2011)

Species	2009	2010	2011
Buffalo	2	1	0
Duiker	0	0	1
Eland	1	0	1
Elephant	22	25	54
Gemsbok	0	0	0
Implala	0	0	2
Jackal	0	1	0
Kudu	0	0	2
Lion	0	0	0
Sable	0	0	0
Seenbok	0	0	2
Tsessebe	0	0	1
Warthog	0	1	0
Waterbuck	0	0	0
Zebra	0	0	0
Total	**25**	**28**	**63**

Table 4.5b Poaching Statistics - Ghanzi (2009-2011)

Species	2009	2010	2011
Eland	2	3	0
Kudu	1	0	0
Gemsbok	6	2	0
Warthog	0	2	0
Porcupine	0	1	1
Pangolin	0	1	0
TOTAL	**9**	**9**	**1**

Source: Department of Wildlife and National Parks

Table 4.5c Poaching Statistics - Kgalagadi (2009- 2011)

Species	2009	2010	2011
Gemsbok	13	22	5
Cheetah	3	5	0
Hartebeest	3	4	1
Steenbok	3	4	0
Springbok	5	3	0
Ostrich	2	2	0
Eland	8	15	0
Jackal (Black Backed)	0	6	0
Caracal	1	1	0
Lion	4	0	0
Genet	1	0	0
Bat eared Fox	3	0	0
Total	**46**	**62**	**6**

Source: Department of Wildlife and National Parks

Table 4.5d Poaching Statistics - Kgatleng (2009-2011)

Species	2009	2010	2011
Brown hyena	0	0	1
Kudu	0	6	5
Fish	0	1	2
Steenbok	0	2	0
Warthog	0	0	3
Duiker	1	2	0
Wildebeest	0	1	0
Impala	4	10	16
Blue hartebeest	0	0	1
Leopard	0	0	1
Total	**5**	**22**	**29**

Source: Department of Wildlife and National Parks

Table 4.5e Poaching Statistics - Kweneng (2009-2011)

Species	2009	2010	2011
Leopard	3	0	0
Eland	0	1	0
Kudu	1	3	1
Python	1	0	0
Gemsbok	3	0	0
Warthog	0	2	0
Hartebeest	6	0	0
Total	**14**	**6**	**1**

Table 4.5f Poaching Statistics – Ngamiland (2009-2011)

Species	2009	2010	2011
Bush Buck	0	1	0
Buffalo	5	4	3
Eland	1	0	0
Elephant	9	11	10
Fish	0	0	0
Gemsbok	1	0	1
Giraffe	4	5	0
Hyena	0	0	0
Hippo	0	1	1
Impala	3	2	3
Kudu	2	1	3
Lechwe	0	4	0
Leopard	0	0	0
Lizard	0	0	0
Python	1	0	0
Puff Adder	0	0	0
Reedbuck	0	0	0
Rhino	0	0	0
Warthog	0	0	0
Waterbuck	0	0	0
Wildebeest	3	1	0
Zebra	3	0	1
Total	**32**	**30**	**22**

Source: Department of Wildlife and National Parks

Table 4.5g Poaching Statistics - Southern (2009-2011)

Species	2009	2010	2011
Leopard	0	0	0
Cheetah	2	0	1
Eland	0	0	0
Kudu	0	0	4
B/hyena	1	0	1
Python	0	1	0
Steenbok	0	0	0
Gemsbok	0	1	1
Warthog	0	0	0
Duiker	0	0	0
Hartebeest	0	0	0
Springbok	0	1	0
Turtle	0	1	0
Ostrich	0	0	2
Total	**3**	**4**	**9**

Source: Department of Wildlife and National Parks

4.5.1.1 Impact of Poaching

Globally, poaching is a threat to conservation efforts especially when vulnerable species are involved (Department of Environmental Affairs, 2011). In Botswana some of the poached species are on the IUCN Red List of globally threatened species such as elephant and cheetah. The list is shown on Table 4.5e. Although the list is the most globally accepted, it is not a complete list of all species in Botswana thus "it may not reflect the national status of species in Botswana"(Government of Botswana, 2009).

According to environment.about.com only about 10,000 rhinos exist today globally which is an 85 percent decrease from the 1970's population. The decrease is mainly due to poaching as rhino horns are quite expensive around the world. The Black rhino has for years been classified as critically endangered, as it has been nearing extinction mainly as a result of poaching. It is however gratifying that the species population is found to be increasing. Botswana came up with an initiative to re-introduce and grow black rhino population in Khama Rhino Sanctuary.

In the Red List lion, cheetah, hippo and black footed cat are classified as vulnerable and their populations are declining. Besides human settlements encroachment into their habitat, lions are under threat from illegal hunting (African Wildlife Foundation).The elephant population is classified as near threatened but the population is increasing both globally and locally. The increasing population is due to great conservation effort by the country. In addition the restriction of trade in ivory by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to which Botswana is a party contributes to the growing population.

Table 4.5e List of Globally Threatened Mammals in Botswana

Common Name	Scientific Name	Conservation Status	Population Trend
Cheetah	*Acinonyx jubatus*	Vulnerable	Declining
White Rhinoceros	*Ceratotherium simum*	Near Threatened	Increasing
Black Rhinoceros	*Diceros bicornis*	Critically Endangered	Increasing
Straw-coloured fruit Bat	*Eidolon helvum*	Near Threatened	Declining
Black-footed Cat	*Felis nigripes*	Vulnerable	Declining
Hippopotamus	*Hippopotamus amphibius*	Vulnerable	Declining
Roan Antelope	*Hippotragus equines*	Least concern	Declining
Brown Hyena	*Hyena brunnea*	Near Threatened	Declining
Puku	*Kobus vardonii*	Near Threatened	Declining
Botswana Long-eared Bat	*Laephotis botswanae*	Least concern	Unknown
African Elephant	*Loxodonta africana*	Near Threatened	Increasing
Southern African Mastomys	*Mastomys coucha*	Least concern	Stable
Lion	*Panthera leo*	Vulnerable	Declining
Leopard	*Panthera pardus*	Near Threatened	Declining

Source: Botswana Fourth National Report to the Convention of Biological Diversity, 2009 Government of Botswana

5. FORESTS

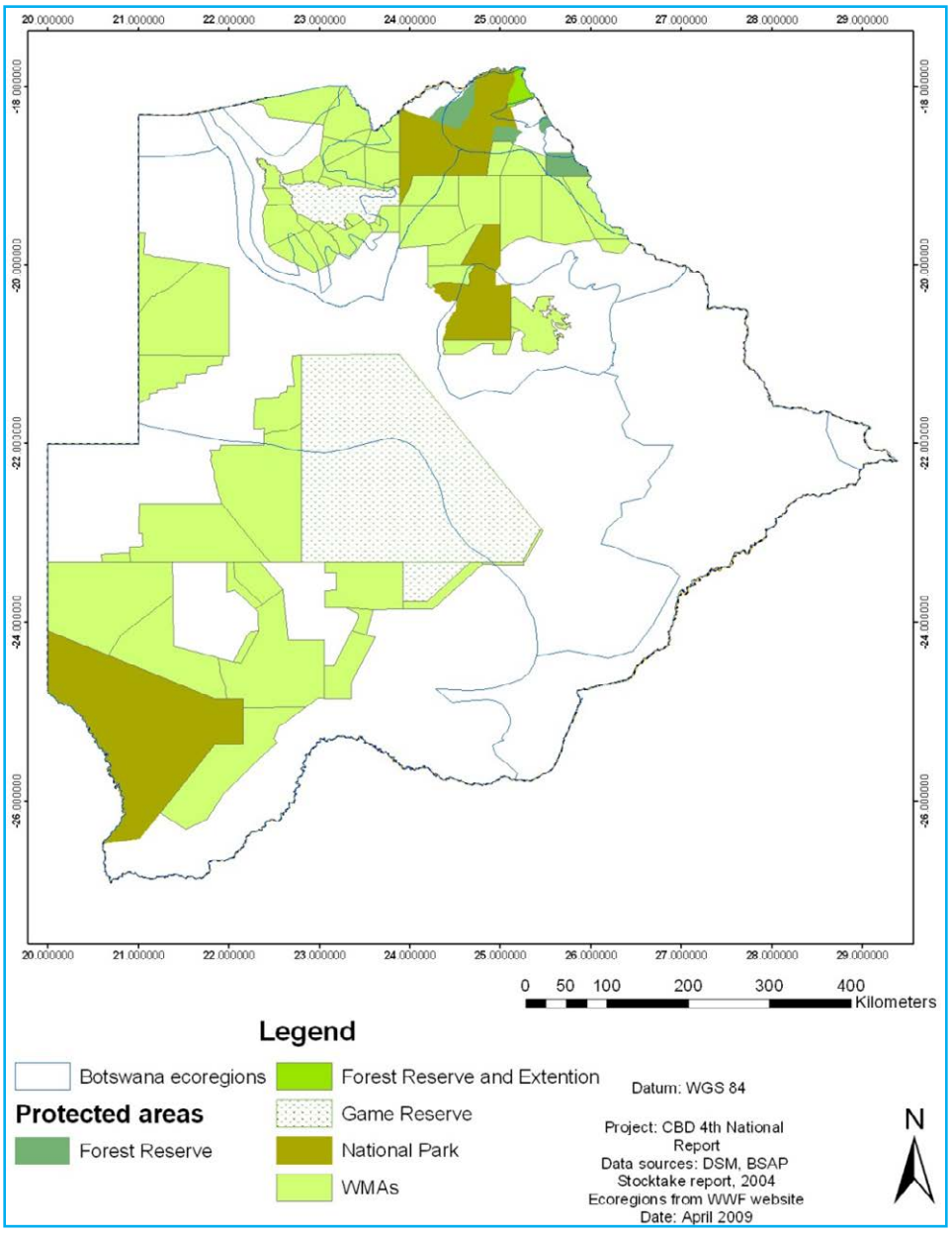
5.1 Introduction

Botswana's forests are endowed with natural resources that people and ecosystems depend on. They also provide habitats and food for the wildlife, upon which the country depends to a large extent, especially through tourism revenue. Botswana does not have a national policy specific to the management of forests and their resources, but has legislation in the form of the Forest Act of 1968.

5.2 Forest Reserves and Protected Areas in Botswana

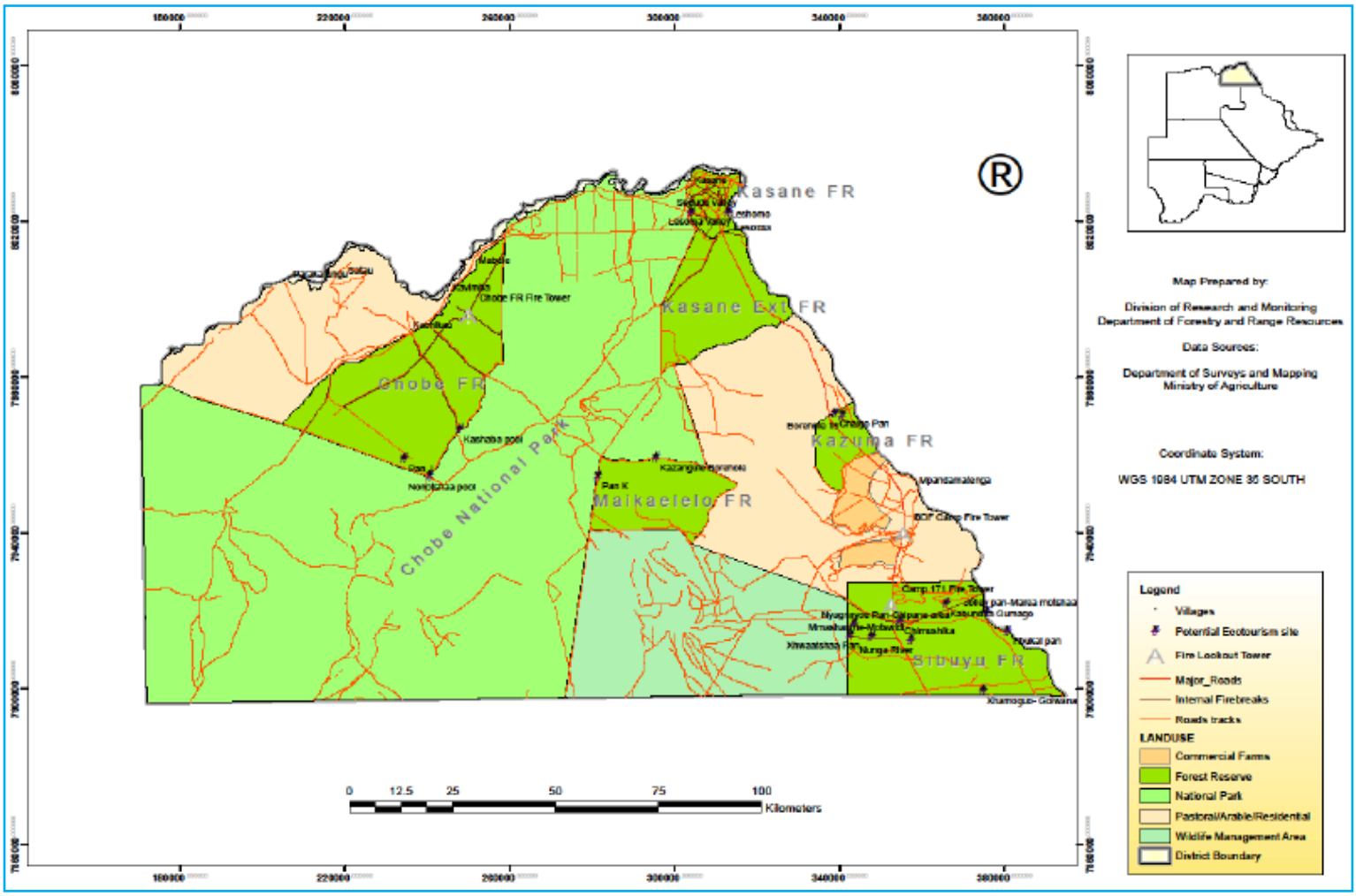
About 45 percent of Botswana's land area is set aside as protected areas. The types of protected areas includes forest reserves, game reserves, national monuments, Wildlife Management Areas (WMAs), within which are Controlled Hunting Areas (CHAs), national parks and private wildlife and nature reserves (4th National Report to CBD: 2009).

Figure 5.2a: Protected Areas in Botswana



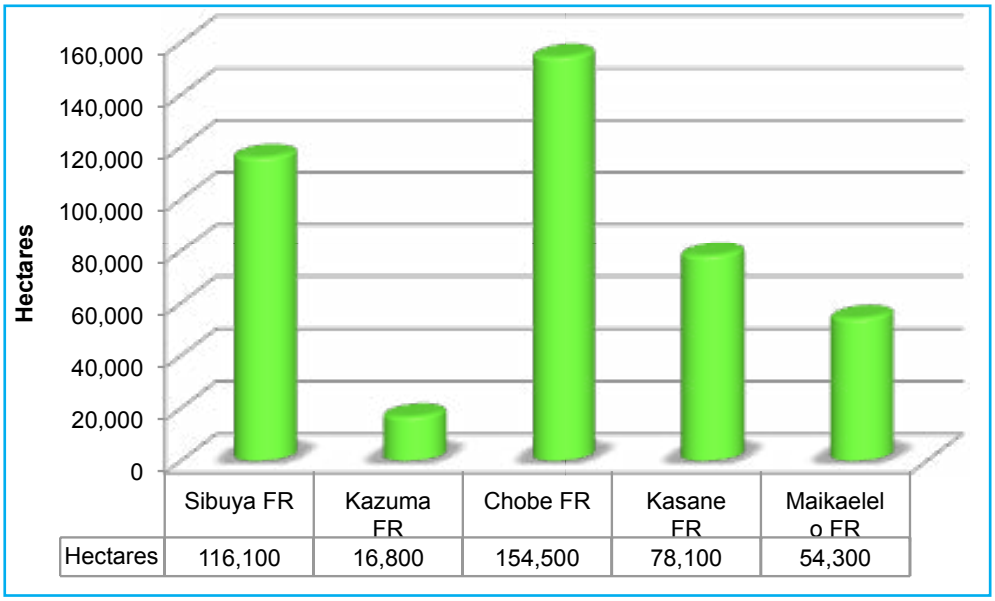
Source: Botswana 4th National Report to the CBD; 2009

Figure 5.2b: Location of Forest Reserve in Botswana



The five forest reserves of Botswana are in the northern region, (Figure 5.2b) and account for a total of 4,190 square kilometres of Botswana's land area (4th National Report to CBD:2009). This translates into about 0.7 percent of the country's total land area, and 1.6 percent of the total protected area in Botswana. Figure 5.2c illustrates the sizes of the forest reserves.

Figure 5.2c: Size of Botswana's Forest Reserves



Source: Centre for Applied Research; 2009

5.3 Trends in Botswana Forest Cover

Botswana's total land area is 582,000 square kilometres. Botswana's forest cover stood at about 11,346 square kilometres in 2011 (Department of Forestry and Range Resources: 2012), after a gradual decline from around 13,595 square kilometre in 1991. This is a decline of about 17 percent in ten years. Forests and woodlands areas together cover about sixty percent of the land area of Botswana (Government of Botswana: 2010).

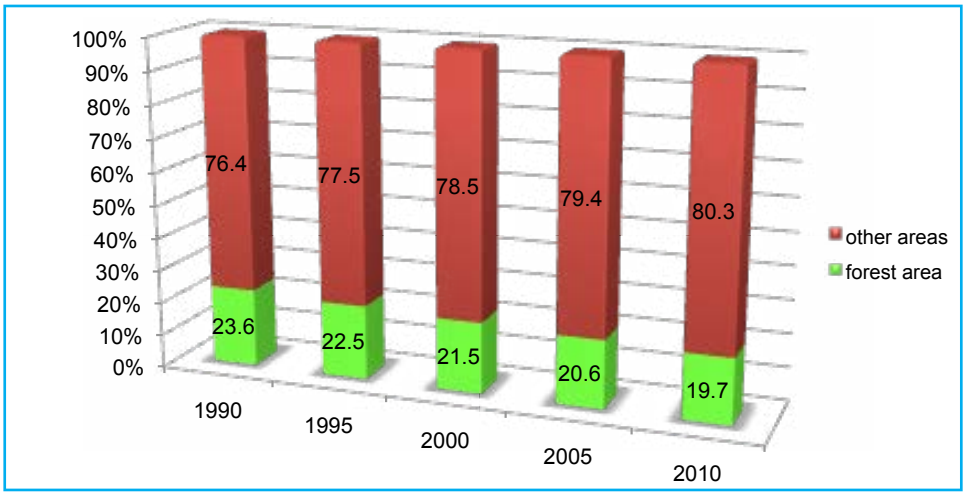
Table 5.3a shows the forest cover decline using selected years between 1990 and 2010. The total forest area in Botswana declined from 23.6 percent in 1990 to 19.7 percent in 2010. Reasons for deforestation include fuel wood harvesting and land clearing for human settlements. The declining trend is also depicted graphically in Figure 6.3a.Figure 6.3b indicates the trend in Botswana's forest cover between 1990 and 2011.

Table 5.3a Botswana Forest Cover

Year	1990	1995	2000	2005	2010
Total forest area (ha)	13,718,000	13,111,702	12,532,201	11,978,312	11,448,903
Total area (ha)	58,200,000	58,200,000	58,200,000	58,200,000	58,200,000
% of total land area	23.6	22.5	21.5	20.6	19.7

Source: Department of Forestry and Range Resources, 2012

Figure 5.3a: Botswana Forest Cover



Source: Department of Forestry and Range Resources Data (2012)

Figure 5.3b: Botswana Forest Cover(Hectares): 1990-2011

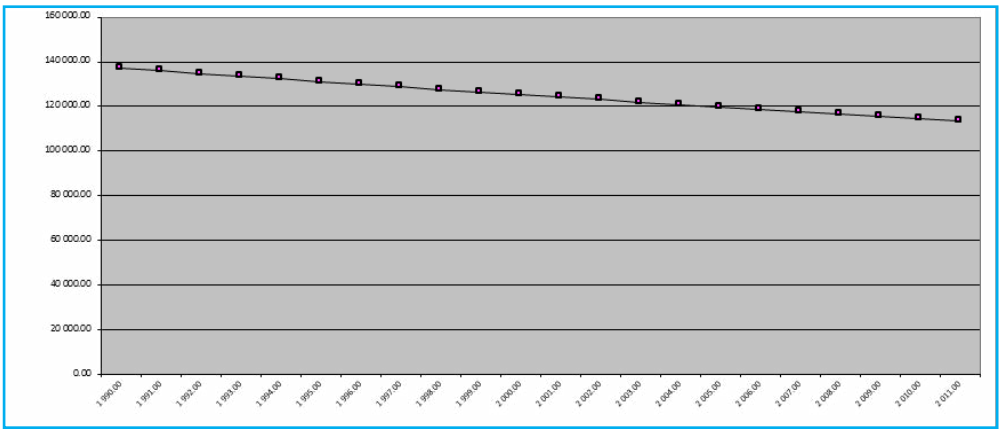


Table 5.3b shows the proportion of forest reserves to total forest cover. The proportion of forest cover that is protected is rising, but only because of the falling total forest cover, and not because of any additional forest covers being designated as protected. Cognizant of the above said, Botswana's total forest cover is declining.

Table 5.3b: Forest Reserve as a Proportion of Forest Cover (Square Kilometres): 2008-2011

Year	2008	2009	2010	2011
Forest cover	11,658	11,553	11,449	11,346
Total forest reserve	4,190	4,190	4,190	4,190
Percentage of forest cover that is protected	36	36.3	36.6	36.9

Source: Department of Forestry and Range Resources

The trend in the land covered by forests in Botswana is also reflected in the carbon stock in living Biomass seen in Table 5.3c, which shows a falling trend from 1990 to 2010. An annual reduction of 2,000 tonnes is estimated.

Table 5.3c: Carbon Stock in Living Biomass

Carbon stock in living forest biomass					Annual change (000t/yr)	
Year	**1990**	**2000**	**2005**	**2010**	**90-2000**	**2000-05**
(million tonnes)	680	663	655	646	-2	-2
Tonnes per hectare	n/a	n/a	n/a	57t/ha	n/a	n/a

n/a - data not available
Source: Global Forest Resources Assessment; 2010

5.4 Pressures on Forests

5.4.1 Fuel Wood

The largest consumer of energy in Botswana is the household sector, which is dominated by a dependence on fuel wood (Sampa:2011). Fuelwood is the primary household energy source in Botswana, especially for rural households, 90 percent of whom primarily depend on fuelwood (Government of Botswana; 2009).The use of fuel wood presents pressures on forest resources and challenges for their management and conservation. This is especially the case as the rate and manner of exploitation of the resource is not known or monitored.

5.4.2 Fire

A major threat to forests in Botswana is that presented by wild fires. Wild fires destroy forests and disrupt ecological balances. This presents threats to biodiversity. Wild fire management in protected areas is hindered by the lack of perceivable incentives for communities to control fires that are within the boundaries of the protected areas. This is largely due to the perception that protected areas are Government-owned entities that are off limits to communities. Wild fires also destroy livestock and the grazing resources they depend on. In 2011/12, Kweneng district had 11cattle, 5 horses and 18 goats burned to death in wild fires, while Central district had 3 cattle, 12 goats, and 9 sheep burned in fires in 9 ranches. In Ngamiland 28 ranches and one A1 ranch were burnt in the same period (Ministry of Finance and Development Planning 2012).

Table 5.4a shows the extent of area affected by wild fires by district for the years 2006 to 2011. The table indicates the sharp increase in the areal extent of fires over Botswana in the year 2008 (11,846,790 hectares), followed by a sharp decline in 2009 to 2,124,952hectares, and two highs for 2010 and 2011 at 13,586,774 hectares and 15,439,035hectares respectively.

Table 5.4a: Area Burnt by District (Hectares): 2006-2011

District	2006	2007	2008	2009	2010	2011	District size
Central	803,070	56,820	1,460,431	179,136	2,757,523	1,150,172	14,637,419
Chobe	771,400	309,390	683,599	446,677	534,789	812,350	2,101,920
Ghanzi	1,428,153	1,109,580	5,241,479	238,065	5,291,407	5,228,384	11,472,587
Kgalagadi	665,520	738,995	397,478	357,151	901 ,540	3,466,251	10,491,604
Kgatleng	3,280	0	111,452	2,571	122,939	159,396	761,943
Kweneng	74,427	167,010	1,287,104	9,336	683,658	514,127	3,696,345
Ngamiland	1,929,956	854,680	2,565,514	842,762	2,408,697	3,712,408	11,134,421
North East	32,955	1,070	1,910	3,301	494	14,846	514,619
South East	5,350	0	9,888	0	1,503	2,804	85,800
Southern	2,090	58,620	87,933	45,953	884,225	378,296	2,723,320
Grand Total	**5,716,201**	**3,296,165**	**11,846,790**	**2,124,952**	**13,586,774**	**15,439,035**	**57,619,978**

Source: Department of Forestry and Range Resources

Figure 5.4a displays the information from the above table in a graphic manner. Central, Ghanzi, Ngamiland and Kgalagadi districts have the largest areas burnt by wild fires. They are also the bigger group of districts, in land size.

Figure 5.4a: Area Burnt by District (2006-2011)

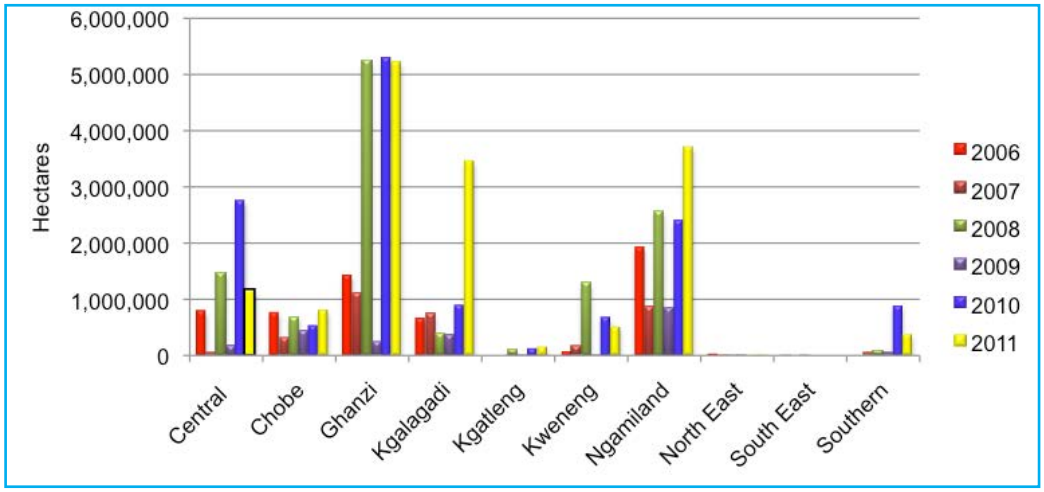


Table 5.4b shows the proportion of areas burnt in each of the districts for the years 2006 to 2011. Proportionately, Ghanzi District and Chobe District show more burnt areas, while Central District's size results in lower proportionate burnt areas. Figure 5.4b graphically illustrates the areas burnt in proportion to the district size.

Table 5.4b: Proportion of Areas Burnt By District 2006-2011

District	2006	2007	2008	2009	2010	2011	District size (Hectares)
Central	5.5	0.4	10	1.2	18.8	7.9	14,637,419
Chobe	36.7	14.7	32.5	21.3	25.4	38.6	2,101,920
Ghanzi	12.4	9.7	45.7	2.1	46.1	45.6	11,472,587
Kgalagadi	6.3	7	3.8	3.4	8.6	33	10,491,604
Kgatleng	0.4	0	14.6	0.3	16.1	20.9	761,943
Kweneng	2	4.5	34.8	0.3	18.5	13.9	3,696,345
Ngamiland	17.3	7.7	23	7.6	21.6	33.3	11,134,421
North East	6.4	0.2	0.4	0.6	0.1	2.9	514,619
South East	6.2	0	11.5	0	1.8	3.3	5,800
Southern	0.1	2.2	3.2	1.7	32.5	13.9	2,723,320
Total	9.9	5.7	20.6	3.7	23.6	26.8	57,619,978

Source: Department of Forestry and Range Resources

Figure 5.4b: Proportion of Areas Burnt By District 2006-2011

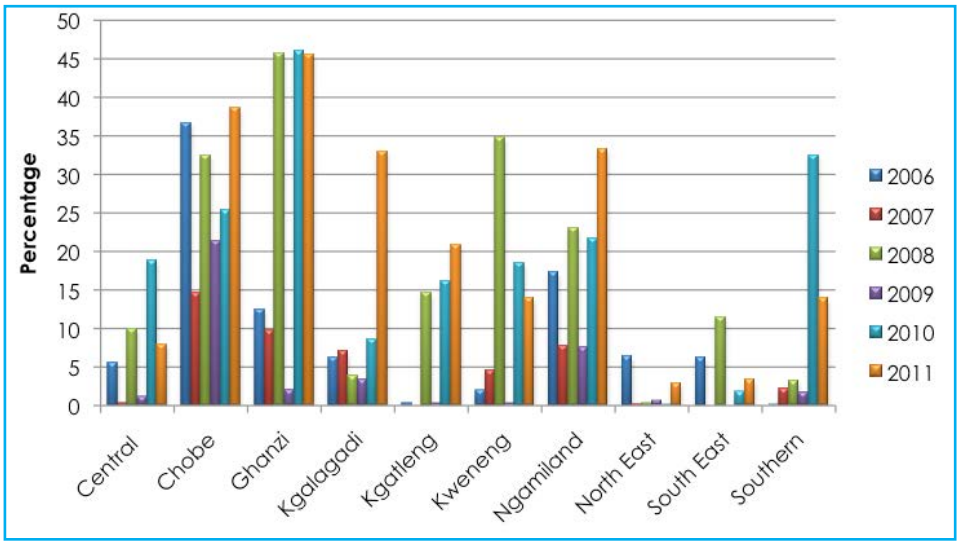


Table 5.4cindicates the incidence of fires by district for the years 2009 to 2011. Central district consistently recorded the highest incidences while South East had the least incidences. The highest number of incidences was recorded in the year 2010.

Table 5.4c: Incidence of Fires By District 2009 – 2011

District	2009	2010	2011	Total
Central	34	55	48	137
Chobe	9	11	15	35
Ghanzi	17	28	42	87
Kgalagadi	19	26	18	63
Kgatleng	3	9	8	20
Kweneng	5	52	35	92
Ngamiland	25	18	28	71
North East	6	1	8	15
South East	0	3	4	7
Southern	11	53	45	109
Grand Total	129	256	251	636

Source: Department of Forestry and Range Resources

Table 5.4d and Figure5.4d shows the areas burnt in protected areas in Botswana for the period 2008 to 2011.The Central Kalahari Game Reserve (CKGR) shows the greatest extent of wild fires, but is also the biggest of the protected areas. The Kgalagadi Trans-frontier Park (KTP) is also relatively big and shows one of the largest areal expanses of burning, particularly for the years 2009 and 2011.

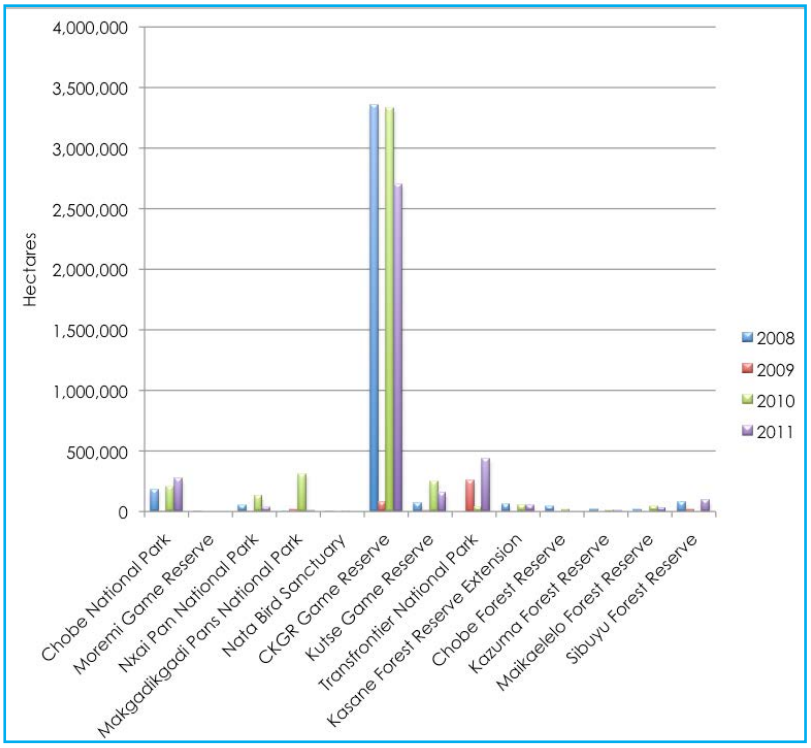
Table 5.4d: Burnt Areas in Protected Areas (2008-2011)

Protected Areas	Size (ha)	burnt 2008	burnt 2009	burnt 2010	burnt 2011
Chobe National Park	1,062,447	180,185	4,774.36	208,757	274,791.00
Moremi Game Reserve	489, 614	794	n/a	0	0
Nxai Pan National Park	249, 093	53,491	1,865.70	127,744	36,636.30
Makgadikgadi Pans National Park	505, 901	4,723	14 ,616.3	308,531	6,801.80
Nata Bird Sanctuary	24, 943	401	n/a	24	0
CKGR Game Reserve	5,226,136	3,352,491	78,991.40	3,330,236	2,702,829.20
Kutse Game Reserve	255,137	71,948	6,053.60	248,483	157,915.60
Transfrontier National Park	2,620,712	0	257,241.40	39,459	435,282.10
Kasane Forest Reserve Extension	67,175	59,583	n/a	54,747	48,466.00
Chobe Forest Reserve	143,197	42,686	n/a	15,692	0
Kazuma Forest Reserve	19,536	17,980	n/a	13,380	8,944.00
Maikaelelo Forest Reserve	53 220	15 447	n/a	40,826	30,312.49
Sibuyu Forest Reserve	119 433	81 525	15,135.93	0	98,302.49

n/a - data not available

Source: Ministry of Finance and Development Planning Drought Assessment Reports

Figure 5.4c: Burnt Areas in Protected Areas (2008-2011)



In Figure 5.4d, the CKGR and the Trans-frontier Park are excluded, showing the extent of burnt areas in the other protected areas.

Table 5.4e and Figure 5.4e depict the proportion of each of the protected areas (excluding CKGR and KTP) that was burnt for the period 2008 to 2011. Khutse Game Reserve experienced fires that burnt nearly the reserve's whole area in 2010 (97 percent).

Figure 5.4d: Burnt Areas 2008-2011 (excluding CKGR and Transfrontier Park)

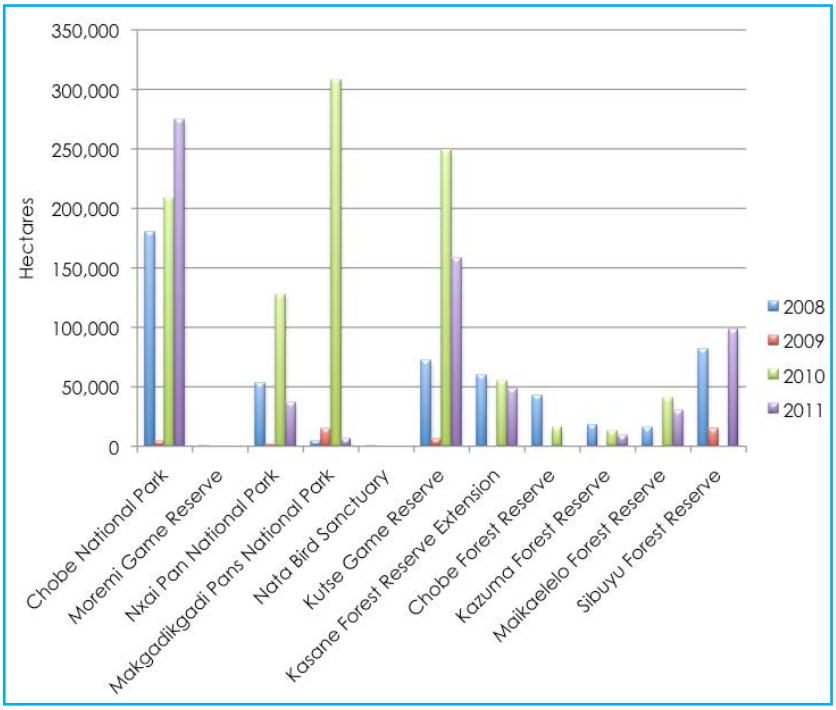
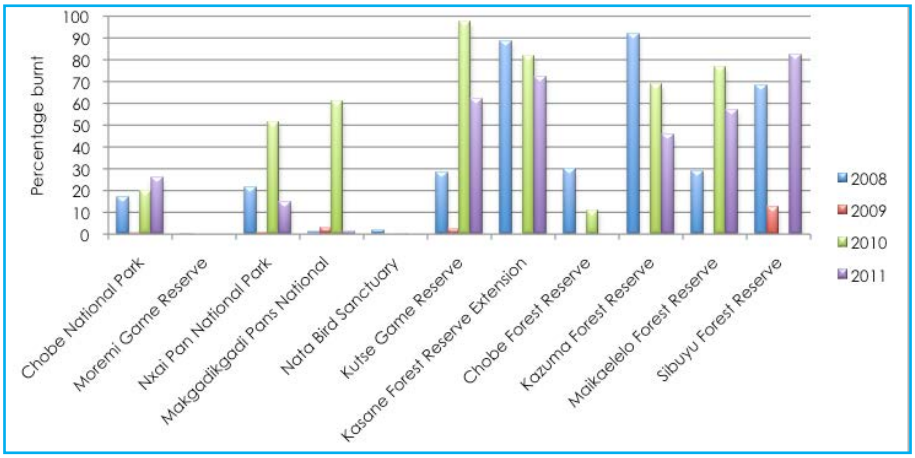


Table 5.4e: Percentage Burnt in Protected Areas (2008-2011)

Protected areas	Size (ha)	2008	2009	2010	2011
Chobe National Park	1,062,447	17	0.5	20	25.9
Moremi Game Reserve	489,614	0.2	n/a	0	0
Nxai Pan National Park	249,093	21.5	0.8	51.3	14.7
Makgadikgadi Pans National Park	505,901	0.9	3	61	1.3
Nata Bird Sanctuary	24,943	1.6	n/a	0.1	0
Kutse Game Reserve	255,137	28.2	2.4	97.4	61.9
Kasane Forest Reserve Extension	67,175	88.7	n/a	81.5	72.2
Chobe Forest Reserve	143,197	29.8	n/a	11	0
Kazuma Forest Reserve	19,536	92	n/a	68.5	45.8
Maikaelelo Forest Reserve	53,220	29	n/a	76.7	57
Sibuyu Forest Reserve	119,433	68.3	12.7	0	82.3
Total area	**10,836,544**	**35.8**	**10**	**40.5**	**35**

n/a - data not available
Source: Ministry of Finance and Development Planning Drought Assessment Reports

Figure 5.4e: Percentage Burnt in Protected Areas (2008-2011)



Extracting the forest reserves and showing them alone, Table 5.4f shows the percentage of the forest reserves that were burnt. The forest reserve that experienced the highest proportion of area burnt is Kazuma Forest Reserve in the year 2008, when 92 percent of its area was burnt by wild fires. Kasane Forest Reserve had consistently high proportion of area burnt throughout the years. Indications are that on average, each of the forest reserves experiences burning of over 50 percent of its area annually. On average, about 37 percent of the country's total forest reserves area experienced burning by wild fires annually, for the years 2008, 2010 and 2011.

Figure 5.4f compares the extent of area burnt in absolute terms in each of the forest reserves. The largest area burnt was that of Sibuyu Forest Reserve, for the years 2011 and 2008.

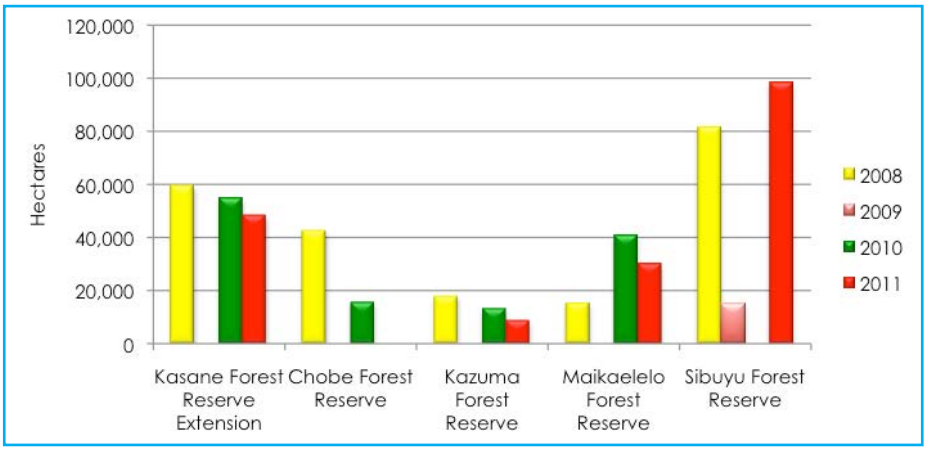
Table 5.4f: Percentage of Forest Reserves Burnt (2008-2011)

	2008	2009	2010	2011
Kasane Forest Reserve Extension	89	n/a	81	72
Chobe Forest Reserve	30	n/a	11	n/a
Kazuma Forest Reserve	92	n/a	68	46
Maikaelelo Forest Reserve	29	n/a	77	57
Sibuyu Forest Reserve	68	13	n/a	82
% of total forest reserve area	36	n/a	41	35

n/a - data not available

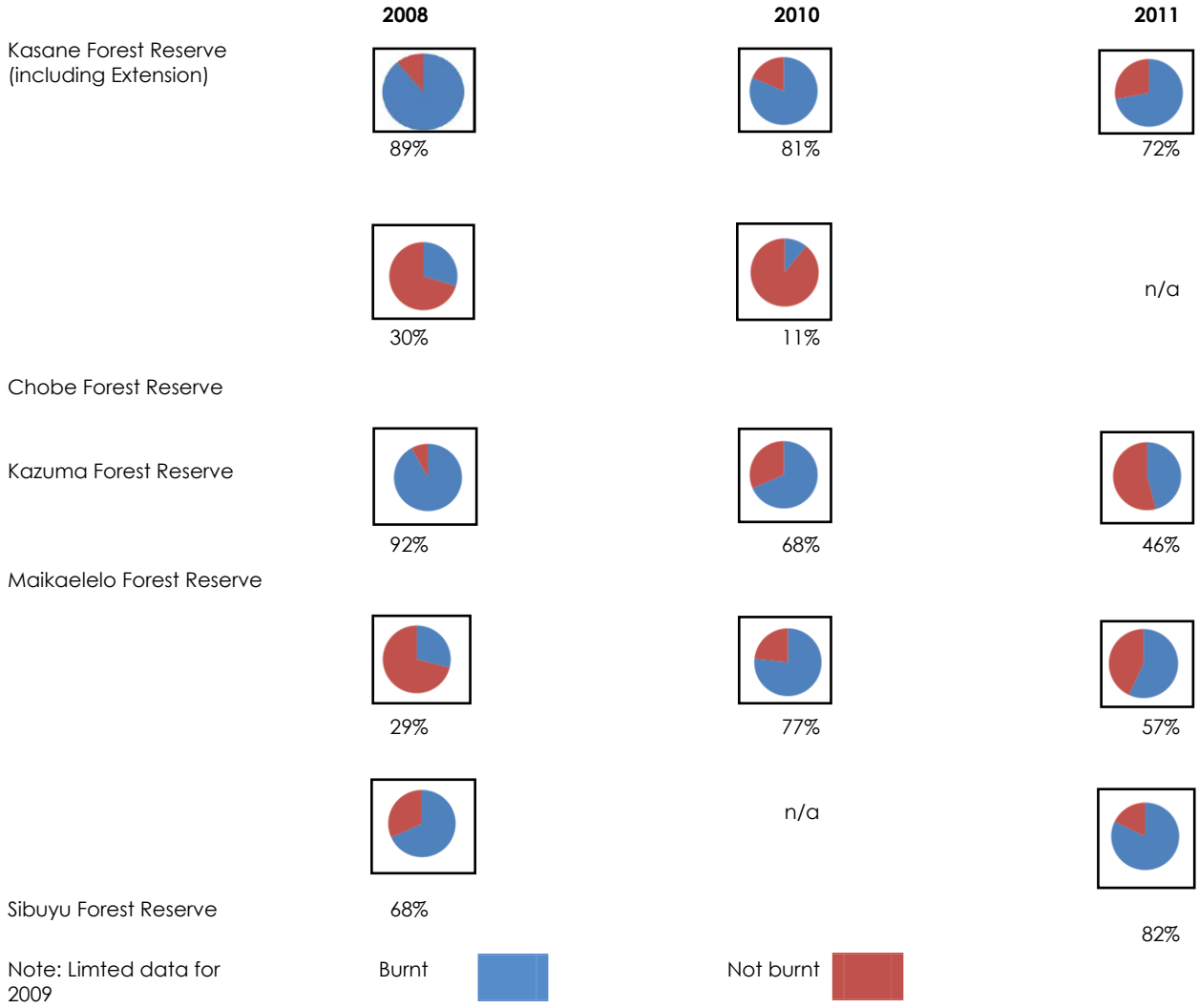
Adapted from data provided by Department of Forestry and Range Resources

Figure 5.4f: Area Burnt in Forest Reserves (2008-2011)



The graphic presentation of the proportions burnt in the forest reserves is given in Figure 5.4g. Kasane Forest Reserve consistently shows high proportions of burnt area for the three years indicated while Kazuma Forest Reserve had the highest proportion burnt in the year 2008.

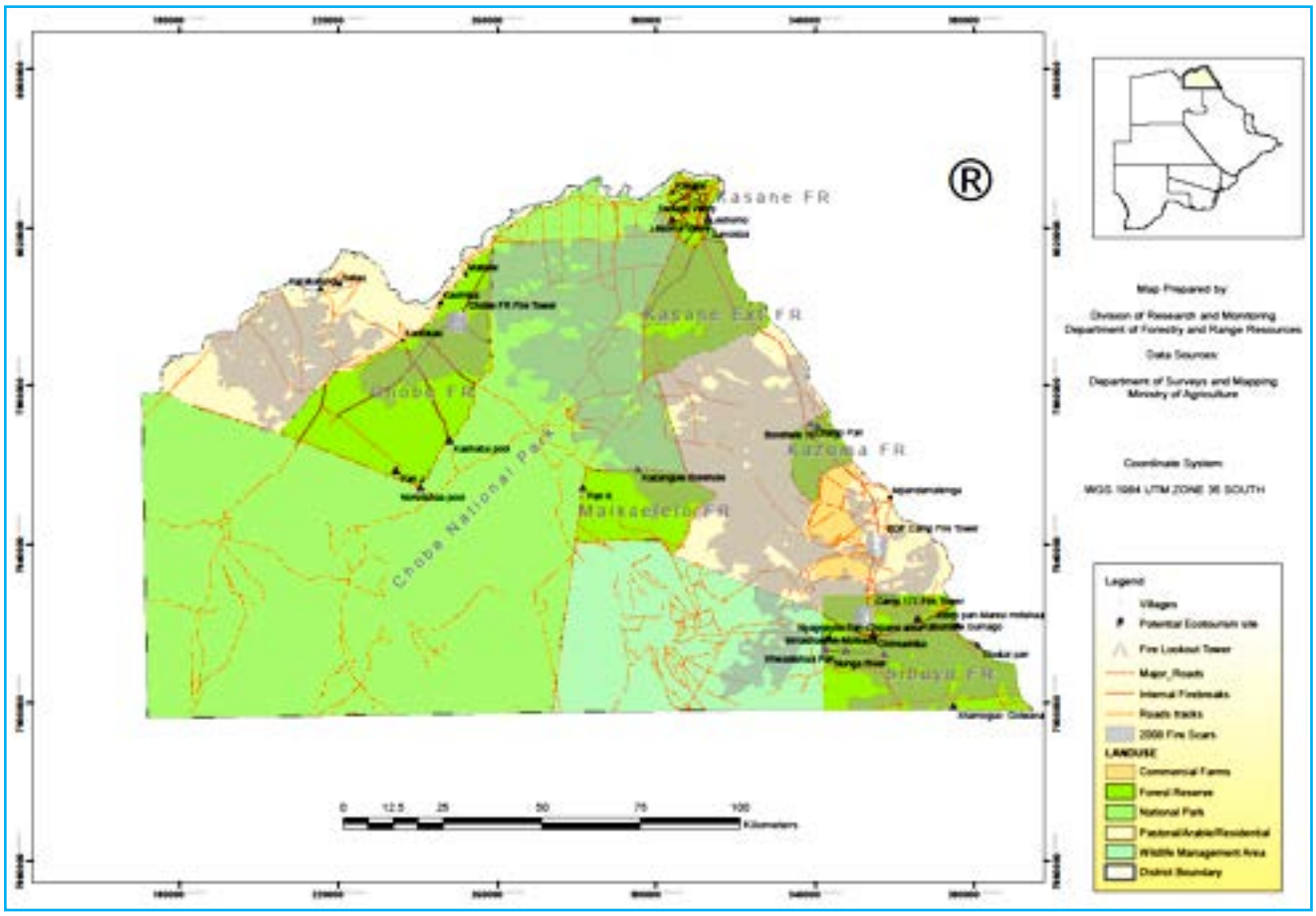
Figure 5.4g: Proportions Burnt in Forest Reserves (2008-2011)



n/a - data not available

The map in Figure 5.4h shows the fire scars in2008 and the extent to which the forest reserves were affected by fire.

Figure 5.4h: 2008 Fire Scars



Source: Centre for Applied Research (2009)

5.4.3 Alien Invasive Species

Invasive Alien Species (IAS) is specie whose introduction and/or spread outside their natural past or present distribution, threatens biological diversity (Convention on Biological Diversity online: 2013). Limited data or inventories exist for Botswana's vegetation or threatened plant species.(Ministry of Environment Wildlife and Tourism Environmental Information System: 2013).

The online Global Invasive Species Database by the Invasive Species Specialist Group (ISSG) of the IUCN Species Survival Commission returns a count of 32 invasive species found in Botswana as of the 18th of January 2013. One of the species threatening biodiversity in the country is Prosopis (Sexanana). Table 5.4g shows the spatial extent affected by the species in 2008.

Table 5.4g: Estimated Coverage in Areas (Hectares) Affected By Prosopis (Sexanana) Invasive Species by District: 2008

District	Location	Area (Ha)
Central	Mmadikolo	5
Ghanzi	Ghanzi Township	1,095
Southern	Mabule	5
	Tshidilamolomo	36
Kgalagadi	Bokspits-Struizendam road	945
	Gakhibana	275
	Hukuntsi	568
	Khuis	220
	Lehututu	75
	Lokgwabe	61
	Rapples, Pan	75
	Struizendam	320
	Tshane	200
	Welverdiend	13
	Werda	200

Source: Department of Forestry and Range Resources

In addition, species of plants are threatened as a result of the pressures on forests and forest resources. Table 5.4h is a list of the threatened plant species in Botswana.

Table 5.4h: Threatened Plant Species in Botswana

	Species	Local name
1	Hoodia spp	Seboka
2	Devils claw	Sengaparile
3	Resurrection plant	Gala la Tshwene
4	Poison Rope	Kombi
5	Long Tailed Cassia	Monepenepe
6	Milk Weed	Mosata
7	Wormwood	Lengana
8	Fever Tea	Mosukujane
9	Truffles	Mahupu
10	African Indingo	Mhetola
11	Morula	Morula
12	Baobab	Mowana
13	Red Milkwood	Mmupudu
14	Wildmedlar	Mmilo
15	Brown Ivory	Motsentsela
16	Cross berry	Mogwana
17	Snot Apple	Morojwa
18	Monkey Orange	Mogorogorwane
19	Fan Palm	Mokolwane
20	Common Reed	Letlhaka
21	Thatching Grass	Mosikiri
22	Aloe Species	Mekgopha / Kgophane
23	Euphorbia Species	n/a
24	Ceropegia Species	n/a
25	Anacampseros spp	n/a
26	Orchids	n/a

n/a - No Setswana name for the collective group of species
Source: Department of Forestry and Range Resources

5.5 Response

The Government of Botswana, through the Department of Forestry and Range Resources (DFRR) and community projects, is mitigating the loss of forests and endeavours to halt and reverse the rate at which forests are declining. To mitigate the loss due to fuel-wood, Government has established woodlots that are mainly planted with Eucalyptus species. The situation regarding the woodlots is given on Table 5.4i.

Table 5.4i: Total Area (ha) of Community Woodlots By Region: 2011

Region	Area allocated	Area utilised
Central	29.8	6.7
Gaborone	85.9	56.9
North West	16.3	7.05
Southern	56.7	11.2
Western	78.4	14
Total Botswana	**267**	**95.9**

Source: Department of Forestry and Range Resources

Indications are that the woodlots are not utilised at their full potential, as manifest in the proportion of area allocated that is actually utilised. Only about 36 percent of the area allocated for the woodlots is utilised.

Further to this, the Government has partnered with communities to combat desertification. Table 5.4j gives some of the initiatives.

Table 5.4j Community Efforts to Combat Desertification

Project/Commemoration	Objective
Lehututu Community Based Natural Woodland Management	Promote management of indigenous vegetation
Rakops Tree Planting	Control soil erosion in the village by planting trees
Matsiloje Land Reclamation and Agroforestry	To rehabilitate land in the village through planting of various plant species. Beekeeping was also introduced.
Mokobeng Agroforestry woodlot	To plant trees and generate income through cutting and selling of timber. Helping to reduce land degradation by providing poles and firewood instead of people relying on the veld for such products.
The commemoration of the National Tree Planting Day	To increase public awareness and education on the importance of tree planting and conservation of forests/woodlands and environmental protection.

Source: Department of Forestry and Range Resources

6. NATURAL DISASTERS

"Natural disasters are naturally occurring events or aftermath of natural hazards affecting daily human activities" (CSO, 2008). Floods and Drought are the natural disasters that often affect daily human lives in Botswana. Veld (wild) fires also occur frequently in Botswana, resulting in loss of life, property and ecological damage.

A detailed study conducted by the National Disaster Management Office in 2008 identified a number of disasters and risks prevalent in Botswana. These risks include, flooding, drought, animal epidemics and wild land fires, motor vehicle accidents, and human epidemics such as HIV/AIDS, Cholera, Diarrhoea, and Malaria (National Disaster Management Office, 2009).

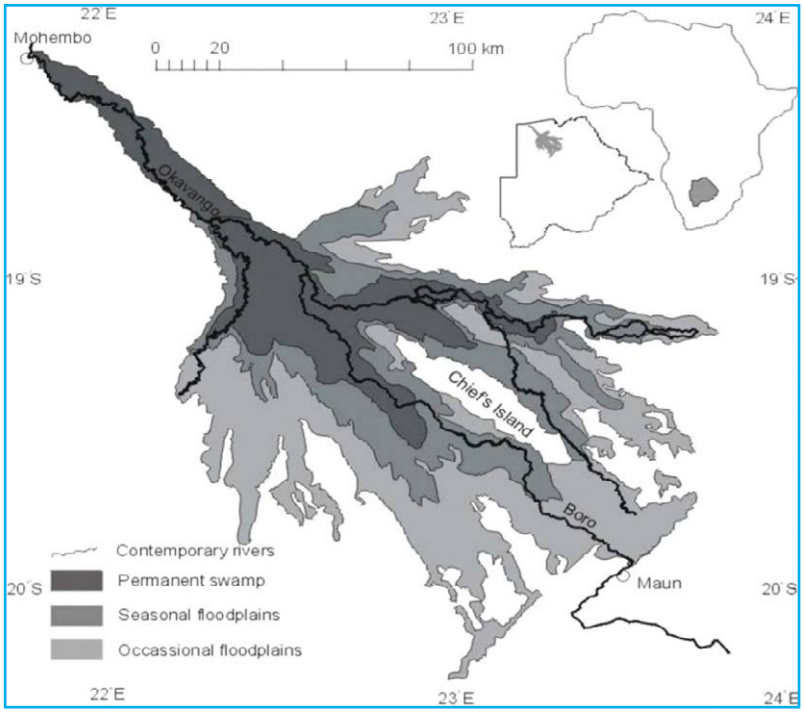
6.1 Floods and Storms

A flood is a great flow of water beyond its normal confines (CSO, 2008). Floods result in loss of human and animal life, loss of property, damage to infrastructure, crop failures and the spread of water-borne diseases. A storm is defined by the Oxford Dictionaries (Oxforddictionaries.com) as a violent disturbance of the atmosphere with strong winds, and usually rain, thunder, lightning, or snow. Storms and floods are common occurrences in Botswana.

6.1.1 Floods in the Okavango

The Okavango delta is the world's largest inland delta, and is situated in the Northwest of Semi-Arid Botswana. It is characterised by a distance of 600 kilometres from the headwaters of the Okavango River, and a low topographic gradient of the alluvial fan (1:3500), which causes a delay in the annual flood of the system, with flooding occurring in the distant part of the delta only during the late dry season (Wolski et. al. 2006). Flooding of varying levels is a regular occurrence in the delta. Figure 6.1a is a map indicating the floodplains of the delta. Flooding in the delta is the result of water from rainfall during the wet seasons and upstream inflows from the Angolan highlands. About 10 billion cubic metres of water is discharged annually to the delta from the Okavango River (Mladenov, 2004).

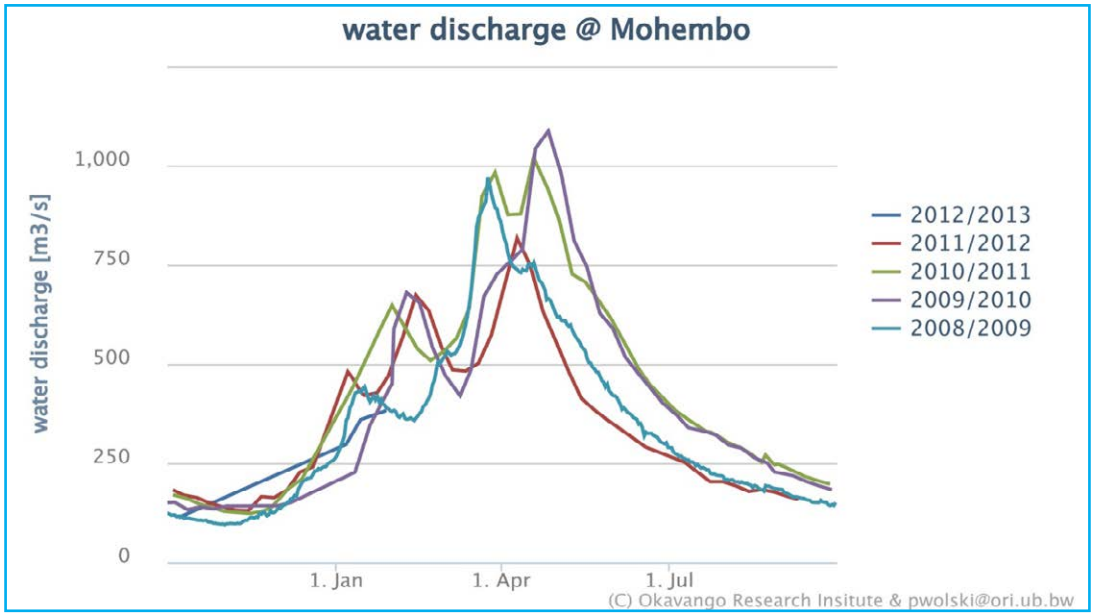
Figure 6.1a: Permanently and Seasonally Flooded Areas of the Okavango Delta Botswana.



Source: Mladenov 2004

Figure 6.1b shows the discharge of the Okavango River measured at Mohembo in the panhandle, over the years 2008/09 to 2012/13. It shows that 2009/10 and 2010/11 were years with higher than average flows. The year 2011/12 shows peaking lower than the preceding seasons.

Figure 6.1b: Okavango River Discharge at Mohembo



Time series data and trends show that 2010 and 2011 are the only post-2000 years to have had discharge flows for the month of June, above 1000 cubic metres per second (see Figure 6.1c and 6.1d). The lowest flows were recorded in 1946 and 1996.

The time-series graph in Figure 6.1d shows the trends in discharge as measured in June of every year. The years have been ordered from the least to the highest. The years 2009, 2010 and 2011 had high discharge, while the year 2012 shows a return to more average discharge rates.

Figure 6.1c: Annual Okavango River Discharge at Mohembo

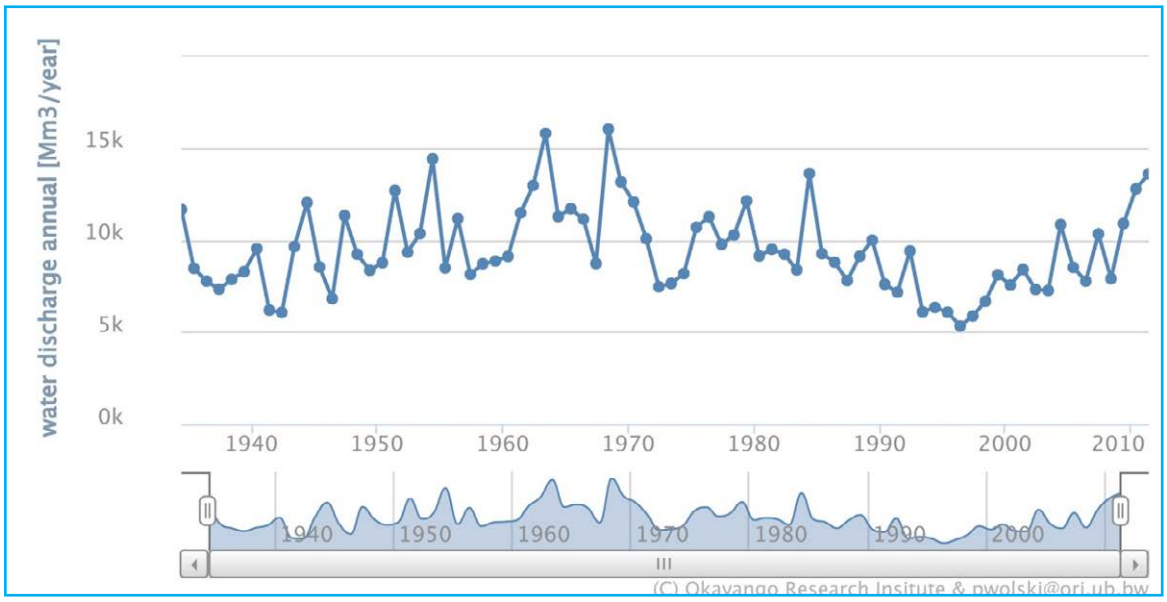
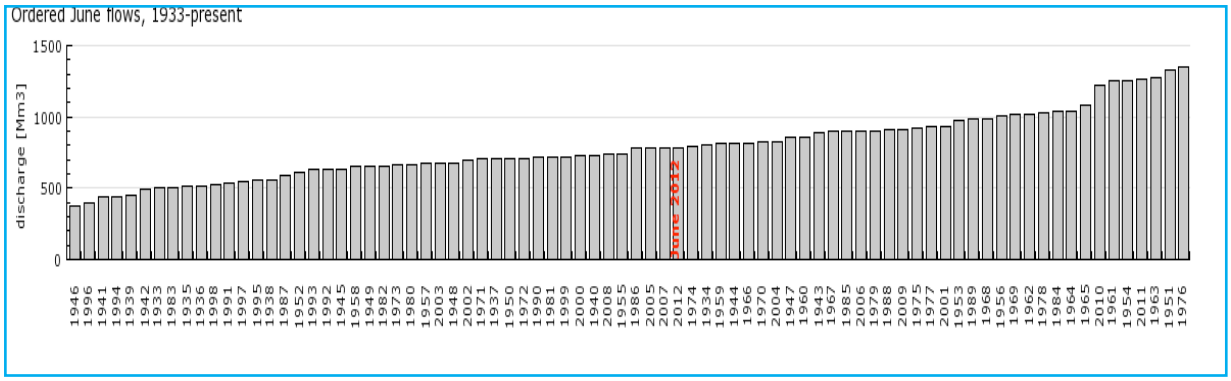


Figure 6.1d: Ordered Okavango River Discharge at Mohembo (June flows)



6.1.2 Storms and Floods in Villages

Rainfall measured at Maun Airport between October 2008 and April 2012 generally shows a trend that is in consonance with the discharge rates indicated in the previous section. Table 6.1a and Figure 6.1e show the Maun Airport rainfall measurements. The period from late 2009 through to early 2011 shows the highest rainfall.

These conditions led to floods in the Okavango area in 2010, affecting households and displacing hundreds of people.

Table 6.1a: Rainfall at Maun Airport (mm): 2008/09 to 2011/12

Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
2008/09	0	0	0	0	28.4	41.2	83	39.1	118.3	0	20.7
2009/10	0	0	0	40.3	31.3	109.5	222.7	182	65.4	96.6	1
2010/11	0	0	0	0.2	45.3	84.3	186.2	46.3	130.5	25.1	0
2011/12	0	0	0	0	48.4	140.5	54.6	62.9	15.4	0	0

Source: Department of Meteorological Services

Figure 6.1e: Rainfall at Maun Airport (mm) 2008/09 to 2011/12

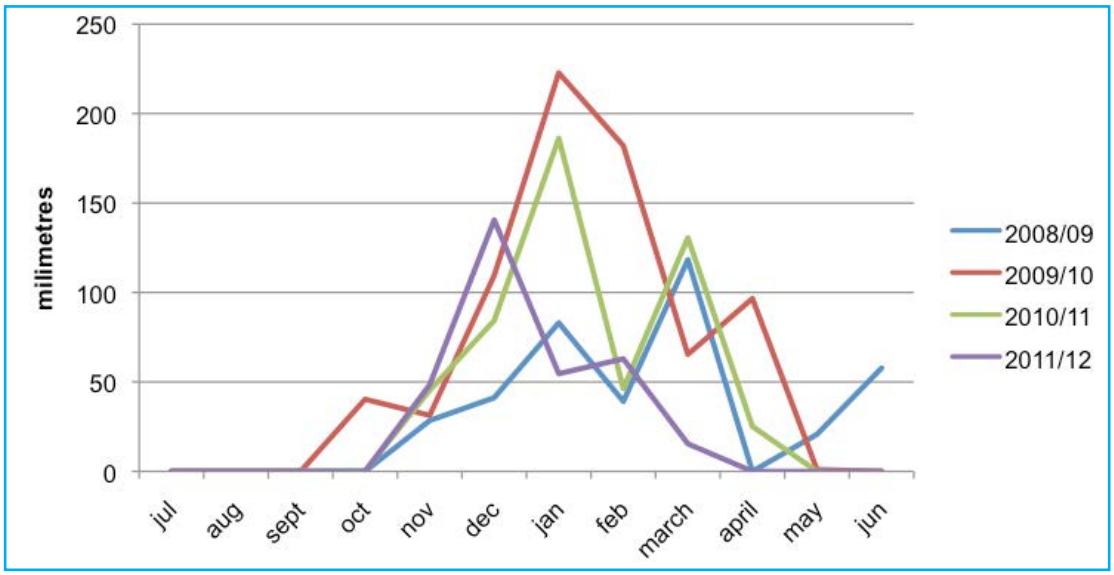


Table 6.1b shows the recorded natural disasters of the years 2010 and 2012. During the year 2010, floods accounted for most of the displacement of people, affecting 10 villages and a total of 168 households in those villages. As a result 800 people were affected and/or displaced. The worst hit was Etsha 13 village, where 94 households of 502 individuals were affected.

Storm rains in Maun village, in April 2010 affected 132 households leading to the displacement of 568 people. Hailstorms accompanied by heavy rains in April 2010 were responsible for the displacement of 212 people in 32 households, in the villages of Ramotlabaki, Malolwane and Kgomodiatshaba in Kgatleng District. Storm winds are also a threat in Botswana, and during January 2010, in Maun village, they left 89 people from 37 households needing relief aid. These scenarios are further illustrated on Tables 6.1c and 6.1d.

Table 6.1b: Impact of Floods and Storms (2010 and 2012)

Incident	Year	Villages affected	No. Of households affected	Total no. Of individual affected / displaced	Assistance given	
					Tents	Food Baskets
Floods	2010	Ikoga, Nxamasere, Etsha 13, Mohembo east, Kauxhwi, Jao Flats, Eretsha, Beetsha, Gudigwa, Tubu.	168	800	235	0
Storm rains	2010	Maun	132	568	132	69
Hail storm and heavy rains	2010	Ramotlabaki, Malolwane, Kgomodiatshaba	32	212	32	0
Hailstorm	2010	Ntlhantlhe, Lekgolobotlho	49	0	18	0
Storm winds	2010	Maun	37	89	4	5
Storm rains	2012	Mahalapye	329	1,756	119	322

Source: National Disaster Management Office

Table 6.1c details the damage caused by the storm rains in December 2012, in the Mahalapye (Central District) which affected 13 wards, 329 households and totalling 1,756 individuals who were displaced. The highest numbers of affected people were in Dilaene and Paruse wards, as depicted in the table.

Table 6.1c: Impact of Rain Storms in Mahalapye (12 December 2012)

Ward	No. Of households	No. Of individuals affected / displaced	Tents	Food baskets
Tidimalo	32	136	8	32
Madiba	23	137	13	23
White city	5	24	2	5
Thama	7	36	1	7
Xhosa 2	2	16	n/a	2
Xhosa 1	5	11	4	3
Borotsi	2	13	1	2
Herero	12	46	4	12
Bokaa	9	78	1	9
Dilaene	113	633	37	113
Mowana	16	94	7	15
Paruse	84	422	36	81
Tshikinyega	19	110	5	18
Total	**329**	**1,756**	**119**	**322**

n/a - data not available
Source: National Disaster Management Office, Office of the President

Table 6.1d depicts the floods and storm rain of 10th April 2010 that affected many households in Ngamiland as indicated on Table 6.1b. The storm rain in Maun alone affected 568 people in 132 households.

The floods covered 10 villages, with Etsha 13 having the highest number of people affected, at 502 individuals of 94 households.

Table 6.1d: Impact of Floods and Storm Rain in Ngamiland/Okavango (2010)

Village	No. of Households	No. of individuals affected / displaced	Tents	Food baskets**
Ikoga	13	72	15	
Nxamasere	12	61	26	
Etsha 13	94	502	144	
Mohembo East	14	59	14	
Kauxhwi	1	8	1	
Jao Flats	9	23	13	
Eretsha	10	31	6	
Beetsha	15	44	0	
Gudigwa	0	0	9	
Tubu	0	0	7	
Maun*	132	568	132	69

***(Storm rains)**
****NB- Where blank it is not known if food baskets were not given or not**
Source: National Disaster Management Office

6.2 Drought

Drought is determined through the relationship between rainfall and evaporation rates, but due to limited data on evaporation rates, only the variables of rainfall and temperatures are examined. Table 6.2a shows the past occurrences of drought in Botswana.

Table6.2a: Past Occurrences of Drought in Botswana

Year	Impact area
1961-1965	North East, Central
1979-1980	Bobirwa
1981-1987	Whole country
1991-1999	Whole country
2001-2005	Whole country
2007-2008	Whole country

Source: Natural Disasters Digest 2008

6.2.1 Drought Pressure in Botswana

Botswana declares drought years after assessments are carried out countrywide through the annual Drought and Food Security Assessments. Three key aims of the assessments are to establish seasonal rainfall deficiencies and their extent, and also to establish the impacts of rainfall on plant growth, water sources and thus on rural incomes and livelihoods, as well as to assess the levels of human vulnerability and possible effects of their interaction with the observed impacts of the rainfall levels. All this is done to determine the need or otherwise for continuation, form, nature and scope of Government intervention (MFDP 2012).

The Drought and Food Security Outlook for the year 2012 recommended that the country be declared drought-stricken. The report concluded that for the period October 2011 to March 2012, the country received inadequate rainfall. This was with the exception of the third dekad of November and the whole of December, which received normal to above normal rainfall (MFDP 2012).

6.2.2 National Crop Yield and Production

Drought conditions lead to lower national crop production and possible malnutrition, especially for subsistence farmers and the rural poor. National crop yields can also be reduced by erratic rainfall, or excessive rainfall that floods or washes away fields. In Table 6.2b is shown the communal sector area planted over the years 2007/08 to 2011/12. The year 2011/12 had a higher communal sector area planted than the previous year, 2010/11.

Table 6.2b: Estimated Area Planted ('000 ha) Communal Sector: 2007/08 – 2011/12

Agric Region	2007/08	2008/09	2009/10	2010/11	2011/12
Southern	15.1	21.3	21.3	0	60.6
Gaborone	12.4	30	43.4	40.7	82
Central	22.9	35.1	34.1	89.9	102.6
Francistown	11	17	17.9	43.6	46.5
Maun	3.2	9.3	3.8	23.8	21.9
Western	0.7	1.5	1.4	1.9	2.5
commercial	0	0	0	24.4	22.6
Country Total	**65.2**	**114.1**	**121.8**	**224.2**	**338.8**

When considering total estimated area planted, The 2011/12 year was less favourable than the 2010/11 year's cropping season due to environmental conditions. The year was characterised by poor erratic and unevenly distributed rainfall, resulting in lower planted hectares. This is despite the fact that it proved to be a good year for Molapo farmers since they did not experience flooding (MFDP, 2012). Figure 6.2a shows a dip in the estimated area planted when comparing the two years.

Figure 6.2a: Estimated Area Planted in Hectares

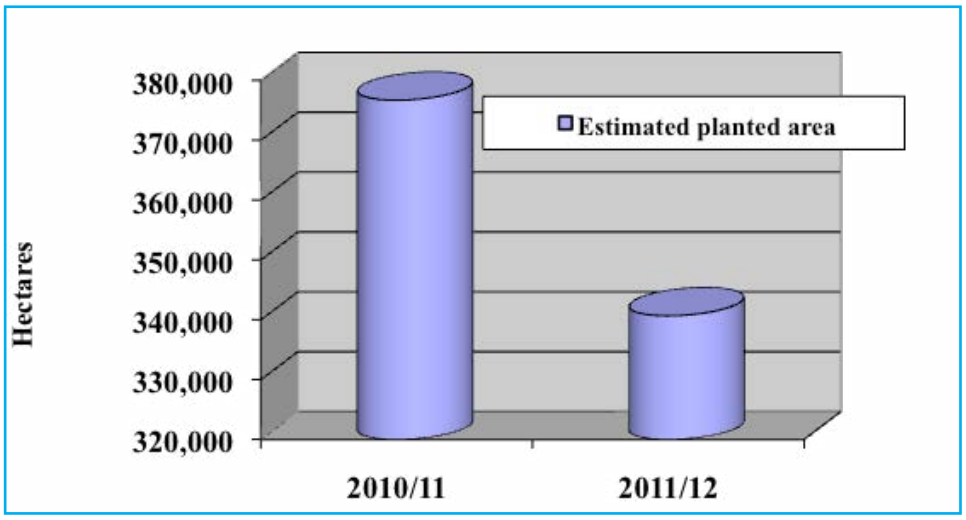


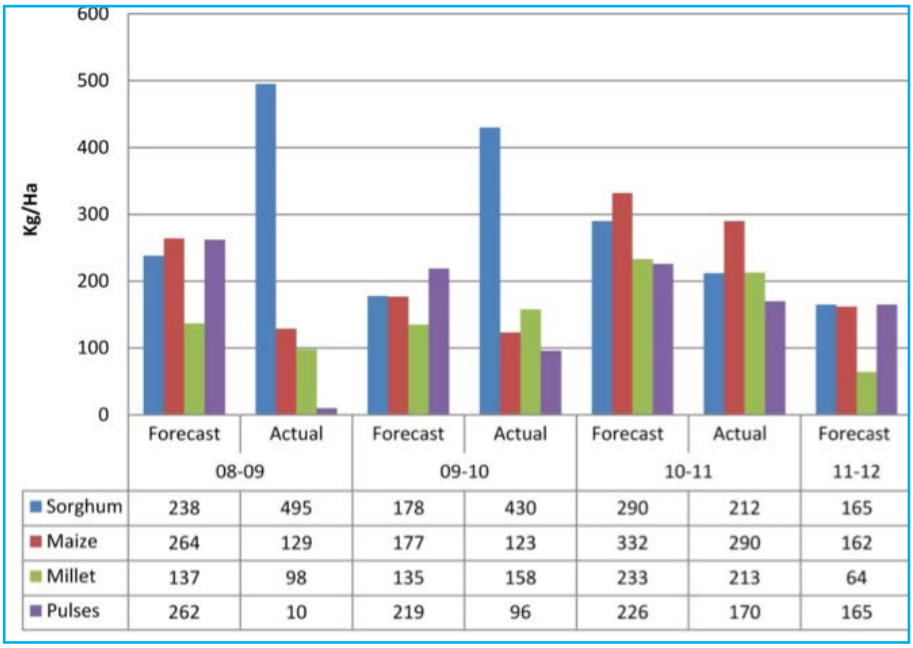
Table 6.2c shows the national crop yield forecasts for 2008/09 to 2011/12, and the actual yields in kilograms per hectare.

Table 6.2c: National Crop Yield Forecasts for 2008/09 to 2011/12 (kg/ha)

	2008/09		2009/10		2010/11		2011/12	
	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual
Sorghum	238	495	178	430	290	212	165	n/a
Maize	264	129	177	123	332	290	162	n/a
Millet	137	98	135	158	233	213	64	n/a
Pulses	262	10	219	96	226	170	165	n/a

n/a - data not available
Source: Ministry of Finance and Development Planning:2012

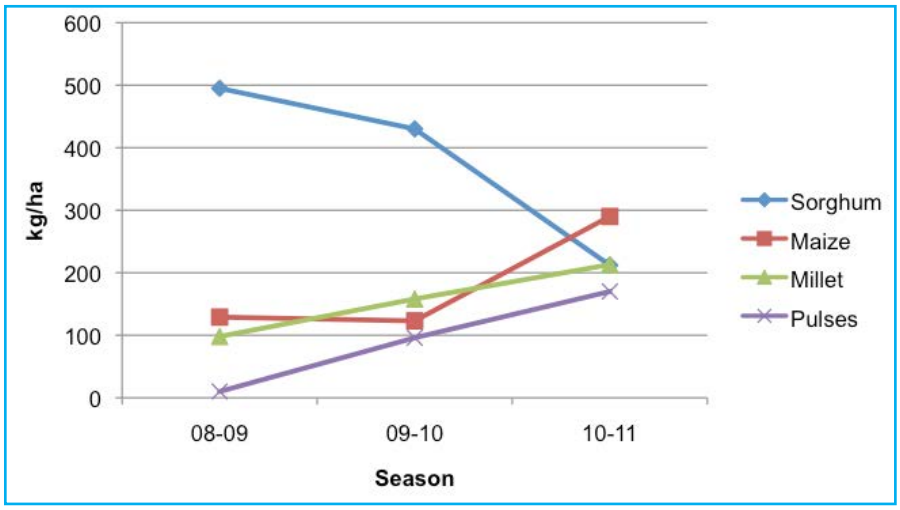
Figure 6.2b: National Crop Yield Forecasts for 2008/09 to 2011/12 (kg/ha)



	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast
	08-09		09-10		10-11		11-12
Sorghum	238	495	178	430	290	212	165
Maize	264	129	177	123	332	290	162
Millet	137	98	135	158	233	213	64
Pulses	262	10	219	96	226	170	165

Figure 6.2c, compares actual yield over the period, excluding the forecasts yields. Sorghum shows a decline through the three planting seasons, while the millet, pulses and maize have a generally upward trend.

Figure 6.2c: Crop Yields for 2008-09 to 2010-11 Planting Seasons



6.2.3 Rangeland, Wildlife and Water Conditions

The drought has a bearing on the condition of rangelands, the wildlife and the water situation in the country. Below is the are Table 6.2d and graphs depicting the rangelands, wildlife and water conditions as concluded in the country's drought assessments. The scores in the table are on a scale of 1 to 5, and are graded as indicated in the key below the table.

Table 6.2d: Rangeland, Wildlife and Water Condition 2009/10 – 2011/12

	Rangelands			Water			Wildlife		
	2009/10	2010/11	2011/12	2009/10	2010/11	2011/12	2009/10	2010/11	2011/12
Kanye	3	3	3	3	3	2	3	4	3
Moshupa	3	3	3	3	3	2	3	4	3
Goodhope	3	n/a	3	3	n/a	2	4	n/a	3
Mabutsane	3	3	2	2	3	2	3	3	3
Kgalagadi N.	4	3	3	3	2	2	5	3	4
Kgalagadi S.	4	3	3	3	2	2	5	3	4
Gantsi	4	3	3	4	2	4	4	3	3
Ngami	4	4	n/a	4	4	n/a	5	4	n/a
Okavango	4	n/a	n/a	4	n/a	n/a	5	n/a	n/a
Chobe	5	5	5	4	4	4	4	5	3
Kweneng East	4	3	3	3	3.5	4	4	4	4
Kweneng West	4	3	2	3	3	2	4	4	3
Kgatleng	3	3	3	3	3	3	3	4	3
South East	4	4	2	4	4	2	4	4	3
Mahalapye	3	3	3	1	3	1	3	4	4
Palapye	2	2.5	3	2	2	2	3	3	3
Serowe	3	3	3	2	3	0	3	3	3
Bobirwa	2	2.5	1	3	3	2	3	3	3
Boteti	4	2	3	3	3	2	4	2.5	4
Tutume	5	3	5	5	5	3	5	4	5
Tonota	4	2	2	2	3	2	4	5	2
average	3.6	3.1	2.9	3	3.1	2.3	3.9	3.7	3.3

0: Very poor 1: poor 2: Fair 3: Good 4: Very good 5: Excellent
n/a - data not available
Source: adapted from Drought and Household Food Security Outlooks 2010, 2011 and 2012

Rangelands showed a general decline in conditions over the years. The Bobirwa and Tonota areas are typical of the decline in the conditions of the rangelands during the period. Chobe had excellent conditions throughout the period, and although Tutume rangeland condition dipped in 2010/11, it was excellent in the other two years. Figure 6.2d illustrates.

The graph in Figure 6.2e for wildlife conditions shows the general depiction of a better 2009/10 than the subsequent 2010/11 and 2011/12. The water condition (Figure 6.2f) shows a similar trend to the rangelands and wildlife conditions.

Figure6.2d: Rangeland Condition 2009/10-2011/12

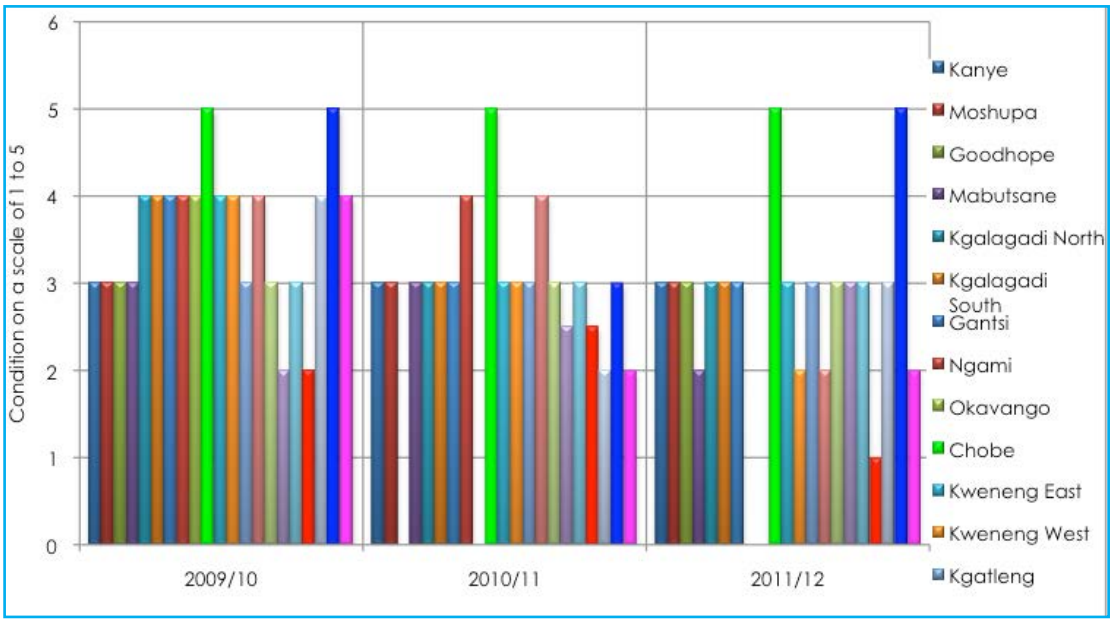


Figure6.2e: Wildlife Condition 2009/10 - 2011/12

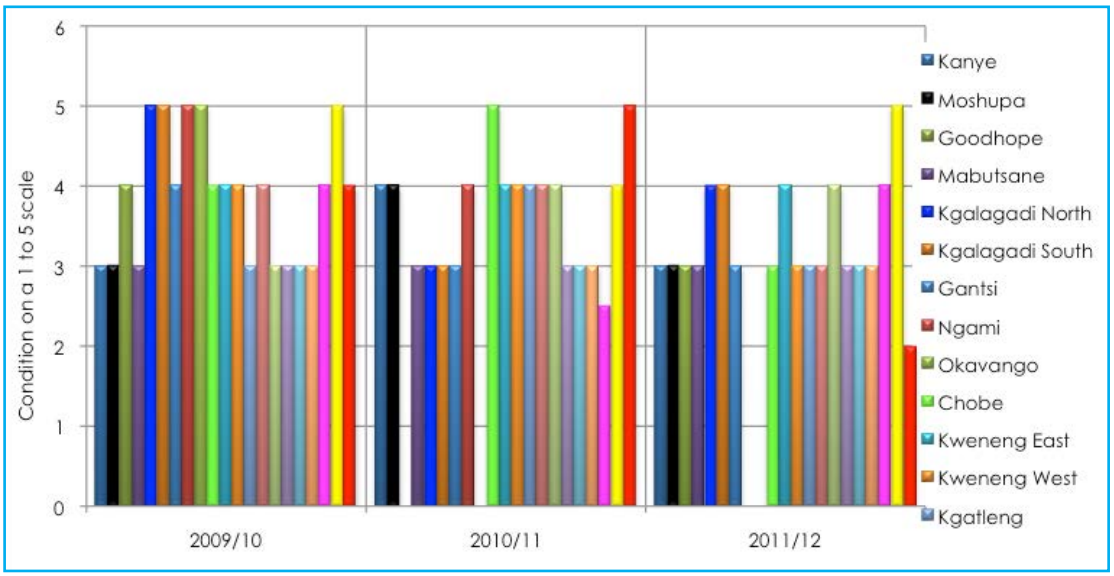


Figure6.2f: Water Condition 2009/10-2011/12

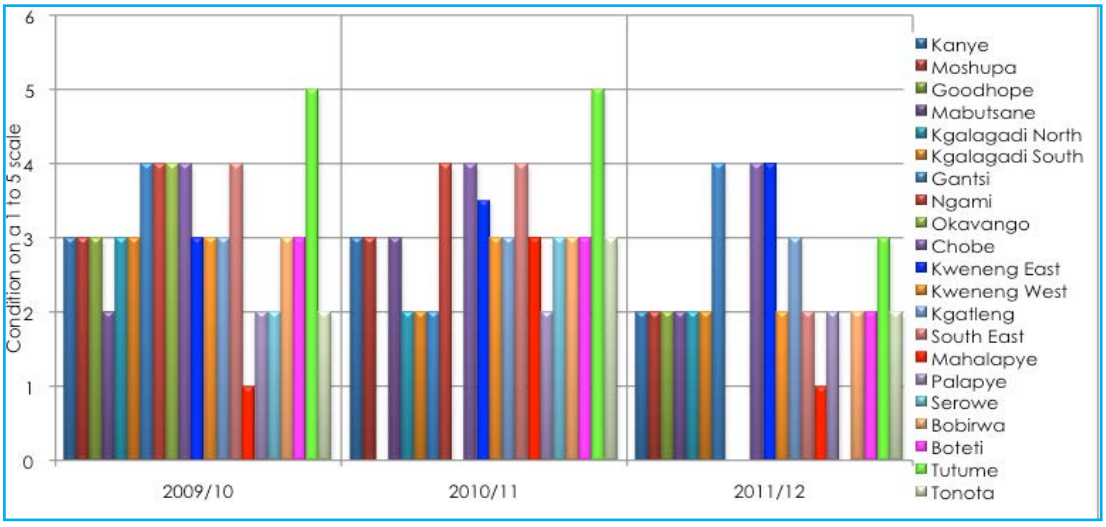
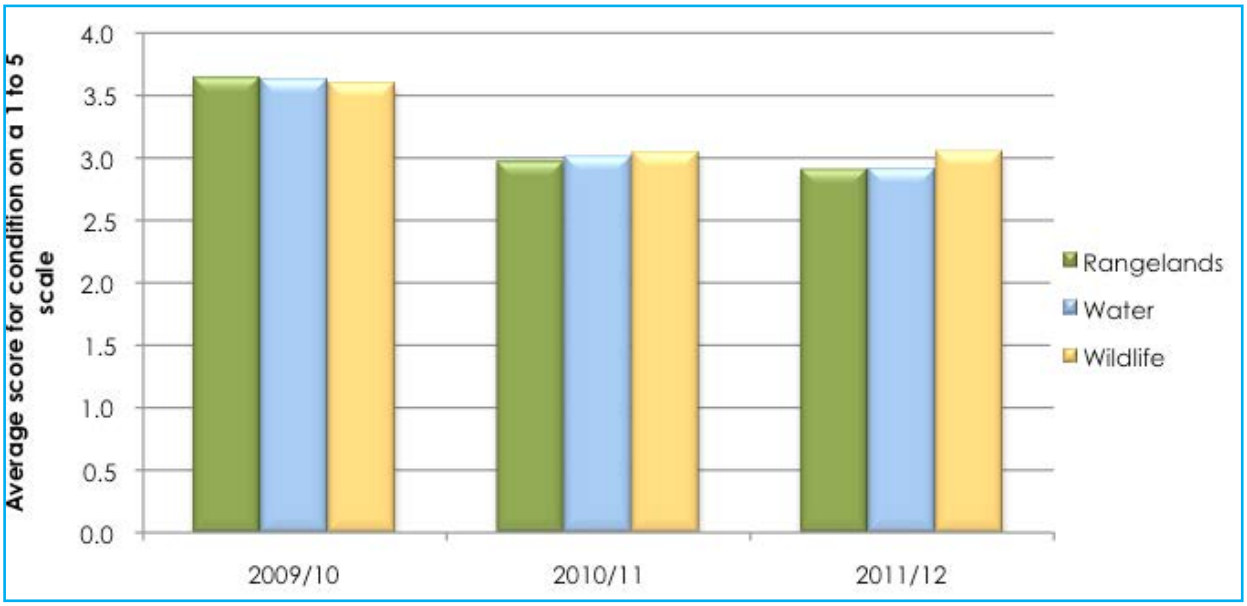


Table6.2e: Condition of Rangelands, Water and Wildlife 2009/10 to 2011/12

	2009/10	2010/11	2011/12
Rangelands	3.6	3	2.9
Water	3.6	3	2.9
Wildlife	3.6	3	3.1

Source: adapted from Drought and Household Food Security Outlooks 2010, 2011 and 2012

Figure6.2g: Average Scores of Conditions for Rangelands, Water and Wildlife (2009/10 – 2011/12)



6.2.4 Effects on Livestock

Rangelands and water conditions have an effect on the livestock conditions. Table 6.2f shows the cumulative animal mortality for livestock, comparing the years 2010 through 2012.

The most affected were cattle and horses. Most of the livestock deaths were drought-related, with the exception of some of the cattle killed for the eradication of the foot and Mouth Disease (FMD).

Table 6.2f: Livestock Mortality 2010/11 – 2012/13

District	2010/11					2011/12					2012/13				
	Cattle	Goats	Sheep	Horses	Donkeys	Cattle	Goats	Sheep	Horses	Donkeys	Cattle	Goats	Sheep	Horses	Donkeys
Kgalagadi N	0	0	0	0	0	195	7	2	0	0	130	0	0	0	0
Kgalagadi S	300	0	0	0	0	340	0	0	0	0	0	0	0	0	0
Kgatleng	n/a	17	0	0	0	76	28	28	5	0	0	0	0	0	0
Maun	n/a	0	0	0	0	418	22	19	60	15	10,950	2,902	115	478	536
Serowe	97	21	0	0	0	0	0	0	0	0	7	0	0	0	0
Kanye	7	16	0	0	0	0	0	0	0	0	0	0	0	0	0
Jwaneng	3	3	0	0	3	31	200	12	1	0	0	0	0	0	0
Mahalapye	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0
Gantsi	170	89	4	5	0	0	0	0	0	0	313	3	97	8	0
Shakawe	53	100	0	0	0	0	0	0	0	0	0	0	0	0	0
South East	0	0	0	0	0	0	58	39	0	0	33	0	0	0	0
Kasane	n/a	0	0	0	0	9	90	3	2	0	0	0	0	0	0
Bobirwa	n/a	n/a	n/a	n/a	n/a	3,330	405	103	68	15	49,220	0	0	0	0

n/a - data not available
Source: compiled from Drought and Household Food Security Outlooks (2010, 2011 and 2012) and Drought Assessment Tour (DAT) data

Bobirwa experienced high cattle mortality in 2011/12 and 2012/13. The deaths were largely drought-related, but also exacerbated by the Foot and Mouth Disease (FMD) eradication exercise. Maun also shows a very high livestock drought-related mortality in the last two years. Maun and the surrounding Ngamiland District also experienced FMD outbreaks. Jwaneng, South east and Kasane's loss of livestock in 2011/12 show signs abating in the subsequent year of 2012/13, while Gantsi shows a worsening situation from 2011/12, with relatively high cattle deaths in 2012/13.

7. MINING

7.1 Introduction

The act of extracting valuable minerals or geological materials from the earth is referred to as mining. The commonly extracted materials include diamonds, copper, coal, gold, nickel, silver, gravel, sand, and salt, just to mention a few. According to the CSO Report (2006), mining in a wider sense can also include extraction of petroleum and natural gas.

In Botswana, the major minerals mined are diamond, coal, copper &nickel, soda ash, salt and gold. According to the Botswana National Atlas, 'Botswana is one of the world's leading diamond producers.' Diamond has been the leading component of the mineral sector since large-scale diamond production began 25 years ago. Most of the diamond production was of gem quality, which resulted in the country's position as the world's leading producer of diamond by value. Copper, gold, nickel, and soda ash production also has held traditionally significant, though smaller, roles in the national economy (Ericsson & Löf, 2009). Botswana Export Development and Investment Authority (BEDIA) (undated) further notes that the diamond industry transformed Botswana from an agriculture-based economy to one in which diamonds account for 80 percent of exports and 50 percent of government revenue. Moreover, the government has consistently applied a policy of using mining generated revenue, in particular diamond revenue, to finance development priority areas such as health, education and infrastructure.

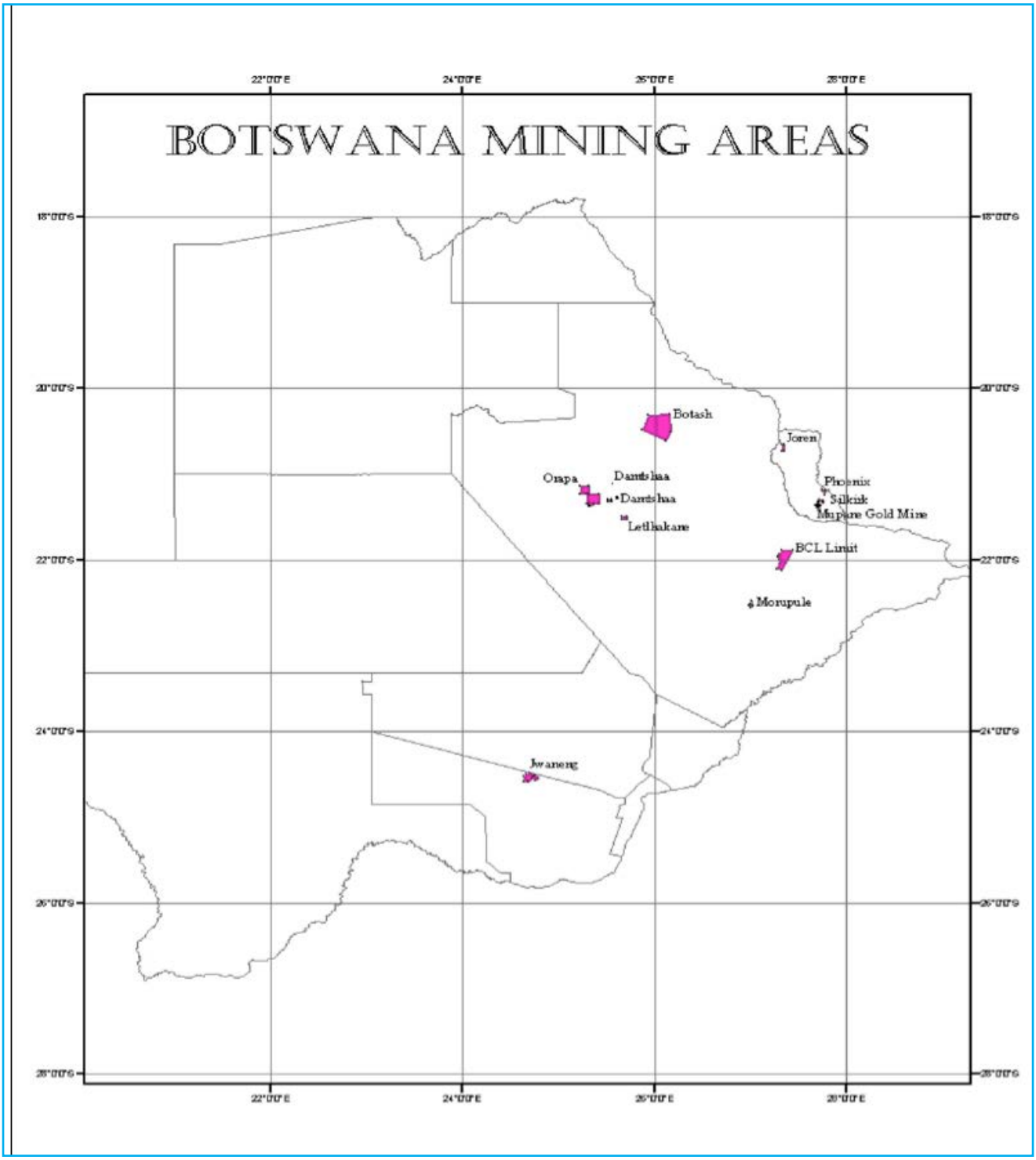
The purpose of this section is to present and analyse statistics on mineral revenue, production, export, import of minerals, and their contribution to the Gross Domestic Product. Also discussed in this section are; employment and important actors in the mining industry, and response to the impacts caused by the excavation of minerals on the environment. The section will zero-in on the following minerals; diamond, gold, copper and nickel, coal, soda ash, cobalt, precious metals, and other minerals.

7.1.1 Mineral Excavation Types in Botswana

Mining techniques can be divided into two basic excavation types: surface and sub-surface.

Surface mining is used to excavate deposits of minerals that are close to the surface. Open-pit mining is used to extract diamond at the following diamond mines; Jwaneng (Southern District), Orapa, Letlhakane and Damtshaa mines (Central District). Morupule Colliery also uses open pit form of mining. Bamangwato Concessionary Limited (BCL) at Selibe Phikwe on the other hand uses the Vertical hosting shafts type of mining at the following mining areas: Phikwe, Selebi, and Selebi North. Figure 7.1a shows the major mining areas in Botswana.

Figure 7.1a: Major Mining Areas of Botswana



Source: Department of Mines; \\Jmn01sw04\nas\Operations and Development\general\Mines - Leases Addresses.doc

7.1.2 Important Actors on the Mining Industry

The mining industry in Botswana is dominated by a number of companies, and some in partnership with the Government. They include, Debswana in the diamond sector; BCL (Bamangwato Concessions Limited) and Tati (nowadays controlled by Russian Norilsk) in nickel/copper and Botash in soda ash and in coal the Morupule Coal Mine owned by Debswana. The Government leases the mining areas and as a result attracts some revenue through payment of royalties by the mining companies. As reported by Ericsson and Löf (2009), ownership of major mining companies is as follows:

i. Jwaneng Diamond Mine

Ownership, early 2009, Jwaneng Diamond Mine
└<100% Debswana Diamond Co, Botswana
├< 50% De Beers Centenary AG, Switzerland
└< 50% State of Botswana, Botswana

ii. Phoenix Nickel Mine

Ownership, early 2009, Phoenix Nickel Mine
└<100% Tati Nickel Mining Co, Botswana
├< 85% Francistown Mining & Exploration Ltd, Botswana
└< 15% State of Botswana, Botswana

iii. Damtshaa Diamond Mine

Ownership, early 2009, Damtshaa Diamond Mine
└<100% Debswana Diamond Co, Botswana
├< 50% De Beers Centenary AG, Switzerland
└< 50% State of Botswana, Botswana

iv. Letlhakane Diamond Mine

Ownership, early 2009, Letlhakane Diamond Mine
└<100% Debswana Diamond Co, Botswana
├< 50% De Beers Centenary AG, Switzerland
└< 50% State of Botswana, Botswana

v. Mupane Gold Mine

Ownership, early 2009, Mupane Gold Mine
└<100% Mupane Gold Mining Pty Ltd, Botswana

vi. Orapa Diamond Mine

Ownership, early 2009, Orapa Diamond Mine
└<100% Debswana Diamond Co, Botswana
├< 50% De Beers Centenary AG, Switzerland
└< 50% State of Botswana, Botswana

vii. Selebi-Phikwe Nickel/Copper Mines

Ownership, early 2009, Selebi-Phikwe Nickel/Copper Mines
└<100% BCL Ltd (Bamangwato), Botswana

viii. Lerala Diamond Mine

Ownership, early 2009, Lerala Diamond Mine
└<100% Diamonex Ltd, Australia

ix. Monarch Gold Mine

Ownership, parents, early 2009, Monarch Gold Mine
└<100% Gallery Gold Ltd, Australia

x. Selkirk Nickel Mine

Ownership, early 2009, Selkirk Nickel Mine
└<100% Tati Nickel Mining Co, Botswana
├< 85% Francistown Mining & Exploration Ltd, Botswana
└< 15% State of Botswana, Botswana

xi. Mmamabula Coal Deposit

Ownership, early 2009, Mmamabula Coal Deposit
└<100% Meepong Resources (Proprietary) Limited, Botswana
├< 50% CIC Energy Corporation, Botswana
└< 50% International Power plc. UK

xii. Morupule Coal Mine

Ownership, early 2009, Morupule Coal Mine
└<100% Debswana Diamond Co, Botswana
├< 50% De Beers Centenary AG, Switzerland
└< 50% State of Botswana, Botswana

7.2 Botswana Mining Industry Performance, 2005/06 – 2011/12

7.2.1 Mineral Revenue

This sub-section presents the Government tax revenue, with more emphasis on minerals comparatively to other sources of tax revenue. Table 7.2a and Figure 7.2a clearly show that mineral revenue contributed more to the total government tax revenue compared to other sources of tax revenue. During the 2005 – 2011 period, minerals contributed 82, 324.6 million Pula followed by customs and excise, and non-mineral income tax with 48, 687.2 million Pula and 32, 309.2 million Pula respectively. The table also reveals that mineral revenue dropped from 10, 181.7 million Pula in 2008 to 9, 088.4 million Pula in 2009 then elevated to 12, 059.9 million Pula in 2010. The decrease in mineral revenue in 2009 is attributed to the economic recession which hit the world during the year.

Value addition by economic activity for the years 1994 to 2011 is presented in Tables 7.2b and 7.2c, and Figure 7.2b. It is evident from the tables that Botswana's economy is reliant on mining, though just like any other economic activity the mining sector's value addition experiences some decline. For example, in 2007 the mining sector's value addition to the GDP dropped from 18,113.7 million Pula to 10,760.6 million Pula in 2011. This result further buttress on the earlier statement that 2009/10 was the year the effects of the economic recession were more profound. During the period under review, general government's contribution to the GDP came second after mining except in 2011 when trade, hotels and restaurants overtook the general government to claim the second spot.

Table 7.2a: Government Tax Revenue, 2005 - 2011

Period	Tax Revenue										
			Other taxes								
	Customs & excise	Mineral tax revenue1	Non-mineral income tax	Export duties	Property taxes	Vehicles taxes	Licence fees	Sales tax/VAT	Airport tax	Sub total	Total
2005/06	3, 929.9	**11, 045.1**	3, 003.2	0.3	12.8	122.9	19.4	1, 978.9	17.6	2, 151.8	20, 130.0
2006/07	6, 610.5	**13, 114.3**	3, 072.3	0.4	17.1	138.5	21.5	2, 247.5	8.5	2, 433.4	25, 230.6
2007/08	7, 834.8	**11, 012.1**	3, 894.4	0.4	32.6	158.7	24.4	2, 852.0	21.8	3, 090.0	25, 831.2
2008/09	7, 750.1	**10, 181.7**	4, 608.5	1.7	25.7	191.4	27.5	4, 376.6	21.5	4, 644.4	27, 184.8
2009/10	7, 931.0	**9, 088.4**	5 ,560.6	0.7	27.3	188.8	33.3	3, 943.5	0.2	4, 193.8	26, 773.9
2010/11	6 ,206.6	**12, 059.9**	6, 413.4	1.7	34.8	228.7	33	4, 637.7	-	4, 935.9	29, 615.7
2011/12	8, 424.3	**15, 823.1**	5, 756.8	1.4	64.8	207.3	39.3	4, 964.5	-	5, 277.3	35, 281.5

1Mineral royalties and dividends are included under Mineral tax, hence forms part of tax revenue
Source: Bank of Botswana (2011)

Figure 7.2a: Government Tax Revenue, 2005 - 2011

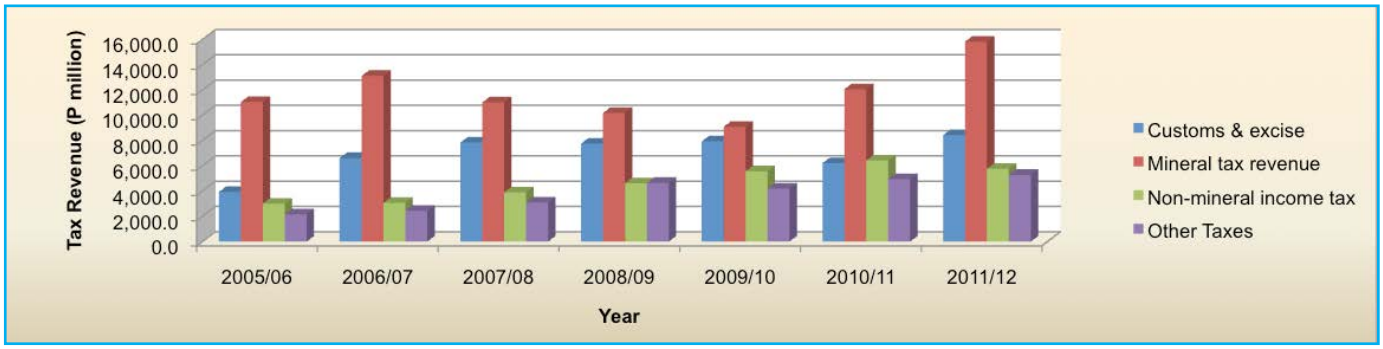


Table 7.2b: Value Added by type of Economic Activity and GDP at 2006 (Constant) Prices, 2002-2011 (include informal Sector estimates)

Year	Agriculture	Mining	Manufacturing	Elec	Constr	Trade, Hotels & Restau-rants	Transport & Comm	Financial and Bus. Serv	General Govt	Personal and Social Serv	V.A	Taxes on	Other taxes	Subsi-dies	GDP	GDP per Capita	Taxes less subsidies
1994	1,068.60	11,492.00	1,567.20	477.6	2,078.70	2,791.40	1,305.60	4,022.20	4,764.90	1,289.60	30,857.70	2,091.30	464.6	-87.7	33,325.90	22,934.80	2,468.20
1995	1,284.80	12,194.00	1,899.40	495	2,193.60	3,447.50	1,479.50	4,289.40	4,802.00	1,474.20	33,559.70	1,639.20	457.4	-80.4	35,575.80	23,874.90	2,016.10
1996	1,242.30	11,465.80	2,279.20	489.6	2,438.30	4,423.20	1,452.40	4,634.00	4,863.70	1,660.10	34,948.60	2,228.40	656.5	-184	37,649.50	24,650.30	2,700.90
1997	1,158.00	11,944.60	2,652.20	519.3	2,709.70	4,565.90	1,700.40	4,795.50	5,481.60	1,752.50	37,279.70	2,765.80	837.4	-190.3	40,692.60	25,992.90	3,412.90
1998	1,097.00	11,292.10	2,849.80	591.5	2,782.50	4,732.00	1,728.50	4,994.30	5,648.90	1,752.90	37,469.40	2,779.30	930.4	-232.5	40,946.50	25,517.20	3,477.10
1999	1,192.30	12,095.00	2,921.10	641.2	3,071.30	5,644.40	1,921.10	5,186.10	6,216.00	1,859.80	40,748.30	3,374.60	1,049.20	-189.6	44,982.50	27,717.40	4,234.20
2000	1,062.20	13,895.60	2,864.20	685.6	2,521.20	5,063.60	1,835.10	5,472.40	6,387.60	1,769.80	41,557.20	3,495.20	951	-206	45,797.50	27,901.50	4,240.20
2001	1,141.50	14,252.10	2,772.90	744.3	2,166.70	4,956.20	1,748.60	5,880.40	6,629.80	1,844.20	42,136.70	2,888.10	884.2	-145.9	45,763.00	27,568.10	3,626.30
2002	908.7	15,900.80	2,787.70	811.5	2,974.60	5,347.80	1,784.00	6,048.80	7,135.20	1,960.90	45,660.00	2,108.40	1,045.50	-249.2	48,564.80	28,926.50	2,904.80
2003	1,093.30	16,955.10	2,565.80	865.9	2,483.00	5,638.80	1,725.10	6,187.60	7,485.30	2,042.60	47,042.50	2,267.90	1,669.20	-200.2	50,779.30	29,905.20	3,736.90
2004	1,092.30	16,705.00	2,535.00	886.8	2,476.90	5,306.90	1,737.40	6,270.90	8,081.70	2,181.40	47,274.40	2,889.20	2,194.70	-236.2	52,122.00	30,362.40	4,847.70
2005	1,067.90	18,087.70	2,613.90	762.2	2,444.70	5,528.30	1,991.10	6,379.60	7,993.50	2,593.70	49,462.70	3,203.50	2,191.80	-257.4	54,600.60	31,535.10	5,137.90
2006	1,210.70	19,019.00	3,123.00	785.1	2,838.00	7,032.30	2,250.50	6,675.40	7,818.50	2,938.90	53,691.50	3,428.80	2,276.30	-289.8	59,106.80	33,867.50	5,415.30
2007	1,365.20	18,113.70	4,105.40	746.3	3,538.60	8,165.60	2,613.40	7,467.20	8,256.20	3,191.10	57,562.70	4,261.90	2,860.60	-327	64,358.20	36,626.30	6,795.50
2008	1,386.80	16,660.90	3,897.10	795.5	3,538.60	9,623.00	2,882.20	8,344.60	8,276.60	3,678.50	59,083.90	4,434.60	3,573.10	-352.8	66,738.90	37,723.50	7,655.00
2009	1,486.60	8,966.00	4,023.40	744.7	3,992.40	9,951.60	3,301.80	8,421.50	8,586.50	4,092.40	53,566.80	4,011.60	4,278.10	-375.8	61,480.60	34,186.30	7,913.80
2010	1,718.40	11,005.50	4,412.20	725.5	4,214.80	10,913.70	3,446.50	9,358.80	8,808.20	4,373.30	58,976.80	3,800.40	4,100.60	-401.4	66,476.50	36,469.40	7,499.60
2011	1,333.80	10,760.60	4,561.90	185.1	4,994.80	12,380.50	3,751.50	10,176.40	10,148.50	4,692.90	62,985.90	4,035.40	5,216.20	-436.9	71,800.50	35,458.80	8,814.60

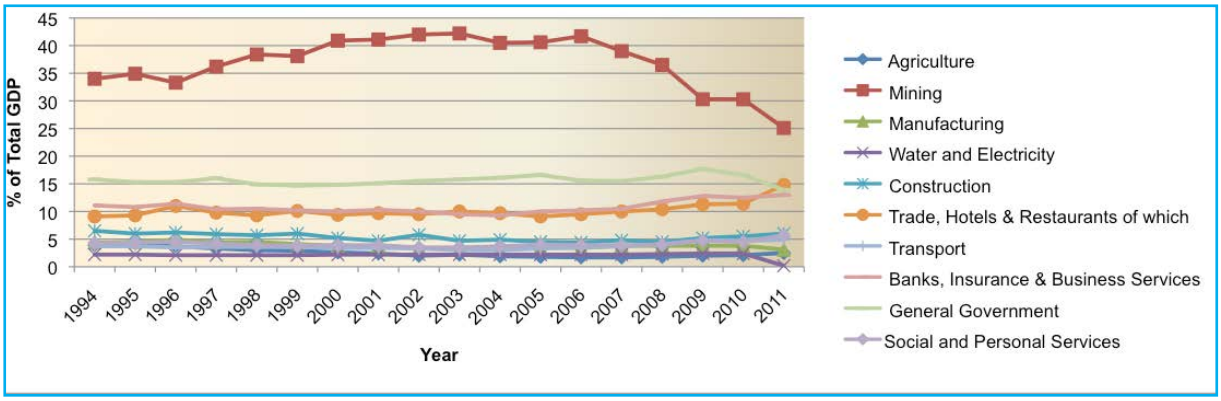
Source: Statistics Botswana- National Accounts

Table 7.2c: Percentage of Total GDP by Economic Activity, 1994-2011

ECONOMIC ACTIVITY	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011*
1. Agriculture	3.9	4.3	3.7	3.3	3	2.9	2.6	2.4	2	2.2	1.9	1.8	1.7	1.7	1.8	2	2.1	2.5
2. Mining	34	34.9	33.3	36.2	38.4	38.1	40.9	41.1	42	42.2	40.5	40.6	41.7	39	36.5	30.3	30.3	25.1
3. Manufacturing	4.4	4.5	4.9	4.4	4.5	4.1	3.8	3.8	3.4	3.3	3.3	3.5	3.4	3.8	3.8	3.8	3.8	3.1
4. Water and Electricity	2.2	2.2	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.3	2.4	2.4	0.2
5. Construction	6.5	6	6.2	5.9	5.7	6	5.2	4.7	5.8	4.7	4.9	4.5	4.4	4.8	4.5	5.2	5.5	6
6. Trade, Hotels & Restaurants of which:	9.1	9.3	11	9.8	9.3	10.1	9.4	9.7	9.5	10	9.7	9.1	9.5	10	10.4	11.3	11.4	14.8
Trade excluding Hotels & Restaurants	7.3	7.6	9.4	8.2	7.9	8.9	8.3	8.4	8.2	8.3	8.3	7.6	7.5	7.9	8	8.6	8.6	8.9
Hotels & Restaurants	1.7	1.6	1.5	1.5	1.4	1.2	1.1	1.3	1.4	1.6	1.5	1.5	2	2.2	2.3	2.7	2.9	5.9
7. Transport	3.7	3.7	3.5	3.6	3.6	3.6	3.4	3.4	3.3	3	3	3.3	3.5	3.7	4.1	4.8	4.7	4.9
8. Banks, Insurance & Business Services	11.1	10.8	11.4	10.4	10.5	10.2	10	10.3	10	9.5	9.3	10	10.2	10.5	11.8	12.8	12.5	13
9. General Government	15.8	15.3	15.3	16	14.9	14.7	14.8	15.1	15.5	15.8	16.1	16.6	15.6	15.5	16.3	17.7	16.6	13.9
10. Social and Personal Services	4.3	4.4	4.5	4.2	3.9	3.8	3.9	3.9	3.5	3.5	3.7	4	3.9	3.9	4	4.7	4.5	5.7
+ Adjustments items of which:																		
FISIM	-2.8	-2.6	-2.6	-3.1	-3	-3.2	-3	-3.2	-3.2	-3.5	-3	-3.4	-3.7	-4.3	-5.2	-5.7	-5.2	
Taxes on Imports	6.5	5.8	5.6	5.9	5.6	6.1	5.3	5	4	4.1	4.4	4.2	4.4	5.4	5.8	5.9	5.9	4.9
Taxes on products/ production	1.5	1.7	1.6	1.8	2	2	1.9	1.8	2.5	3.3	4.4	4	3.7	4	4.5	5.4	6	6.3
Subsidies on products/ production	-0.3	-0.4	-0.5	-0.4	-0.5	-0.4	-0.4	-0.3	-0.5	-0.4	-0.5	-0.5	-0.5	-0.5	-0.5	-0.6	-0.6	-0.5
Total GDP excluding Mining Value added	**66**	**65.1**	**66.7**	**63.8**	**61.6**	**61.9**	**59.1**	**58.9**	**58**	**57.8**	**59.5**	**59.4**	**58.3**	**61**	**63.5**	**69.7**	**69.7**	**74.9**

***Financial Intermediation Services Indirectly Measured (FISIM) is now distributed among sectors and no longer a stand-alone.**
Source: Statistics Botswana- National Accounts

Figure 7.2b: Percentage of Total GDP by Economic Activity, 1994-2011



7.3 Mineral Production

7.3.1 Diamonds

Botswana Government and the De Beers Mining Company joined forces as far as mining diamonds is concerned in the country. As a result of the joint venture, Debswana came into existence. Individual mines sort their diamonds and subsequently take them for valuation at Diamond Trading Company Botswana (DTC Botswana). Currently diamonds are cut and polished locally, unlike in the past where they were sent overseas for these processes.

Like mentioned earlier in this section, 2009 is the year the world was affected the most by the economic recession. The Department of Mines (2009) asserts that, as a result of poor diamond sales due to global economic crisis production at all the Debswana operations was suspended up to mid April 2009 after which Damtshaa Mine and Orapa No.2 Plant were placed on care and maintenance. The Orapa No.2 Plant resumed production in July 2009. The Department of Mines further states that there was a positive improvement in the demand of diamonds from April 2009 but the future remained very unpredictable and volatile since the global economy had not fully recovered from the global financial crisis. As a result of the global financial crisis the following changes took place;

• Diamonex Botswana was under care and maintenance and has been under Judicial Management since 23rd January 2009 due to the global economic crisis which resulted in the company failing to meet its financial obligations. Some of the Diamonex Creditors led by Flemming Asset Management had initiated a process to restructure the company's debts and refinance the project. The Judicial Manager was also in discussion with a number of potential off takers for its production.

• Boteti Exploration (Pty) Ltd. Lucara Diamond Corporation acquired DeBeers shareholding in Boteti Exploration (Pty) Ltd in December 2009.

• Gope Exploration (Pty) Limited, was granted an extension to the validity period of its retention licence up to the 31st December 2010.

Table 7.3a and Figure 7.3a show the production of diamonds from 2002 to 2011 and the associated contributions to the total exports. Debswana diamonds production has been on the increase since the 2002 figure of 28.412 million carats to the highest quantity ever of 34.293 million carats in 2006. From 2007 to 2011 the production figures plummeted with a lowest quantity produced of 17.733 million carats in 2009.

With regard to the value of diamonds exported, there was an increase from 8,377 million

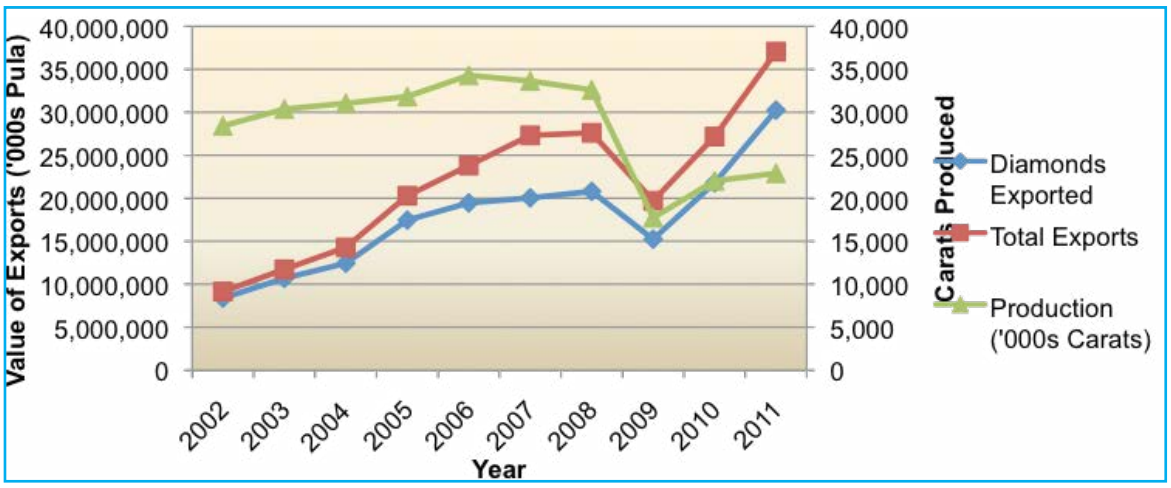
Pula in 2002 to 20, 793 million Pula in 2008 and suddenly dropped to 15, 234 million Pula in 2009. The value of diamonds exported then increased significantly to 30, 248 million Pula in 2011. On the other hand diamonds contribution to the total exports was on the increase with the highest contribution registered between 2002 and 2006. On average the yearly percentage contribution to the total exports stood at 82.5 percent during the period under review. According to CSO (2006), diamond production is not at all proportional to the value of diamonds exported. Moreover, some of the diamonds produced is stock piled if the producers feel that prices in the international market are low.

Table 7.3a: Production of Diamonds and Contribution to Total Exports: 2002-2011

Year	Value of Diamonds Exported in P million	Total Exports in P million	Production ('000 Carats)	% Contribution to Total Exports
2002	8,376,963,420	9,139,596,958	28,412	91.66
2003	10,681,112,474	11,722,647,591	30,371	91.12
2004	12,434,503,742	14,278,605,397	31,037	87.08
2005	17,449,741,072	20,286,258,981	31,832	86.02
2006	19,452,526,343	23,802,456,542	34,293	81.72
2007	20,043,400,783	27,313,501,669	33,639	73.38
2008	20,793,314,918	27,611,470,618	32,595	75.31
2009	15,234,114,763	19,699,337,008	17,733	77.33
2010	21,779,885,141	27,170,409,361	22,018	80.16
2011	30,247,714,850,	37,050,535,439	22,901	81.63

Source: Statistics Botswana- Trade Statistics& National Accounts Units

Figure 7.3a: Productions from the Diamond Mines and Value of Diamond Exports



7.3.2 Copper and Nickel

Copper and Nickel mining industry is a joint venture between Botswana Government and other Companies, including Anglo American Corporation, De Beers, International Power plc., Bamangwato Concession Limited, Francistown Mining and Exploration Limited, just to mention a few. The extracted ore is fed to the on-site concentrator, and thereafter dried and smelted. The matte produced is then exported for separation and refining. Copper-Nickel matte contains high metal content and small quantities of cobalt.

Matte production fluctuated during the 2002-2011 period with the highest matte production recorded in 2005 (59.365 million tonnes) and the lowest matte production of 31.929 million tonnes recorded in 2011. Furthermore, the highest quantity of copper/nickel (58.998 million tonnes) was recorded in 2005. However, it does not automatically mean that the higher the matte quantity the higher the quantities of copper and nickel (Table 7.3b and Figure 7.3b).

Table 7.3b and Figure 7.3b-7.3c further reveal that, the percentage contribution of copper/nickel to total exports increased from 2002 to 2007, and subsequently went on the decrease from 2008 to 2011. The highest percentage contribution to the total exports was recorded in 2007 with 24.8 percent. On average the annual percentage contribution of copper/nickel to the total exports was about 14 percent. During the entire period copper/nickel trailed behind diamonds as far as the percentage contribution to the total exports is concerned.

The international market prices for copper/nickel was depressed between the period 1991 and 2004, and this resulted in the Government of Botswana having to give BCL Mine grants and loans from international financial institutions to keep the mining town of Selibe Phikwe going (CSO, 2006). The BCL Mine fluctuates profitably in line with international metal prices and an accumulated debt burden has inhibited new investment, but the operation has entered a new phase through a partnership with Tati Nickel Mining Company (TNMC), which exploits the nearby Phoenix copper-nickel deposit and sends its concentrate for toll-smelting at Selebi Phikwe (BEDIA, undated).

Table 7.3b: Production of Copper/Nickel, 2002-2011

Year	Matte Production ('000 Tons)	Contained Metals		% of Matte Content		Copper/Nickel Exports	Total Exports ('000 Pula)	% Contribution
		Copper/Nickel	Cobalt	Copper/Nickel	Cobalt			
2002	45,756	45,486	270	99.41	0.59	688,425,561	9,139,596,958	7.53
2003	51,983	51,689	294	99.43	0.57	923,596,131	11,722,647,591	7.88
2004	44,140	43,914	226	99.49	0.51	1,668,013,607	14,278,605,397	11.68
2005	59,365	58,998	367	99.38	0.62	2,480,977,279	20,286,258,981	12.23
2006	56,222	55,888	334	99.41	0.59	3,957,499,038	23,802,456,542	16.63
2007	49,475	49,121	354	99.28	0.72	6,771,128,899	27,313,501,669	24.79
2008	52,422	52,086	336	99.36	0.64	5,925,387,274	27,611,470,618	21.46
2009	53,753	53,425	328	99.39	0.61	3,621,226,069	19,699,337,008	18.38
2010	49,167	48,890	277	99.44	0.56	4,231,266,943	27,170,409,361	15.57
2011	31,929	31,780	149	99.53	0.47	2,940,266,074	37,050,535,439	7.94

Source: Statistics Botswana- Trade Statistics& National Accounts Units

Figure 7.3b: Contribution of Copper/Nickel Exportation to the Total Exports

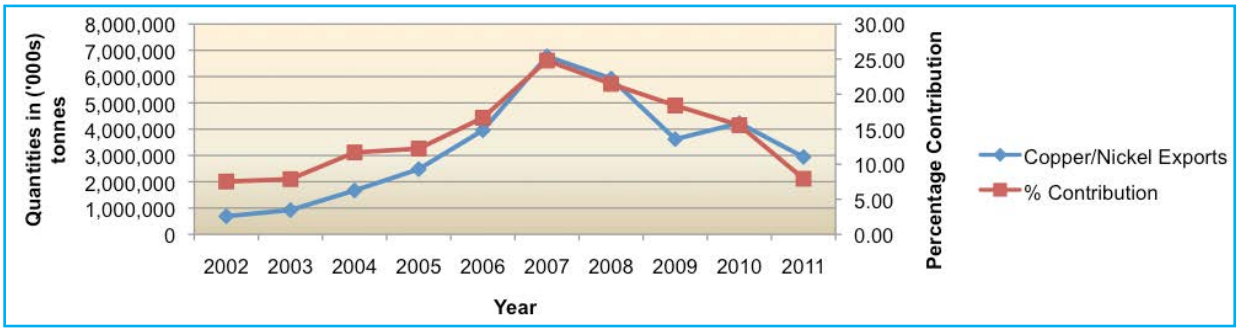
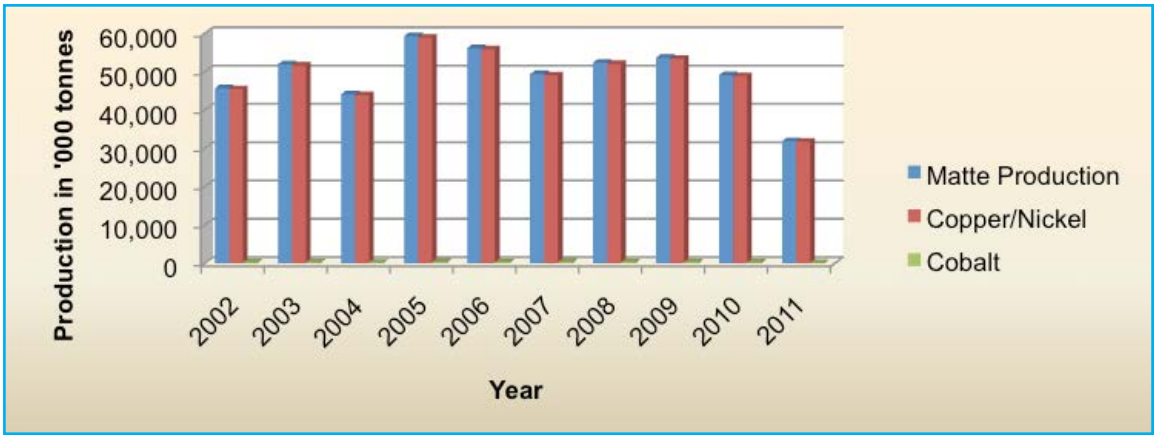


Figure 7.3c: Production of Copper Nickel between 2002 and 2011



7.3.3 Soda Ash and Salt

The mining of soda ash started in 1991 at Sua Pan. With the capacity to produce 650,000 tonnes of salt per year the soda ash plant at Sua Pan is currently operating just below capacity. According to CSO (2006) the reason why the plant is operating below capacity is mainly due to weak market conditions for its products. The plant exports coarse salt to South Africa for use in the production of chlorine and caustic soda, whereas both fine and coarse salt is supplied for domestic use throughout southern and central Africa.

As far as ownership of shares is concerned the Department of Mines (2009) reports that, in July 2009, Chlor- Alkali Holdings (Pty) Ltd acquired 50 percent shares in Botswana Ash (Pty) Ltd held by Private Shareholders (Anglo American South Africa Limited, De Beers SA, AECI Limited, First National Bank and Nedbank) subject to regulatory approvals from South Africa.

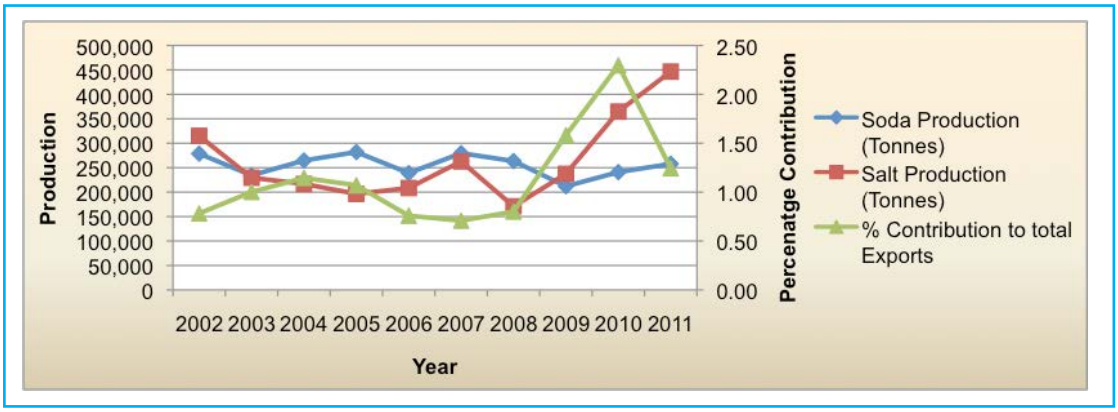
Shown in Table 7.3c and Figure 7.3d is the production and exportation of Soda and Salt from 2002 to 2011. The table shows that the highest production levels reached for soda ash was 281,976 tonnes in 2005 whilst salt reached its peak production in 2011 with 446,525 tonnes. The contribution of combined Soda and Salt to total exports fluctuated during the review period with the highest percentage contribution of 2.30 percent recorded in 2010. Average annual percentage contribution to total exports stood at 1.1 percent.

Table 7.3c: Production and Exportation of Soda Ash & Salt, 2002-2011

Year	Production		Export Values in P million		Total Exports in P million	% Contribution to total Exports
	Soda (T)	Salt (T)	Soda	Salt		
2002	278,767	315,113	42,354,284	29,147,672	9,139,596,958	0.78
2003	234,236	229,432	81,391,731	36,060,737	11,722,647,591	1
2004	264,695	216,745	106,547,877	57,002,387	14,278,605,397	1.15
2005	281,976	196,443	122,645,566	94,341,520	20,286,258,981	1.07
2006	238,942	208,412	114,442,227	66,104,144	23,802,456,542	0.76
2007	279,625	262,852	123,072,327	70,375,511	27,313,501,669	0.71
2008	263,566	170,994	99,658,519	121,496,647	27,611,470,618	0.8
2009	211,975	237,414	199,967,258	111,596,654	19,699,337,008	1.58
2010	240,898	364,734	488,951,641	134,995,143	27,170,409,361	2.3
2011	257,851	446,525	323,179,812,	137,869,865	37,050,535,439	1.24

Source: Statistics Botswana- Trade Statistics& National Accounts Units

Figure 7.3d: Production and Contribution of Soda Ash & Salt to Total Exports, 2002-2011



7.3.4 Coal

Botswana has large untapped reserves of semi-bituminous coal but the sole mining operation is the Morupule Colliery in Eastern Botswana, over which Debswana assumed control from Anglo American in 2003 and has a capacity to produce one million tonnes per year (BEDIA, undated). Morupule Colliery supplies Morupule thermal power station, Selebi Phikwe and Sua Pan Mines with coal and some little remains are exported.

Table 7.3d and Figures 7.3e-7.3f show the production of coal and the associated contributions to the total exports for the years 2002-2011. It is evident from the table and figure that coal production has been a little below one million tonnes per year, averaging an annual production of 888,547 tonnes. Coal production fluctuated during the period under review. Generally the value of coal exported has been on the increase coupled with its percentage contribution to the total exports. The highest value of coal exported was experienced in 2008 with 50.606 million Pula and contributed about 0.2 percent to total exports during the same year.

Table 7.3d: Production of Coal and the Contribution to Total Exports: 2002-2011

Year	Production (T)	Value of Coal Exported in P million	Total Exports in P million	% Contribution to Total Exports
2002	953,084	2,328	9,139,596,958	0
2003	822,780	2,173,957	11,722,647,591	0.02
2004	910,968	3,507,322	14,278,605,397	0.02
2005	984,876	8,067,127	20,286,258,981	0.04
2006	962,427	14,393,791	23,802,456,542	0.06
2007	828,164	15,542,580	27,313,501,669	0.06
2008	909,511	50,606,268	27,611,470,618	0.18
2009	737,798	32,436,771	19,699,337,008	0.16
2010	988,240	49,235,923	27,170,409,361	0.18
2011	787,624	48,894,034	37,050,535,439	0.13

Source: Statistics Botswana- Trade Statistics & National Accounts Units

Figure 7.3e: Production of Coal (tonnes) from 2002 to 2011

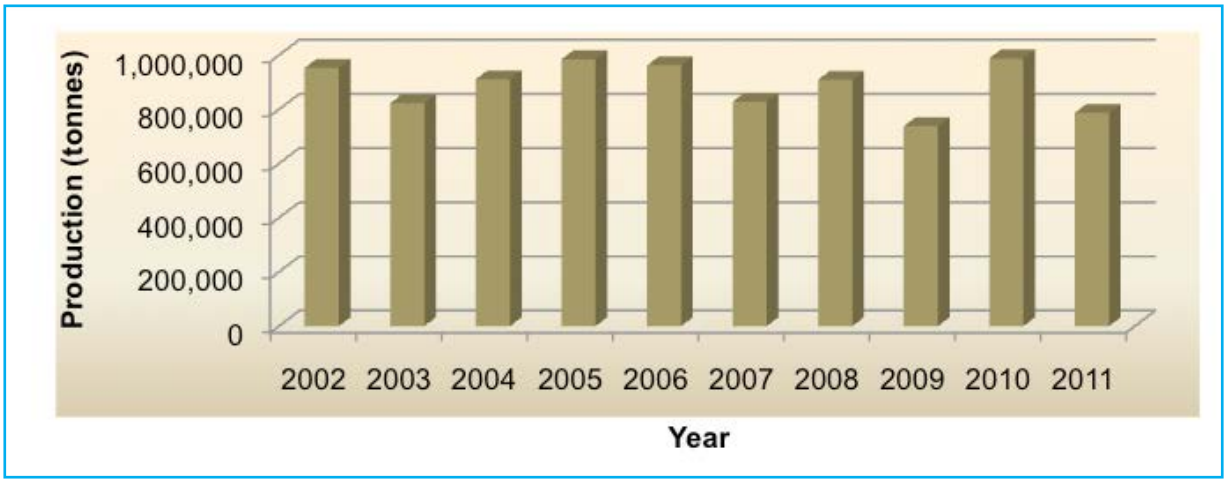
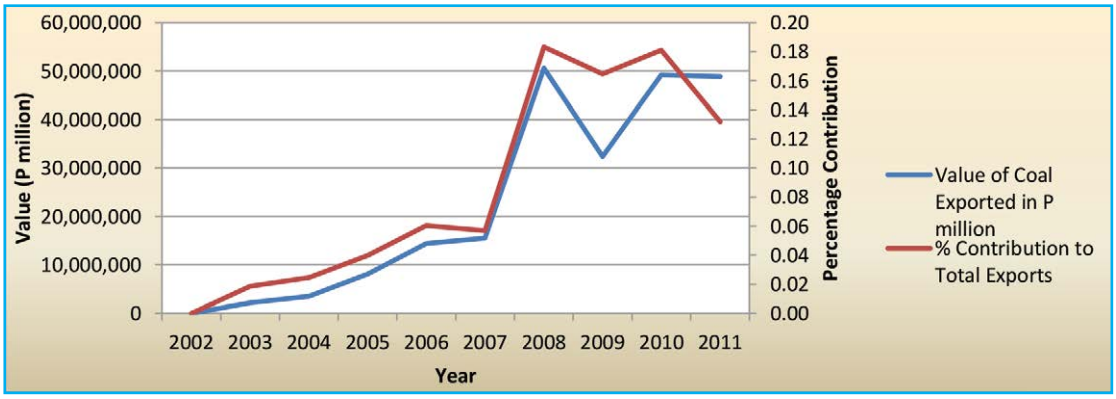


Figure 7.3f: Contribution of Coal to Total Exports



7.3.5 Precious Metals

Botswana became a significant gold producer for the first time in 2004, with the opening of the Mupane open pit mine in the Francistown area- where the metal has been internationally mined on a small scale for many years- by Australia's Gallery Gold (BEDIA, undated).

According to CSO (2006) a number of mines are operating today and most of them salvage from tailings left by older, less efficient methods of extraction. Furthermore, Monarch Gold Mine has been re-opened with more advanced technologies for small scale operations; In addition, Jacamar Manganese re-opened the manganese mine at Kgakgwe Hill in the Southern District.

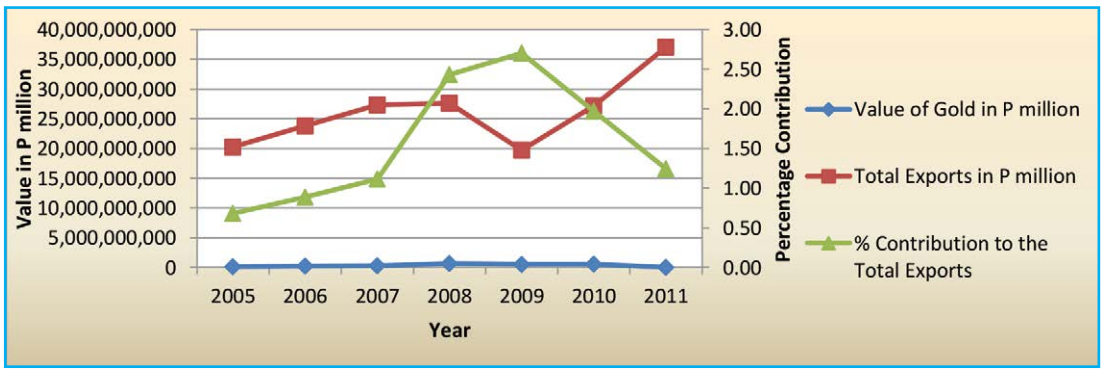
Table 7.3e and Figure 7.3g show the production of Gold and its contribution to the total exports in monetary values from 2005 to 2011. Gold production dropped from 3,235 Kg in 2005 to 1,562 Kg in 2011 though it generally fluctuated between the other years. On the other hand, percentage contribution of Gold to total exports experienced the highest value of 2.70 percent in 2009, not because the production was high but rather due to the continued strengthening of Gold prices during 2009, to US$1100/oz in December 2009 from US$872/oz in December 2008.

Table 7.3e: Gold Production and Value Exported

Year	Production in Kg	Value of Gold in P million	Total Exports in P million	% Contribution to the Total Exports
2005	3,235	138,146,699	20,286,258,981	0.68
2006	3,021	211,835,971	23,802,456,542	0.89
2007	2,655	304,706,410	27,313,501,669	1.12
2008	3,176	670,784,511	27,611,470,618	2.43
2009	1,626	531,987,755	19,699,337,008	2.7
2010	1,774	535,068,029	27,170,409,361	1.97
2011	1,562	461,049,677,	37,050,535,439	1.24

Source: Statistics Botswana- Trade Statistics& National Accounts Units

Figure 7.3g: Contribution of Gold to Total Exports



7.3.6 Other Minerals

Other minerals found in Botswana are as follows, though most of their production is almost non-existent: Glass Sand, Agates, Zinc, Fluorite, Kyanite, Silver, Antimony, Graphite, Limestone, Talc, Gypsum, Lead, altered Serpentinite, Asbestos Manganese, Uranium, Chromite, Iron, Platinum, and Feldspar Kaolin. Exploitation of some of the mentioned minerals has been hampered by such factors as, unpredictable markets, inadequate reserves, unfavourable metallurgical properties, lack of infrastructure and the location of the sites. CSO (2006) asserts that, asbestos, talc, kainite and manganese have been exploited in the past, but are no longer in commercial production because mining them is no longer feasible.

7.4 Mining Labour

Through the forward and backward linkages the mining industry in Botswana creates employment windows not only within the industry itself but to other related industries. In 2009 the total labour force in mining industry dropped to 15,482 compared to 18,830 employees recorded in 2008 as indicated on Table 7.4a. Figure 7.4a presents trend of employment in the mining companies with the highest number of employees. The results reveal a decrease of 17 percent in 2009 comparatively to an increase between 2007 and 2008 of about 15 percent. The drop in the mining employment is attributable to the 2009 global economic recession. According to the Department of Mines (2009), the global economic recession resulted in mining operations laying off employees or shutting down.

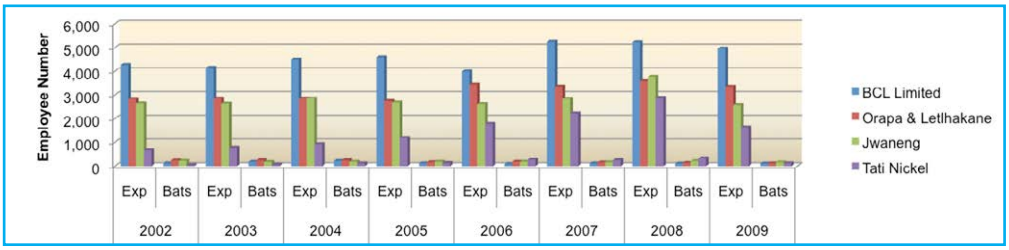
Table 7.8 and Figure 7.10 also show that diamond industry had more work-force compared to other mining industries, and trailing just behind the diamond industry is the copper/nickel mining industry. Generally expatriates dominated the mining industry labour force during the 2002-2009 period. The highest value of 17, 842 expatriate employees was recorded in 2008 while the lowest stood at 12, 378. On the other hand Batswana employees dawdled behind expatriates with the highest number of employees recorded in 2004 (1, 028 employees), which is by far lesser than the lowest expatriate figure.

Table 7.4a: Annual Employment in the Mining Industry, 2001 – 2009

Mine	2002		2003		2004		2005		2006		2007		2008		2009	
	Exp	Bats	Exp	Bats	Exp	Bats	Exp	Bats	Exp	Bats	Exp	Bats	Exp	Bats	Exp	Bats
BCL Limited	4,271	122	4,148	190	4,487	227	4,606	124	3,992	92	5,247	122	5,226	110	4,966	110
Orapa & Letlhakane	2,838	246	2,853	248	2,853	248	2,751	172	3,449	190	3,359	160	3,585	140	3,354	120
Jwaneng	2,649	226	2,645	181	2,856	186	2,692	188	2,622	188	2,841	171	3,780	213	2,586	160
Morupule Colliery	310	4	334	5	329	15	240	6	244	5	253	6	275	6	304	5
Botswana Ash	535	80	565	81	444	49	415	52	413	32	418	19	422	17	435	20
Tati Nickel	668	46	785	65	927	124	1,196	137	1,788	279	2,221	254	2,885	332	1,645	120
Mupane	N/A	N/A	N/A	N/A	233	71	281	64	339	55	379	57	232	45	352	42
Messina Copper	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16	11	417	45	167	27
Diamonex	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	78	7	197	30	14	3
Small mines	38	4	6	0	7	0	7	0	27	1	16	1	15	1	105	20
Quarries	1,211	75	1,042	88	968	108	770	106	804	54	696	48	808	49	874	55
Sub Total	**12,520**	**803**	**12,378**	**858**	**13,104**	**1,028**	**12,958**	**849**	**13,678**	**896**	**15,524**	**856**	**17,842**	**988**	**14,801**	**681**
Total		**13,323**		**13,236**		**14,132**		**13,807**		**14,574**		**16,380**		**18,830**		**15,482**
% Increase		**1.37%**		**-0.65%**		**6.77%**		**-2.30%**		**5.56%**		**12.39%**		**14.96%**		**-17.23%**

Note: Exp= Expatriates & Bats= Batswana
Source: Department of Mines (2009)

Figure 7.4a: Trend of Employment in the Selected Mining Companies, 2002-2009



7.5 Response to Impacts of Mining: Rehabilitation and Legislation

As much as large chunks of land is cleared to make way for minerals excavation some little land is rehabilitated so as to restore the biological diversity of the environment. The Department of Mines (2009) reports that no new rehabilitation of old workings was done during the 2009/10 review period; however a project to rehabilitate the old and abandoned mines in and around Monarch area (Francistown) which started in November 2007 was completed. The objective of the project was to remove dangers posed by the existence of the shafts and sudden failure of ground because of the existing underground voids that have been left by old mining activities in the area. The activities included backfilling of old shafts using the existing dump material, levelling of the dumps sides to a gentle slope, re-vegetation of the area and public sensitization. Department of Mines further reports that by the end of 2009/10 a cumulative total of 564 small scale mining concessions were rehabilitated since the 2005/06 financial year.

In the 20th century, the extraction of construction minerals grew by a factor of 34, while that of ores and industrial minerals by a factor of 27. This growth significantly outpaced a quadrupling of world population and a 24-fold increase in GDP (United Nations, Department of Economic and Social Affairs). The world economically benefits from mining mineral resources though at the expense of the natural environment. The growing of the extraction of construction ores and industrial minerals implies that more land is cleared to make way for minerals excavation, and it defeats the purpose of sustainable development.

The Environmental Impact Assessment (EIA) is one other tool that takes into cognisance the importance of managing natural resources. All mining project proposals have to be accompanied by a sound EIA Report before a license to mine any mineral resource is granted. For a long time, Botswana had been without EIA legislation. The screening of the EIA Reports is currently done at the Department of Environmental Affairs (DEA). The EIA Act was promulgated in 2005. The EIA studies that were undertaken before the EIA Act entered into force were either on voluntary basis or as requirements from donor agencies. Despite the lack of EIA legislation prior to 2005, other institutions like the Departments of Mines and National Museum, Monuments and Art Gallery had EIA provisions in their legislations and as such some projects went through the EIA process (http://www.mewt.gov.bw/DEA/article.php?id_mnu=157).

Environmental Impact Assessment (EIA) Report is a document that achieves the following overall objectives:-

- To meet the environmental requirements and directives under the Mines and Minerals Act No. 17 of 1999 and other statutory and legislative instruments.
- To provide a single document that will satisfy the various authorities that are concerned with the regulation of the environmental impacts of mining.
- To give reasons for the need for, and the overall benefit of, the proposed project.
- To describe the relevant baseline environmental conditions at and around the proposed site.

- To describe briefly the mining method and associated activities so that an assessment can be made of the significant impacts that the project is likely to have on the environment during and after mining.
- To describe how the negative environmental impacts will be managed and how the positive impacts will be maximised.
- To set out the environmental management criteria that will be used during the life of the project so that the stated and agreed land capability and closure objectives can be achieved and a closure certificate issued.
- To indicate that resources will be made available to implement the Environmental management programme.

Botswana has put legislative measures in place so as to regulate mining activities. The key mining legislation in the country may be summarised as follows:

- Mines and Minerals Act 1999,
- Precious and Semi-Precious Stones (Protection) Act, Chap.6603 (Act 4, 1991),
- Diamond Cutting Act, Chap6604 (Act 25, 1979),
- Export and Import of Rough Diamonds Regulations.

8. AGRICULTURE

Agriculture is the mainstay of rural livelihoods in Botswana as people depend on arable and livestock farming. However this sector is often threatened by unfavourable environmental conditions. Foremost, the climate is characterized by erratic and inadequate rainfall and high temperatures; conditions not conducive to productive growth of crops and good pasture for livestock. Furthermore the soils are predominantly sandy; a condition that does not support growth of some plants and crops.

In addition rangeland degradation has been identified as one of the pressing environmental pressures (National Conservation Strategy; 1990), quantification of such is however found to be problematic. Therefore restoration and conservation of rangelands is key to development planning given the significance of agricultural sector. According to Southern African Development Community/International Union for Conservation of Nature/Southern African Research and Documentation Centre (2001) degradation leads to decreased productivity of crops and livestock which has a bearing on food security and livelihoods.

These challenges and others notwithstanding, agriculture remains the main economic activity in most parts of the country.

8.1 Arable Farming

Arable farming consists of traditional (subsistence) and commercial farming. The crops that are planted mostly by subsistence farmers are sorghum, maize, millet and beans/pulses. For commercial farming the following crops are planted among others; sorghum, maize, sunflower and beans/pulses.

Table 8.1a shows total area planted and area harvested for years 2009 and 2010 in the traditional sub-sector. The table indicates that total area planted decreased by about 9 percent in the period. Area harvested correspondingly decreased by approximately 15 percent. However the situation differs at regional level, with some regions having an increase others a decrease.

Out of the area planted in 2009 about 68 percent was harvested while in 2010 about 64 percent of area planted was harvested. The Western Region had the lowest area planted and harvested in the country, probably due to the sandy soils coupled with unfavourable climate. As indicated under Chapter 1on Climate, Tshane and Tshabong which are both in the Western region received lowest total rainfall (211.9mm and 213.4mm respectively) relative to other regions.

Table 8.1b and Figure 8.1a show total production for the crops under discussion for 2009 and 2010. There was a general decline in total production in the period considered for all crops at national level. Sorghum production declined by about 22 percent followed by maize at 19 percent, while beans/pulses declined by 7 percent. The decline occurred mainly from Central, Francistown and Western regions. For maize and beans/pulses the decline was more pronounced in Gaborone and Central regions.

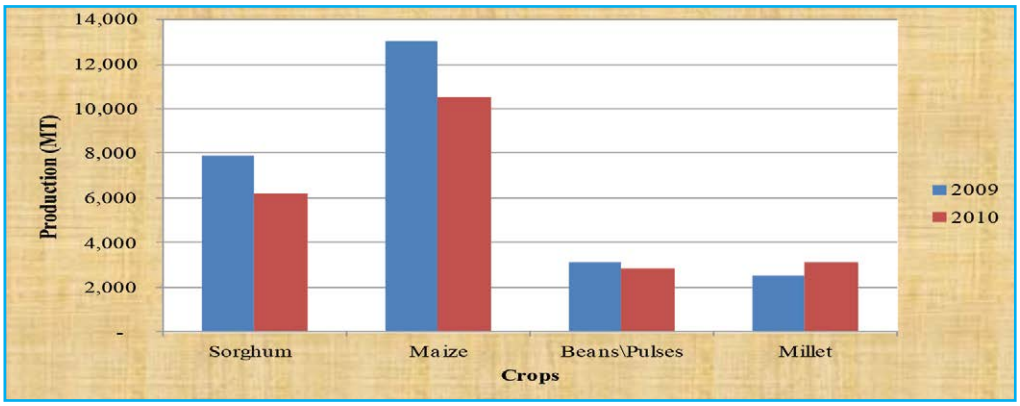
Table 8.1a Total Area Planted and Harvested (Ha) by Region

	2009		2010	
Region	**Planted Area**	**Harvested Area**	**Planted Area**	**Harvested Area**
Southern	24,829	16,989	35,827	28,540
Gaborone	76,888	51,291	61,903	35,774
Central	81,514	54,104	52,019	25,230
Francistown	49,719	36,409	55,015	40,098
Maun	8,295	6,077	12,320	9,580
Western	1,418	826	2,975	2,023
Total Traditional	**242,663**	**165,696**	**220,059**	**141,245**

Table 8.1b Total Production (MT) by Crop and Region

	2009				2010
Region	**Sorghum**	**Maize**	**Beans\Pulses**	**Millet**	**Sorghum**
Southern	265	1,460	352	0	267
Gaborone	708	6,067	800	28	1,087
Central	3,393	3,326	1,043	105	1,397
Francistown	3,117	1,831	742	1,713	2,846
Maun	419	275	101	655	584
Western	2	81	52	0	0
Total Traditional	**7,904**	**13,040**	**3,090**	**2,501**	**6,181**

Figure 8.1a Total Production (MT) by Crop and Year



In the commercial sub-sector, area planted increased between the years 2009 and 2010 for all crops except sunflower which had a decrease of 38 percent (Table 8.1c and 8.1d). The area harvested correspondingly increased for sorghum and beans, while for sunflower and maize it decreased. This picture is again depicted in total production for both years. Unlike in the traditional sub-sector, most (in some cases all) of the area planted was harvested in both years.

Table 8.1c Area Planted, Area Harvested (ha) & Production (metric tonnes) by Type of Crop and Block: 2009

	Area Planted				Area Harvested				Total Production			
BLOCK	**Sorghum**	**Maize**	**Beans/ Pulses**	**Sunflower**	**Sorghum**	**Maize**	**Beans/ Pulses**	**Sunflower**	**Sorghum**	**Maize**	**Beans/ Pulses**	**Sunflower**
Tuli Block	4	8	-	-	4	8	-	-	4	9	-	-
Tati Block	52	28	4	1	52	24	4	1	88	6,011	1	0
Gantsi Freehold	-	1	6	-	-	0	6	-	-	10	2	-
Molopo Freehold	-	-	-	-	-	-	-	-	-	-	-	-
Gaborone Freehold	-	3	2	-	-	0	-	-	-	0	-	-
Pandamatenga	11,618	195	1,212	2,201	11,618	195	1,166	2,201	21,378	156	1,224	1,632
Lobatse Freehold	-	10	-	-	-	-	-	-	-	-	-	-
Sand Veld TGLP*	-	-	-	-	-	-	-	-	-	-	-	-
Ngwaketse TGLP	-	30	-	-	-	17	-	-	-	15	-	-
Kgalagadi TGLP	-	-	-	-	-	-	-	-	-	-	-	-
Kweneng TGLP	2	2	1	-	-	2	1	-	-	1	0	-
Gantsi TGLP	-	1	1	-	-	-	1	-	-	-	0	-
Haina Veldt TGLP	-	-	-	-	-	-	-	-	-	-	-	-
Nata TGLP	-	1	-	-	-	1	-	-	-	2	-	-
Lepasha TGLP	10	2	1	10	10	2	1	10	5	1	0	5
Barolong Farms	-	-	-	-	-	-	-	-	-	-	-	-
Letlhakane TGLP	-	-	-	-	-	-	-	-	-	-	-	-
				-								
Total Commercial	**11,686**	**281**	**1,227**	**2,212**	**11,684**	**249**	**1,179**	**2,212**	**21,475**	**6,207**	**1,227**	**1,637**

Table 8.1d Area Planted, Area Harvested (ha) & Production (metric tonnes) by Type of Crop and Block: 2010

	Area Planted				Area Harvested				Production			
BLOCK	**Sorghum**	**Maize**	**Beans/ Pulses**	**Sunflower**	**Sorghum**	**Maize**	**Beans/ Pulses**	**Sunflower**	**Sorghum**	**Maize**	**Beans/ Pulses**	**Sunflower**
Tuli Block	4	8	-	-	4	8	-	-	4	9	-	-
Tati Block	41	15	7	1	41	13	7	1	16	6,005	2	-
Gantsi Freehold	-	1	5	-	-	-	5	-	-	10	20	-
Molopo Freehold	-	-	-	-	-	-	-	-	-	-	-	-
Gaborone Freehold	-	-	-	-	-	-	-	-	-	-	-	-
Pandamatenga	13,988	195	2,552	1,361	13,988	195	2,396	1,361	29,256	156	2,231	1,232
Lobatse Freehold	-	91	-	-	-	10	-	-	-	-	-	-
Sand Veld TGLP	-	-	-	-	-	-	-	-	-	-	-	-
Ngwaketse TGLP	-	-	-	-	-	-	-	-	-	-	-	-
Kgalagadi TGLP	-	2	-	-	-	2	-	-	-	-	2	-
Kweneng TGLP	2	2	1	-	-	2	1	-	-	-	-	-
Gantsi TGLP	-	1	1	-	-	-	1	-	-	-	-	-
Haina Veldt TGLP	-	6	2	-	-	6	1	-	-	5	-	-
Nata TGLP	-	1	-	-	-	1	-	-	-	2	-	-
Lepasha TGLP	10	2	1	10	10	2	1	10	5	1	-	5
Barolong Farms	-	-	-	-	-	-	-	-	-	-	-	-
Letlhakane TGLP	-	-	-	-	-	-	-	-	-	-	-	-
Total Commercial	**14,045**	**324**	**2,569**	**1,372**	**14,043**	**239**	**2,412**	**1,372**	**29,281**	**6,188**	**2,255**	**1,237**

Source: Agricultural Statistics Unit; Statistics Botswana

Table 8.1e Land Holdings by Reason for not ploughing/Planting and Region

	2009							2010					
Region	Lack of Rain	Lack of Money	Lack of Seeds	Lack of Labour	Lack of Draught Power	Lack of Equipment	Total	Lack of Rain	Lack of Money	Lack of Seeds	Lack of Labour	Lack of Draught Power	Lack of Equipment
Southern	434	111	10	210	57	0	822	368	56	30	44	215	0
%	53	14	1	26	7	0	100	52	8	4	6	30	0
Gaborone	601	307	431	22	517	55	1,933	810	99	6	425	287	67
%	31	16	22	1	27	3	100	46	6	0	24	16	4
Central	418	16	0	313	190	0	937	1,686	68	0	585	238	50
%	45	2	0	33	20	0	100	64	3	0	22	9	2
Francistown	121	602	0	389	270	0	1,382	1,376	54	0	841	43	10
%	9	44	0	28	20	0	100	58	2	0	36	2	0
Maun	0	0	0	0	0	10	10	15	0	0	102	51	0
%	0	0	0	0	0	100	100	9	0	0	61	30	0
Western	81	0	0	0	74	0	155	10	0	0	0	0	0
%	52	0	0	0	48	0	100	100	0	0	0	0	0
Total	**1,655**	**1,036**	**441**	**934**	**1,108**	**65**	**5,239**	**4,265**	**277**	**36**	**1,997**	**834**	**127**
%	32	20	8	18	21	1	100	56	4	0	26	11	2

It has already been indicated that unfavourable climatic conditions are some of the factors affecting agricultural production. This is further demonstrated by the reasons given by farmers for not ploughing/planting.

Table 8.1e gives number of holdings by reason for not ploughing/planting. It is shown from the table that all Regions, except Francistown in 2009 and Maun in 2009 and 2010, cited lack of rain as the reason for not ploughing/planting. Maun region generally has relatively high rainfall in the country, a fact that is also depicted under Chapter 1 of this Report.

8.2 Livestock Farming

Livestock in Botswana is not only held for economic reasons but for socio-cultural factors as well. They are often used in social activities like funerals and weddings.

Like arable farming, livestock rearing consists of traditional and commercial sub-sectors. In traditional sub-sector cattle, goats and sheep are the major types of livestock kept. Table 8.2a and Figure 8.2a show that cattle had the highest population followed by goats in both 2009 and 2010. The number of cattle and goats slightly increased in the period while sheep population slightly declined.

Livestock numbers are influenced by the number of births, deaths and off-take. In both years births exceed deaths for all livestock types. The number of births and deaths for cattle increased slightly, while it marginally decreased for goats and sheep. This means that the population of livestock is bound to continue increasing. The increasing population has implications on carrying capacity of land.

Table 8.2a Livestock Statistics: 2009 and 2010

		2009							
		Traditional Sector				Commercial Sector			
		Number	Births	Deaths	offtake	Number	Births	Deaths	offtake
2009	Cattle	2,086,581	538,954	121,631	182,731	326,054	65,750	11,021	35,462
	Goats	1,824,346	794,361	361,316	125,654	42,284	15,905	5,568	4,012
	Sheep	272,489	96,456	43,102	19,870	20,906	6,673	2,610	1,218
		2010							
2010	Cattle	2,249,364	552,054	134,298	163,405	399,478	78,593	12,724	48,956
	Goats	1,888,761	788,082	352,337	105,184	49,210	18,037	4,411	4,806
	Sheep	252,057	82,311	34,338	11,915	27,180	8,650	1,777	2,337

Source: Agricultural Statistics Unit; Statistics Botswana

Figure 8.2a Livestock Statistics: 2009 and 2010

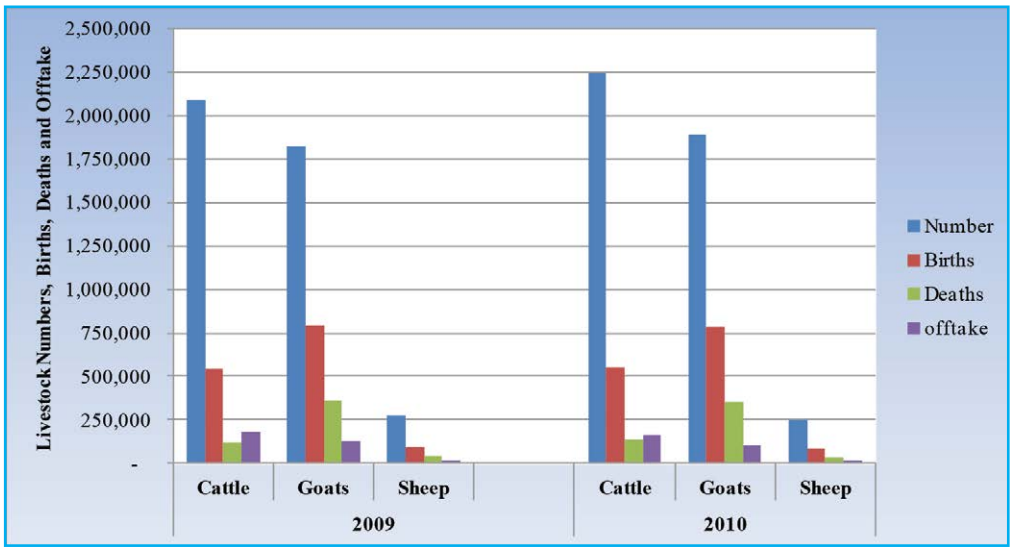


Table 8.2b and 8.2c show that even though generally the number of cattle holdings and goats' holdings in the traditional sub-sector slightly decreased between 2009 and 2010, the number of cattle and goats on the other hand increased. This has implications on the stocking rate per livestock holding. Total number of holdings for sheep correspondingly declined with the total number of sheep.

Central region had the highest number of livestock holdings and the highest number of livestock in 2009 while on the other hand Western region had the highest average number of livestock per holding for all livestock types thereby indicating a possible over-stocking especially given the fragile nature of the land in the Western region (Table 8.2b).

In 2010, the highest number of livestock holdings was found in Gaborone region, but the highest number of livestock was found in Central region (Table 8.2c). The highest average number of cattle and goats per holding was again found in Western region while that of sheep was found in Maun region with Western having a close second highest.

Table 8.2b Livestock Holdings and Population by Region (2009)

	Cattle			Goats			Sheep		
Region	Total Holdings	Total Cattle	Av No of Cattle per Holding	Total Holdings	Total Goats	Av No of Goats per Holding	Total Holdings	Total Sheep	Av No of Sheep per Holding
Southern	11,540	210,825	18	13,089	241,803	18	3,542	47,304	13
Gaborone	19,990	459,540	23	22,297	434,011	19	5,414	58,803	11
Central	26,799	955,220	36	30,280	733,292	24	8,423	117,305	14
Francistown	11,131	197,174	18	13,887	211,312	15	2,016	30,787	15
Maun	3,879	121,118	31	3,800	75,190	20	451	6,598	15
Western	3,031	142,704	47	3,573	128,738	36	463	11,692	25
Total	**76,370**	**2,086,581**	**27**	**86,926**	**1,824,346**	**21**	**20,309**	**272,489**	**13**

Table 8.2c Livestock Holdings and Population by Region (2010)

	Cattle			Goats			Sheep		
Region	Total Holdings	Total Cattle	Av No of Cattle per Holding	Total Holdings	Total Goats	Av No of Goats Per Holding	Total Holdings	Total Sheep	Av No of Sheep Per Holding
Southern	13,665	279,763	20	13,671	254,585	19	4,215	45,335	11
Gaborone	20,307	480,566	24	22,725	481,992	21	5,963	74,950	13
Central	18,025	690,977	38	19,757	506,396	26	4,547	82,911	18
Francistown	14,246	427,232	30	18,222	400,885	22	2,181	23,335	11
Maun	6,296	230,002	37	5,860	119,922	20	536	11,620	22
Western	3,328	140,824	42	3,313	124,968	38	667	13,906	21
Total	**75,867**	**2,249,364**	**30**	**83,548**	**1,888,748**	**23**	**18,109**	**252,057**	**14**

Source: Agricultural Statistics Unit; Statistics Botswana

Environmental Implications of Farming

As indicated in the foregoing sub-chapters, there is a gap between area planted and harvested in the period under review which may indicate a deficiency in soil productivity and harsh weather; i.e. availability and timing of rainfall, and scorching heat. This makes dry land farming which is mainly practiced by subsistence farmers to be a risky venture.

Arable production is also shown to vary by region according to ecological and climatic differences. The Western region had the lowest levels of production; the region is predominated by the Kalahari Desert.

In a bid to increase productivity of soil, farmers' often add artificial fertilizers. Accumulation of fertilizer components may affect soil structure and texture in the long run; it may also pollute underground waters. Fertilizers may also be a source of greenhouse gas (nitrous oxide) emission due to nitrogen content of some fertilizers. Detailed data on usage of fertilizers in Botswana was not readily available to be included in this report. In addition livestock contribute to greenhouse gas (methane and nitrous oxide) emissions through enteric fermentation and manure management which cause climate change.

With livestock, the relatively low rates of off-take compared with birth rate leads to high livestock population that may be resulting in overstocking and land degradation. Noticeable is the high average number of livestock per holding especially in Western region. In relation to this is the practice of communal grazing that allows farmers open access to the same grazing land and to keep any number of livestock. Overstocking of livestock has been seen to be detrimental to the environment as it causes overgrazing and soil compaction. The latter leads to loss of soil structure thereby limiting the ability of the soil to support plant growth. Compacted soil also has poor water draining capacity thus promoting welling of waters. It is also a threat to underground water resources due to pollution from livestock manure.

Another challenge associated with livestock rearing is that water is self-provided and the amount abstracted is not monitored nor accounted for by the farmers. There is therefore a likelihood of over-harvesting of ground water. Farmers use a permit given by Water Apportionment Board which licenses them to abstract but does not regulate the abstraction. It should be noted that although farming has such negative effects on the environment, the sector is also negatively affected by environmental factors. Botswana is known for the cyclical droughts which are detrimental to the sector. It has been indicated that most people cited lack of rain as the main reason for not planting in 2009 and 2010. Drought and its impact are covered under Chapter 6 on Natural Disasters.

These negative factors notwithstanding, agriculture remains a significant source of rural livelihoods.

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APPENDICES

Table A1: Problem Animal Incidents Summary by Species and District (2009-2011)

Species	Ghanzi			Kgalagadi			Ngamiland			Kweneng			Kgatleng			Central			Southern		
	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
Baboon	0	0	0	0	0	0	1	2	1	3	15	5	15	10	6	0	2	2	0	43	33
Birds	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	3		2	5
Black b-jackal	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	6	1
Brown Hyaena	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3	4	4	0	19	14
Buffalo	0	0	0	0	0	0	1	6	1	0	0	0	0	0	0		128		0	0	0
Caracal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	64	1	0	1	0
Cheetah	34	16	13	1	12	1	18	5	16	36	14	1	42	0	0	11	1	11	25	7	11
Crocodile	0	0	0	0	0	0	11	76	56	0	0	0	0	0	4	0	0	0	0	0	0
Duiker	0	0	0	0	0	0	0	0	0	0	0	0	11	1	1	0	0	0	0	26	21
Elephant	2	1	10	0	0	0	671	923	712	0	0	0	0	0	0	2	2	60	0	0	0
Guinea fowl	0	0	0	0	0	0	0	0	0	0	0	0	4	6	1	0	0	0	0	17	12
Hippopotamus	0	0	0	0	0	0	58	109	59	0	0	0	0	0	2	0	0	0	0	0	0
Hyaena (unknown)	1	0	2	2	24	15	6	2	0	17	15	0	22	15	13	0	0	0	0	0	0
Impala	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Jackal (unknown)	5	1	2	2	6	3	0	0	0	0	0	0	8		0	1	1	2	0	0	0
Kudu	0	0	0	0	0	0	3	1	1	34	55	27	34	63	60	67	4	78	0	122	105
Leopard	112	89	76	12	89	45	251	201	188	247	188	126	51	52	81	231	325	210	73	64	55
Lion	21	34	47	8	38	18	450	409	278	270	64	50	0	0	0	17	10	72	0	0	0
Monkey	0	0	0	0	0	0	0	0	0	0	0	0	0	8	3	0	0	2	0	5	3
Porcupine	0	0	0	0	0	0	3	2	0	3	7	5	10	3	4	2	0	3	0	15	16
Snakes	0	1	0	0	0	0	1	21	9	0	0	0	18	6	6	8	3	15	0	38	45
Spotted hy-aena	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	11	0	6	0
Spring hare	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	7	2
Steenbok	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	22
Warthog	0	0	0	0	0	0	100	1	182	0	0	0	2	1	0	0	0	0	0	6	9
Wild dog	179	280	174	7	74	62	118	152	257	115	57	57	0	0	7	64	7	90	2	3	1
Total	**356**	**422**	**326**	**32**	**244**	**146**	**1,694**	**1,910**	**1,760**	**725**	**415**	**271**	**196**	**152**	**178**	**411**	**556**	**565**	**100**	**405**	**355**

Table A2: Wildlife Mortality by Cause (2009-2011)

Species	Cause of Death	Central	Ghanzi	Ngamiland	Kgalagadi	Kgatleng	Southern	Total
kudu	road accident	9	3	0	0	4	0	16
	poaching	33	1	9	0	0	0	43
	pac	43	1	0	0	5	4	53
	Natural death	0	33	0	0	0	0	33
	unknown	2	0	0	3	0	0	5
	injured	18	0	3	0	0	0	21
	fence	18	2	0	0	0	0	20
	Total	**123**	**40**	**12**	**3**	**9**	**4**	**191**
impala	road accident	0	0	0	0	1	0	1
	poaching	33	0	7	0	0	0	40
	pac	1	0	0	0	2	0	3
	injured	2	0	0	0	0	0	2
	unknown	0	0	1	0	0	0	1
	Total	**36**	**0**	**8**	**0**	**3**	**0**	**47**
warthog	road accident	1	0	0	0	0	0	1
	poaching	0	0	0	0	0	0	0
	pac	22	0	0	0	0	0	22
		23	0	0	0	0	0	23
blue wildebeest	poaching	1	0	0	0	0	0	1
	pac	0	0	0	0	0	0	0
	fence	2	0	0	0	0	0	2
	unknown	1	0	0	0	0	0	1
		4	0	0	0	0	0	4
python	pac	7	0	0	0	5	5	17
		7	0	0	0	5	5	17
leopard	road accident	0	0	0	0	1	0	1
	poaching	5	0	0	0	0	0	5
	pac	61	29	3	17	6	9	125
	unknown	0	0	0	1	0	0	1
		73	**29**	**3**	**18**	**7**	**9**	**139**
hyena	road accident	1	0	0	0	3	0	4
	pac	10	0	1	1	2	1	15
	unknown	0	1	0	0	0	0	1
		11	**1**	**1**	**1**	**5**	**1**	**20**
b/b jackal	road accident	2	2	0	0	0	0	4
	pac	2	0	0	0	1	0	3
	unknown	0	0	0	14	0	0	14
		4	**2**	**0**	**14**	**1**	**0**	**21**
wild pig	pac	2	0	0	0	0	0	2
		2	0	0	0	0	0	2
baboon	road accident	2	0	0	0	0	0	2
	pac	0	0	0	0	1	0	1
		2	**0**	**0**	**0**	**1**	**0**	**3**
eland	road accident	1	0	0	0	0	0	1
	poaching	1	0	0	0	0	0	1
		2	**0**	**0**	**0**	**0**	**0**	**2**
lion	pac	3	23	5	24	0	0	55
	unknown	1	3	0	0	0	0	4
		4	**26**	**5**	**24**	**0**	**0**	**59**
African civet	pac	4	0	0	0	0	0	4
		4	**0**	**0**	**0**	**0**	**0**	**4**
giraffe	unknown	0	4	0	0	0	0	4
		0	4	0	0	0	0	4

steenbok	road accident	2	0	0	0	1	0	3
	pac	0	0	0	0	0	7	7
	fence	1	0	0	0	0	0	1
	unknown	0	0	0	7	0	0	7
		3	**0**	**0**	**7**	**1**	**7**	**18**
spring/scrub hare	road accident	1	0	0	0	0	0	1
	unknown	0	0	0	1	0	0	1
		1	**0**	**0**	**1**	**0**	**0**	**2**
genets	road accident	2	0	0	0	0	0	2
		2	**0**	**0**	**0**	**0**	**0**	**2**
elephant	poaching	2	0	4	0	0	0	6
	pac	5	6	20	0	0	0	31
	unknown	7	0	5	0	0	0	12
		14	**6**	**29**	**0**	**0**	**0**	**49**
eagle	pac	1	0	0	0	0	0	1
		1	**0**	**0**	**0**	**0**	**0**	**1**
buffalo	pac	2	0	0	0	0	0	2
		2	**0**	**0**	**0**	**0**	**0**	**2**
zebra	poaching	4	0	0	0	0	0	4
	fence	1	0	0	0	0	0	1
		5	**0**	**0**	**0**	**0**	**0**	**5**
porcupine	pac	20	0	0	0	0	0	20
		20	**0**	**0**	**0**	**0**	**0**	**20**
gemsbok	pac	45	0	0	0	0	0	45
	unknown	0	6	0	1	0	0	7
		45	**6**	**0**	**1**	**0**	**0**	**52**
mongoose	pac	1	0	0	0	0	0	1
		1	**0**	**0**	**0**	**0**	**0**	**1**
Ostrich	unknown	0	0	0	1	0	0	1
		0	**0**	**0**	**1**	**0**	**0**	**1**
Cheetah	pac	0	1	3	0	0	0	4
	unknown	0	5	0	0	0	0	5
		0	**6**	**3**	**0**	**0**	**0**	**9**
Hartebeest	unknown	0	0	0	3	1	0	4
		0	**0**	**0**	**3**	**1**	**0**	**4**
Kori Bustard	unknown	0	0	0	1	0	0	1
		0	**0**	**0**	**1**	**0**	**0**	**1**
Bat Eared Fox	unknown	0	0	0	15	0	0	15
		0	**0**	**0**	**15**	**0**	**0**	**15**
Hippo	Unknown	0	0	0	0	1	0	1
		0	**0**	**0**	**0**	**1**	**0**	**1**
Guinea Fowl	Unknown	0	0	0	0	1	0	1
		0	**0**	**0**	**0**	**1**	**0**	**1**
Bush Buck	PAC	0	0	0	0	1	0	1
		0	**0**	**0**	**0**	**1**	**0**	**1**
Monkey	PAC	0	0	0	0	1	0	1
		0	**0**	**0**	**0**	**1**	**0**	**1**
Squirrel	Road Accident	0	0	0	0	1	0	1
		0	**0**	**0**	**0**	**1**	**0**	**1**
Aardwolf	PAC	0	0	0	0	1	0	1
		0	**0**	**0**	**0**	**1**	**0**	**1**
Cape Vulture	PAC	0	0	0	0	5	0	5
		0	**0**	**0**	**0**	**5**	**0**	**5**
Other Snake	PAC	0	0	0	0	5	0	5
		0	0	0	0	5	0	5

Table A3: Fees for Single Game Licenses

Species	Fees to be paid for each licence in Botswana Pula (1BWP 0.2 USD)		Maximum number of licences that can be held by an individual	
	Citizen	Non-citizen	Citizen	Non-citizen
Baboon/Tshwene	50	200	1	1
Bat-eared fox/Mothose	50	200	1	1
Black-backed jackal/ Phokoje	50	200	2	1
Buffalo/Nare	1500	5000	1	1
Bushbuck/Serolobothoko	500	1000	1	1
Caracal/Thwane	100	500	1	1
Crocodile/Kwena	300	1000	1	1
Duiker/Phuti	100	300	2	1
Eland/Phofu	700	2500	1	1
Elephant /Tlou	8000	20 000	1	1
Gemsbok/Kukama	7000	2500	1	1
Hartebeest/Kgama	300	1000	1	1
Impala/Phala	150	500	2	1
Kudu/Tholo	300	1000	1	1
Lechwe/Letswee	300	1000	1	2
Leopard/Letotse	1500	10 000	1	1
Lion/Tau	1500	10 000	1	1
Ostrich/Ntshe	300	1000	1	1
Porcupine/Noko	50	200	1	1
Reedbuck/Mhele	500	1500	1	1
Sable/Kwalata	1500	5000	1	1
Scrub hare/Mmutla	15	50	1	1
Side-striped jackal/Sek-gee phokoje	50	200	1	1
Silver fox/Lesie	50	200	1	1
Sitatunga/Sebogata	1500	5000	1	1
Spotted hyena/ Phiri yo moramaga	100	300	1	1
Springbok/Tshephe	150	400	2	2
Springhare/Ntole	15	50	4	2
Steenbok/Phuduhudu	100	300	2	1
Tsessebe/Tsessebe	500	3000	1	1
Vervet monkey/Kgabo	50	200	2	2
Warthog /Mathinthinyane	150	500	2	2
Wild cat/Tibe	50	200	1	1
Wild pig/ Kolobe ya naga	150	500	1	1
Wildebeest/Kgokong	500	2500	1	1
Zebra/Pitse ya naga	1000	5000	1	1

Table A4: All Districts Concession Areas Wildlife Hunting Quotas (2009-2011)

	Central			Ngamiland			Chobe		
Species	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**
Baboon	21	21	21	49	24	24	7	7	7
Buffalo	8	13	13	98	26	26	2	4	4
Cat, Wild	3	0	0	15	0	0	1	0	0
Crocodile	0	0	0	7	0	0	0	0	0
Duiker	21	12	12	49	16	16	0	0	0
Eland	4	1	0	7	3	3	2	1	1
Elephant	38	58	58	134	82	82	16	22	22
Gemsbok	6	5	5	6	3	3	1	2	2
Hare, Cape	15	15	15	70	12	12	5	5	5
Hare, Scrub	15	15	15	70	12	12	5	5	5
Hyena_ Spotted	3	1	1	13	0	0	1	0	0
Impala	7	13	13	294	28	28	3	5	5
Jackal	9	0	0	16	0	3	3	0	0
Kudu	9	6	6	58	15	15	2	2	2
Lechwe	0	0	0	134	12	12	0	0	0
Leopard	3	0	0	8	0	0	1	0	0
Lion	0	0	0	0	0	0	0	0	0
Monkey, Vervet	4	4	4	22	9	9	2	2	2
Ostrich	15	6	6	20	3	3	0	0	0
Porcupine	6	3	3	22	4	4	2	1	1
Springbok	3	3	3	6	5	5	0	0	0
Steenbok	45	21	21	125	35	35	9	5	5
Tsessebe	0	0	0	151	10	0	0	0	0
Warthog	4	4	4	111	13	13	2	2	2
Wildebeest, blue	4	3	3	84	9	9	2	2	2
Zebra	8	6	6	95	15	15	2	2	2
Total	**251**	**210**	**209**	**1,664**	**336**	**329**	**68**	**67**	**67**

Table A5: All Districts Community Managed Areas Hunting Quotas (2009-2011)

	Ghanzi			Kgalagadi			Ngamiland			Chobe			Kweneng			Southern			Central	
Species	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**
Baboon	0	0	0	0	0	0	28	28	12	0	0	0	0	0	0	7	7	7	7	3
Buffalo	0	0	0	0	0	0	29	41	20	14	16	16	0	0	0	0	0	0	0	0
Cat, Wild	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Crocodile	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Duiker	5	8	10	60	40	40	24	21	0	13	8	8	26	8	8	18	12	12	5	7
Eland	0	0	0	8	5	5	6	5	0	3	3	3	0	0	0	0	1	1	0	0
Elephant	0	0	0	0	0	0	109	131	103	32	48	48	0	0	0	0	0	0	34	34
Gemsbok	12	12	0	126	24	20	28	10	0	0	0	0	6	0	3	8	0	0	0	0
Hare, Cape	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hare, Scrub	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyena_ Spotted	0	0	0	4	4	4	10	5	3	2	2	2	0	0	0	4	0	0	1	2
Impala	0	0	0	0	0	0	171	168	40	21	22	22	0	0	0	0	0	0	20	50
Jackal (Black-backed)	3	6	2	10	5	5	4	4		0	0	0	0	0	0	3	0	0	0	0
Kudu	2	4	2	25	10	10	29	21	10	6	7	7	10	2	2	5	2	6	6	6
Lechwe	0	0	0	0	0	0	48	43	10	2	3	3	0	0	0	0	0	0	0	0
Leopard	1	1	0	4	3	3	5	0	0	2	0	0	0	0	0	0	1	1	0	0
Lion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monkey, Vervet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostrich	4	4	0	137	59	59	22	17	0	0	0	0	12	6	6	9	2	2	4	3
Porcupine	0	0	0	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Springbok	0	2	3	58	26	30	2	2	0	0	0	0	3	0	0	21	9	9	2	0
Steenbok	12	24	5	65	30	30	69	70	0	17	10	10	26	12	12	43	22	22	6	3
Tsessebe	0	0	0	0	0	0	31	26	0	0	0	0	0	0	0	0	0	0	0	0
Warthog	0	0	0	0	0	0	37	31	12	5	5	5		0	0	3	3	3	2	0
Wildebeest, blue	0	0	0	8	6	6	18	14	0	3	3	3	0	0	0	0	0	0	2	0
Zebra	0	0	0	0	0	0	12	11	10	6	7	7	0	0	0	0	0	0	2	4
Hartbeest	2	2	0	16	12	12	8	5	0	0	0	0	0	0	0	2	3	3	0	0
Side striped Jackal	0	0	1	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Total	**41**	**63**	**23**	**527**	**230**	**230**	**695**	**655**	**220**	**126**	**134**	**134**	**83**	**28**	**31**	**123**	**62**	**66**	**92**	**112**

Table A6: All Districts Citizen Wildlife Hunting Quotas (2009-2011)

	Kgalagadi			Ngamiland			Central			Kweneng		
Species	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**
Baboon	0	0	0	8	7	7	24	24	24	0	0	0
Buffalo	0	0	0	0	0	0	0	0	0	0	0	0
Duiker	18	16	16	37	32	32	80	56	56	10	16	16
Elephant	0	0	0	0	0	0	24	37	37	0	0	0
Gemsbok	6	4	4	5	4	4	0	0	0	5	2	2
Hyena_ Spotted	0	0	0	0	0	0	8	2	2	0	0	0
Impala	0	0	0	147	100	100	103	94	94	0	0	0
Kudu	2	2	2	64	24	24	34	16	34	5	4	4
Ostrich	20	6	6	28	14	14	68	20	20	12	31	31
Springbok	10	5	5	26	11	11	16	4	4	3	2	2
Steenbok	23	12	12	80	37	37	80	40	40	10	6	6
Tsessebe	0	0	0	8	4	0	0	0	0	0	0	0
Warthog	0	0	0	55	12	12	0	0	0	0	0	0
Wildebeest, blue	0	0	0	20	9	9	2	2	0	0	0	0
Zebra	0	0	0	10	5	5	2	2	2	0	0	0
Total	**79**	**45**	**45**	**488**	**259**	**255**	**441**	**297**	**313**	**45**	**61**	**61**

Table A7: Minerals Production, 1990-2011

Calendar year	Diamonds ('000 Carats)	Matte (tonnes)	Copper/Nickel (tonnes)	E.V.P P'000	Coal (tonnes)	E.V.P P'000	Soda Ash (tonnes)	E.V.P P'000	Salt (tonnes)	E.V.P P'000	Gold (KG)	E.V.P P'000
1990	17,350	47,959	39,634		794,041							
1991	16,541	48,319	39,870		783,873		63,154		6,733			
1992	15,978	48,071	39,286		901,452		122,367		79,917			
1993	14,731	50,748	41,753		890,497		126,000		106,922			
1994	15,540	51,488	41,821		900,298		174,222		252,233			
1995	16,674	49,931	39,701		898,376		201,641		392,258			
1996	17,707	53,349	46,562		765,030		117,739		107,961			
1997	20,151	42,112	41,764		775,012		199,990		184,533			
1998	19,693	36,976	36,563		924,008		189,700		139,805			
1999	20,965	39,343	39,037		945,316		228,693		167,610			
2000	24,554	45,516	45,195		946,898		190,489		184,755			
2001	25,583	41,959	41,636		930,374		251,234		179,792			
2002	28,412	45,756	45,486		953,084		278,767		315,113			
2003	30,371	51,983	51,689		822,780		234,236		229,432			
2004	31,037	44,140	43,914		910,968		264,695		216,745			
2005	31,832	59,365	58,998	1,983,784	984,876	31,024	281,976	232,629	196,443	42,164	3,235	218,309
2006	34,293	56,222	55,888	3,747,877	962,427	51,810	238,942	259,674	208,412	56,062	3,021	333,773
2007	33,639	49,475	49,121	5,091,287	828,164	44,582	279,625	352,312	262,852	81,747	2,655	360,034
2008	32,595	52,422	52,086	4,050,599	909,511	48,959	263,566	329,721	170,994	53,179	3,176	606,428
2009	17,733	53,753	53,425	2,809,687	737,798	39,714	211,975	265,180	237,414	74,768	1,626	344,872
2010	22,018	49,167	48,890	2,718,083	988,240	51,871	240,898	296,683	364,734	111,061	1,774	488,444
2011	22,901	31,929	31,780	1,658,514	787,624	42,403	257,851	322,572	446,525	138,869	1,562	544,010

Note: E.V.P- Estimated Value of Production
Source: Statistics Botswana- National Accounts

Table A8: Annual Percentage Growth of Produced Minerals, 2005-2011

Calendar year	Diamonds ('000 Carats)	Matte (tonnes)	Copper/Nickel (tonnes)	Coal (tonnes)	Soda Ash (tonnes)	Salt (tonnes)	Gold (KG)
2005	2.6	34.5	34.3	8.1	6.5	-9.4	
2006	7.7	-5.3	-5.3	-2.3	-15.3	6.1	-6.6
2007	-1.9	-12	-12.1	-14	17	26.1	-12.1
2008	-3.1	6	6	9.8	-5.7	-34.9	19.6
2009	-45.6	2.5	2.6	-18.9	-19.6	38.8	-48.8
2010	24.2	-8.5	-8.5	33.9	13.6	53.6	9.1
2011	4	-35.1	-35	-20.3	7	22.4	-12

Source: Statistics Botswana- National Accounts

Table A9: Value of Minerals Exported in P Million, 2002-2011

Description	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Diamonds	8,376,963,420	10,681,112,474	12,434,503,742	17,449,741,072	19,452,526,343	20,043,400,783	20,793,314,918	15,234,114,763	21,779,885,141	30,247,714,850
Gold	2,109,489	46,561	9,516,034	138,146,699	211,835,971	304,706,410	670,784,511	531,987,755	535,068,029	461,049,677
Salt	29,147,672	36,060,737	57,002,387	94,341,520	66,104,144	70,375,511	121,496,647	111,596,654	134,995,143	137,869,865
Soda Ash	42,354,284	81,391,731	106,547,877	122,645,566	114,442,227	123,072,327	99,658,519	199,967,258	488,951,641	323,179,812
Cobalt	0	0	42,410	1,601	2,053	0	42	0	220,469	102
Precious or Semi-Precious Stones	596,532	439,957	2,979,340	405,244	46,766	817,739	828,707	444,509	21,995	188,985

Source: Statistics Botswana- Trade Statistics

Table A10: Value of Minerals Imported (P Million): 2002-2011

Description	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Copper/Nickel	42,585,190	73,788,854	40,620,843	311,225,191	356,435,746	212,493,772	545,398,301	437,562,505	318,342,413	2,318,049
Diamonds	14,175,139	293,764,103	111,233,341	178,008,220	387,424,634	786,387,601	3,142,051,848	2,607,950,278	4,471,254,579	5,882,111,704
Gold	7,146,601	28,612	57,886	7,373,116	214	19,238	0	14,106	56,786	2,911,616
Salt	4,036,533	4,281,515	5,790,790	8,254,229	6,325,285	7,295,641	10,333,409	10,870,522	10,455,993	12,846,652
Soda Ash	16,615	28,240	17,657	25,677	68,870	86,614	145,517	104,428	2,096,881	37,867
Cobalt	15,242,254	62,774	22,603	1,785,182	148,052	16,491	8,559	13,626	6,897	4,468
Precious or Semi-Precious Stones	52,452	18,553	602	1,690	96,187	13,212	58,556	28,048	27,882	80,182

Source: Statistics Botswana- Trade Statistics