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Abbreviations and acronyms

EAD	Energy Affairs Department
BEMP	Botswana Energy Master Plan
BEST	Biomass Energy Strategy
BIDPA	Botswana Institute of Development and Policy Analysis
BOTEC	Botswana Technology Centre
BPC	Botswana Power Corporation
BSAP	Botswana Biodiversity Strategy and Action Plan
CBNRM	Community Based Natural Resources Management
CBOs	Community Based Organisations
DEMS	Department of Electrical and Mechanical Services
FAB	Forestry Association of Botswana
FED	Final Energy Demand
FIMP	Fuelwood Inventory and Monitoring Program
GDP	Gross Domestic Product
GTZ	German Technical Cooperation
HIES	Household Income and Expenditure
LPG	Liquid Petroleum Gas
MMEWR	Ministry of Minerals, Energy, and Water Resources
NCS	National Conservation Strategy
NDP 9	National Development Plan 9
NGO	Non Governmental Organisation
ProBEC	Programme for Basic Energy Conservation
PV	Photovoltaic
RCS	Rural Electrification Collective Scheme
RIIC	Rural Industries Innovation Centre
RIPCO (B)	Rural Industries Promotions Company (Botswana)
SACU	Southern African Customs Union
SADC	Southern African Development Corporation
SMMEs	Small to Medium Micro Enterprises
UNDP	United Nations Development Programme



1. Geographical description

1.1 Size of the country

Botswana is a landlocked country situated in the middle of Southern Africa and bordered by Namibia to the west, Zambia and Zimbabwe to the north east and South Africa to the south. The country is predominantly flat to gently rolling tableland and covers 600,370 square kilometres occupying the centre of the Southern African plateau at a mean altitude of 1000 metres.

1.2 Number of provinces

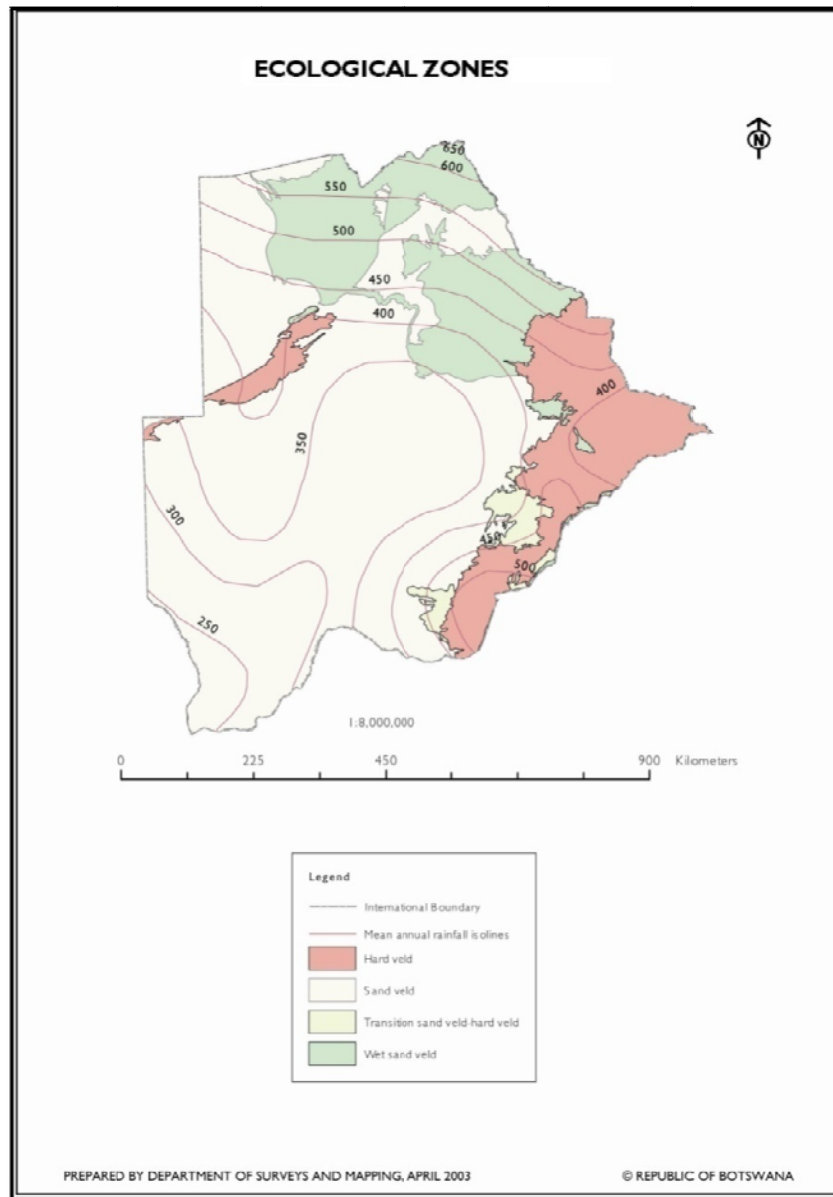
The country is divided into 10 districts, which are Central, Chobe, Gantsi, Kgalagadi, Kgatleng, Kweneng, North-East, Ngamiland, South-East and Southern (refer to figure 2 below).

1.3 Climate

The climate of Botswana is semi-arid and characterised by warm winters and hot summers. The rainy season is between September and April, but is mostly intense between late December and towards the end of February. Rainfall is erratic, averaging at about 450 mm per year and ranges between 650 mm in the north-east (Chobe) and as low as 250 mm in the south-west (Gemsbok National Park) (refer to figure1). The rainfall season varies from year to year punctuated with periods of severe drought.

Temperatures can be hot and cold with summer temperatures soaring up to 44°C between October to March and averaging between 35°C and 40°C during midday of the same period. The hottest months are between December and January. Night temperatures seldom fall below 26°C and winters are mostly dry with day-time temperatures of about 27°C, lowering to $\pm 7^\circ\text{C}$ at night. Occasionally it drops below freezing with July being the coldest month^[1].





Source: www.eis.gov.bw

Figure 1: Ecological Zones of Botswana

1.4 Geographical features

Major geological features include the Kalahari Desert in southwest, which covers about 70% of the country; the Okavango Delta, which covers approximately 15 000 km²; the Makgadikgadi Pans, which cover about 12 000 km²; the Chobe River and Linyanti Swamp, which form the northern boundary; the Hardveld in the east where the landscape is decorated with sandstone, granite and dolerite outcrops and bordered by the Shashe and Limpopo rivers; the Tsodilo Hills and the Drotsky's Caverns in the north west of the country.



2. Map

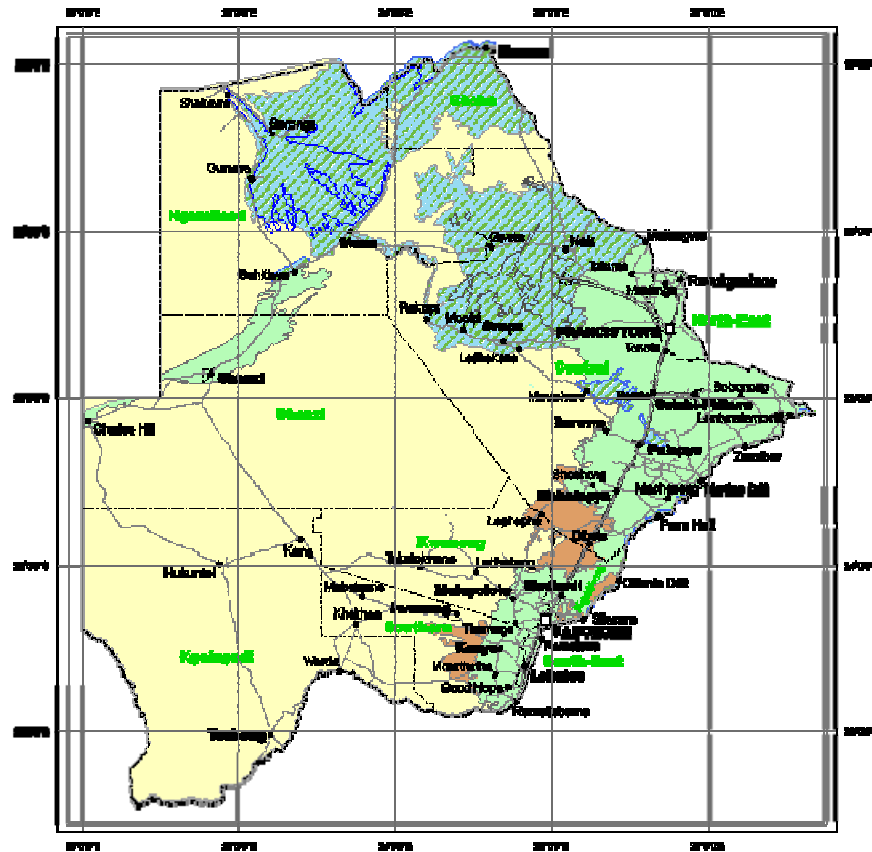


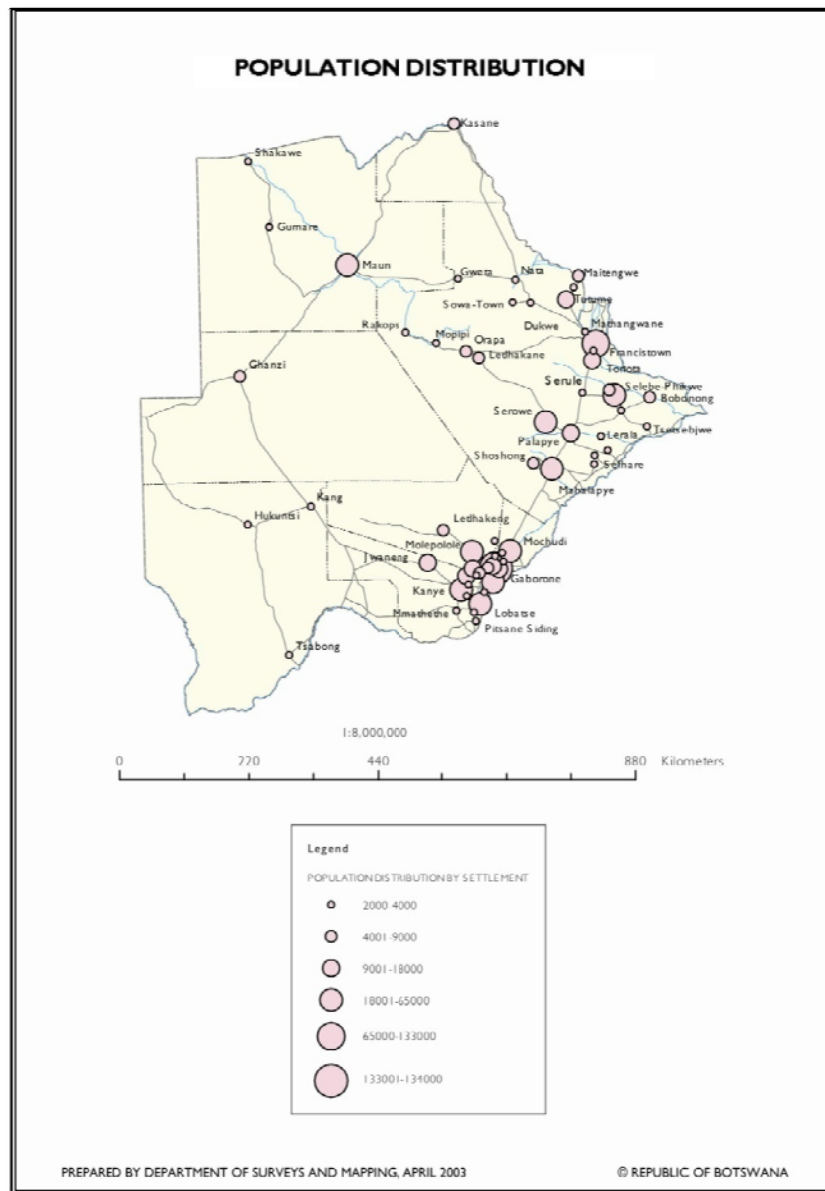
Figure 2: Botswana Country Map

3. Population

3.1 Total Population

The 2001 population census estimates that the population was 1,680,863 people, representing a population growth of 26.69% from 1991 to 2001. Of this population, 48.4% (813,625) were male and the balance, 51.6% (867,238), were female. The 2008 projected population is estimated to be 1,755,246 people. The proportion of the population in the 0-28 year-old group decreased from 71.0% in 1991 to 67.6% in 2001. In spite of the population growth, Botswana is still a sparsely populated country, and thus faces added challenges in providing adequate and affordable energy services to all sectors of the population who are dispersed across the country, often in remote areas (refer to figure 3).





Source: www.eis.gov.bw

Figure 3: Botswana population distribution map

3.2 Urban population (million)

According to the 2001 census, 54.2% of the households were in urban areas (large villages – over 5000 population – are considered to be urban). This represents an increase of 8.5% from 45.7% in the 1991 census and the increase was mainly due to reclassification of a number of large villages from rural to urban.

3.3 Rural population (million)



The rural population from the 2001 census accounted for 45.8% of the population numbering 763,835 persons.

3.4 Urban population (%)

The percentage of the population living in urban areas is 54.2% (based on 2001 census)

3.5 Number of households

The 2001 census estimated that there were 404,706 households (refer to Table 1, below) with an average family size of 4.10 persons and of these 218,007 were male headed compared to 186,699 that were female headed.

3.6.1 Urban

Because of the high urbanisation rates, 58% (234,757 households) of the households were in urban areas,

3.6.2 Rural

Because of the high urbanisation rates, 58% (234,757 households) of the households were in urban areas,

3.6.3 Average household size

The average household size is estimated to be 4.10 which is split between an average of 3.81 persons for urban households and 4.49 persons for rural households. Thus more households were male headed whilst rural households had larger families.

Table 1: Households - Urban and Rural Distribution

Locality	No. Households	% of national Households
Whole country	404,706	100
Urban Centers	113,619	28.1
Urban Villages	121,138	29.9
Urban areas	234,757	58.0
Rural areas	169,949	42.0

Source: CSO, 2001 Population and Housing Census Results

4. Economic profile

Botswana has had an impressive economic performance over the past four decades mainly due to its diamond exports and good governance supported by sound democratic principles, transparency and accountability. Government, in an endeavour to reduce the vulnerability arising from heavy dependence on diamonds, has put in place economic diversification policies that support growth and development of the non-mining sectors such as manufacturing and agriculture. These programmes, policies and strategies include provision of requisite infrastructure, maintaining a conducive macro-economic policy regime for private sector initiatives, and increasing labour productivity through human resources development.

Some major projects planned for the next five years to accelerate the economic growth rate include increasing the capacity of Morupule Power Station at an estimated cost of US\$600 million or about P3.6 billion; construction of Mmamabula Export Power Station costing about US\$5 billion or P30 billion; investment of about P6.5 billion by De Beers and Debswana on projects such as the construction of the



Diamond Trading Company (Botswana) facilities and the Orapa III plant; and the implementation of the overall government development budget for NDP9 now in its final year of implementation.

The confidence in Botswana's economy was illustrated by the maintenance of investment grade A sovereign credit ratings with a stable outlook by Moody's and Standard and Poor's. Botswana has also been rated by the Heritage Foundation, in collaboration with the Wall Street Journal, as among the top 30 countries in the world and number one in Africa with respect to economic freedom. These favourable ratings reflect the country's strong public sector balance sheet and political and macro-economic stability. However, these positive attributes are undermined by insufficient economic diversification and challenges posed by the HIV/AIDS pandemic and poverty.

Foreign exchange reserves amounted to P59.8 billion at the end of November 2007, from P 48.8 billion in November 2006. In US dollar terms, the foreign exchange reserves increased by US\$2.3 billion to US\$10.2 billion over the same period. These reserves were estimated to be equivalent to 28 months cover of imports of goods and services, representing a one month decrease from the 2006 cover.

4.1 *Economic growth rate*

Over the past eight years the average GDP growth was 6.4%. The real GDP for the financial year 2006/2007 was estimated to be 6.2%. During the same period, the mining sector grew by 5.2% compared to a decline of 3.8% in the previous year and the non-mining sector grew by 6.8% up from 3.9% in the previous year. Growth in the non-mining sector augurs well, with government efforts of economic diversification and major growth concentrating on transport and communication (at 20.3%), followed by trade, hotels and restaurants (at 16.3%), manufacturing (at 12%), banks, insurance and business services (at 6.6%) and the remainder at less than 2%. The current growth rate is comparable to the growth rate that was recommended in the mid-term review of NDP9 of 6.3%, but is less than that set in Vision 2016 of 8% for total poverty eradication by 2016.

The mining sector contributed 40.7%, followed by the government at 15.6%; banks, insurance & business services and trade, hotels & restaurant each contributed 10.3% to the 2006/7 financial year GDP.

4.2 *Inflation rate*

Inflation rate averaged 7.1% in 2007 compared to 11.6% in 2006. However inflation has of late been on an upward trend reaching 9% in March 2008 and this has been largely due to the rising petroleum prices and rising food prices which have weighed heavily of the Consumer Price Index.

4.3 *Gini coefficient*

The gini coefficient shows that income inequality increased in the rural areas during the 2002/03 period compared to the 1993/4 period (i.e. from 0.414 to 0.515 disposable income and from 0.522 to 0.622 disposable cash income).

In comparison, the urban households' disposable cash income inequality did not change during the same period. However the disposable cash income inequality is greater in rural households than in urban households (i.e. 0.622 compared to 0.513 and 0.552) (Table2). Overall, the national inequality increased over the 1993/4, 2002/3 period.



Table 2: Average Disposable Monthly Income - Pula

Stratum	Disposable Income		Disposable Cash Income	
	1993/4	2002/03	1993/4	2002/03
Cities/Towns	0.539	0.503	0.548	0.513
Urban Villages	0.451	0.523	0.552	0.552
Rural	0.414	0.515	0.599	0.622
National	0.537	0.573	0.638	0.626

Source: HIES 2002/03

This demonstrates that there is more inequality in disposable cash income in all regions of the country, in comparison with total incomes.

4.4 Per capita income

Botswana's per capita income is projected to be P18.340 (US\$ 3,056) a very significant increase from the independence per capita income of P70 (US\$12)¹.

4.5 Income groups

Table 3 below shows the income groups in Botswana and is derived from the 2002/03 HIES report.

Table 3 National Income Groups by gender and Locality.

Pula Per Month	National			Cities/Towns			Urban Villages			Rural Areas		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
<100	2.0	2.3	1.7	1.3	1.2	1.5	1.7	1.4	2.1	2.7	3.8	1.4
100 - 200	2.8	2.6	3.1	1.0	0.8	1.3	2.0	1.2	2.7	4.7	4.8	4.5
200 - 300	4.3	3.4	5.3	1.2	0.7	1.9	3.9	3.0	4.7	6.6	5.7	7.7
300-400	5.6	4.2	7.2	2.1	1.0	3.8	5.1	3.2	6.9	8.3	7.3	9.4
500-750	6.5	6.0	7.1	4.1	3.1	5.6	5.6	5.4	5.8	8.7	8.5	9.0
750-1000	13.8	13.1	14.6	9.8	8.0	11.5	10.2	8.9	11.3	19.2	19.2	19.1
1000-1500	10.8	9.4	12.5	8.7	8.2	9.5	10.6	7.9	13.0	12.5	11.3	13.8
1500-2000	13.5	12.4	14.8	13.8	13.1	14.8	13.5	10.7	16.1	13.3	13.0	13.8
2000-3000	8.5	9.2	7.6	9.1	9.3	8.9	9.6	11.2	8.1	7.3	7.9	6.6
3000-4000	9.5	1.0	9.0	12.1	12.1	12.0	12.1	15.0	9.4	6.0	5.2	6.9
4000-6000	6.7	7.2	6.2	8.5	9.1	7.7	8.4	9.7	7.3	4.3	4.2	4.4
6000-8000	6.5	7.7	5.0	9.6	9.8	9.3	8.0	10.1	6.1	3.2	4.6	1.6
8000-10000	3.6	4.0	3.1	6.1	6.1	6.0	4.0	4.3	3.6	1.7	2.3	0.9
10000-15000	2.1	2.8	1.2	3.8	5.0	2.0	2.5	3.6	1.5	0.6	0.7	0.5
15000-20000	3.1	4.3	1.6	6.7	8.8	3.6	2.5	3.6	1.4	1.0	1.5	0.5
20000+	0.8	1.3	0.2	2.2	3.2	0.6	0.4	0.8	0.1	0.0	0.1	0.0
Total Number	394,272	211,403	182,869	109,556	65,730	43,826	121,321	57,880	63,440	163,395	87,793	75,602

¹ <http://www.unbotswana.org/bw/undp/poverty.html>



According to table 3 above, 15% of the population earn less than the gazetted minimum wage. This proportion could be less if the wage increases that were awarded since the last Household Income and Expenditure (HIES) report are taken into account. A higher proportion of rural households (63%) earn less than P1500, compared with urban villages and cities'/towns' households (39% and 28% respectively). This bias is gendered: a higher proportion of women (52% of women) earn less than P1500 compared to men (42% of men).

4.6 Average monthly recommended wage²

The gazetted minimum wage ranges from P2.10 per hour (US\$2.63/day) to P3.80 per hour (US\$4.75/day) depending on the industrial sector (refer to table 4 for a detailed break down). The domestic sector has the least minimum wage of P2.10 per hour, whereas that of the agriculture sector has been set at P408.00 (US\$63.75) per month as opposed to other sectors that have a set minimum hourly rate. It is noted that most workers earn more than the set minimum wage (i.e. 85% nationally, 96% in cities and villages and 13% in urban villages). However a significant portion of the rural working population (22%) earn less than the minimum wage (table 4).

Table 4: Gazetted minimum wages by industrial sector

Trade or Industry	Wage (BWP)
Building, Construction, Exploration, Quarrying Industries	P3.80 per hour
Wholesale and Retail Distributive Industry Trade	P3.80 per hour
Manufacturing, Service and Repair Trades	P3.80 per hour
Hotel, Catering and Entertainment Trades	P3.80 per hour
Garage, Motor Trade and Road Transport	P3.80 per hour
Retail Distributive Trade	P3.30 per hour
Watchmen employed in the above Industries and Trades or any sector thereof	P3.20 per hour
Domestic sector	P2.10 per hour
Agriculture sector	P408.00 per month
Security Guards Employed by security companies	P3.80 per hour

Source: (Ministry of Labour & Home Affairs)

5. Poverty

Botswana's fight against poverty is addressed in the Vision 2016 and the Poverty Reduction Strategy of 2003, with a target to reduce poverty levels to 23% by 2007 and total eradication by 2016. Poverty levels are still considered too high considering the national goals of total poverty eradication by 2016. According to the 2000 "Macro-Economic Impact of HIV/AIDS" study, the proportion of households living below the poverty datum line could rise by 6%, while that of poor individuals could rise by 4% and the GDP could fall by 1.5% for over a 25 year period (1996 – 2021).

Women are worse off than men when it comes to poverty: a 1995 study by BIDPA reported that, although the national poverty level was 47%, in fact 50% of female-headed households lived below the poverty datum line. In contrast, 44% male-headed houses fall in the same category.

² 6.40 Pula = US\$1



Major causes of poverty have been found to be unemployment, small domestic market, low FDI, low export growth and economic diversification.

5.1 Population living below \$1 per day

According to the HIES report of 2002/03, the proportion of households living below the US\$1 per day increased from 19.9% in 1993/94 to 23.4% in 2002/03. The largest contribution is from the urban villages and rural areas (in increasing order) which had sectoral contributions of 19.3% and 36.1% in 2002/03 respectively (refer to table 5).

Table 5: Proportion of people living below \$1 /day

Region	Total Households based on HIES	Total number of persons Est.	Number of households with persons below USD1/day	Number of persons below USD1/day	Proportion below USD1/dy
2002/03 HIES					
Cities/Towns	109,556	369,812	3,449	18,699	5.1%
Urban Villages	121,321	545,253	15,398	105,118	19.3%
Rural	163,395	717,857	41,850	258,915	36.1%
National	394,272	1,632,922	60,697	382,732	23.4%
1993/94 HIES					
Cities/Towns	87,419	316,139	4,511	25,814	8.2%
Urban Villages	67,218	330,445	8,610	56,389	17.1%
Rural	136,973	704,319	29,310	186,095	26.4%
National	291,610	1,350,903	42,431	268,298	19.9%

Source: HIES 2002/03

5.2 Population living below \$2 per day

According to a comprehensive poverty study that was carried out by BIDPA in 1997, 47% of the population lived on less than \$2 per day and 30% on less than \$1 per day. Subsequent studies conducted in 2002 suggested a decline to 36.7% and 23.4% respectively, thus showing an improvement.

5.3 Population living below the national poverty line

382,732 (HIES, 2002/03)

5.4 Rural population below the national poverty line (%)

36.1%

5.5 Number of rural poor

258,915

6. Energy profile

The energy consumption of Botswana increased from 26,497 TJ in 1981 to 64,675TJ in 2003 (figure 4). Wood consumption, which is also the largest, increased from 15,456TJ in 1981 to 21,808TJ in 2003. However, its proportional contribution decreased from 58.3% in 1981 to 34%. This decrease is attributed



to fuel switching to other sources as LPG and electricity, as well as being a result of wood scarcity and other economic factors. Other fuels that contribute significantly to the final energy demand are petrol, diesel, electricity and coal. The contribution of these fuels increased in the same period from 7% to 61% for petrol, 10 to 22% diesel and 7 to 19% for electricity, while coal contribution decreased slightly from 16% to 9%.

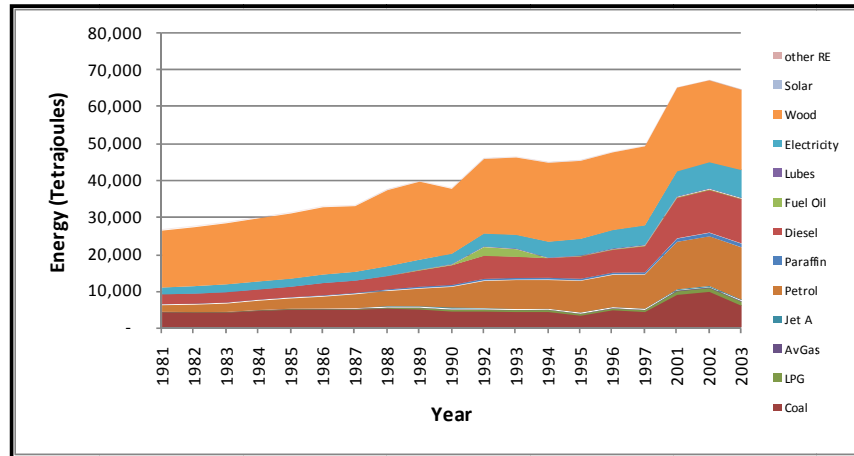


Figure 4: Energy in Demand Profile in Botswana from 1981 - 2003

6.1 Sectoral Energy consumption

Energy use is dominated by the household sector which has consistently accounted for over 38% of annual final energy demand (FED) between the period 1981 to 2003. The major household energy source is fuelwood and this accounts for the significant contribution that the sector makes to FED. This is mainly because most of the wood is used inefficiently due to the unavailability of energy efficient devices. Hence, more energy is used in fuelwood applications than in other more efficiently combusted energy sources like LPG or electricity. Additionally, the energy source is considered 'free' and hence it is used uneconomically.

Over the same period, there has been an increase in energy consumption by the commercial sector, notably by the mining, manufacturing and transport sectors due to their economic growth. These factors lead to an increase in energy use by commercial enterprises in comparison with 1981 use.

The contribution of the transport, government and industry sectors to the final energy demand increased to 24%, 9% and 29% respectively in 2003, thus reducing the dominance of the household sector (figure 5). The principal energy sources used in these sectors are petrol and diesel. Other major energy sources consumed under these sectors are electricity and coal. The agriculture sector contribution has remained constant at 2% and this is due to the lack-lustre economic performance of this sector.



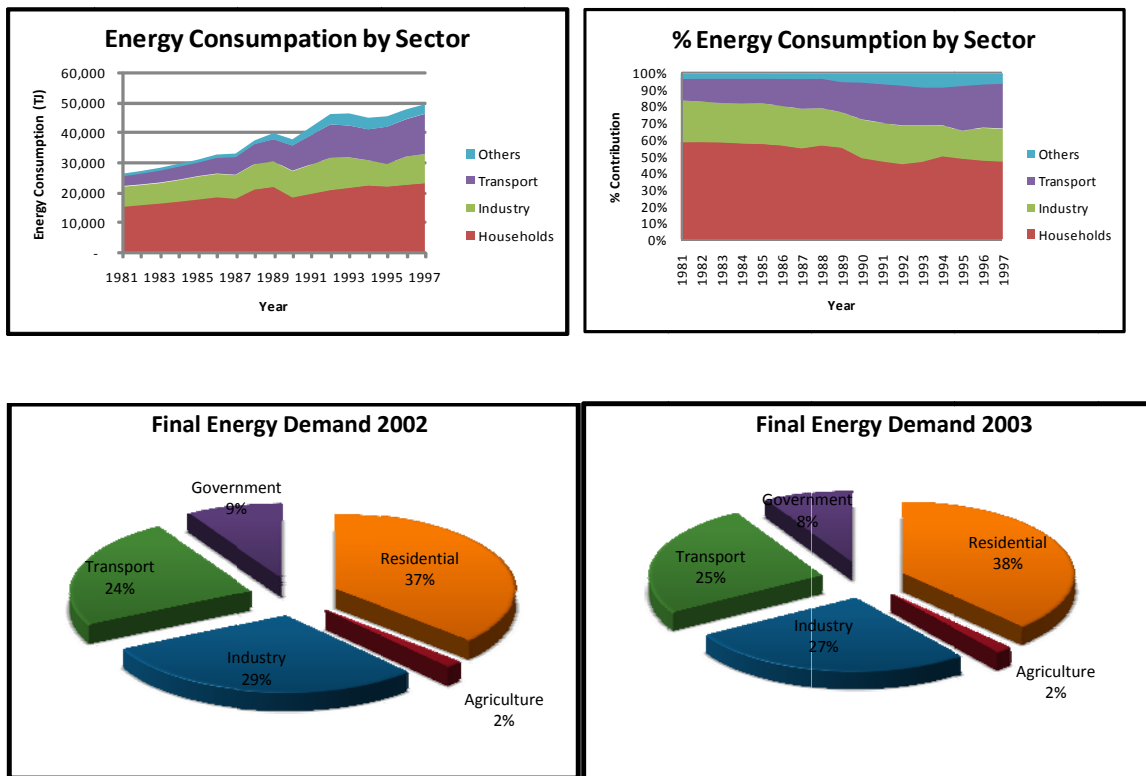


Figure 5: Sectoral Energy Consumption of Botswana from 1981-1997, 2002 & 2003

6.2 Electrification levels

In total, 49% of households have access to electricity nationally of which 30% of the households are in the urban and rural villages and the remaining 19% of the households are in cities and towns. However, there is more access to electricity in the town and cities (71.76% of the households) whereas access at urban and rural village level, stands at 40.75% of the households.

6.3 Household energy consumption

The household fuel usage is mostly dependent on the fuel application (refer to figure 6). Forty-six percent (46%) of the households use fuelwood for cooking and 43.4% use LPG. A smaller proportion of the households use electricity (4.7%) and paraffin (5.5%) for cooking. Fuelwood is also the dominant fuel for heating and is used by 54% of the households followed by electricity that is used by 8.1% of the households. LPG, solar energy and paraffin are used by 0.9%, 0.1% and 0.7% of the households. Fuel preference for lighting varies, with 53.2% and 26.8% of households using paraffin and electricity respectively. A minor percentage of the households (12.8%) use candles or a combination of paraffin and candles for lighting.



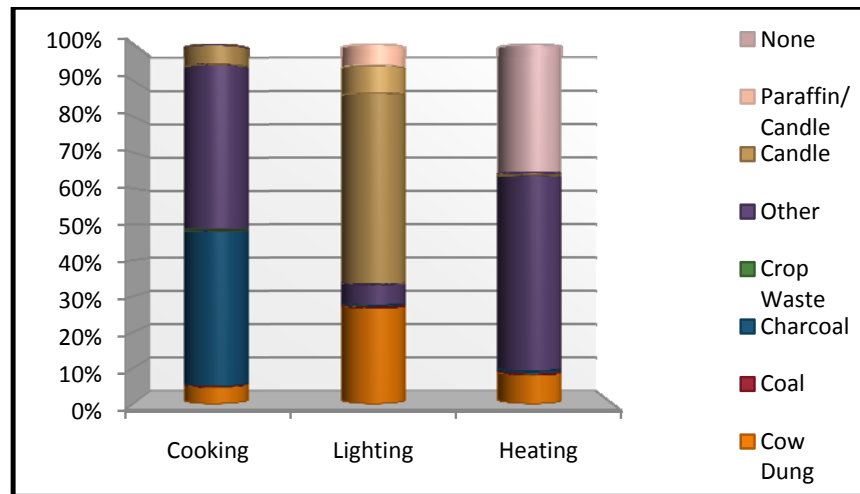


Figure 6: % National household energy usage by application and fuel

6.4 Household energy use profile

Household fuel use is dominated by fuelwood, LPG, paraffin and electricity. However, usage is dependent on the application and its location in the country (whether rural, urban village or in a town).

6.5 Fuel use

The kind of fuel used for the most common day-to-day household energy applications varies greatly from urban households to rural households and depending on the application. The most dominant fuel for cooking and space heating is fuelwood, contributing 46% and 54% to the usage respectively. LPG accounts for 43% of the national household energy used for cooking, whereas electricity contributes 4.7%. However, LPG is the least favourite option for space heating, where it contributes 0.9% of the total usage, compared to the electricity contribution of 8% (refer to table 6, 7 & 8).

70 % of urban households, 55% of urban villages, and 0.1% of rural households prefer to use LPG for cooking. Fuelwood is the least desired energy source for cooking by urban dwellers (5.3%) and those in urban villages (35.5%) and it is the most preferred option of rural households (81%).

Paraffin on the other hand is the most dominant lighting fuel nationally and in all three household sectors: urban, urban village and rural households (refer to tables 6, 7 & 8).



Table 6: Number of households and % by stratum and main source of fuel for cooking

Fuel	National		Cities/Towns		Urban Villages		Rural	
	H/holds	%	H/holds	%	H/holds	%	H/holds	%
Electricity	18,432	4.7%	12,899	11.8%	4,005	3.3%	1,528	0.9%
Solar Power	270	0.1%		0.0%	270	0.2%	27,026	16.5%
LPG	171,017	43.4%	77,039	70.3%	66,952	55.2%	213	0.1%
Bio-Gas	1,585	0.4%	902	0.8%	470	0.4%	2,213	1.4%
Wood	181,298	46.0%	5,802	5.3%	43,080	35.5%	132,415	81.0%
Paraffin	21,670	5.5%	12,913	11.8%	6,544	5.4%		0.0%
Cow Dung		0.0%		0.0%		0.0%		0.0%
Coal		0.0%		0.0%		0.0%		0.0%
Charcoal		0.0%		0.0%		0.0%		0.0%
Crop Waste		0.0%		0.0%		0.0%		0.0%
Other		0.0%		0.0%		0.0%		0.0%
Total	394,272	100%	109,555	100%	121,321	100%	163,395	100%

Source: (HEIS, 2002/03)

Table 7: Number of households and % by stratum and main source of fuel for lighting

Fuel	National		Cities/Towns		Urban Villages		Rural	
	H/holds	%	H/holds	%	H/holds	%	H/holds	%
Electricity	105,570	26.8%	52,621	48.0%	42,930	35.4%	10,019	6.1%
Solar Power	1,581	0.4%	113	0.2%	149	0.1%	1,432	0.9%
LPG	734	0.2%		0.0%	394	0.3%	227	0.1%
Bio-Gas	83	0.0%		0.0%		0.0%	83	0.1%
Wood	23,085	5.9%		0.0%	516	0.4%	22,569	13.8%
Paraffin	209,758	53.2%	46,431	81.6%	63,262	52.1%	100,065	61.2%
Candle	30,356	7.7%	6,415	11.3%	7,347	6.1%	16,594	10.2%
Paraffin/Candle	22,985	5.8%	3,975	7.0%	6,723	5.5%	12,287	7.5%
Other	120	0.0%		0.0%		0.0%	120	0.1%
Total	394,272	100%	109,555	100%	121,321	100%	163,396	100%

Source: (HEIS, 2002/03)

Table 8: Number of households and % by stratum and main source of fuel for heating

Fuel	National		Cities/Towns		Urban Villages		Rural	
	H/holds	%	H/holds	%	H/holds	%	H/holds	%
Electricity	31,964	8.1%	20,542	18.8%	9,002	7.4%	2,420	1.5%
Solar Power	254	0.1%		0.0%	91	0.1%	163	0.1%
LPG	3,698	0.9%	1,420	1.3%	1,403	1.2%	874	0.5%
Wood	214,552	54.4%	16,716	15.3%	59,303	48.9%	138,533	84.8%
Paraffin	2,909	0.7%	826	0.8%	1,156	1.0%	927	0.6%
Cow Dung	50	0.0%	50	0.0%		0.0%		0.0%
Coal	190	0.0%	117	0.1%	73	0.1%		0.0%
Charcoal	122	0.0%	122	0.1%		0.0%		0.0%
None	140,533	35.6%	69,762	63.7%	50,293	41.5%	20,478	12.5%
Other		0.0%		0.0%		0.0%		0.0%
Total	394,272	100%	109,555	100%	121,321	100%	163,395	100%

Source: (HEIS, 2002/03)

6.6 Appliance ownership

According to the 2002/03 HIES report, very few households were found to use or own a coal or wood stove, in spite of the abundant availability of both fuels in Botswana and the extensive use of fuelwood



for cooking among the rural population. The survey showed that only 1.4% households use coal stoves nationally. 9% of households use electricity, 24.5% use paraffin and 55.5% use gas stoves.

In addition, the preference for gas cookers and electric stoves increases with income level increases, whereas interest in coal stoves seems to be distributed evenly across the various income groups using the devices. Gas stoves and electric stove ownership is highest in cities and urban villages. Ownership in rural areas is minimal (Table 9 & 10).

Table 9: Percentage ownership of household items by disposable cash income strata - National

Item	Total	Disposable Cash										
		<200	200 - 400	400 - 600	600 - 800	800 - 1000	1000 - 1500	1500 - 2000	2000 - 4000	4000 - 6000	6000 - 10000	10000 +
Total Households	394,272	66,772	54,934	40,526	31,312	23,181	38,111	25,658	56,102	24,416	19,340	13,920
Electric Stove	9	0.7	1	2.1	2.8	4.1	5.3	6.1	15	24.5	34.6	50.9
Gas Cooker	55.6	22.4	26.7	43.7	53.1	62.9	70.3	78.1	84	85.9	82.5	70.5
Coal Stove	1.4	1.2	1	0.9	1.8	1.3	1	2.3	1.3	1.7	1.4	2.7
Paraffin Stove	24.5	19.8	27.1	35.8	34.2	35	35.2	27.6	17.4	12.8	7.5	1.7

Source: (HEIS, 2002/03)

Table 10: Percentage ownership of household items by Location

Item	National	Cities/Towns	Urban Villages	Rural Areas
<i>Total Households</i>	<i>394,272</i>	<i>109,556</i>	<i>121,321</i>	<i>163,395</i>
Electric Stove (%)	9	17.9	10.3	0.9
Gas Cooker (%)	55.6	77.4	72.2	11.9
Coal Stove (%)	1.4	1.3	1.7	0.5
Paraffin Stove (%)	24.5	32.3	25.7	7.6

Source: (HEIS, 2002/03)



6.7 Level of household access to electrification

The Botswana government has embarked on a rural electrification program that has seen the number of rural households being electrified gradually increase in the periods from the drafting of NDP7 until today's NDP9.

To date, the BPC claims that 49% of households have access to electricity nationally. This is significantly higher than the 2003 access rate of 28%. The current access rate comprises 62% of rural households and 38% of urban households, while in 2003 it was split between 53% rural households and 47% urban households.

Access to electricity in rural households (at 40.8%) is still lower than urban households (at 71.8%). The rise in connections has been necessitated by the reduction of the connection deposit for rural homes to 5% of the price with the remaining 95% being paid by the government over a 15-year-period. **To date P559 million has been spent in the Rural Electrification Collective Scheme. (Spent by whom, what is the scheme?)**

Rural electrification remains at the core of government plans to provide access to electricity to the Batswana. At the start of NDP9, the government connected 15 villages during 2003/4 of the 105 villages it intended to electrify during the plan. The programme was stalled for three years due to budgetary constraints. However under a Nordic Bank finance scheme, the government is going to electrify 100 villages, and the programme will cost US\$ 89 million.

30 additional villages will be financed under a government-financed scheme, thus bringing the total number of villages to be electrified during NDP9 to 145 villages (EAD, 2008). "RE Botswana," a government GEF financed scheme, is an off-grid electrification project, scheduled to run until 2010.

Under the "100 villages program", 30 villages are scheduled to be electrified in 2007/08, a further 35 villages in 2008/09 and 35 villages in 2009/10. **In addition, the existing infrastructure will be extended to 20 villages and the network will be extended to six villages in the period 2007/2008. (What is the difference between infrastructure and the 'network' – does this mean grid?)**

Tables 11 and 12 show a breakdown of electrified households in the districts (excluding towns).

Table 11: Household Access to Electricity for Districts March 2008

District	2001 Population	H/holds	Connections		Access %
			Total	Domestic	
Central	501,381	100,276	39,855	37,862	37.76
Chobe	18,258	3,652	2,163	2,055	56.27
Kgalagadi	42,049	8,410	3,539	3,362	39.98
Kgatleng	73,507	14,701	10,838	10,296	70.03
Kweneng	230,335	46,067	18,748	17,811	38.66
Ngamiland	124,712	24,942	8,783	8,344	33.45
North East	49,399	9,880	4,472	4,248	43.00
Southern	171,652	34,330	11,203	10,643	31.00
South East	60,623	12,125	9,784	9,295	76.66
Gantsi	33,170	6,634	2,591	2,461	37.10
Totals	1,305,086	261,017	111,976	106,377	40.75

Source: BPC, 2008



Though rural households outnumber urban households, the table below shows that access to electricity is higher in towns (72%) than in rural households (41%). This represents a significant increase since 2003 when the access was 50% of town households and 20% of rural households. Access to electricity has increased by equal margins in both town and rural households. The disparity can be attributed to higher costs required for the transmission and installation costs of rural areas, and the prohibitively low-income levels of rural consumers who cannot afford to connect to the grid.

Table 12: Household access to electricity for towns, March 2008

Towns	2001 Population	H/holds	Connections		Access %
			Total	Domestic	
Gaborone	186,007	46,502	40,753	38,715	83.26
Francistown	83,023	20,756	13,344	12,677	61.08
Selibe Phikwe	49,849	12,462	7,365	6,997	56.14
Lobatse	29,689	7,422	3,355	3,187	42.94
Jwaneng	15,179	3,795	3,239	3,077	81.09
Orapa	9,151	2,288	2	1,858	81.22
Sowa	2,879	720	1,061	902	125.30
Totals	375,777	93,944	69,119	67,413	71.76

Source: BPC, 2008

6.8 Biomass use profile

The following are the prominent stakeholders in the energy sector:

The Ministry of Minerals, Energy and Water Resources (MMEWR), through the Energy Affairs Division (EAD) is responsible for formulation, direction and coordination of the national energy policy.

The Botswana Power Corporation (BPC), a parastatal under MMEWR, is responsible for electricity generation and supply.

The following ministries, parastatals and non-governmental organisations (NGOs) share energy portfolio responsibilities with MMEWR:

The Ministry of Environment, Wildlife and Tourism is responsible for forestry and environmental conservation. Excessive harvesting of fuelwood and high greenhouse gas emissions are some of its main concerns.

Relevant sections are the **Department of Forestry and Rangeland Resources** and the **Department of Environmental Affairs**.

Forestry Association of Botswana (FAB) engages in long-term research on fuelwood, productivity of natural woodlands and in the promotion and implementation of fuelwood programmes.

Ministry of Works and Transport is responsible for off-grid power supply and installation and maintenance of solar energy equipment in government institutions in rural and urban areas through its Department of Electrical and Mechanical Services (DEMS).



Oil companies are responsible for purchasing, supply and physical distribution of petroleum products. However, government manages its strategic reserves through the oil companies. There are four oil companies operating in Botswana: BP, Shell, Total and Engen.

Rural Industries Innovation Centre (RIIC) is responsible for developing, testing and disseminating renewable energy technologies.

Botswana Technology Centre (BOTECH) undertakes research and development and information dissemination on solar energy

Ministry of Commerce and Industry, particularly its department of **Commerce and Consumer Affairs** handles...

7. Policy profile

The government has developed over twenty-five separate laws related to environmental and resource management issues as well as many national policies, some of which are listed below.

7.1 Draft Energy Policy

The Draft White Paper on Energy Policy defines national energy policy development principles and objectives that should be addressed through a selection of key energy goals, measures and strategies. The policy is derived from the BEMP.

In relation to biomass, the policy aims to:-

- lessen deforestation caused by fuel-wood collection; and
- ensure access to adequate and affordable energy services for all households and community services;

Policy also covers the promotion of fuel switching from fuelwood to coal for government institutions. Specifically, the policy is intended to “promote sustainable fuelwood management practices, appropriate combustion equipment, community management of natural resources and switching to alternative energy sources”.

The policy recognizes the role that women play in the selection and collection of energy (especially in the case of fuelwood) and the concomitant environmental and health problems such as indoor pollution, arising from the use of traditional biomass fuels. To that end, the policy seeks to integrate gender issues into all facets of the energy service provision process and to empower all fuelwood collectors on sustainable use of the resource for subsistence and other purposes. (How does it do this? Does it just state this as a goal?)

7.2 Industrial Development Policy

The Industrial Development Policy (1997) was developed in response to the perceived opportunities and threats offered by increased globalisation and its trade agreements, as they are defined by international and regional organisations such as the World Trade Organisation, SADC and SACU. The policy aims to diversify the economy from a mining-based economy through the establishment of a viable export-oriented manufacturing and services industry.



It aims to achieve this through technological (both technical and human) innovation and beneficiation of local raw materials such as diamonds, salt, soda ash, hides and skins, and timber for export. In addition to ensuring that the economic fundamentals are in place, the policy seeks to facilitate the creation of the service and small-scale manufacturing industries to support the export sector. Priority will also be given for employment creation and SMMEs in rural areas by extending the corporation of government with CBOs and NGOs. Emphasis is on the realisation of the potential for agriculture and tourism to boost rural SMMEs.

7.3 National Water Policy (2005-review)

Under the policy, government's priority is to provide water for human consumption and, where capacity permits, water can be used for other applications such as agricultural production (for example, peri-urban uses such as poultry, horticulture, piggery, dairy, ostrich farming, processing, cleaning and storage). Large irrigation dams are the responsibility of the government through the Department of Water Affairs and the Ministry of Agriculture (for example, in the support of livestock farming and the construction of agricultural dams etc.)

7.4 Policy for Wastewater and Sanitation Management

The policy seeks to promote the health and wellbeing of the country through the provision of appropriate and sustainable wastewater/sanitation management so as to ensure waste water re-use and the sustained supply of potable water. The policy document links potable water supply with wastewater utilisation, by recognising waste water as a resource that can be used for irrigation and even human consumption after appropriate treatment. Furthermore, the document estimates that 300,000 cum (explain measurement unit) per day of treated wastewater will be produced in Botswana by 2020, thus providing an opportunity for its use in the irrigation of commercial crops and hence stimulating the growth of the agricultural sector.

Though the policy does not address biomass directly, the implication is that there is an opportunity for the utilisation of wastewater in the commercial production of biomass. Likewise, there is scope for adapting the existing wastewater treatment facilities with the commercial production of biogas and possibly electricity generation. This will also facilitate the cost recovery.

7.5 National Forest Policy (being drafted)

The policy provides an enabling framework for achieving conservation, sustainable management and development of forestry.

7.6 Environmental policy

(This is still being drafted)

7.7 National Policy on Natural Resources Conservation and Development of 1990 (the National Conservation Strategy - NCS)

The NCS is founded on the principles of sustainable development, commonly defined as "... development that meets the needs of the present generation without compromising the ability of future generations to meet their own..." (does it claim to be based on this or is this a value-driven analysis? Is it doing this and if so how do you measure it? Or does it just set this as its goal)

7.8 National Agricultural Policy

The main objective is the diversification of the agricultural production base (e.g. pulses, dairy, poultry, piggery, forestry, beekeeping, ostrich farming and veldt products); the conservation of scarce agricultural



and land resources for future generations. This objective is consistent with the broader agricultural strategy for developing the agricultural economy, while conserving its natural resources.

7.9 *Indigenous Livestock Species policy (draft):*

This policy aims to ensure the conservation of indigenous livestock species to achieve food security and to guarantee a future supply of animal products and biodiversity in Botswana.

7.10 *Plant Genetic Resources policy (draft):*

Formulated after the realization that certain varieties of crops are being replaced by modern cultivars, which are often less diverse. The policy supports institutions concerned with agro-diversity with the objective to conserve and maintain the diversity of plant genetic resources material through in situ and ex situ conservation.

7.11 *Tourism policy (draft):*

The policy promotes low-volume, high-value tourism in Botswana aimed at a market of middle- to high-income patrons. It also ensures relatively fewer disturbances to the natural environment with less tourist traffic.

7.12 *Forestry Policy (draft):*

The forestry policy will support (1) the development of sustainable forest management options based on sound ecological principles, (2) domestication and commercialization of forest products such as fruits and medicines and (3) restoration of degraded land using afforestation and plantations to make the land reusable.

7.13 *Policy on Small Medium and Micro Enterprises in Botswana*

The main aims of the policy are to create an enabling environment within which SMMEs can flourish, provide an integrated approach to SMME development and reduce dependency on government. Policy specific objectives are to empower citizens through economic diversification whilst also promoting the export sector. Further objective are to encourage the development of a competitive and sustainable SMME community that generates sustained employment, promote vertical integration between SMMEs and primary industries in agriculture, mining and tourism and improve service delivery efficiency of SMMEs. The policy sets the foundation for the establishment of a viable commercial biomass industry.

7.14 *Community Based Natural Resource Management Policy (CBNRM)*

The goal of the CBNRM policy is to create a foundation for conservation-based development, in which the need to protect biodiversity and ecosystems is balanced with the need to improve rural livelihoods and reduce poverty. The policy proposes the provision of diversified livelihoods and economic options, opportunities and incentive by managing and sustainably exploiting the country's natural resources to communities.

The specific objectives of the CBNRM are to:-

- Specify land tenure and natural resources user rights, which may be devolved to communities;
- Establish a framework that provides for incentives to manage natural resources in a sustainable manner;
- Create opportunities for community participation in natural resource management;
- Promote conservation and CBNRM strategies that are based on sound scientific principles and practices;
- Enhance the relationship between protected areas' management and CBNRM;



- Protect the intellectual property rights of communities with regards to natural resources and the management of such natural resources;
- Encourage communities to participate meaningfully in the monitoring of CBNRM;
- Facilitate capacity building within communities to engage in natural resource-based tourism;
- Establish an institutional support framework for the implementation of CBNRM;
- Promote communication, education and public awareness on CBNRM.

7.15 Strategy Documents: Vision 2016

States, “Botswana will have attained a sustainable use of its natural resources, particularly, non-renewable resources such as minerals. Communities will be in the forefront in the use and exploitation of natural resources and wildlife management. Every Motswana will be expected to appreciate the importance of a clean environment.”

Vision 2016 places emphasis on:

- Education and information - for instance HIV/AIDS awareness building will be achieved through all possible media of communication,
- Prosperity, productivity and innovation - emphasising the role of Government as facilitator in partnership with the private sector to create an environment where business and entrepreneurship activities are encouraged and supported,
- Compassion, justice and caring - offering support and opportunity to those who are poor,
- Safety and security,
- Democracy, transparency and accountability, and
- Morality and tolerance, and unity and pride.

Vision 2016 recognises energy as a pre-requisite for successful industrialisation and hence Botswana should develop cost-effective sources of energy and cooperate in the region in energy delivery, particularly for electricity as a way of reducing costs of utilities by benefiting from economies of scale. There is special focus for developing the solar resource in Botswana as a potential source of electricity in schools in remote areas.

7.16 Ministerial Visions

The Vision of the Ministry of Minerals, Energy and Water Resources under which energy falls is as follows:-

The Ministry of Minerals, Energy and Water Resources is fully committed to complete customers’ satisfaction in the provision of products and services in accordance with best international practice.

Following from that the Energy Affairs Division- the arm of the ministry dealing with energy issues has as its mission statement

“.. to formulate and coordinate national energy policy and programmes and facilitate availability of effective, reliable and affordable energy services to customers in an environmentally sustainable manner...”

7.17 National Development Plan 9 (NDP 9 – 2003/09)



The National Development Plan 9 (NDP 9) is based on Vision 2016 and emphasises Sustainable Development through competitiveness in global markets resulting in:

- Economic diversification,
- Employment creation,
- Poverty alleviation,
- Continued macroeconomic stability and financial discipline,
- Public sector reforms,
- Environmental protection,
- Rural development, and
- Human resource development including the fight against HIV/AIDS and disaster management.

With NDP9, the Government aimed to provide energy costs that reflect the true costs of supply. Importance was placed in avoiding risk of supply and vulnerability to supply disruptions. NDP9 recognised the importance of gender and social equity and justice in energy.

It is acknowledged in NDP9 that (90%) of the rural population depends on fuelwood. To address this problem, a community fuelwood management project to empower communities on how to sustainably utilize their wood resources was conceptualised and was to be implemented in NDP9. The following were to be carried out during NDP9:-

Complete the Forestry Policy and review Legislation

- Continue with implementation of Chobe management plans
- Carry out forest inventories to facilitate implementation of community-based woodland management programs
- Establish community based woodland management areas.

The NDP 9 energy policy for the fuelwood sub sector is to:

- Ensure a sustainable use of fuelwood.
- Create an inventory of and monitor woody biomass resources

Strategies to address these were to include:

- Establishing a biomass database
- Monitoring and controlling fuelwood use by government institutions.
- Introducing efficient fuelwood stoves
- Promoting community-based natural resource management

7.18 Botswana Energy Master Plan

The Botswana Energy Master Plan (BEMP) highlights the links between energy and achievement of the socio-economic and environmental goals as stipulated in the Vision 2016 and NDP9.

BEMP identifies issues for Integrated Energy Planning, the demand sectors, supply sectors (electricity, oil and gas, biomass, coal and new and renewable sources of energy), energy efficiency, cross-cutting issues and governance and regulation in the energy sector. The master plan highlights the priorities, measures and policy goals for each of the issues mentioned above and only those that are pertinent to biomass are mentioned below.



On the demand side, the BEMP focuses on addressing energy poverty at household level, particularly for the low-income households with the general objective of facilitating a move by low-income households to cleaner and modern sources of energy. There are opportunities for government institutions to move away from using fuelwood since they can afford alternative energy fuels/sources.

At the time of drafting BEMP, fuelwood was rated as the most commonly utilised fuel in households and in government Institutions. However institutions such as the Botswana Defence Force, prisons and some government schools have since been encouraged to stop using fuelwood. In spite of these efforts, a sizeable number of institutions in the rest of the country are still using fuelwood as a source of energy e.g. primary schools.

On the supply side, BEMP focuses on sustainable use and harvesting of biomass energy resources and the need to engage with other key stakeholders in developing policies and legislation that can support community-based fuelwood management.

There is inherent difficulty in determining the availability of fuelwood, as the existing woody biomass does not always translate to available fuelwood. Furthermore, the BEMP cites the land clearing for agriculture, timber harvesting for construction, and infrastructure development as the major causes of deforestation. Fuelwood harvesting, on the other hand, makes a minimal contribution.

On the institutional side, BEMP identifies the need for proper co-ordination of stakeholders in the various government departments such in the Ministry of Lands and Housing, Ministry of Agriculture, and Ministry of Environment, Wildlife and Tourism to prevent fragmentation of biomass issues among the different ministries. The BEMP also recommends the enactment of legislation and policies that allow for development of new technologies that can be adapted for biomass production for fuel and support community participation in woodland management.

7.19 Botswana Biodiversity Strategy and Action Plan (BSAP)

The goal of the biodiversity strategy and action plan is to contribute to the long-term health of Botswana's ecosystem and related species, to encourage sustainable and wise use of resources through the framework for specific activities designed to improve the way biodiversity is perceived, utilised and conserved. The guiding vision of the BSAP is:

For a nation in balance, with fair access to biological resources, where the benefits deriving from the use of these resources and shared equity for the benefit and livelihoods of current and future generations, and where all citizens recognise and understand the importance of maintaining Botswana's biological heritage and related knowledge and their role in the conservation and sustainable use of Botswana's biodiversity.

The strategy is supported by 11 objectives:

- Better understanding of biodiversity and ecological processes,
- Long-term conservation and management of Botswana's biological diversity and genetic resources,
- Efficient and sustainable utilization of all components of biodiversity in Botswana through appropriate land and resource use practices and management,
- An institutional environment, including human capacity, conducive to effective biodiversity conservation, sustainable use and management,
- Coping with changes to environmental threats to biodiversity,



- Appropriate valuation/appreciation of biological diversity, and raised public awareness on the role of biodiversity in sustainable development and public participation in biodiversity related activities and decision making,
- Fair access to biological resources and equitable sharing of benefits arising from the use of biological resources,
- Safe industrial and technological development and other services based on national biodiversity resources for future prosperity,
- Improved availability and access to biodiversity data and information, and promotion of information exchange,
- Recognition of Botswana's and the Southern African region's roles with regards to biodiversity,
- Implementation of the biodiversity strategy and action plan.

7.20 Strategy for Waste Management

The strategy outlines Botswana's vision for waste management through cost effective methods that protect human health and the environment based on principles of prevention, polluter accountability and socio-cooperation. The hierarchy of waste management in the strategy is based on prevention, reuse/recycling, treatment and disposal.

The document affirms the government's commitment to encourage the development of markets for recycled materials and to vigorously promote the re-use of waste through research and development on recycling technologies customised for Botswana, market development of recycled products by enforcing use of recycled products within the government system, optimising the collection and sorting systems and reducing the external costs of re-use and recycling. In addition, it outlines various strategies for specific types of waste such as household waste, paper, agricultural waste, scrap metal, food industry waste and sewerage sludge, among others.

7.21 Poverty Reduction Strategy

The primary focus of the strategy is to provide opportunities for the population to have sustainable livelihoods to be achieved through employment creation through geographically broad based development by ensuring that all districts achieve economic growth based on effective utilisation of their resources. The document identifies the need to review the Land Policy to ensure security of tenure. In addition, six programmes for sustained livelihoods are cited, namely small scale horticulture development, employment through rain-fed crop production, increasing small stock production, strengthening the community-based natural resource management programme, creating employment opportunities in the tourism industry and building capacity for small and medium-sized businesses.

This policy, coupled with the rural development policy, supports the sustainable utilisation of natural resource for social development and poverty reduction. In this regard, biomass could indirectly play a pivotal role in the attainment of these national goals.

7.22 Revised National Food Strategy

The vision of this strategy is the realisation of a stable and sustainable access to basic, adequate and safe food for all to live a healthy and productive life. To achieve this, the strategy seeks to improve national socio-economic security, provide household economic access to food by attainment of broad income security, ensure food availability through imports and national production and guaranteeing food security and nutritional security. The strategy aims to ensure food availability through a combination of production, imports and reserves.



The policy emphasis is on food security rather than self sufficiency. Thus with more food going to be imported as opposed to local production, this has an impact on the amount of crop residues available for biomass fuel production.

7.23 National Conservation Strategy (1990):

The strategy demonstrates Botswana's commitment to the sustainable use and conservation of the country's biodiversity. It sets out to increase the effectiveness with which natural resources are used and managed, and to integrate the efforts of ministries and non-governmental interest groups to maximize the conservation of natural resources in the country.

7.24 Eco-Tourism Strategy (2001)

The strategy seeks to develop eco-tourism as an alternative to relieve pressure on purely wildlife or specific natural attractions such as the Okavango Delta. It is envisaged that eco-tourism will enable diversification into other attractive ecological products offered by natural geological features and resources, such as the Kalahari sand dunes. Another benefit lies in the fact that it will enable rural communities to avoid unsustainable over-exploitation of natural resources that may lead to land degradation.

Thus the major objective of the strategy is to provide opportunities for rural communities to engage in socio-economic eco-tourism activities for poverty alleviation and enhancement of their livelihoods.

7.25 Biomass Energy Strategy (BEST)

Botswana currently has no biomass energy strategy (BEST), but is however working on the BEST under German Technical Cooperation (GTZ)-sponsored initiatives. The major objective of the strategy is to ensure the sustainable utilisation of biomass energy resources in Botswana. A lead consultant (EECG Consultants) has been contracted to assist the lead Agent (EAD) in coordinating with other stakeholders in drafting the BEST. The projects started late in March 2008 and an inception report was submitted at the end of April. This will be followed by the first stakeholders' workshop in May and the project will run until the end of December, when it is anticipated that the strategy will be ready for implementation in NDP10.



8. List of relevant reports

Report Title: ***Fuelwood/woody biomass inventory and monitoring programme (FIMP) – Eastern Botswana***

Publication date:

Author: EECG

Commissioned by: EAD

Report Abstract:

The Ministry of Minerals Energy and water affairs commissioned two fuelwood/woody biomass assessments in Botswana with the aim of creating an inventory of woody biomass as well as designing and testing inventory techniques. The first study examined the woody biomass inventory in the areas of Mochudi and Bobonong and led to the development of a prototype Fuelwood Inventory and Monitoring Programme (FIMP). In 2001-2002, a second study (so-called FIMP-II) extended the woody biomass assessment, spatially to cover six and a quarter Landsat scenes, in eastern Botswana (i.e. Barolong, Jwaneng, Orapa, Limpopo Lephephe, Mmashoro and Maitengwe). Both these studies were intended to provide a benchmark assessment of woody biomass in Botswana against which future changes in the resource can be compared, so enabling the sustainable management of fuelwood resources in the country [NRP, 2003].

Report Title: **Makomoto Study**

Publication date: March 2008

Author(s): DFRR: K.S. Kemoreile, E. Mosimayana, B. Philimon & L. Basalumi

Commissioned by: **Department of Forestry and Rangeland Resources**

Report Abstract:

The Department of Forestry and Range Resources undertook a vegetation resources assessment at Makomoto – Sese area in response to concerns over possible unsustainable utilization of forest and range resources for commercial fuel production around that area. The overall objective of the study was to carry out a detailed forest inventory of the area between Sese Veterinary Fence and Tonota village to assess the standing stock biomass and diameter distributions for both live and dead trees that could potentially be utilized for fuelwood production as well as other purposes such as provision of construction materials, fencing materials etc.

Findings indicated that there were 33 different tree species found within the study area and *Colophospermum mopane* accounted for 57.33% of the species composition, followed by *Acacia erubescens* at 8.87%, *Combretum apiculatum* at 6.67%, *Acacia karoo* at 5.41% and *Acacia tortillis* at 5.33%. A total of 502 various trees were estimated per hectare, amounting to average a total of 85, 358, 520 trees were estimated to be found within the project area on average, if a complete inventory of the area were to be conducted. Furthermore, on average there were 181 tree stumps observed per hectare for all species, 74.62% of the stumps were from *C. mopane*, 5.77% were from *Combretum apiculatum* and *Acacia tortillis* had 5.26%. *C. mopane* was popular for use as firewood and for other household uses, followed by *C. apiculatum*. *Acacia tortillis* was commonly used to fence homes, fields and kraals.

Results also indicated that there was harvesting of live trees at Makomoto, approximating to half of the 45-167kg/ha of removed biomass. However, due to the lack of field data to determine the end use of the trees removed, it is difficult to safely say how much of this “live biomass” has been used for commercial firewood sales.



Report Title: **Feasibility study for the production and use of biofuels in Botswana**

Publication date: November 2007

Author: EECG

Commissioned by: EAD

Report Abstract:

The feasibility study on the Production and Use of Biofuels in Botswana was commissioned by the Ministry of Minerals, Energy and Water Resources through the Department of Energy in April 2007. Its main objective was to assess the potential of producing biofuels in Botswana particularly ethanol, biodiesel and bio-gel. The study involved market assessment, assessment of feedstock production potential, identification of appropriate technologies and a cost and benefit analysis. It also examined the policy, environmental, legal, institutional, employment and capacity building implications of biofuels production and use.

Sweet sorghum and sugar cane were identified as potential feedstocks for production of ethanol in Botswana and suitable land for production was identified in Chobe District. On the other hand, *Jatropha* was identified as the most suitable energy plant for biodiesel production, with suitable land for its production centred in the Central District.

Other edible oil producing crops were not cost effective as they have low yields in Botswana, implying high production costs and hence prices. Use of edible oils and food crops for fuel production in Botswana is in direct conflict with the national policy of achieving food security.

Output of tallow as a by-product of the Botswana Meat Commission slaughter houses is small (2000 tonnes per year) and would not warrant a separate plant for its processing into biodiesel as the tallow is also used for soap making. Moreover, the size of processing plants required for processing such small quantities of feedstock would not be cost competitive compared to prices of fossil diesel.

The study also concluded that biogel could replace methylated spirit and paraffin, and bio-oil also had potential in substituting paraffin for lighting. Both biogel and bio-oil were however expensive and biogel in particular, reflects the highest cost of service for cooking. There are also emissions of carbon monoxide and unburnt hydrocarbons and odour associated with biogel combustion, which necessitate good ventilation [EECG, 2007].

Report Title: **Energy Use, energy Supply, Sector reform and the Poor in Botswana (Report 1)**

Publication date: **June 2004**

Author: EECG Consultants

Commissioned by: The World Bank

Report Abstract:

The report was part of a two-phase World Bank study that was done in four countries and provides information on energy use, supply and energy reforms based on secondary data or past studies and surveys. The report takes note of the absence of high level energy reforms in Botswana, as opposed to the existing low-level reforms instituted mainly in the electricity sub-sector. Furthermore, in the absence of a comprehensive analysis on the impacts of these reforms, the report presupposes some of the potential impacts, such as the need for rural connection scheme to increase rural electrification uptake and highlights the need for further work to expose the impacts. In addition, uptake of LPG and Kerosene



seemed to be on an upward trend due to favourable pricing and government support in the case of kerosene.

The report presents socio-economic characteristics that could reveal links between income status, poverty levels and affordability of various energy sources. It further analyses the fuel preferences and consumption patterns for application such as cooking and water heating in urban and rural households, as well as the seasonal differences. Lastly, it examines the supply and demand barriers to fuel use.

Report Title: **Energy Use, energy Supply, Sector reform and the Poor in Botswana**
Publication date: **November 2004**
Author: EECG Consultants
Commissioned by: The World Bank
Report Abstract:

The report analyses energy use, energy supply, and sector reforms and impact on the poor in Botswana. Having been done in two parts, the report provides findings of a combined household and community study that was done in 2003 on community structures, household socio-economics, energy consumption, energy supply chains and impact of income and expenditure on uptake of modern energy services.

The lessons learnt from the study are:

Community and Household Settings

The report asserts that the socio-economic development of the poor is too low for them to benefit fully from energy reforms that do not address their societal needs. The household income level of the households that were surveyed was low and their amenities ranged from inadequate to rudimentary. But there were noticeable differences between the rural and urban. Urban households had smaller families compared to rural households and the unemployment level was higher in rural households.

Household Energy Consumption

The report acknowledges that while electricity, kerosene and candles are the main lighting fuels in rural and urban households, and electricity being more preferred in urban households, the major barriers for electricity usage in rural households were the tariffs that were too high, as well as the unavailability of connections in certain remote locations.

Expenditure on energy was higher for electricity, which averaged P403.23 for urban households and P105.58 for rural households followed by LPG, which averaged P166.07 and P155.39 for rural and urban households respectively. Expenditure on fuel decreased in the following order: electricity, LPG, fuelwood and coal. Fuel preference also followed the same order.

The report concluded that though there was growth in the uptake of modern energies, namely, electricity and LPG. Poor households were lagging behind as expenditure on energy was higher in comparison to their income. The urban poor were not catered for in policy whilst their energy consumption pattern was similar to the rural poor. It further concludes that the Rural Electrification Collective Scheme (RCS) was making an impact with rural electricity connection exceeding that of urban consumers and further recommended the scheme to include supply of devices.



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