

BOTSWANA ENVIRONMENT STATISTICS: FORESTRY DIGEST 2023



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Preface

Statistics Botswana, through the Environment Statistics Unit (**ESU**), presents the second edition of the Botswana Environment Statistics: Forestry Digest. The digest provides reliable and recent statistics together with trends analysis on Botswana's forest cover, land cover change, soil organic carbon stock, land degradation, and pressures on forests. Pressures on forests include fuel wood harvest, and wild fires incidences and area burnt by district for the period 2020 to 2023.

The Framework for Development of Environment Statistics (**FDES**) of the United Nations Statistics Division was used in the preparation of this digest. The statistical information provided in this digest is important for evidence-based decision making, with particular reference to promoting sustainable forest management and conservation.

I wish to acknowledge the Department of Forestry and Range Resources for their significant contribution by providing the required data. The continued production of this report is dependent on strong collaboration with our key stakeholders.

For more information and further enquiries, contact the Directorate of Stakeholder Relations at **3671300**. Statistics Botswana outputs/publications are available on the website at **www.statsbots.org.bw** and at the Statistics Botswana Resource Center which is based at the Head-Office in Gaborone.



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Dr Khaufelo R. Lekobane
Statistician General
October 2025

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List Of Acronyms

BDS	Botswana Demographic Survey
DFRR	Department of Forestry & Range Resources
FAO	Food and Agriculture Organisation
FDES	Framework for Development of Environment Statistics
GoB	Government of Botswana
IMTS	International Merchandise Trade Statistics
NDP	National Development Plan
NEUS	National Energy Use Survey
PRAIS	Performance Review and Assessment of Implementation System
SB	Statistics Botswana
SDGs	Sustainable Development Goals
UNCCD	United Nations Convention to Combat Desertification
UNFDES	United Nations Framework for the Development of Environment Statistics
UNISDR	United Nations International Strategy for Disaster Reduction

EXECUTIVE SUMMARY

The purpose of this digest is to provide reliable and recent statistics together with trends analysis on Botswana's forest cover, land cover change, soil organic carbon stock, land degradation, and pressures on forests.

Forest Cover in Botswana: The total area of Botswana is 582,000 Km², and forests and woodlands areas together cover about 27 percent of the total land area. Forest cover was on the increase between the years 2010 and 2020. The total forest area increased from 19.7 percent in 2010 to 35.8 percent in 2020.

Fuel Wood: Wood/charcoal were mostly used in rural areas during the three Botswana Population and Housing censuses (2001, 2011, and 2022), BDS 2017, and NEUS 2023/24, followed by gas (LPG). In urban areas, the most common source of energy for cooking during the period under review is gas (LPG).

Wild fire: The national areal extent of fires increased from 3,214,043 ha in 2020 to 10,568,630 ha in 2021, then reduced to 7,515,312 ha in 2022, and increased to 10,620,036 ha in 2023. Ghanzi district had the largest area (10,710,627 ha) burnt by wild fires during the review period, followed by Kgalagadi and Ngamiland districts, with a total area burnt of 7,116,484 ha, and 6,228,908 ha respectively. Proportionately, Ghanzi, Kgalagadi, and Ngamiland Districts show more burnt areas.

Threatened Plant Species: The underlying causes leading to threatened plant species include unmanaged use of fire. The Department of Forestry and Range Resources reports a total of thirteen threatened plant species as at end of 2023.

National estimates of land cover: The national total land area was estimated at 579,601 Km². Grasslands accounted for the largest share with 331,096 Km² (57.1%) during the review period. Tree-covered areas were estimated at about 208,286 Km² (35.9%) and croplands at 12,103 Km² (2.1%). The remaining land area covered other lands at 14,915 Km² (2.6%), wetlands and artificial surfaces at 8,544 Km² (1.5%) and 4,658 Km² (0.8%) respectively.

Land cover change: Between 2015 and 2019 tree-covered areas gained from grassland (641 Km²), croplands (794 Km²), artificial surfaces (298 Km²) and other lands (28 Km²). Grasslands lost to tree-covered areas (641 Km²), croplands (189 Km²), wetlands (41 Km²), artificial surfaces (14 Km²), and other lands (14 Km²). Croplands lost to tree-covered areas (794 Km²), grasslands (373 Km²), and wetlands (14 km²) gained from tree-covered areas (551 Km²), grasslands (189 Km²), and artificial surfaces (28 Km²).

From 2019 to 2023 tree covered areas gained from grasslands (42 Km²), croplands (69Km²) and artificial surfaces (128 Km²). Tree covered areas gained 168 Km² from 208,159 Km² in 2019 to 208,327 Km² in 2023. An estimated 69 Km² of croplands were converted to tree covered areas and 13 Km² to grasslands. Croplands gained 14 Km² from wetlands during the study period.

National estimates of soil organic carbon stock: Annual soil organic carbon (SOC) stock for all the land cover classes remained constant. Wetlands have the highest annual SOC stock with 19 tonnes per ha, followed by croplands (17 tonnes per ha), and tree-covered areas (16 tonnes per ha). Between 2015 and 2019 the highest SOC stock increase occurred in land cover conversion from croplands to tree-covered areas at 645,702 ton, followed by conversion from other lands to grasslands, and from croplands to grasslands at 237,293 ton, and 191,063 ton respectively.

Between 2019 and 2023 the highest SOC stock increase occurred in land cover conversion from croplands to tree-covered areas with SOC stock change of 38,439 ton. Loss of SOC was highest in the land conversion from tree-covered areas to artificial surfaces with SOC stock change of 114.921 Km², followed by the conversion of tree-covered areas to croplands and croplands to tree-covered areas, at 43,646 Km² and 38,439 Km² respectively.

Degraded land: Land area with degraded land cover reduced from 210,267 Km² (36.3%) in 2016 to 99,215 Km² in 2019 (17.1%), showing a 52.8% decrease. Land area with non-degraded land cover remained at 14 Km² and land area with improved land cover reduced from 84,808 Km² (14.6%) in 2016 to 2,805 Km² (0.5%) in 2019. Land area with stable land cover increased from 284,513 Km² (49.1%) in 2016 to 477,568 (82.4%) Km² in 2019.



1.0. INTRODUCTION

Forests play a central role in human societies, providing livelihoods for millions of people around the world. According to UNSD (2013), forests offer timber, food, shelter, fuel and medicinal products and they also perform significant ecosystem functions such as hydrological regulation, soil protection, carbon sinks and biodiversity protection, among others.

The forests of Botswana are endowed with natural resources that are important in sustaining the livelihoods of the local communities and the ecosystems they depend on. The majority of rural communities depend on forests and woodlands for, among others, energy sources, providing materials for fencing, construction, building, and crafts and maintaining environmental balance. The Government of Botswana has developed several policy documents and it has implemented numerous plans and programmes in the endeavour to promote sustainable forest management and conservation.

One of the important policy documents in the forestry sector is the Forest Policy of 2011. It is a framework that provides guidance and facilitation in the management of forests and range resources of the country through conservation, development, and sustainable use. The policy defines basic principles, objectives, strategies and action plans for the management of forests and range resources through conservation, development, and sustainable utilisation to meet social, cultural, economic, environmental and ecological needs of present and future generations. The overall goal of this Forest Policy is “to optimize the contribution of the forest and range resources to the long-term socio-economic development of Botswana by ensuring equitable and sustainable flow of benefits to all segments of the population now and in the future” (GoB, 2011).

Another important national document that has prioritised forest management as a development agenda is Vision 2036. Through Pillar 3 under Sustainable Development theme, Botswana has set a target that stipulates that by 2036, sustainable and optimal use of our natural resources will have transformed the economy and uplifted people's livelihoods. Achieving this target will involve management of land as a finite resource and a determining factor of sustainable development (GoB, 2016). Its management affects the well-being of all ecosystems such as humans, forests, wetlands and wildlife species.

Sustainable Development Goals (SDGs) also promote sustainable management of forests. In particular, SDG 15: Life on Land, focuses specifically on managing forests sustainably, halting and reversing land and natural habitat degradation, successfully combating desertification and stopping biodiversity loss. The aforementioned efforts combined aim to ensure that the benefits of land-based ecosystems, including sustainable livelihoods, will be enjoyed for generations to come.

In order to monitor progress made in achieving targets set in NDP, Vision 2036, and SDGs, it is crucial to understand the extent and characteristics of forests and to produce statistics about their diverse dimensions. Therefore, the purpose of this digest is to provide reliable and recent statistics together with trends analysis on Botswana's forest cover and pressures on forests. Pressures on forests include fuel wood harvest, wild fires incidences and area burnt by district, for the period 2020 to 2023.

1.1. Methodology

The United Nations Framework for the Development of Environment Statistics (UNFDES) guided the production of this digest. Sub-Component 1.2: Land Cover, Ecosystems and Biodiversity, of the UNFDES was operationalized, with the focus on “Forest area and Forest biomass” indicators.

Administrative records were used for the production of this digest, and were drawn mainly from the Department of Forestry and Range Resources, and other related literature.

Data were captured and analysed in Microsoft Excel software. Descriptive statistics, such as frequencies and percentages, were employed to summarize data on the following indicators: forest cover, fire incidences, land cover change, soil organic carbon stocks, degradation, fire affected area, and trade in forest products. Subsequent to that was the validation of the statistics by data providers as well as the rigorous review of the draft report by Statisticians at different hierarchical levels.

2.

2.0. TRENDS IN FOREST COVER IN BOTSWANA

The total area of Botswana is 582,000 Km², and forests and woodlands areas together cover about 27 percent of the total land area.

Table 2.1 shows that the forest cover was on the increase between the years 2010 and 2020. The total forest area increased from 19.7 percent in 2010 to 35.8 percent in 2020. The increase is due to the use of country-specific total forest area from Botswana Forestry Distribution Map as opposed to the use of FAO estimates as was the case previously, it could also be due to reduction in fuel wood harvesting and land clearing for human settlements, or afforestation. The forest distribution map covers typical forests, riparian forests (wooded area of land adjacent to a body of water) and other woodlands (e.g. Mopane trees). The trend in forest cover is also depicted graphically in **Figures 2.1a** and **2.1b**.

Table 2.1: Botswana Forest Cover (ha), 2010 - 2020

Year	2010	2016	2017	2018	2019	2020
Total Forest Area (ha)	11,448,903	15,831,300	15,727,900	15,727,900	15,727,900	20,814,600
Total Area (ha)	58,200,000	58,200,000	58,200,000	58,200,000	58,200,000	58,200,000
% of Total Land Area	19.67	27.2	27.02	27.02	27.02	35.76

Source: Department of Forestry & Range Resources

Figure 2.1a: Forest Cover as a Proportion of Total Land Area, 2010 - 2020



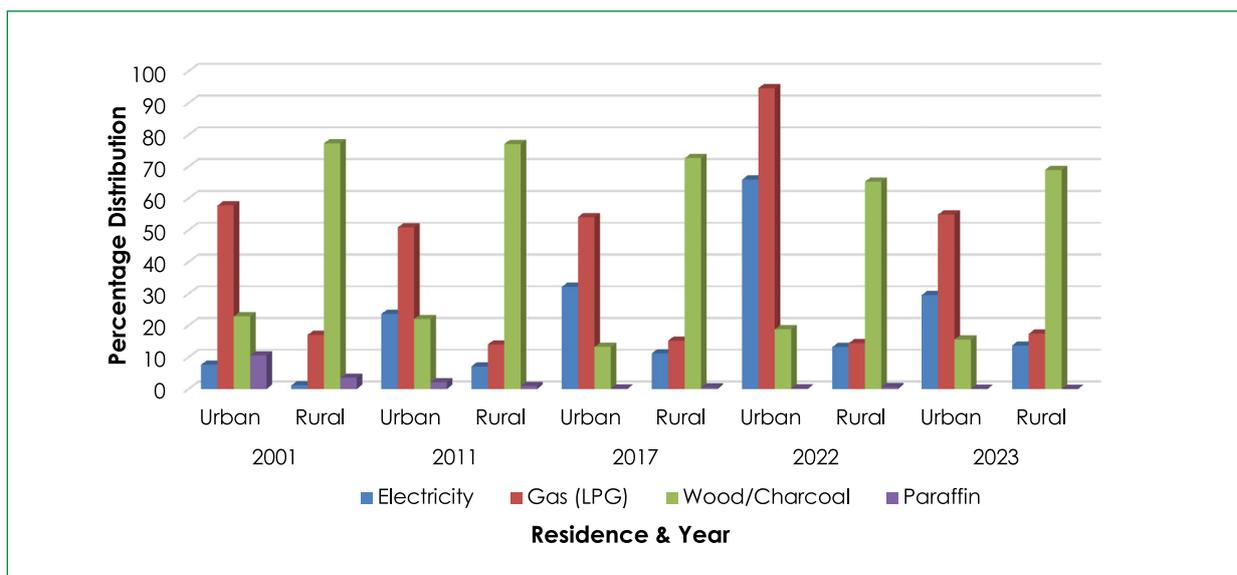
Figure 2.1b: Botswana Forest Cover (ha), 2010 - 2020



2.2. Fuel Wood

Forest resources can be depleted by fuelwood harvesting, as well as land clearing for human settlements. Fuelwood is the main source of energy for cooking in the majority of households in Botswana, particularly in rural areas. **Figure 2.2** reveals that wood/charcoal were mostly used in rural areas during the three censuses (2001, 2011, and 2022), BDS 2017, and NEUS 2023/24, followed by gas (LPG). In urban areas, the most common source of energy for cooking during the period under review is gas (LPG).

Figure 2.2: Households in Urban and Rural by Principal Energy Source for Cooking in 2001, 2011 & 2022 Censuses, BDS 2017, & NEUS 2023/24



2.3. Fire

Wild fires are a major threat to forest resources in Botswana. They threaten and destroy natural biodiversity and ecosystems resulting in the disruption of ecological balances. **Table 2.2** displays the extent of area affected by wild fires by district for the period 2020 to 2023. The table shows a fluctuating trend in the national areal extent of fires during the period under review.

The national areal extent of fires increased from 3,214,043ha in 2020 to 10,568,630ha in 2021, then reduced to 7,515,312ha in 2022, and increased to 10,620,036ha in 2023. **Figures 2.3a – 2.3d** display the area burnt by district during the years 2020 - 2023.

The results show that Ghanzi district had the largest area burnt by wild fires during the review period, followed by Kgalagadi and Ngamiland districts, with total area burnt of 10,710,627ha, 7,116,484ha, and 6,228,908ha respectively. The afore-mentioned districts constitute the largest percentage share of the total land area of Botswana.

Table 2.2 Area Burnt by District (Ha), 2020 - 2023

District	2020	2021	2022	2023	District Size (Hectares)
Central	159,677	671,777	645,060	973,584	14,637,419
Chobe	251,585	400,407	499,692	506,423	2,101,920
Ghanzi	1,238,534	2,688,722	2,846,692	3,936,679	11,472,587
Kgalagadi	483,863	3,925,958	1,162,885	1,543,777	10,491,604
Kgatleng	159	5,384	47,314	44,853	761,943
Kweneng	78,412	323,748	572,705	938,045	3,696,345
Ngamiland	995,717	2,261,360	1,190,551	1,781,279	11,134,421
North East	-	8,160	5,686	3,836	514,619
South East	-	3,513	5,856	11,582	5,800
Southern	6,095	279,600	538,870	879,978	2,723,320
Grand Total	3,214,043	10,568,630	7,515,312	10,620,036	57,539,978

Figure 2.3: Area Burnt by District, 2020 - 2023

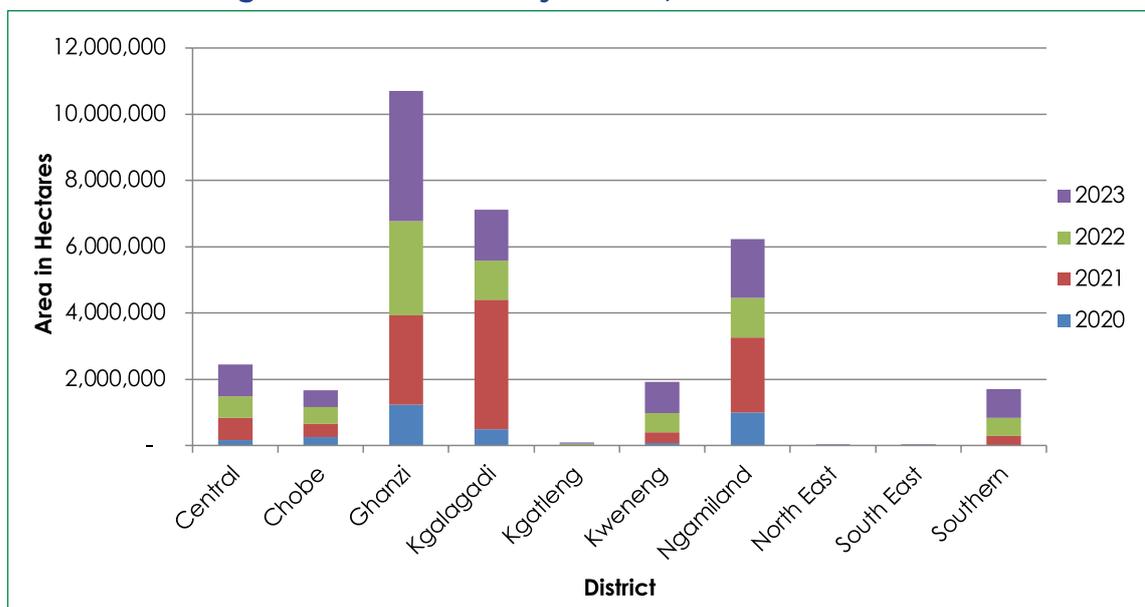


Figure 2.3a: Burnt Scars by District, 2020

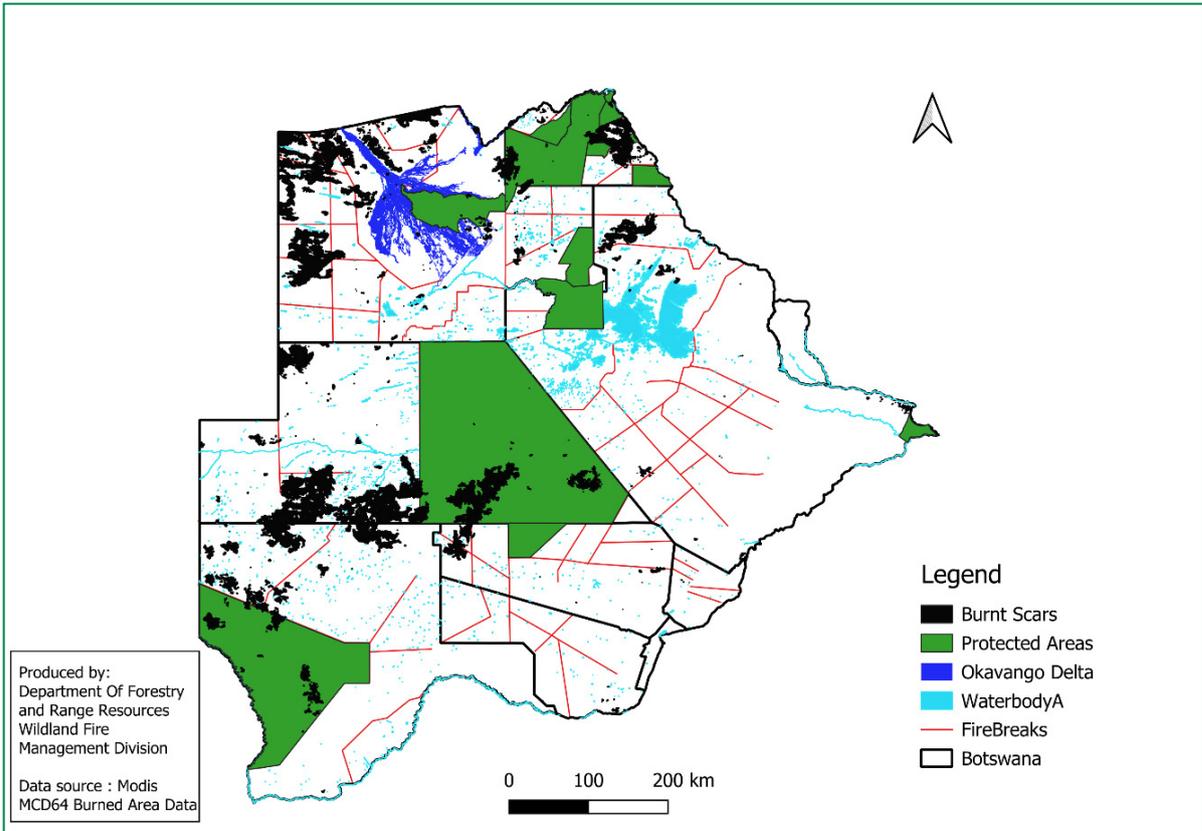
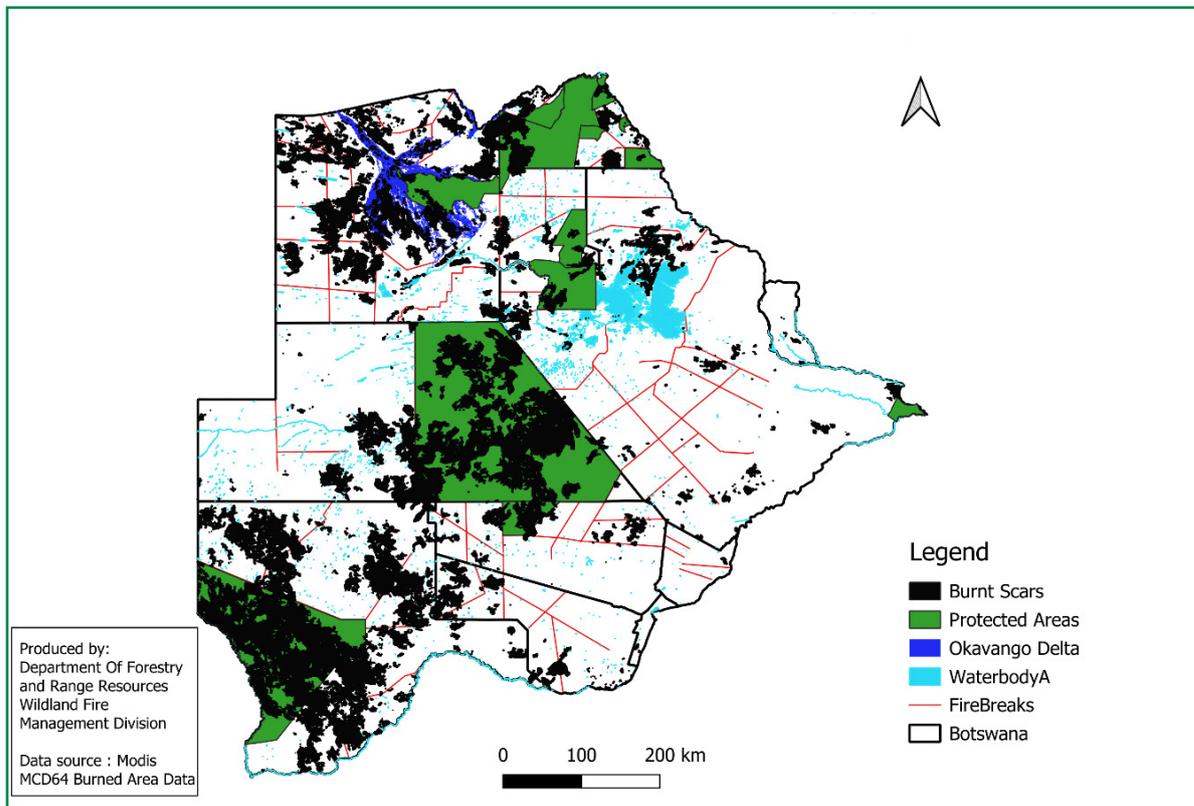


Figure 2.3b: Burnt Scars by District, 2021



6.

Figure 2.3c: Burnt Scars by District, 2022

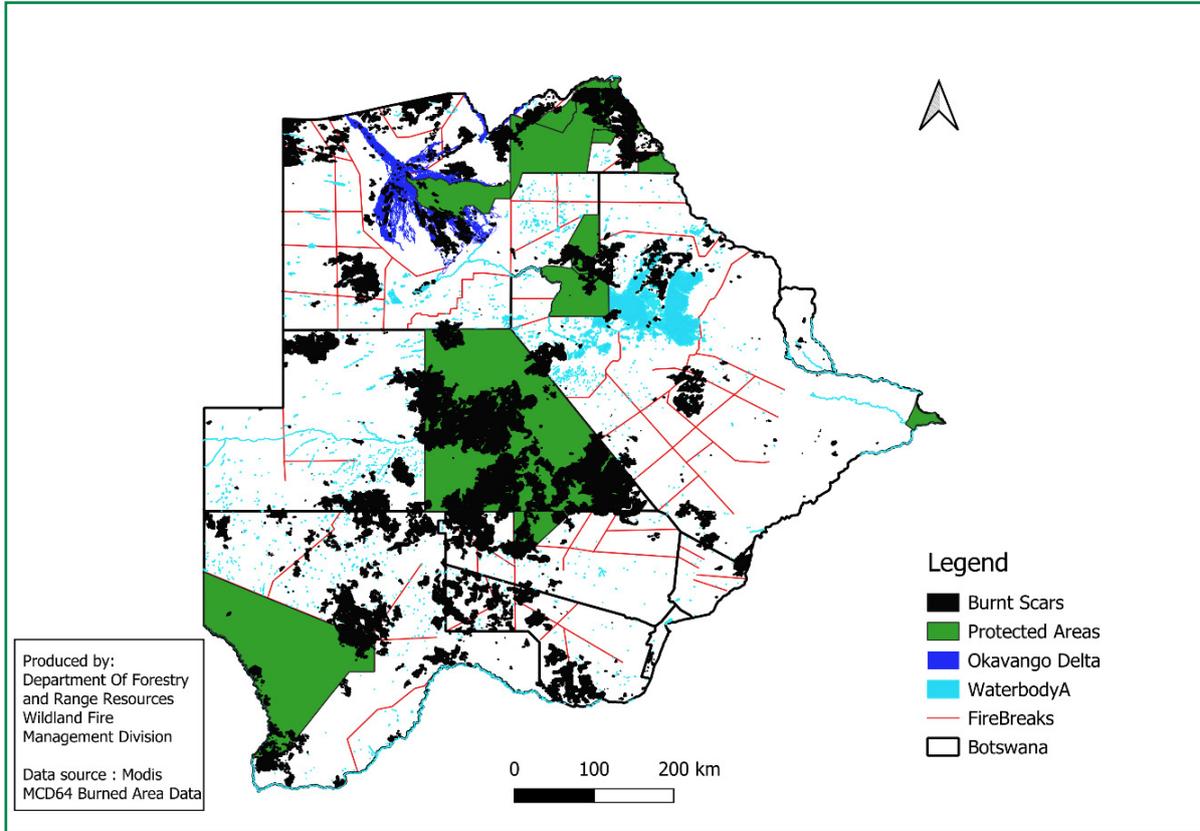


Figure 2.3d: Burnt Scars by District, 2023

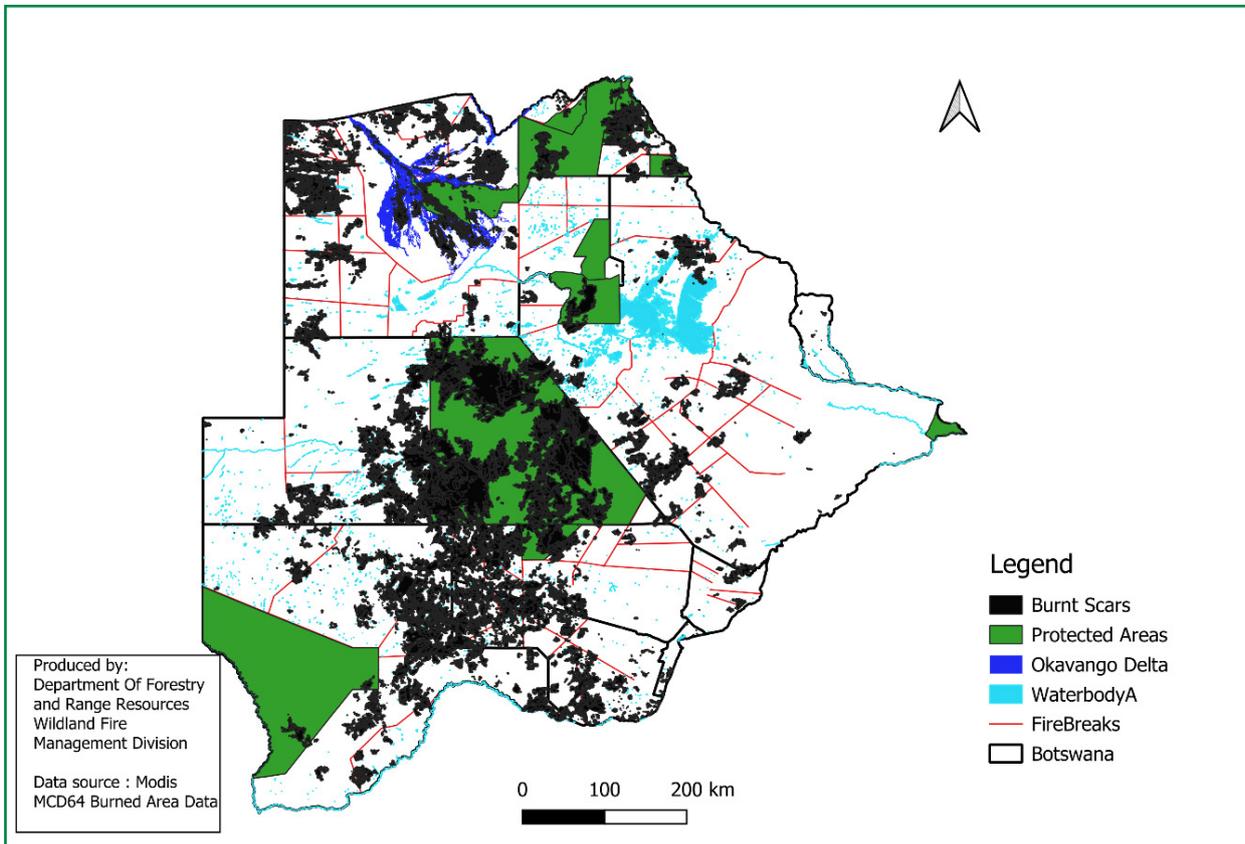


Table 2.3 shows the proportion of areas burnt in each of the districts during the years 2020 to 2023. Proportionately, Ghanzi, Kgalagadi, and Ngamiland Districts show more burnt areas. Conversely, the Kgatleng, South East, and North East Districts' small sizes resulted in lower proportionate burnt areas. **Figure 2.3e** graphically depicts the areas burnt in proportion to the district size.

Table 2.3: Proportion of Areas Burnt by District, 2020 - 2023

District	2020	2021	2022	2023	District Size (Hectares)
Central	4.97	6.36	8.58	9.17	14,637,419
Chobe	7.83	3.79	6.65	4.77	2,101,920
Ghanzi	38.54	25.44	37.88	37.07	11,472,587
Kgalagadi	15.05	37.15	15.47	14.54	10,491,604
Kgatleng	0	0.05	0.63	0.42	761,943
Kweneng	2.44	3.06	7.62	8.83	3,696,345
Ngamiland	30.98	21.4	15.84	16.77	11,134,421
North East	-	0.08	0.08	0.04	514,619
South East	-	0.03	0.08	0.11	5,800
Southern	0.19	2.65	7.17	8.29	2,723,320
Grand Total	3,204,659	10,563,553	7,509,179	10,607,986	57,539,978

Source: Department of Forestry & Range Resources

Note: (-) Data not available

Figure 2.3e: Proportion of Areas Burnt by District, 2020 - 2023

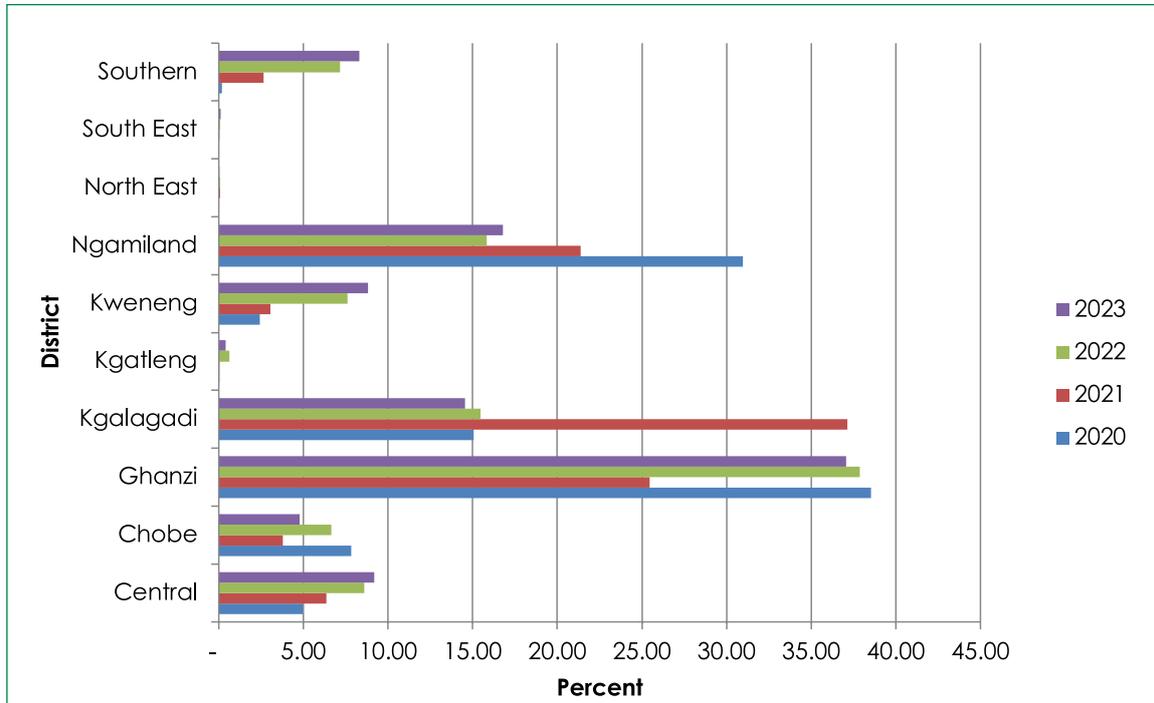


Table 2.4 presents the incidence of fires by district for the years 2020 to 2023. Ngamiland, Central and Southern districts recorded the highest incidences during the review period, while South East had the least incidences. Generally, the national incidence of fires followed an upward trend, with the highest number of incidences recorded in 2022.

8.

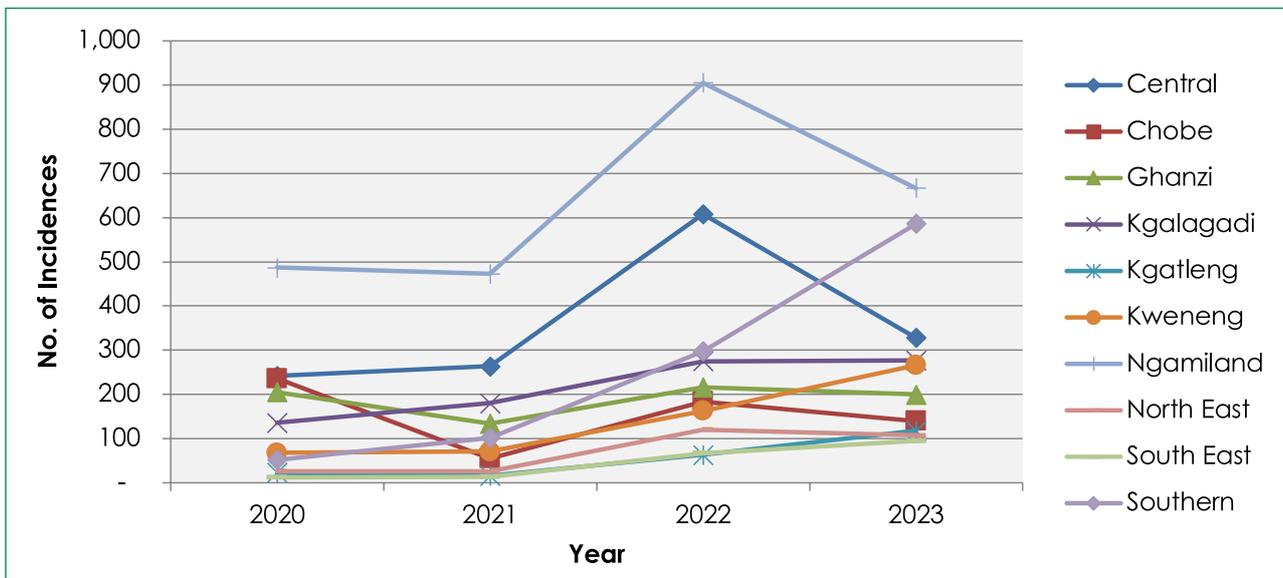
BOTSWANA ENVIRONMENT STATISTICS: FORESTRY DIGEST 2023

Table 2.4: Incidence of Fires by District, 2020 - 2023

District	2020	2021	2022	2023	Total
Central	242	264	608	328	1,442
Chobe	236	55	184	140	615
Ghanzi	205	134	216	200	755
Kgalagadi	136	180	275	277	868
Kgatleng	23	16	63	118	220
Kweneng	68	71	163	266	568
Ngamiland	487	473	905	667	2,532
North East	26	26	120	107	279
South East	12	14	67	95	188
Southern	52	102	298	586	1,038
Grand Total	1,487	1,335	2,899	2,784	8,505

Source: Department of Forestry & Range Resources

Figure 2.3f: Number of fire incidences by District, 2020 - 2023



2.4. Threatened Plant Species

Threats and contributing factors to biodiversity loss are derived primarily from development expansion, but are also due to limited management of the environment and natural resources (GoB, 2015). Specifically, the underlying causes leading to threatened plant species include habitat degradation (e.g. overgrazing, nutrient loading in riparian systems), unmanaged use of fire (fires used to stimulate sprouting for grazing, clear bush to improve visibility, etc.) These fires affect recruitment of key tree species, and also exert pressure on certain valuable or medicinal species. The Department of Forestry and Range Resources reports a total of thirteen threatened plant species as at end of 2023 ([Table 2.5](#)).

Table 2.5: Threatened Plant Species in Botswana, 2017 – 2023

No.	Species	English Name	Local Name
1.	Adenium boehianum	Bushman poison	n/a
2.	Adenium oleifolium	Bitter Kambro	Mooka
3.	Hoodia lugardi	Bushman's hat	Thokabotshwaro/Sekopane/Seboka
4.	Huernia levyi	n/a	n/a
5.	Orbea tapscottii	Carrion flower	n/a
6.	Orbea knobelii	n/a	n/a
7.	Euphorbia venterii	Venter's Spurge	n/a
8.	Aloe spp.	Zebra leaf aloe, Aloe zebrine Baker, Spotted Aloe	Mekgwapha
9.	Encephalartos spp.	Cycads	n/a
10.	Pterocarpus spp	Timber species (Mukwa)	Mukwa / Mokwa
11.	Dalbergia spp.	n/a	n/a
12.	Osyris lanceolata	African sandalwood	Morogabaloi
13.	Orchidaceae	Orchids	n/a

n/a - No Setswana name for the collective group of species

Source: Department of Forestry & Range Resources

3.0. LAND COVER AND LAND COVER CHANGE

Land cover statistics provide information on the bio-physical aspects of the land surface, including natural and managed ecosystems such as croplands, forests, tree-covered areas, and urban areas (FAO, 2021). This chapter provides statistics on land cover and land cover change in Botswana by land cover class, between 2015 and 2023. The land cover classes are constituted by the following classes: tree-covered areas, grasslands, croplands, wetlands, artificial surfaces, other Lands, and water bodies.

3.1. National estimates of land cover

Table 3.1 presents national estimates of land cover in square kilometres (Km²) from 2015 to 2020. The national total land area is estimated at 579,601 Km² (excluding area under water bodies). Grasslands accounted for the largest share with 331,096 Km² (57.1%) during the review period. Tree-covered areas covered about 208,286 Km² (35.9%) and croplands 12,103 Km² (2.1%). Other lands 14,915 Km² (2.6%), wetlands 8,544 Km² (1.5%) and artificial surfaces 4,658 Km² (0.8%) covered the remaining land area.

Table 3.1: National estimates of land cover (Km²), 2015 – 2020

Year	Tree-covered areas	Grasslands	Croplands	Wetlands ¹	Artificial surfaces	Other Lands	Water bodies ²
2015	208 429	330 992	12 075	8 619	4 574	14 913	-
2016	208 456	331 006	12 020	8 619	4 587	14 913	-
2017	208 327	331 120	12 122	8 519	4 600	14 913	-
2018	208 172	331 133	12 163	8 506	4 714	14 913	-
2019	208 186	331 133	12 149	8 492	4 714	14 927	-
2020	208 146	331 190	12 091	8 506	4 756	14 913	-
Average	208 286	331 096	12 103	8 544	4 658	14 915	-

Source: Department of Forestry & Range Resources

Note: (-) Data not available in area under Water bodies

Presented in **Table 3.2** is the national estimates of land cover change between 2015 and 2019. According to OECD, land cover change is the change of natural and semi-natural land to other land cover types, such as grassland, shrubland, wetland, or tree cover. It is important to quantify land cover change to monitor biodiversity loss, reduction of carbon sinks, among other challenges.

Table 3.2 further shows how much of each land cover was converted to another land cover from 2015 to 2019. The table also shows the area of each land cover that stayed persistent. Out of the tree-covered area of 208,428 Km² in 2015, about 206,724 Km² remained tree-covered, while some area was lost to grasslands (1,139 Km²), croplands (551 Km²), and other lands (14 Km²). Tree-covered areas gained from grassland (641 Km²), croplands (794 Km²), artificial surfaces (298 Km²) and other lands (28 Km²) to reach a total of 208,485 in 2019.

Generally tree-covered areas gained by 57 Km² from 208,428 Km² in 2015 to 208,485 Km² in 2019.

Grasslands gained by 1,421 Km² from 330,992 Km² in 2015 to 332,413 Km² in 2019. About 330,093 Km² of grasslands remained grasslands. The gains were from croplands (373 Km²), artificial surfaces (402 Km²), other lands (406 Km²), and tree-covered areas (1,139 Km²). However, grasslands lost to tree-covered areas (641 Km²), croplands (189 Km²), wetlands (41 Km²), artificial surfaces (14 Km²), and other lands (14 Km²).

Between 2015 and 2019, about 10,894 Km² of croplands area remained croplands. Croplands lost by 413 Km² from 12,075 Km² in 2015 to 11,662 Km² in 2019. Croplands lost to tree-covered areas (794 Km²), grasslands (373 Km²), and wetlands (14 Km²). On the other hand, croplands gained from tree-covered areas (551 Km²), grasslands (189 Km²), and artificial surfaces (28 Km²).

¹**Wetlands:** includes any geographic areas that are transitional between pure terrestrial and aquatic systems, where the water table is usually near the surface or the land is covered by shallow water (e.g., marshes, swamps and aquatic beds), (PRAIS).

²**Water bodies:** includes any geographic area covered by inland water bodies with a water persistence of 12 months per year, such as lakes and/or rivers, (PRAIS).

Wetlands gained 155 Km², from 8,619 Km² in 2015 to 8,774 Km² in 2019. The gains accrued from other lands (100 Km²), grasslands (41 Km²), and croplands (14 Km²). Wetlands lost no land area between 2015 and 2019. About 8,619 Km² of wetlands remained wetlands.

Artificial surfaces lost by 714 Km² from 4,574 Km² in 2015 to 3,860 Km² in 2019. The loss ensued from grasslands (402 Km²), tree-covered areas (298 Km²), and croplands (28 Km²). Only 14 Km² was gained from grasslands. About 3,846 Km² of artificial surfaces remained artificial surfaces.

From the total of 14,913 Km² of other lands in 2015, about 14,899 Km² remained other lands, with losses to grasslands (406 Km²), wetlands (100 Km²), and tree-covered areas (28 Km²). Only 14 Km² was gained from grasslands.

Table 3.2: National estimates of land cover change (Km²) between 2015 & 2019

Opening land cover	Closing land cover							Opening stock (2015)
	Tree-covered areas	Grasslands	Croplands	Wetlands	Artificial surfaces	Other Lands	Water bodies	
Tree-covered areas	206,724	1,139	551	0	0	14	0	208,428
Grasslands	641	330,093	189	41	14	14	0	330,992
Croplands	794	373	10,894	14	0	0	0	12,075
Wetlands	0	0	0	8,619	0	0	0	8,619
Artificial surfaces	298	402	28	0	3,846	0	0	4,574
Other Lands	28	406	0	100	0	14,379	0	14,913
Water bodies	0	0	0	0	0	0	0	0
Closing stock (2019)	208,485	332,413	11,662	8,774	3,860	14,407	0	579,601
Change in area (%)	0.027	-0.429	-3.42	1.798	-15.61	-3.393	0	

Source: Department of Forestry & Range Resources

Figure 3.1: Change in extent of land cover classes in 2015-2019

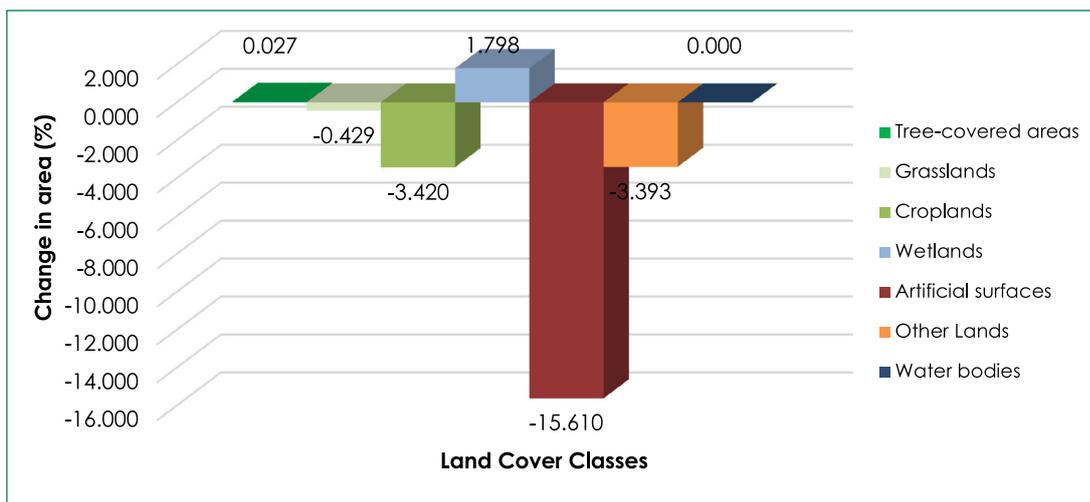


Table 3.3 shows how much of each land cover was converted to another land cover or stayed persistent from 2019 to 2023. Tree covered areas that remained persistent amounted to 208,088 Km² and some were lost to grasslands (14 Km²) and croplands (57 Km²). Tree covered areas gained from grasslands (42 Km²), croplands (69 Km²) and artificial surfaces (128 Km²) to reach a total of 208,327 Km² in 2023. Tree covered areas gained 168 Km² from 208,159 Km² in 2019 to 208,327 Km² in 2023.

Grasslands lost 42 Km² from 331,162 Km² in 2019 to 331,120 Km² in 2023, with 331,079 Km² remaining persistent. The losses of grasslands were 42 Km² to tree covered Areas, 14 Km² to croplands and other lands each and 13 Km² to wetlands. Grasslands gains were from tree covered areas (14 Km²), croplands (13Km²) and wetlands (14 Km²).

12.

BOTSWANA ENVIRONMENT STATISTICS: FORESTRY DIGEST 2023

Croplands that remained unchanged from 2019 to 2023 were 12,037 Km², while 69 Km² were converted to tree covered areas and 13 Km² to grasslands. Croplands gained 14 Km² from wetlands during the study period.

Wetlands that remained persistent were 8,492 Km² while 14 Km² of the wetlands were lost to grasslands. Wetlands gained 13 Km² from grasslands and 14 Km² from other lands.

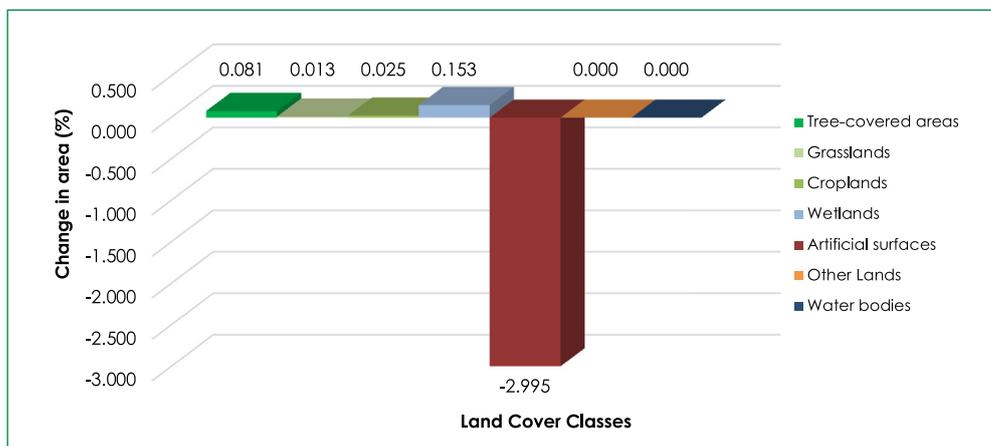
Artificial surfaces lost 128 Km² to tree covered areas and 14 Km² to croplands, while 4,600 Km² of the artificial surfaces remained persistent. 14,899 Km² of other lands remained persistent. The other lands lost 14 Km² to wetlands and gained 14 Km² from grasslands

Table 3.3: National estimates of land cover change (Km²) between 2019 & 2023

Opening land cover	Closing land cover							Opening stock (2019)
	Tree-covered areas	Grasslands	Croplands	Wetlands	Artificial surfaces	Other Lands	Water bodies	
Tree-covered areas	208,088	14	57	0	0	0	0	208,159
Grasslands	42	331,079	14	13	0	14	0	331,120
Croplands	69	13	12,037	0	0	0	0	12,119
Wetlands	0	14	0	8,492	0	0	0	8,506
Artificial surfaces	128	0	14	0	4,600	0	0	4,742
Other Lands	0	0	0	14	0	14,899	0	14,913
Water bodies	0	0	0	0	0	0	0	0
Closing stock (2023)	208,327	331,120	12,122	8,519	4,600	14,913	0	579,601
Change in area (%)	0.081	0.013	0.025	0.153	-2.995	0	0	

Source: Department of Forestry & Range Resources

Figure 3.3: Change in extent of land cover classes in 2019-2023



4.0. SOIL ORGANIC CARBON

Soil Organic Carbon (SOC) is carbon located in the soil organic matter. SOC is one of the most important carbon sinks globally which contributes to the largest terrestrial carbon pool (Watson et al. 2000; Tao et al. 2022). Terrestrial ecosystems contain large amounts of organic carbon. A slight change in terrestrial organic carbon can cause significant changes in the atmospheric concentration of carbon dioxide (CO₂), which is highly related with global warming (Davidson and Janssens, 2006).

Land cover and land use change has an effect on soil carbon stock and its spread in the ecosystem, and thus plays a vital role in relation to global carbon dynamics (Sharma et al. 2019). Specifically, land cover and land use change result in loss in natural vegetation and alteration in equity between input and output of carbon from soil which leads to decrease in soil carbon stock (Ostle et al. 2009). Soil is regarded as the major reservoir of carbon and it has the maximum carbon sequestration potential (Lal, 2005; Sharma et al. 2019).

On the other hand, forests play an important role in mitigating global climate change by capturing and sequestering atmospheric carbon (Solomon et al. 2018). The estimation of carbon storage in forest ecosystems is critical for informing forest management policies with the aim of combating climate change.

Therefore this section provides information on national estimates of soil organic carbon stock in topsoil by land cover class, as well as changes in soil organic carbon stock due to land cover conversion between 2015 and 2023.

4.1. National estimates of the change in soil organic carbon stock

Tables 4.1 and **4.2** present national estimates of the change in soil organic stock due to land cover conversion between 2015 and 2019, and 2019 and 2023. It is worth noting that the estimates of soil organic carbon (SOC) changes due to land conversion vary depending on the type of conversion and the initial SOC.

Table 4.1 shows that, between 2015 and 2019 the highest soil organic carbon stock increases occurred in land cover conversion from croplands to tree-covered areas, followed by conversion from other lands to grasslands, and from croplands to grasslands with SOC stock change of 645,702 ton, 237,293 ton, and 191,063 ton respectively. In terms of the net area change, the land cover conversion from croplands to tree-covered areas gained 551 Km², conversion from other lands to grasslands gained 296 Km², and conversion from croplands to grasslands gained 189 Km². The results further reveal that loss of carbon was highest in land conversion from grasslands to other lands with SOC stock change of 636,808 ton. The initial SOC stock reduced 17.4 ton/ha and 1.7 ton/ha. Other significant loss of SOC stock occurred in land conversion from tree-covered areas to croplands, and from grasslands to artificial surfaces with SOC stock change of 606,043 ton, and 487,576 ton respectively.

Table 4.1: National estimates of the change in soil organic carbon stock due to land cover conversion, between 2015 & 2019 (tonnes per ha)

Land Conversion		Soil organic carbon (SOC) stock change					
From	To	Net area	Initial SOC	Final SOC	Initial SOC	Final SOC	SOC stock
		change (km ²)	stock (t/ha)	stock (t/ha)	stock total (t)	stock total (t)	change (t)
Tree-covered areas	Croplands	794	17.9	10.3	1,422,459	816,416	-606,043
Tree-covered areas	Grasslands	641	17.1	15.7	1,096,041	1,006,423	-89,618
Tree-covered areas	Other lands	28	15.8	1.6	44,157	4,416	-39,741
Tree-covered areas	Artificial surfaces	298	18.2	1.8	541,751	54,175	-487,576
Grasslands	Croplands	373	17.6	9.9	657,226	370,970	-286,256
Grasslands	Tree-covered areas	1,139	15.8	15.6	1,801,945	1,775,250	-26,695
Grasslands	Other lands	406	17.4	1.7	707,564	70,756	-636,808
Grasslands	Artificial surfaces	402	15.5	1.6	623,411	62,341	-561,070
Croplands	Tree-covered areas	551	16.9	28.6	932,060	1,577,762	645,702
Croplands	Grasslands	189	17	27.1	321,856	512,919	191,063
Croplands	Artificial surfaces	28	22.1	2.2	61,921	6,192	-55,729
Wetlands	Croplands	14	21.1	14.4	29,554	20,210	-9,344
Wetlands	Grasslands	41	18.6	17.5	76,106	71,713	-4,393
Wetlands	Other lands	100	16	1.6	159,530	15,953	-143,577
Artificial surfaces	Grasslands	14	19.4	35.2	27,192	49,323	22,131
Other lands	Tree-covered areas	14	17.6	34.4	24,602	48,108	23,506
Other lands	Grasslands	296	28.3	36.3	837,811	1,075,104	237,293

Source: Department of Forestry & Range Resources

Table 4.2 shows that, between 2019 and 2023 the highest soil organic carbon stock increases occurred in land cover conversion from croplands to tree-covered areas with SOC stock change of 38,439 ton. Land cover changes of Grasslands to wetlands and croplands to artificial surfaces resulted in no change in the SOC stock. In terms of the net area change, the land cover conversion from croplands to tree-covered areas gained 57.2 Km², conversion from grasslands to wetlands and croplands to artificial surfaces each gained 13.9 Km².

Loss of soil organic carbon was highest in the land conversion from tree-covered areas to artificial surfaces with SOC stock change of 114.921 Km² followed by the conversion of tree-covered areas to croplands and croplands to tree-covered areas, at 43,646 Km² and 38,439 Km² respectively.

The greatest loss of SOC in tons per hectare (t/ha) is that of the conversion of wetlands to other lands, where the conversion dropped the initial stock from 25.4 t/ha to the final stock of 2.5 t/ha.

Table 4.2: National estimates of the change in soil organic carbon stock due to land cover conversion, between 2019 & 2023 (tonnes per ha)

Land Conversion		Soil organic carbon (SOC) stock change					
From	To	Net area	Initial SOC	Final SOC	Initial SOC	Final SOC	SOC stock
		change (km ²)	Initial SOC	stock (t/ha)	stock total (t)	stock total (t)	change (t)
Tree-covered areas	Croplands	stock (t/ha)	Final SOC	11.2	121,043	77,397	-43,646
Tree-covered areas	Grasslands	stock (t/ha)	Initial SOC	16.6	71,479	70,096	-1,383
Tree-covered areas	Artificial surfaces	stock total (t)	Final SOC	7.7	213,785	98,864	-114,921
Grasslands	Croplands	stock total (t)	SOC stock	28.4	37,554	37,273	-281
Grasslands	Tree-covered areas	change (t)	14.0	14.0	19,490	19,402	-88
Grasslands	Wetlands	13.90	22.5	22.5	31,276	31,276	0
Croplands	Tree-covered areas	57.24	18.3	25.1	105,006	143,445	38,439
Croplands	Grasslands	13.90	11.7	11.5	16,302	15,987	-315
Croplands	Artificial surfaces	13.90	15.9	15.9	22,081	22,081	0
Wetlands	Grasslands	13.11	17.1	16.8	22,413	21,979	-434
Wetlands	Other lands	13.90	25.4	2.5	35,244	3,524	-31,720
Other lands	Grasslands	13.90	15.8	15.5	21,976	21,551	-425

Source: Department of Forestry & Range Resources

5.0. DEGRADED LAND

“Land degradation is defined as a negative trend in land condition, caused by direct or indirect human-induced processes including anthropogenic climate change, expressed as long-term reduction or loss of at least one of the following: biological productivity, ecological integrity, or value to humans.” (IPCC, 2024)

This chapter provides information on land degradation in Botswana during the period 2016 to 2019. **Table 5.1** and **Figure 5.1** show degraded land area for the period 2016 to 2019. Land area with degraded land cover reduced from 210,267 Km² (36.3%) in 2016 to 99,215 Km² (17.1%) in 2019. This is a reduction of 111,052 Km² (52.8%).

Land area with non-degraded land cover remained at 14 Km² and land area with improved land cover reduced from 84,808 Km² (14.6%) in 2016 to 2,805 Km² (0.5%) in 2019. Land area with stable land cover increased from 284,513 Km² (49.1%) in 2016 to 477,568 (82.4%) Km² in 2019. Data on land area with no land cover is not available.

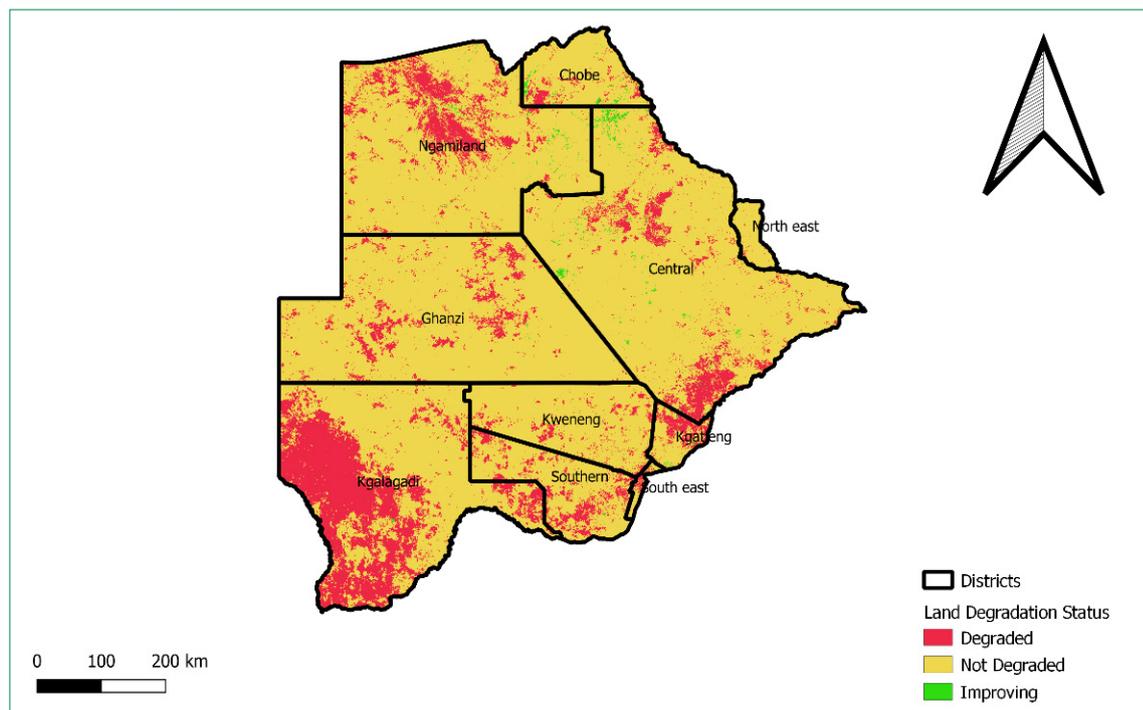
Table 5.1: Land area (Km²) 2016 – 2019

Land area	2016	2019
Land area with degraded land cover ³ (Area km ²)	210,267	99,215
Land area with non-degraded land cover ⁴ (Area km ²)	14	14
Land area with improved land cover ⁵ (Area km ²)	84,808	2,805
Land area with stable land cover ⁶ (Area km ²)	284,513	477,568
Land area with no land cover ⁷ data (Area km ²)	-	-
Total	579,602	579,602

(-): Data not available

Source: Department of Forestry & Range Resources

Figure 5.1: Botswana Land Degradation Map, 2016-2019



³**Degraded land cover:** a land area where the natural vegetation and soil conditions have been significantly diminished due to human activities.

⁴**Non-degraded land cover:** a land area that maintains its natural biological productivity and ecological integrity

⁵**Improved land cover:** a more detailed and accurate representation of the physical characteristics of the Earth's surface

⁶**Stable land cover:** a land surface area where the physical characteristics, like vegetation type, soil exposure, or water bodies, remain relatively unchanged over a significant period of time.

⁷**No land cover:** an area where there is no physical surface cover on the ground.

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