

BOTSWANA MINERAL ACCOUNTS REPORT 2017/18.



Republic of Botswana



**Botswana
Geoscience
Institute**
Excellence in Geoscience



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Executive Summary

- This Mineral Accounts report, provides updates on Diamonds, Gold, Coal, and Soda Ash & Salt mining; the major mined minerals in Botswana for 2017/18. Just like the previous reports of Botswana Mineral accounts, this report adopts a similar format with updates on the country's remaining resources/reserves, production trends; mineral exports statistics, depletion, mineral rent and economic value of the major mineral commodities.
- Diamonds continue to dominate the mining sector and the economy of Botswana; contributing the largest majority of the export earnings and mineral revenues.
- As at the 2017/18 update, Botswana Diamond mines stood at an estimated 37 years of remaining life of mining.
- From the available datasets, Gold mining reserves have been declining since production started in 2005. This is coupled by an observed decline in production over the years.
- In most recent years, Gold production only rose slightly in 2016 and 2017 measuring 754.79 kg and 920.22 kg respectively. This is still far from an all-time production high of 3234.96 kg observed in 2005 in Botswana Gold production history, from the only Mupane Gold Mining Company in the country.
- Coal is still being mined by one mining company- Morupule Coal Mine which produces an average 1.8 million tonnes of Coal annually. The company has large resources of 77 million tonnes in the reserve category (Morupule Coal Mine estimates, 2018).
- In total Botswana has 14.5 billion tonnes of Coal on the measured and indicated resource (Botswana Geoscience report, unpublished on going compilation).
- The Botswana Coal production depends largely on the Botswana Power Corporation (BPC) that uses the Coal for electricity production. It is also equally true that despite this minimal supply risk and large Coal reserves, the mining of the commodity has not generated enough rents for the country in the past years until this reporting period.
- Soda Ash mining is currently the second best performing after Diamond mining which attributes more than 95% mineral economic value whilst Soda Ash contributes about 2-3%.
- With the current production rates, the life of Soda Ash mining based on the company reports stands at 61 years.
- Salt is mined in large quantities. It however has limited market hence occurs as a by-product of Soda Ash mining.
- In 2017, the value of mineral exports reduced from the previous year by 18% from 74,557.1 millions of Pula to 56,513.9 million of Pula. This can be attributed to the previously Copper-Nickel mining company that got liquidated in 2017.
- The (BCL) Limited company produced about 30,279 tonnes in 2016 while in 2017 only the Leboam Holdings which started Copper matte production in 2017 and produced about 1,239 tonnes.
- Two Diamond mines namely; Gem Diamonds and Lerala mines also went onto care and maintenance in 2017, which probably contributed, to a reduction in mineral export value.
- Coal and Gold mining are not generating enough mineral rents compared to diamond, Soda Ash and Salt mining in Botswana.

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Abbreviations and Acronyms

BIDPA	- Botswana Institute For Development Policy Analysis
BCL	- (BCL) Limited
NRA	- Natural Resource Accounts
NCA	- Natural Capital Accounts
NPV	- Net present Value
LOM	- Life of Mine
Mcts	- Million Carats
Mtpa	- million tonnes per annum
OECD	-Organisation For Economic Co-Operation And Development
TMR	- Tailings Mineral Resource
DEA	- Department of Environmental Affairs
DoM	- Department of Mines
GDP	- Gross Domestic Product
Masl	- Meters above Sea Level
MFED	- Ministry of Finance and Economic Development
MCM	- Morupule Coal Mine
RoM	- Rate of Mine
Kcts	- Kilocarats
WAVES	- Wealth Accounting and Valuation of the Ecosystem
BCL	- Bammangwato Concession Limited
Syma	- Five year moving average
SB	- Statistics Botswana
SEEA	- System of Environmental and Economic Accounts
SME	- Small Medium Enterprise

Acknowledgements

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1.0

Introduction

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Chapter One: Introduction

This Report is the 2017/18 annual update of Botswana Mineral Accounts. The main objective of the accounts is to provide information on Botswana's mined resources focusing on the economic value of the measured remaining resources, production trends, mineral exports statistics, depletion, and mineral rent estimations. Emphasis is placed on the current major mined commodities that include Diamonds, Coal, Soda Ash and Salt as a by-product, and Gold.

Review of the current exploration and resource development potential in Botswana are also highlighted although not the main content of the update. Mineral accounts compilation, part of Wealth Accounts, play an important role as an input into the country's National Balance Sheet and is a comprehensive estimate of the country's wealth beyond the measure of Gross Domestic Product (GDP).

The national GDP measure provides an income status about various economic activities' contribution to the growth of the economy whereas the Wealth Accounts provide insights on whether the income is sustainable.

The mineral Wealth Accounts also form part of the Natural Resource Accounts (NRA), also known as Natural Capital Accounts (NCA), that include others like energy and water accounts.

All these are aimed at ensuring that the values of natural resources and ecosystem services serve a role in informing development planning and national economic accounts. Most critically, the accounts deduce policy brief messages, which could be used to inform policy.

During the mineral accounts compilation, it was observed that Botswana's accelerated economic growth over the years and development of the country was due to the mineral revenues generated by mining, particularly diamond sales and its downstream industries (Sefemo & Segobai, 2019).

This larger share/contribution of the mining sector in terms of value added from various economic activities makes Mineral Accounts compilation an important task in NCA to reflect the wealth embodied, the depletion of the mineral rents, and residual economic values of the remaining resources.

Mineral accounts compilation; part of Wealth Accounts, play an important role as an input into the country's National Balance Sheet and is a comprehensive estimate of the country's wealth beyond the measure of Gross Domestic Product (GDP).

The wealth embodied in minerals provide the transparent and effective mechanisms for mineral revenue management as an essential tool for ensuring sustainable development of the country (OECD, 2011).

Mineral policy review and economic diversification also rely on a quantified rationale of natural capital stock flows. Therefore, mineral accounts are critical to development planning to know if we are living off our natural capital and if the revenues generated are sustainably reinvested.

Botswana's mineral accounts from inception, focused on the major mined commodities. The accounts have captured Diamonds and base metal mining valuations from 1979 to date.

The base metal mining valuation ceased in 2016 when the previously only Copper-Nickel mining company got liquidated and Botswana is awaiting mining from Copper/Silver mining from other developing companies in future years.

There has only been some production datasets from the Department of Mines about Leboam Copper producing company however, there is limited information on the company to complete its economic value and rent estimations.

Soda Ash mining is valued from 1991 to date and Gold being valued from 2005 when they started mining to date. The report provides updates on all these commodities with emphasis placed on the 2016, 2017 and 2018 updates.

The first chapter of the report provide updates on mining and the economy of Botswana that include the current state of mining industry in Botswana economy, mining contribution to GDP, and the review of contribution of mining to employment in the country. Subsequent chapters updates on the physical and economic status of Botswana Mineral Accounts.



The Current Status of Botswana's Mining Industry

The Botswana mining industry continues to be dominated by the diamond mining sector and its downstream cutting and polishing industries. Botswana Ash (BOTASH) (Pty) (Ltd) is the only mine producing Salt and Soda Ash in Botswana since 1991.

Soda Ash generates almost 85% of the company's sales while Salt although produced in large quantities is affected by limited market in and outside Botswana. In 2019, the company reported diversification plans of recommissioning the liquid carbon dioxide plant that is used for refrigeration and cooling processes, manufacturing of bicarbonate of soda (ingredient used in baking) and potash to be used as a fertilizer (Sunday Standard, 2018).

Gold resources have been depleting since production began in 2005. Coal on the other hand has large untapped resources, which have recently been gaining attention for development. Botswana is most likely to leverage on these abundant existing Coal resources that could be used for different purposes (e.g. increase Coal exports into the seaborne market, converting Coal to liquids and gas, producing nitrogen based fertilizers from Coal (Paya, 2011).

The Government of Botswana (GoB) has issued mining licences to a number of companies for Coal development e.g. Minergy Coal which reports about 390 Mt of Coal resource (Minergy Coal, 2018) and Jindal Coal Mining company.

Minergy Coal Company also reports that their Coal deposit is a shallow resource that will support a competitive cost structure situated close to the existing rail, road and water infrastructure with significant distance advantages over existing Coal suppliers to regional markets. Coal mining has always been from Morupule Coal Mine that is owned by the Botswana Government. Currently, the Coal mined is mainly used for electricity generation in the country.

Subsequent to the closure of BCL Mine; which was the only base metal mining company in recent years, Botswana has placed hope on the newly upcoming Copper/Silver mining companies in the Kalahari Copper Belt around the Ghanzi and Ngamiland districts.

The GoB has already issued Khoemacau Copper Mining company a mining license for a reported 3.6 million tonnes per annum (mtpa) underground mine production and is anticipated to start production in 2021 (Khoemacau Copper Mining, 2018). In the same region, other exploration companies have advanced to prefeasibility studies for their Copper/Silver deposits development e.g. Tshukudu Metals Exploration-Mining Company. In the past it was difficult to develop this area due to the thick Kalahari Desert sand cover that generally led to high exploration expenditure.

In 2017, it was also observed that, industrial minerals are being mined at an increasing rate due to the rise of the construction sector in Botswana and the government's efforts to promote citizen participation in small scale mining. The Government has mandated the Botswana Geoscience Institute to identify and quantify small scale mined industrial minerals that can lure and improve citizen participation in small-scale mining development.

This includes among many aggregates; limestone for cement making and manufactured sands. Growth in this sector may possibly create a positive business case to include low value industrial minerals into the accounts in future.

Mining in the Economy of Botswana

Botswana's mining sector was the largest contributor in terms of value added from various kinds of economic activities in many years until 2016. In 2017 and 2018 the mining sector was surpassed by Trade, Hotel and Restaurants (Figure 1). There was also an observed growth of other sectors like finance and business services during the same period.

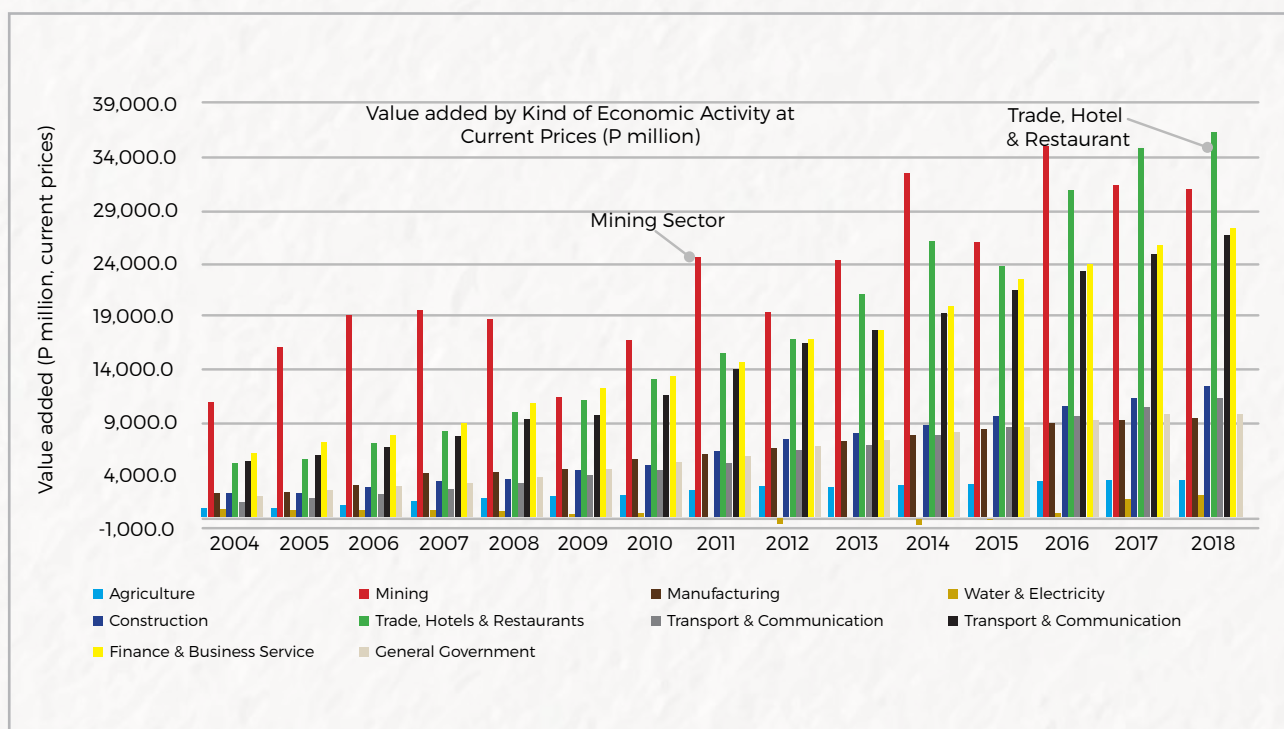


Figure 1: Value added by kind of Economic Activity at current prices (P million), Sourced from Statistics Botswana (Ministry of Finance and Economic Development, 2019).

The mining sector experienced some slumps several times due to weak demand of Diamonds leading to reduced Diamond production in 2012 and 2015 (Figure 1), problems faced by other mining related sectors such as Diamond cutting and polishing industry, and Copper-Nickel mining closure in 2016. However, Diamonds generally remain the largest contributor of Botswana's mining revenue.

Mining and Employment

The mining sector had been the largest source of employment after the general government over the years until 2015 (Figure 2). The situation changed when compensation of employees in the mining sector reduced by 18% from 2015 to 2016 due to the closure of BCL Mine which was the largest employer in the mining sector.

Subsequent to that, in both 2016 and 2017, the mining sector got surpassed by Trade, Hotels & Restaurants and Banks, Insurance & Business Services in terms of compensation to employees (Figure 3). When the mining sector was experiencing this decline during both these periods (2016 & 2017), other sectors like Construction, Social, Personal Services, and Agriculture were showing some growth (Figure 3).

National Development Plan 11 (towards 2023) emphasises promotion of growth and building

economic resilience through economic diversification and employment creation. The private sector is intended to be the main vehicle through which these objectives would be achieved thus reducing the role of government expenditure as the main source of growth (Botswana Ministry of Finance and Economic Development, 2017).

The above mentioned, demonstrates that the government diversification efforts are possibly yielding fruit. Nonetheless, mining in Botswana remains one of the sectors that are of economic importance to the country's development. The country holds reasonable mineral reserves that could still be developed. Expansions are recently being made by the diamond sector especially Debswana mines.

There is an added benefit of expanding the downstream in the diamond sector. There are also several recently discovered deposits with active exploration still going on. The mining sector growth has potential to stimulate the private sector and create more employment opportunities for Botswana.

The mining industry also has a greater impact when it develops inclusive business models that integrate local small medium enterprises (SMEs) into their value chain, fostering development of local entrepreneurs, (Wise & Shtylla, 2007).

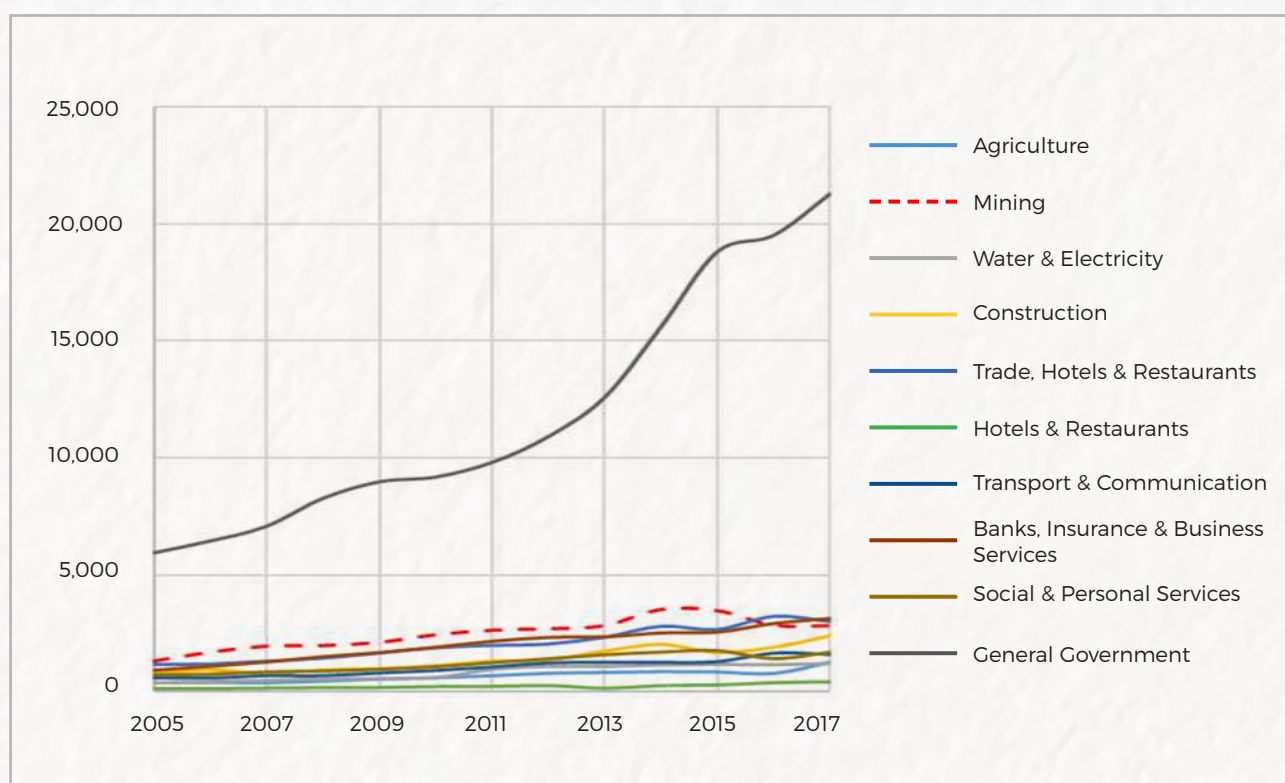


Figure 2: Compensation of Employees by Industry at Current Prices - Millions of pula, Statistics Botswana, (2005 - 2017) (Ministry of Finance and Economic Development, 2019).

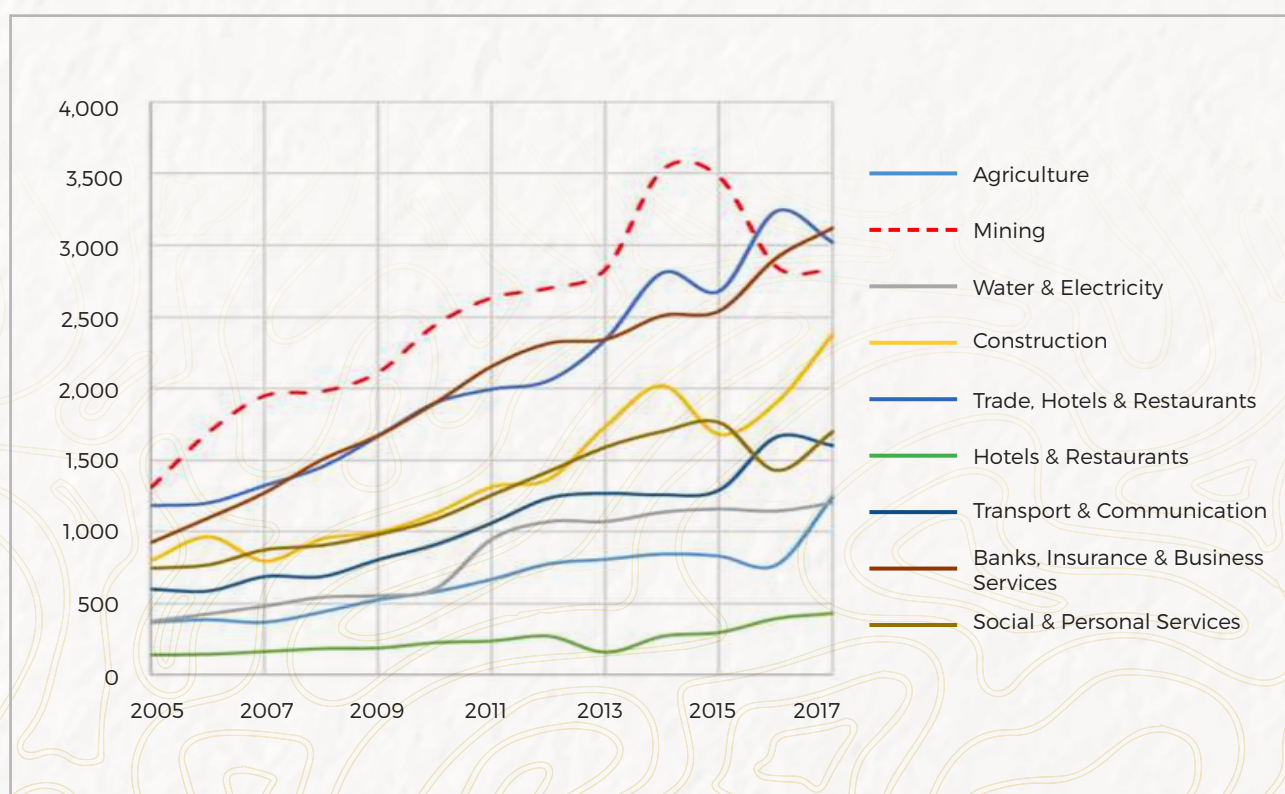
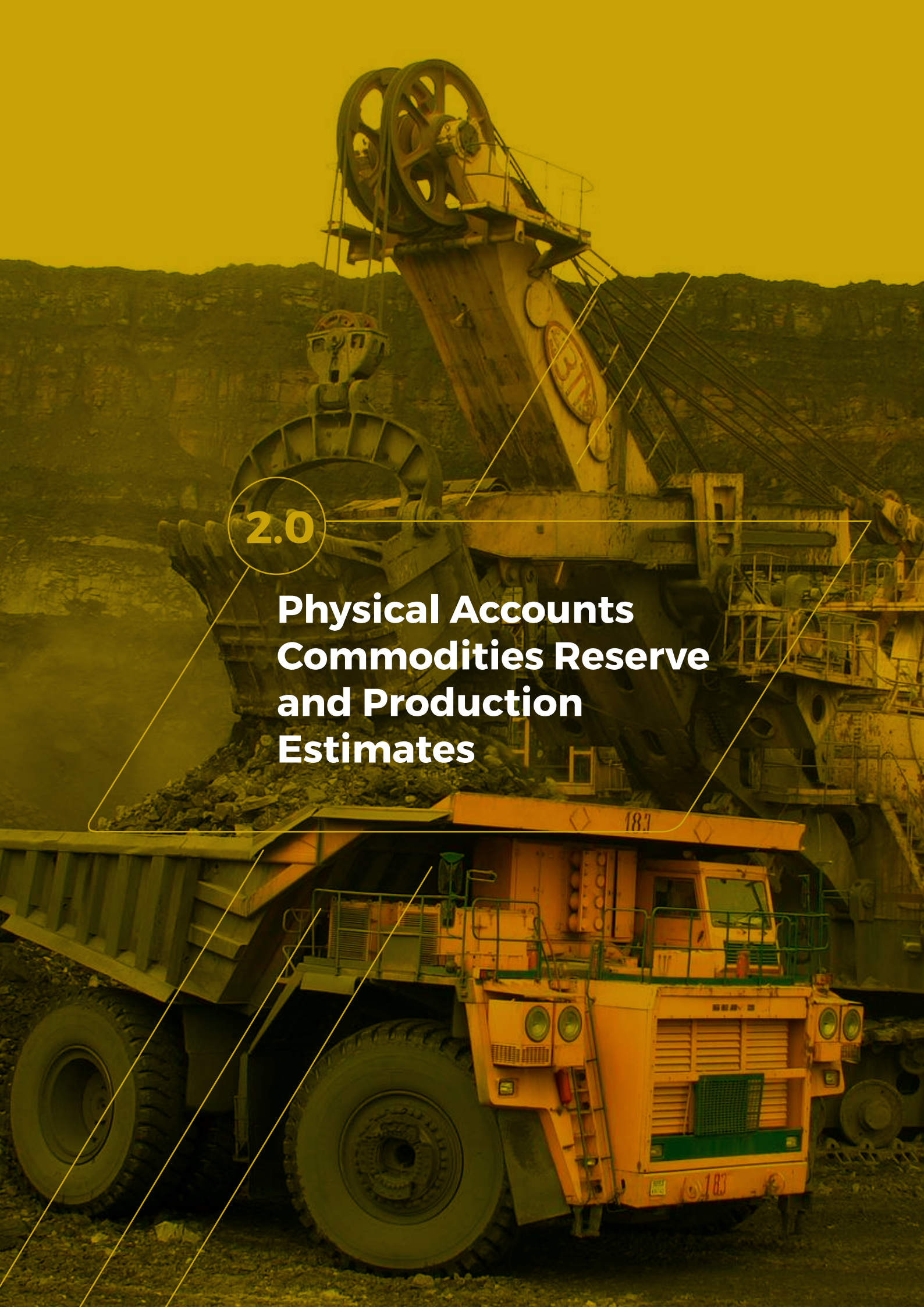


Figure 3: Compensation of Employees by Industry excluding general government at Current Prices - Millions of Pula (2005 -2017). (Ministry of Finance and Economic Development, 2019)

The 2018 statistics on compensation to employees from various sectors is not yet released by Statistics Botswana.



2.0

Physical Accounts Commodities Reserve and Production Estimates

Chapter Two: Physical Accounts Commodities Reserve and Production Estimates

Different mining companies use different reporting standards in justification of their resource and reserve classifications. As explained in previous reports, a mineral resource is the existence of mineralisation in the quantity and grade or quality that has reasonable prospects for economic extraction.

The location, quantity, grade, geological characteristics, and continuity of a Mineral Resource are known, estimated, or interpreted from specific geological evidence. Mineral resources are classified into the Inferred, Indicated, and Measured categories. Inferred Mineral Resources has the lower confidence level that are insufficient to allow the application of technical and economic parameters or to enable an evaluation for economic viability, hence are not usually included for economic valuations with exception for Diamonds in this report.

A mineral reserve on the other hand is the economically mineable part of the measured or indicated mineral resource demonstrated to be feasible by the applied modification factors that include mineability, metallurgical test results, dilution factors, allowance for losses, economic, social factors which at the time of reporting justify economic extraction. The mineral reserves are classified in order of increasing confidence from probable to proven reserves.

A number of reporting standards exists to justify the mineral resource and reserve classifications and reporting by competent persons. These include the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves 2012 edition (the JORC Code), the South African Code for Reporting of Exploration Results, Mineral Resources and Mineral Reserves (SAMREC Code) and the Canadian Institute of Mining and Metallurgy Definition Standards on Mineral Resources and Mineral Reserves Canadian Institute of Mining (CIM).

In this 2017/18 report, information on the resource/reserve of all the major mined reported commodities was obtained from company

reports, publicly listed companies information, on the internet, and the Department of Mines (DOM) who are the mineral development and mining regulators in Botswana. The DOM also critically assist the mineral accounts compilation by providing all mined commodities annual production figures. Data availability for some companies was problematic due to late reporting to the DOM by mining companies especially on reserve estimates. Future work on the next mineral accounts update will include engaging with mining companies directly which is also intended to improve the data quality and consistency. The following is a report on the commodities reserves and production trends by their category.

Diamond Reserve updates

The Diamond reserve update is from Debswana operations (Jwaneng, Orapa, Letlhakane and Damtshaa) – a joint venture between DeBeers and the Government of Botswana and the three other diamond operating mines in Botswana namely; Karowe (run by Lucara Diamond Corp.), Chagoo (run by Gem Diamonds PLC) and Lerala Diamond Mine. The latter two were placed on care and maintenance in 2017 (Botswana Department of Mines, 2018).

Debswana Mines Reserve updates

Debswana Mining companies Diamond reserve and resource estimates are reported in accordance with The South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves (The SAMREC Code, 2016 Edition). Diamond Resources are reported as additional to Diamond Reserves. Two resource types are processed, Kimberlite (mined from in situ material) and Tailings Mineral Resource (TMR), (Anglo American, Ore Reserves and Mineral Resources, 2018). The reserve estimates for Debswana's four operating mines (Orapa, Letlhakane, Damtshaa (OLDM) & Jwaneng) in Botswana are reported below (Table 1 & 2) from 2016 to 2018.

Table 1: Debswana 2016 Reserve Updates

mcts	Reserves	Resources (includes reserves)			
Debswana					
Kimberlite	Measured	Indicated	Inferred	Total	Change
Damtshaa		1.1	1.9	3	-0.1
Jwaneng		106.1	63.5	169.6	30.6
Letlhakane		7	5.2	12.2	5.6
Orapa		299.3	58.6	357.9	59.1
Total	0	413.5	129.2	542.7	95.2
TMR	Probable	Indicated	Inferred	Total	Change
Damtshaa				0	0
Jwaneng			15.9	15.9	-0.6
Letlhakane	8.5		13.1	13.1	0
Orapa				0	0
Total	8.5	0	29	29	-0.6
TOTAL	Probable	Indicated	Inferred	Total	Change
Damtshaa	0	1.1	1.9	3	-0.1
Jwaneng	0	106.1	79.4	185.5	30
Letlhakane	8.5	7	18.3	25.3	5.6
Orapa	0	299.3	58.6	357.9	59.1
Total	8.5	299.3	158.2	571.7	94.6

Source: Anglo American, Ore Reserves and Mineral Resources , 2016.

Table 2: Debswana 2017 Reserve Updates

mcts	Reserves	Resources (includes reserves)			
Debswana	Mct				
Kimberlite	Probable	Indicated	Inferred	Total	Change
Damtshaa	4.9	0.9	1.9	7.7	0
Jwaneng	174.8	62.3	0	237.1	-7.8
Letlhakane		7.1	0	7.1	0.1
Orapa	140.8	297	0	437.8	-6.4
Total	320.5	367.3	1.9	689.7	-14.1
TMR	Probable	Indicated	Inferred	Total	Change

Table 2 continued: Debswana 2017 Reserve Updates

Damtshaa				0	0
Jwaneng			15.4	15.4	15.4
Letlhakane	8.4	1.4	14.1	23.9	8.4
Orapa		130.3	0	130.3	130.3
Total	0	131.7	29.5	169.6	154.1
TOTAL	Probable	Indicated	Inferred	Total	Change
Damtshaa	4.9	0.9	1.9	7.7	0
Jwaneng	174.8	62.3	15.4	252.5	7.6

Source: (Anglo American, Ore Reserves and Mineral resources , 2017)

Table 3: 2018 Debswana Reserve Updates

mcts	Reserves	Resources (includes reserves)			
Debswana					
Kimberlite	Probable	Indicated	Inferred	Total	Change
Damtshaa	4.7	0.9	2	7.6	-0.1
Jwaneng	166.6	57.8	0	224.4	-12.7
Letlhakane		7.1	0	7.1	0
Orapa	131.2	297	0	428.2	-9.6
Total		362.8	2	667.3	-22.4
TMR	Probable	Indicated	Inferred	Total	Change
Damtshaa				0	0
Jwaneng			14.7	14.7	-0.7
Letlhakane	7.6	1.3	14.1	23	-0.9
Orapa		129.8	0	129.8	-0.5
Total		131.1	28.8	167.5	-2.1
TOTAL	Probable	Indicated	Inferred	Total	Change
Damtshaa	4.7	0.9	2	7.6	-0.1
Jwaneng	166.6	57.8	14.7	239.1	-13.4
Letlhakane	7.6	8.4	14.1	30.1	-0.9
Orapa	131.2	426.8	0	558	-10.1
Total	310.1	493.9	30.8	834.8	-24.5

Source : (Anglo American, Ore Reserves and Mineral Resources, 2018)

Debswana Diamond Reserve sizes remains at 834.1 million carats as at 2018 reporting.

Karowe Mine (Lucara Diamond Corporation) Reserve Updates:

Karowe (Lucara) Mine is an existing open pit Diamond mine, extracting and processing ore from the AK6 Kimberlite located in the Central District of Botswana in the Orapa Kimberlite field. The Company Mineral Resource update is based on the Canadian Institute of Mining Definition Standards for Mineral Resources and Reserves as incorporated by National Instrument 43-101 standards of disclosure for mineral projects (Lucara Diamond, n.d.) According to the company, the mineral reserve (Table 4) that are deemed economically extractable are derived from the indicated Mineral resources (Table 5) and have been depleted by mining by May 2018.

Table 4: Mineral Reserve Statement for Karowe Mine, (Lucara Diamond Corp., 2018)

Lobe	Reserve Category	Recoverable Carats(Mcts)
North	Probable	0.14
Centre	Probable	0.49
South	Probable	1.97
In situ Reserve (OP Material)		2.60
Working Stockpiles	Probable	0.21
LOM Stockpiles	Probable	0.16
Total Reserve		2.96

OP= Open pit, **LOM=** Life of Mine, **Mcts** = million carats

Lobe	Resource Category	Carats (Mcts)
North	Indicated	0.20
Centre	Indicated	0.63
South	Indicated	6.78
Total		7.62
LOM Stockpiles	Indicated	0.09
Working Stockpiles	Indicated	0.20
Total Stockpile	Indicated	0.29
Total Indicated		7.90
South lobe	Inferred	1.17

Ghagoo (run by Gem Diamonds PLC) Reserve updates

Gem Diamonds was placed on care and maintenance from March 2017 due to the suppressed Diamond market for the size and quality of goods produced (Gem Diamonds, 2017). The company also reported superficial damages in the mine especially on surface infrastructure due to the 6.5 magnitude earthquake that led to large influx of water into the underground workings. There is limited information on the remaining resource and reserve for the company in the company reports.

Lerala Diamond Mine Reserve updates

Lerala Mine ore reserve and resource updates have been sourced from Kimberly Diamonds Limited (KDL) report of 2015, which acquired Lerala Diamond Mine in February 2014 through the company's acquisition of Mantle Diamonds. Their Diamond mining update is from the five-kimberlite pipes designated K2 to K6. The companies' reserve and resource size stood at 3,253 kilocarats (kcts) of the KDL resource with 454 kcts in the inferred and 2,799 kcts in the indicated resource.

Diamonds Production Statistics (2016- 2018)

Majority of Diamond production comes from Debswana operations (Figure 4 & 5) that amounts to about 98% of Diamond production in Botswana. In 2018, Diamond production was from Debswana (24,013 mcts) and Karowe (364,529 cts) mines only while the other two were on care and maintenance since 2017.

The life of Diamond mines on a five year moving average are estimated to have about 37 years of mining remaining, as at 2018 reporting. It is important to note that these estimates are based on the estimated reserve and production trends which could increase or decrease based on the mining company development plans and ultimately change the Diamond mine life in Botswana.

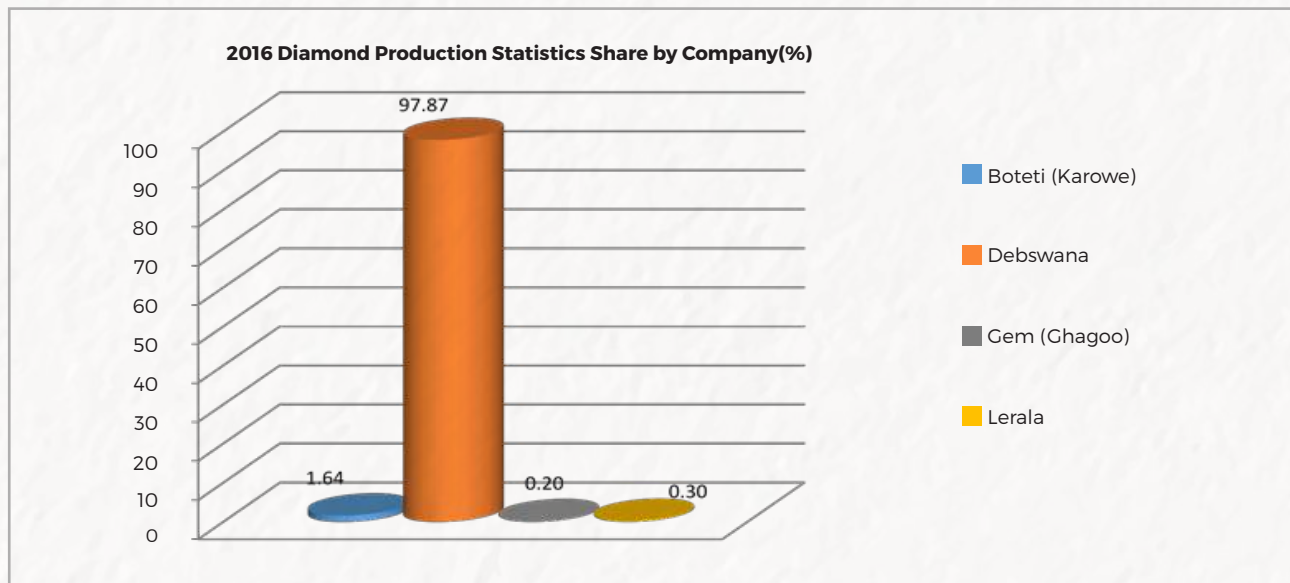


Figure 4: 2016 Diamond production in Botswana by company percentage share (Botswana Department of Mines, 2018)

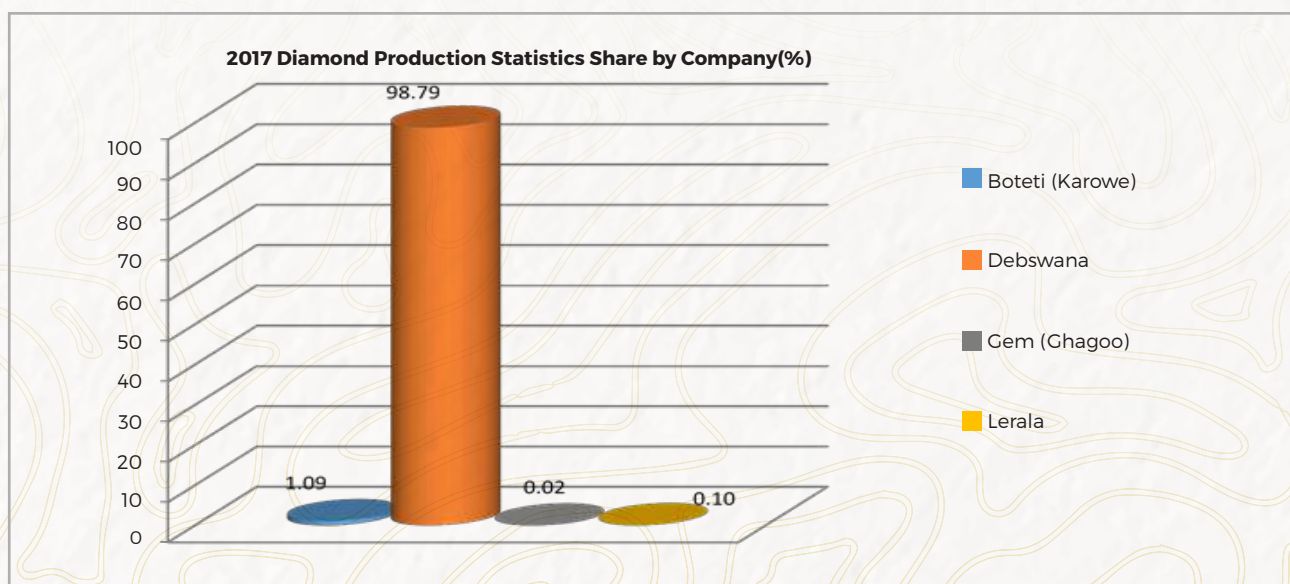


Figure 5: 2017 Diamond production in Botswana by company percentage share (Botswana Department of Mines, 2018).

Coal Reserve Estimates

Coal resources in Botswana are abundant and their estimates have long been a controversial issue (Chatupa, 1991), estimated 210 billion tonnes of Coal resources in the demonstrated (measured and indicated), hypothetical and speculative categories. As Coal gained attention as an economic viable commodity for development in Botswana, several researchers started trying to justify the quality and quantities that could be used for economic use. (Grynberg, 2012), reported 27 billion tonnes - with 11.6 billion tonnes in the demonstrated and 16 billion tonnes in the inferred category.

Botswana Geoscience Institute is currently involved in an ongoing exercise mandated by the Ministry of Mineral Resources, Green

Technology and Energy Security's (MMGE) to classify and quantify Botswana Coal resources. The Institute is still in the process of confirming both the quantity and quality and their progress to date in comparison to existing literature or reports is summarised in Table 5 below. The mine reserve estimations for Morupule Colliery Mines (MCMs); which is the only Coal mining company in Botswana in this period, are summarised in Table 6 (sourced from company reports).

The company reports 77 million tonnes (Table 5) of Coal yet to be mined. The resource category is estimated at a total of 14,631.75Mt of Botswana Coal resources calculated from the available datasets to date (Table 6). The inferred resources have not been considered in this estimation, however, they are estimated to be an additional 13,622 Mt of Coal resource.

Table 5: Morupule Coal Mine Reserve Estimates as at 2018 (Morupule Mine , 2018).

Reserve Block	Proven (Mt)	Probable (Mt)	Derived from Inferred resources (Mt)	RoM Scheduled production (Mt)
MCM1	40	30	7	77

Table 6 : Botswana's Coal resource Estimates from BGI's ongoing work (Mt), (Gwandu, 2019).

Coal Fields	BGI Report		
	Identified (Mt)		
	Demonstrated		Inferred
	Measured	Indicated	
Mmamabula East	2,589.90	24.20	33.90
Mmamabula East_2		243.00	2,119.00
Mmamabula West		892.00	1,541.00
Mmamabula South	2,421.27		
Mmamabula Central	549.50		
Dukwi		508.00	414.00
Foley/ Sese	651.00	1,714.00	2,653.00
Serule			
Tshimoyapula			1,175.00
Lechana		103.00	727.00
Morupule	492.13	591.25	2,001.17
Morupule South	2,026.08		
Mmamantswe	978.00	265.00	
Ncojane			
Bobonong			

Masama	12.71	73.21	304.01
Dutlwe/ Takatokwane		424.50	2,654.00
Sub-Total	9,720.59	4,838.16	13,622.08
Total		14,558.75	13,622.08
Grand total			28,180.83

Coal Production in Botswana

MCM was for many years the only Coal producing mine in Botswana until 2019. The company has a mining capacity of 2.8 million tonnes per annum (Botswana Energy Accounts, 2019). On average, the company produces about 1.8 million tonnes of Coal per annum. The production has been increasing gradually over the years (Figure 6). In 2018, the company had their largest ever production volume of 2.5 million tonnes. The company produces both thermal and washed Coal. Majority of the raw Coal is supplied to Botswana Power Corporation Morupule A thermal power station and used for electricity production. Washed Coal is consumed both locally and internationally.

The estimated remaining Morupule Coal Mine life based on the reported reserves and Syma production profile as at the 2018 reporting period is 38 years.

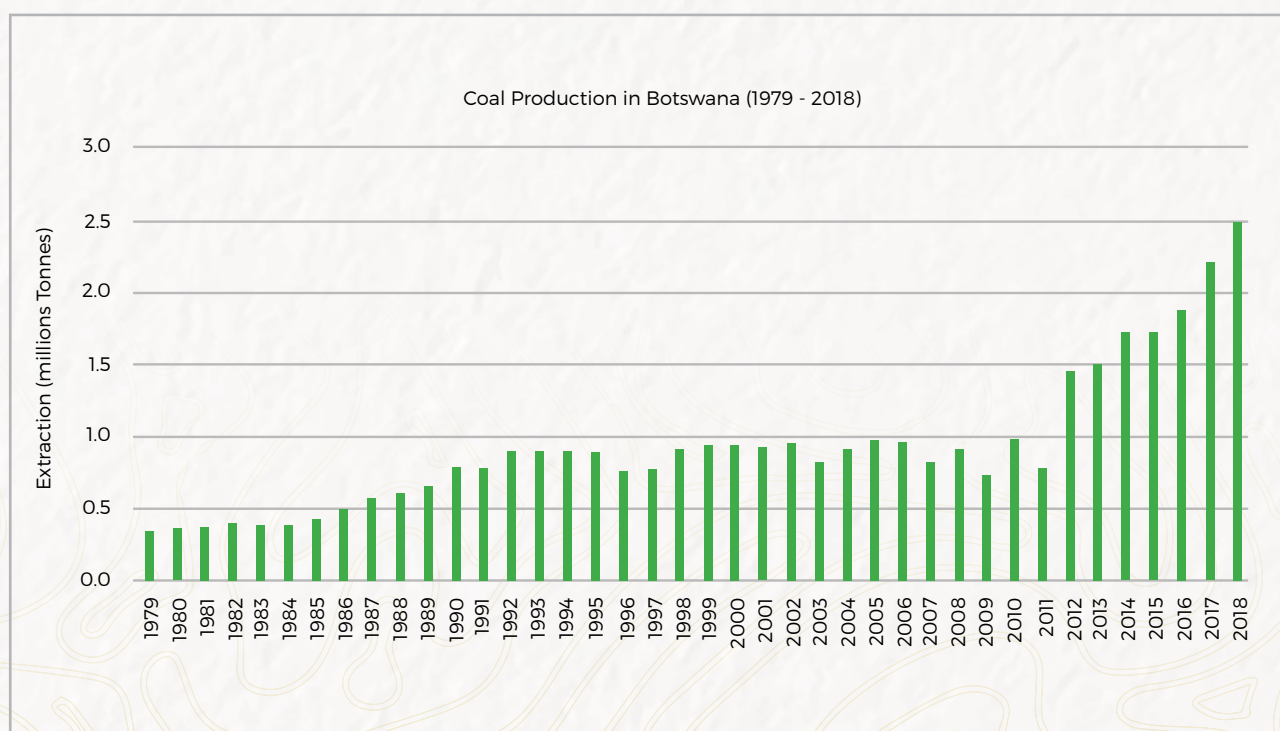


Figure 6: Coal Production in Botswana (1979-2018), (Botswana Department of Mines, 2018)

Soda Ash Reserve Estimates

The Soda Ash reserve estimate has been complex due to the nature of their existence from the brines. There also has been limited information from company reports. As at 2019, the company made an effort to provide estimates for their Soda Ash and Salt that is mined as a by-product. The Botswana Ash company (BOTASH Pty Ltd) has concluded a 1:5 ratio of Soda Ash to Salt in their brines. As at 2018, the company estimated the Soda Ash volume to be 16,566,711 tonnes. Generally, Soda Ash reserves have been declining over the years (figure 7). It is not yet clear if the resources are replenishing or not. Further work has to be done to understand the characteristics determining the Soda Ash volumes in the hydrogeological model.

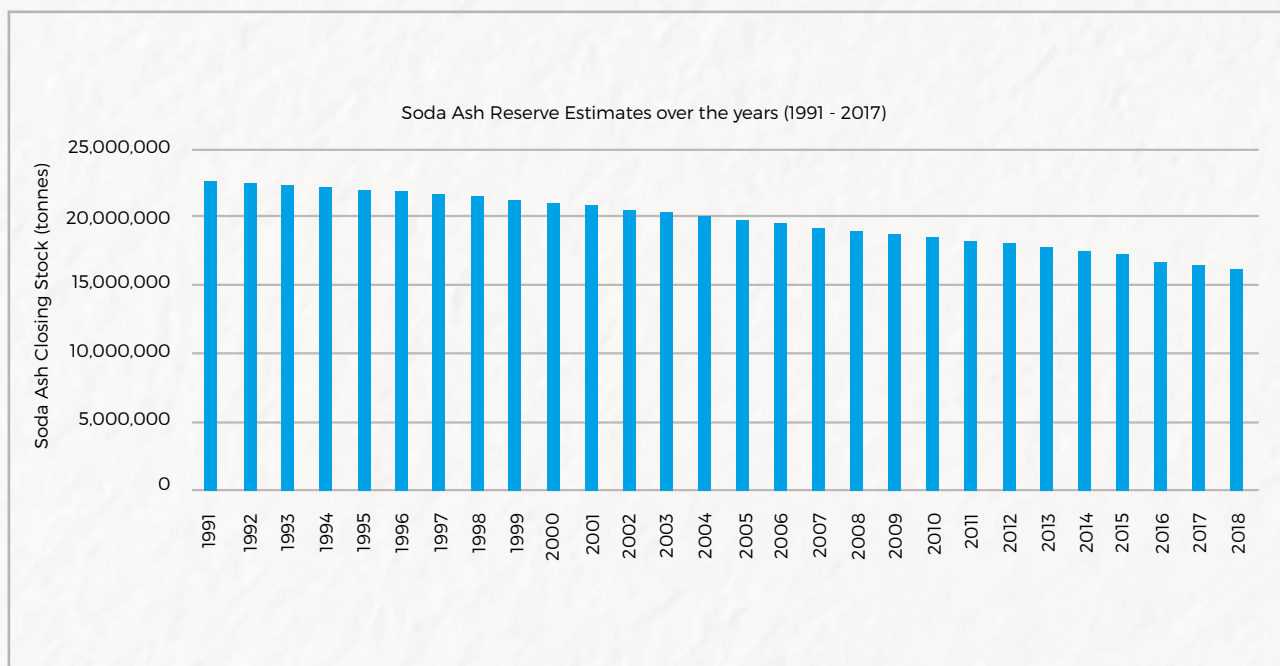


Figure 7 : Soda Ash Reserve Estimates (1991-2018), (Botswana Department of Mines, 2018).

Soda Ash Production Profile

On a 5 year moving average, Botswana Ash produces about 317,640 tonnes of Soda Ash annually. The estimated life of mine of the remaining reserves at the current rate of production is 61 years by 2018 updates (Figure 8).

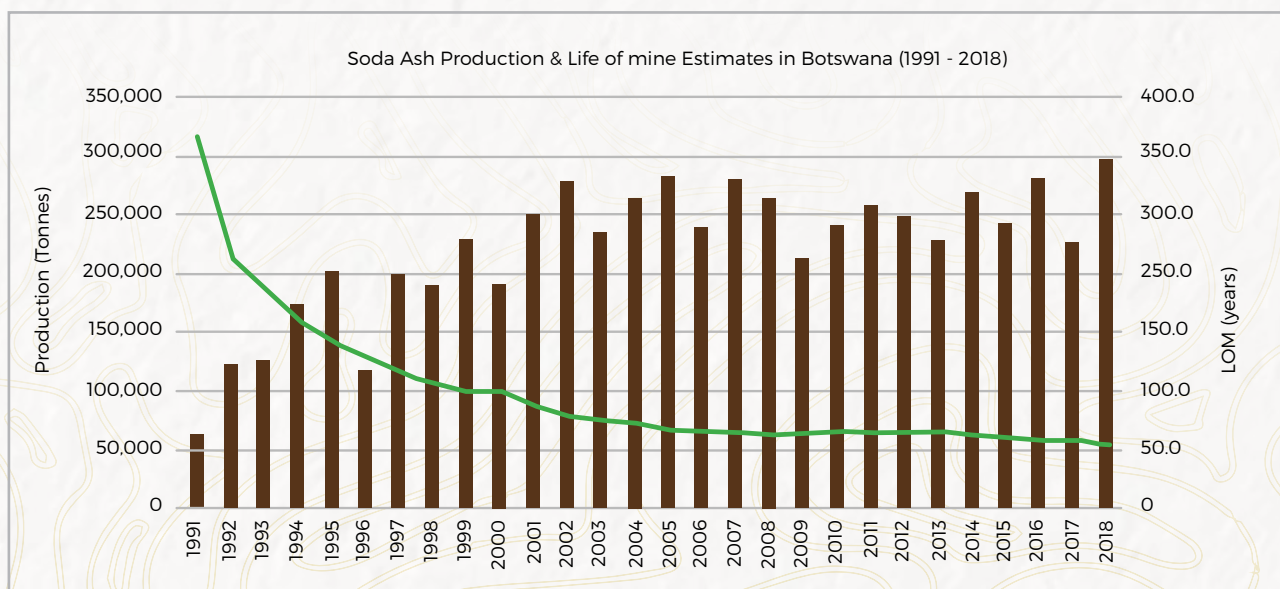


Figure 8: Soda Ash production in Botswana (1991-2018) (Botswana Department of Mines, 2018).

Gold Reserve Estimates in Botswana

Galane Gold Ltd, is the only Gold mining company in Botswana. It reports its mineral reserves and resources in accordance to the standards of the Canadian Institute of Mining, Metallurgy and Petroleum and NI 43-101. All the mineral reserves are reported exclusive of the mineral resources (Galane Gold Report, 2018). No new information has been available to augment the 2015 reserve estimates that were compiled by (Jefferis, Economic Accounting of Mineral Resources in Botswana, 2016) . As at 2018, the estimated reserve sizes is 6,218 kg.



Gold Production and its Life of Mine Estimates in Botswana (2005-2018)

Gold production has generally been declining over the years since production started in 2005 to date. In 2018, the total amount of Gold produced is 1,104.7kg (Figure 9). The estimated life of mine for Galane Gold based on previously reported reserve estimates and current production rates is 6 years.

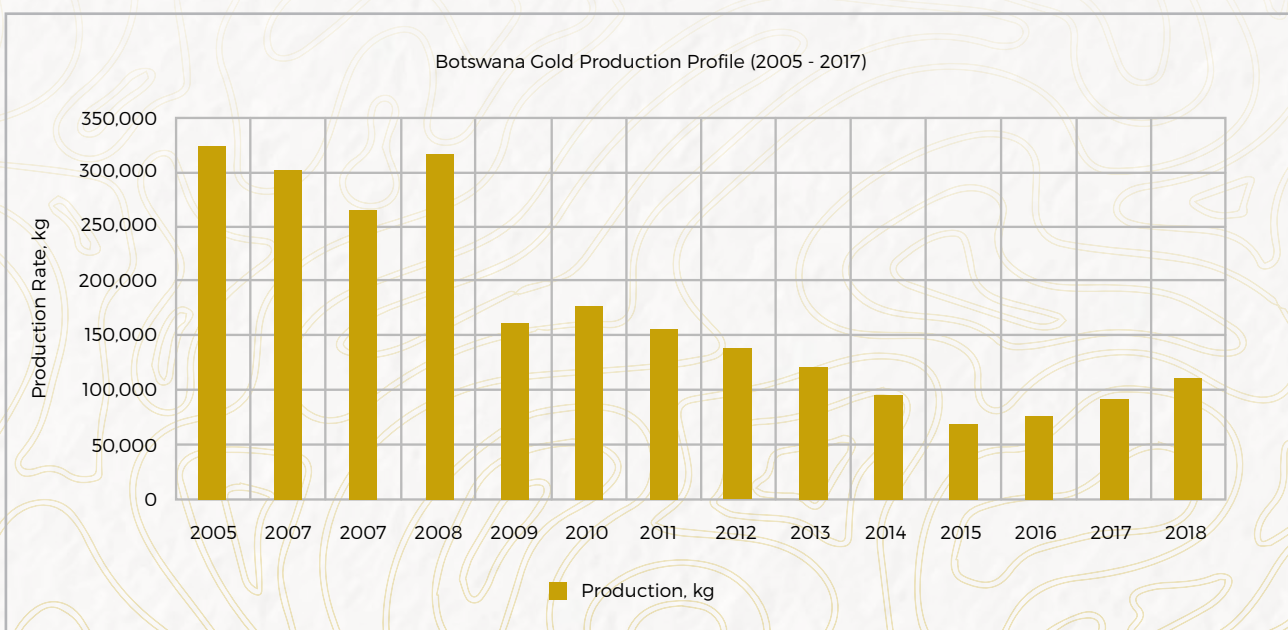


Figure 9 : Gold production and life of a mine estimates in Botswana (2005-2018) (Botswana Department of Mines, 2018).

The background features a dark, textured surface with a grid pattern. Overlaid on this are several financial charts, including a candlestick chart and a line graph, rendered in a golden-yellow color. The charts are positioned diagonally across the frame. A large, semi-transparent white box with a thin black border is centered on the page, containing the text. The number '3.0' is enclosed in a small circle to the left of the main title.

3.0

**Monetary Accounts Mineral
Rents, Exports, Value
Estimates and Depletion
Component of Rent**

Chapter Three: Monetary Accounts Mineral Rents, Exports, Value Estimates and Depletion Component of Rent

There is an analysis of whether the mined mineral commodities are mined economically and whether and government is getting enough rents from the depletion of non-renewable resources.

The economic valuation of minerals is focused on calculating the rent generated from minerals, the depletion component of rent and the estimated value of the remaining mineable mineral commodities. The three make the important component of economic valuations in mineral accounts, which are critical for mineral policy recommendations and decision making in mineral development.

There is an analysis of whether the mined mineral commodities are mined economically and whether and Government is getting enough rents from the depletion of non-renewable resources. (Jefferis, 2016) argues that unless there are specific policies to recover the resource rents from mineral producers, they will accrue as “windfall profits” or super-normal profits to mining companies.

In many countries including Botswana, the law states that the minerals belong to the state. Mining companies are given licenses entitling them to explore and mine for minerals, however the Government as the owner of the resource, is entitled to a return on it (Jefferis, Public Finance and Mineral Revenues in Botswana, 2016). Windfall profits mean that mining companies are getting profits that are over and above what would normally be required to reward a mining company for the capital employed in the mining operation and the risks incurred in mining investment and operation.

Mineral Rents

Rent is collected as the profit above normal return on an investment due to the scarcity of minerals. This is the economic return that comes from the sale of a mineral over and above the

cost of extracting the mineral, including the risk adjusted opportunity cost of capital. The African Natural Resources Centre, African Development Bank simple definition of mineral rents says “the income that comes from the scarcity of the mineral”. The United Nations System of Environmental Economic Accounting (SEEA) methodology, which is the adopted convention of rent computation, is applied in these report calculations.

The formula adopted is as follows:

Resource Rent = OP-RC-FC-PT

Where OP= Operating surplus, RC =Return on capital, FC= Consumption of fixed capital and PT = other taxes on production (adopted from Jefferis, 2016).

Contrary to many mineral led economies especially in the Sub-Saharan region, Botswana has been able to collect resource rents successfully (Jefferis, 2016). The rents are acquired from various taxes that include royalty payments, profit taxes and withholding tax on remitted dividends.

In this report, the resource rent of Botswana’s major mined commodities have been calculated up to 2017 (Figure 10). The capital stock data was available until 2017 and hence has been forecasted onto 2018 using the 5yma in order to estimate the 2018 resource rents for the mined commodities (Diamonds, Gold, Soda Ash & Salt, and Coal)

Copper-Nickel or base metal minerals have not been valued or included from 2016 until 2018 valuations, as there was no Copper-Nickel mining during these periods (Figure 10).

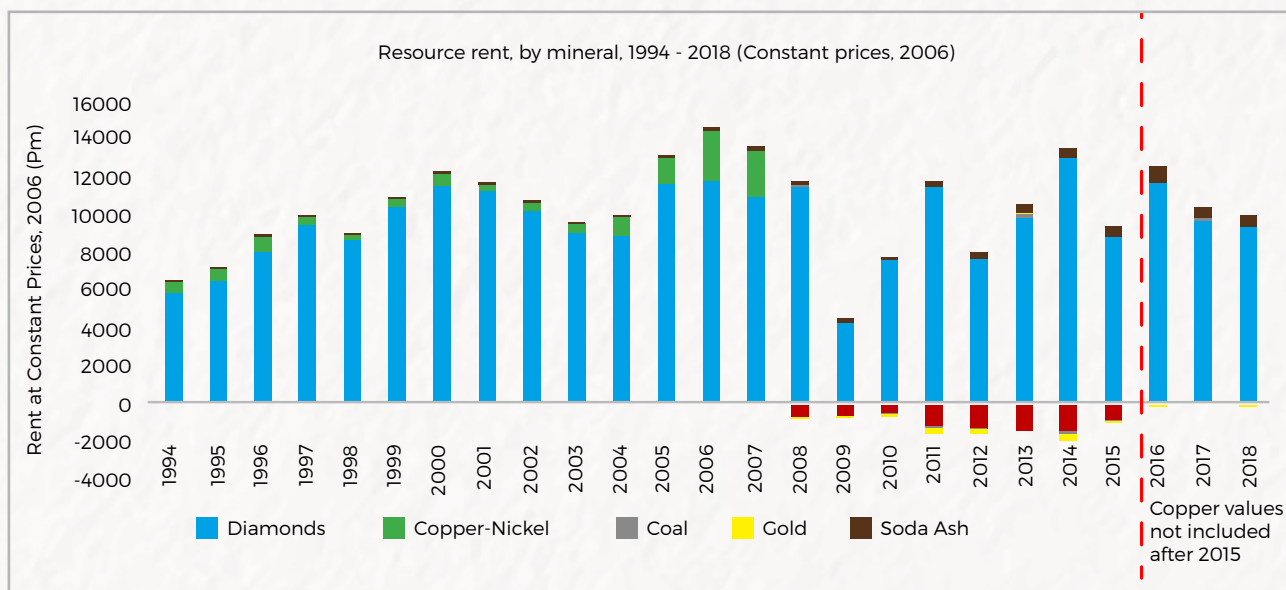


Figure 10: Botswana mined resource rent, 1994 -2018 (constant prices, 2006) calculated by the author.

Botswana's mineral rents largely come from Diamond mining (Figure 10). From 2016 to 2017, they attributed 96% of total mineral rents. The 2018 forecast estimated 97% as the share of diamond mineral rent contribution. Soda Ash is the other mineral commodity that has had positive mineral rent contribution at about 3% from 2016 until the 2018 forecast. Coal mineral rents are still under discussion as to the appropriate risk adjusted opportunity cost of capital/rate of return on capital.

For purposes of these reports, 10% has been used on the basis that, Coal mining in Botswana has less supply risk compared to other mineral commodities. It has a secure contract with the Botswana Power Corporation. Other commodities have been valued at 15% which is a globally acceptable return on invested capital by mining companies.

In 2017, Coal mineral rent that had been consistently negative since 2009 turned positive to 51.2 million of Pula at constant prices. Gold mining in Botswana, which started in 2005, used to be positive until 2013, when Mupane Galane, the only Gold mining company in Botswana experienced negative rent values from 2014 to 2018 on a five-year moving average.

The Botswana Mineral Economic Value

The "mineral economic rent" and "mineral economic value" usually cause a lot of confusion to many people. The mineral economic rent insists on the economic return of extracting a

given mineral resource above the return needed to cover intermediate input costs, labor costs, and the opportunity cost of capital invested in the business (Lange, Marie, & Motinga, 1997). Differently, the mineral economic value can be calculated using three methods: the market based approach, the income approach and the cost based approach.

Botswana mineral accounts have adopted the income based approach. This method estimates the expected future cash flows of the commodity on its estimated life of mine. The mineral rent is used to estimate the economic value of minerals.

The economic value of the resource stock is calculated as the current resource rent per unit of the resource times the size of the stock. The valuation corresponds to the Net Present Valuation method (NPV) and assumes the resource rent will rise at a rate equal the rate of discount. The discount rate accounts for the time value of money.

The rent estimate of the currently mined commodities in Botswana enables us to estimate the economic value of the total mineable resource over time. It has become possible to estimate the Diamonds, Soda Ash, and Gold.

Coal economic value becomes zero due to the negative 5yma per unit rent, when analysed on a long term 5yma trend. As of the 2018 updates, the mineable Coal resources are estimated at 14,635.75 Mt (Botswana Geoscience Institute, 2016).

The per unit rent value calculated for 2017 is used on this measured Coal resources and they yielded the net present value. However, due to longer negative economic value of Coal in the past it has yielded a negative rent on a 5yma estimate. A summary of Diamonds, Gold and Soda Ash economic values are presented below. Copper Nickel has been included but has not been valued after 2016 as was not in production or the was no significant base metal mining in Botswana at this period.

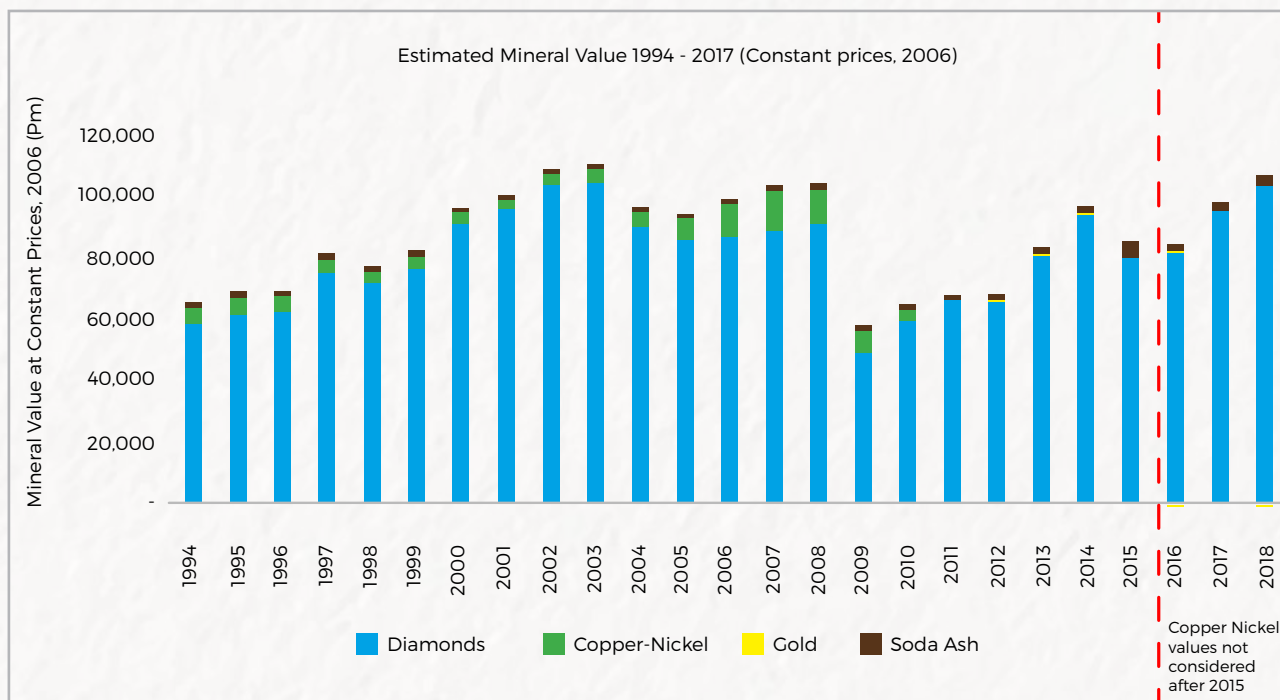


Figure 11: Estimated Botswana Mineral values (1994-2018), constant prices, 2006, calculated by the author.

According to the author's calculations, Diamonds and Soda Ash are the only economically mined commodities to date. Coal generated positive rent in 2017 and 2018, however, the net present value of the Coal mine on a long-term trend remained negative. Gold mining used to be economic until 2016 but in 2017, it observed a negative net present value. A summary of the estimated economic value of the other three mined commodities is summarized in Table 7 below.

Table 7: Economic Value of Botswana Diamonds, Gold and Soda Ash (2013-2018), author's calculations.

Valuation of Mineral Assets in the ground at (Pm at Constant prices)	2013	2014	2015	2016	2017	2018
Diamonds	80,136	93,720	79,894	81,306	94,907	102,711
Gold	514	307	184	66	0	0
Soda Ash	1,873	2,241	4,498	2,819	2,475	3,638
Total	82,524	96,268	84,576	84,191	97,382	106,350

Botswana Mining Revenue

Botswana Mineral Revenues comes in the form of taxes on profits, dividends, royalties and withholding taxes levied on mining companies (Jefferis2, 2016). Mineral revenue dataset from 2006 to 2017 were sourced from the Ministry of Finance and Economic Development.

It appears that the mineral revenues have been accrued in accordance with the rents in most years when the mineral revenues exceed rents (Figure 12). This is a good sign of the Botswana Tax Structure where majority of these surplus profits made by mining companies are recovered by the government as compensation to depletion of minerals.

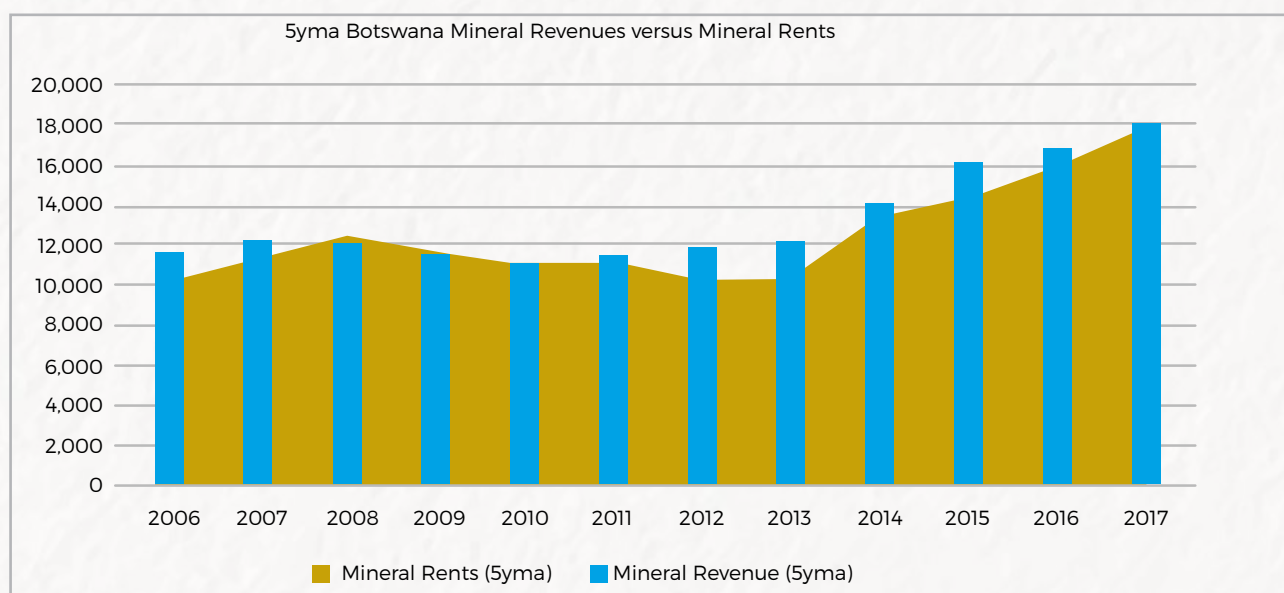


Figure 12: Syma Botswana Mineral revenues versus Mineral Rents

Mining Sector Export Earnings

Table 8 below provides a summary of the Botswana mining export earnings from 2005 to 2017. Diamond exports make the maximum contribution followed by Copper-Nickel, Soda Ash and then Gold. Gold earnings used to be higher than Soda Ash rents in 2005 when Gold mining began until 2012. From 2012, Soda Ash sales began gaining more export earnings than Gold until 2017. Coal is still being mined, however, its dataset was not available at the time of reporting and hence has not been included in the table below.

Table 8: Total Mining Export value (2005-2017), excluding Coal (Statistics Botswana, 2017).

Exports (Million Pula)	Diamonds	Copper-Nickel	Soda Ash	Gold	Total Mining
2005	17,450	2,487	123	138	20,198
2006	18,345	3,972	108	207	22,631
2007	20,043	6,789	123	305	27,260
2008	20,788	6,240	100	671	27,799
2009	15,231	3,735	200	532	19,698
2010	21,780	4,267	489	535	27,071
2011	30,248	2,991	323	546	34,108
2012	36,143	3,551	452	642	40,788
2013	55,367	4,747	499	471	61,084
2014	65,327	4,392	595	373	70,688
2015	52,730	3,790	594	289	57,403
2016	70,781	2,631	721	424	74,557
2017	55,459	41	642	372	56,514

Depletion Component of Rent

As part of the mineral accounts compilation, it is necessary to compute the depletion component of rent that is an important component input into the Adjusted Net National Saving which is part of the System of the Environmental Economic Accounting (SEEA). The depletion component of rent, explains the exhaustibility of mining mineral resources.

Under the SEEA, resource rents in a given year are divided between a depletion component and a return (income) component, according to the following formula:

$$\text{Depletion} = \text{RR} / (1+r)^n$$

Where : RR = annual resource rent, r = chosen discount rate and n = lifetime of mineral deposit (to exhaustion).

The remaining portion of the resource rent is the income component. The depletion component gets larger as the remaining lifetime of the deposit gets shorter.

The lifespan of most of Botswana's mines (notably Diamond mines) is relatively long, hence the depletion component is relatively small (Fig. 13).

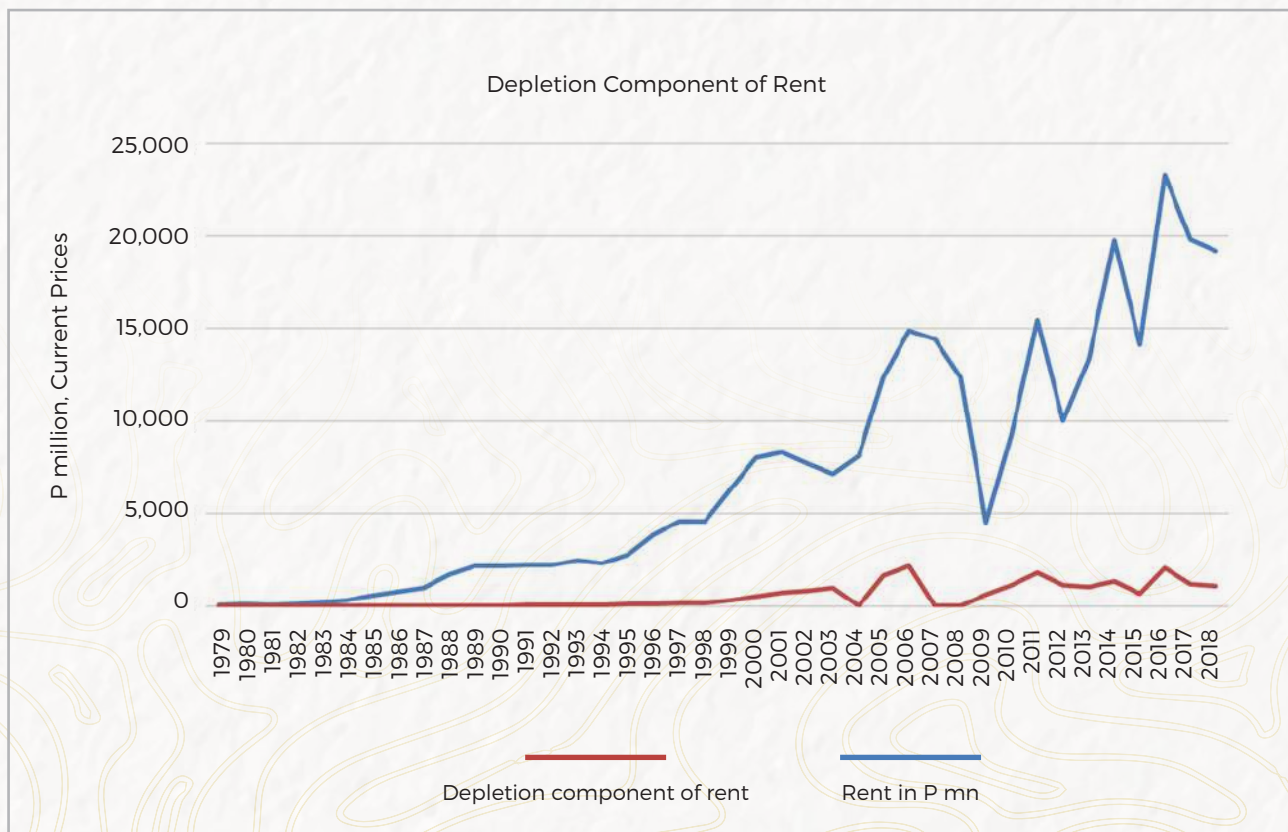


Figure 12: Depletion Component of Rent (1979-2018), authors calculations



4.0

Conclusion, Limitations and Future Work

Chapter Four: Conclusion, Limitations and Future Work

Future work will be focused on addressing the above listed limitations. The mineral accounts technical working group will make visits to mining operations in order to get up to date information and confirm on the ground the actual challenges with operations and reporting.

It is critically important that the mineral accounts findings are used in long-term development of the country, decision making in mineral policy, and national development plan reviews. The keynote findings/conclusions are hence summarized as below.

Conclusions

- The mining sector competitiveness in the economy of Botswana changed after 2015. The sector used to be the main contributor in terms of value added to total GDP. However in 2016 and 2017 (Figure 1), it was surpassed by Trade, Hotel and Restaurants. The sector also experienced a decline in terms of compensation to employees.
- The individual mined mineral commodities that recorded positive economic value in 2017 are Diamonds and Soda Ash mining. Gold mining was economic only until 2014. Coal mining observed negative rents for many years. The situation changed in 2017 when the company observed positive rents due to an increased operating surplus mainly because of increased output by 17.4% from 1.9 mtpa in 2016 to 2.2 mtpa in 2017. However, the Coal mineral rents on a five year moving average remained negative.
- Diamonds remain the largest contributing sector.
- Soda Ash continues to perform well after Diamonds with the company's diversification plans intended to increase their revenues (e.g. recommissioning the liquid carbon dioxide plant and manufacturing of bicarbonate of soda).
- Increased Coal output could possibly turn it economic since the 2017 performance with an

increased output yielded a positive economic value.

- The lifespan of most of Botswana's mines remains relatively long especially for Diamonds.

Limitations

This report compilation encountered some limitations that made it difficult to address policy implications for the current reporting period as follows:

- The capital stock data has a year lag period and it is difficult to forecast monetary performance of individual companies for the current reporting period.
- Some company reports have limited information on the remaining reserve and resource statements
- Non-responsiveness of the companies.

Future Work

Future work will be focused on addressing the above listed limitations. The mineral accounts technical working group will make visits to mining operations in order to get up to date information and confirm on the ground the actual challenges with operations and reporting.

The team, in collaboration with Statistics Botswana, is working on resolving the lagged capital stock datasets. The Mineral accounts team intends to deduce the relevant policy brief messages that can advise both the government and mining companies.

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