BOTSWANA NATIONAL PRODUCTIVITY CENTRE

Together, we transform Botswana

PRODUCTIVITY iNSights

2021

BNPC STRATEGIC FOUNDATIONS AND QUALITY POLICY

Mission Statement
We provide innovative and high impact solutions that enhance national productivity and competitiveness.

Vision
Leader in driving national productivity.

Intent Statement
To drive productivity in national prioritized sectors through innovation, technology and indigenous knowledge by 2023.

Values

Collaboration
We continuously exhibit teamwork and build each other up as we create value for Batswana. This goes beyond the confines of the Centre, therefore we extend the same to all our stakeholders and partners as we form part of the economic transformation value chain.

Innovation
At BNPC, every challenge is an opportunity to create human centered solutions through the use of indigenous knowledge and technology. We embrace our rich Botswana culture and intend to leverage and infuse its uniqueness into all that we do- creating a distinct BNPC mark.

Passion
We are zealous about creating value for Batswana, as we deliver our mission with pride and purpose. We passionately inspire and equip others to constantly strive towards meaningful economic and societal contribution.

Agility
We thrive under pressure and in uncomfortable circumstances with agility. We create opportunities where there appears to be none and remain resilient in the process.

Integrity
Our posture is rooted in doing what is right at all times. Each member of our team reflects resolute integrity by displaying transparency and accountability in all the internal and external engagements.

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Overview of Botswana Productivity

By: Motshabi Kgotlaesele, Reetsang Kenalemang and Zelda Okatch

> The Economic Recovery and Transformation Plan (ERTP), adopted to stimulate the economy and foster economic growth, emphasizes that promoting improvements in productivity, efficiency and competitiveness is central to the recovery and transformation agenda.

1. Introduction

The COVID-19 pandemic has struck at a time when there has been a broad-based slowdown and stagnation in global productivity growth for over a decade. Botswana has not been an exception to this trend, as the total factor productivity (TFP) growth over the past decade has been mainly negative. Unfortunately, the lockdowns, curfews, quarantines caused by contact tracing and social distancing regulations used to curb the spread of COVID-19 only exacerbated the already delicate situation. This is worrisome for it is widely acknowledged that productivity is a key determinant of economic growth (Limam and Miller 2004).

The Economic Recovery and Transformation Plan (ERTP), adopted to stimulate the economy and foster economic growth, emphasizes that promoting improvements in productivity, efficiency and competitiveness is central to the recovery and transformation agenda. The recent 2021/22 budget speech also emphasizes that the promotion of export-led growth requires improved competitiveness and productivity. This is indeed a step in the right direction, however, it is also important to examine the past trends of productivity in order to provide insight on its nature, patterns and characteristics. Assessing the level of production efficiency and technical progress are crucial elements in analyzing the country's growth trends and international competitiveness.

It is against this backdrop that this article provides an overview of Botswana's productivity. The overview examines two distinct, but equally important, aspects of productivity. These being (1) Botswana's productivity trends and (2) factors affecting productivity in Botswana. Discussing these two aspects provides a more comprehensive analysis that can better inform policy. The analysis, in this article, utilizes the productivity indicators published by the Botswana National Productivity Centre (BNPC) in the 2019 Productivity Statistics Report, covering the periods 1998 to 2018 as well as the World Economic Forum's Global Competitiveness Report (2019). The article is structured as follows; a discussion on Botswana's productivity trends is provided in Section 2, while Section 3, provides an analysis of factors affecting productivity. The conclusion of the article is undertaken in Section 4.

2. Botswana's Productivity Trends

2.1 Total Factor Productivity Trends

To examine the productivity trends, the article uses three key productivity indicators, namely the total factor productivity (TFP), capital productivity and labour productivity. Total factor productivity, is widely defined as the amount of wealth created by both labour and capital employed in the wealth creation process. It describes the relationship between output in real terms and the inputs involved in its production. Unlike labour[1] and capital productivity, both of which are partial measures, TFP compares output against multiple inputs at any one point. Hence, it does not measure the specific contributions of the different factors of production, but rather measures the joint influences of technological change, efficiency improvement, returns to scale, and reallocation of resources.

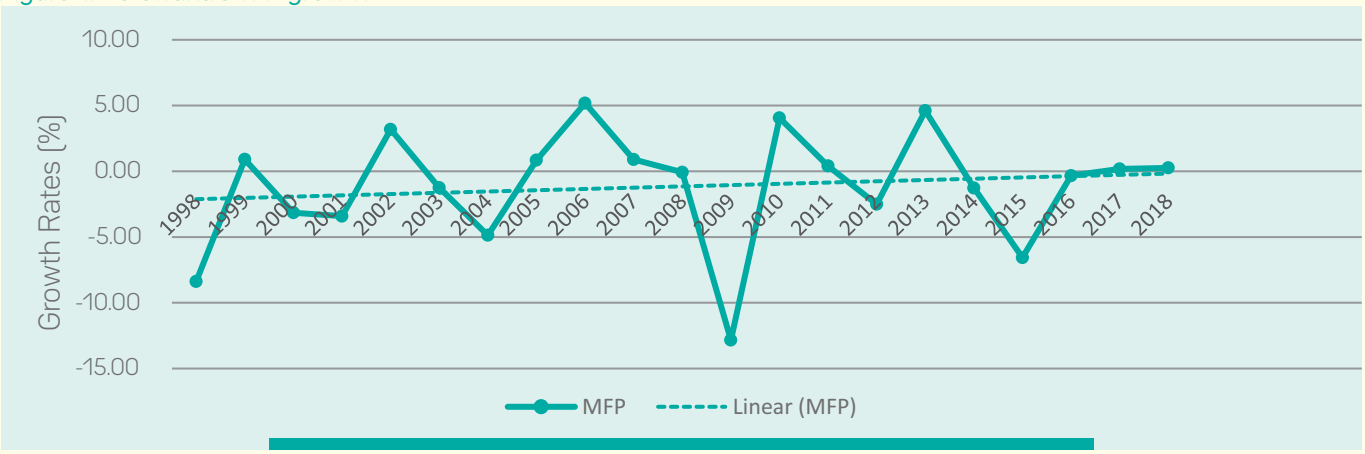
Figure 1, indicates that there have been erratic fluctuations in Botswana's TFP growth rates since 1998. Despite these fluctuations, close observations reveal that on average productivity growth, between 1998 and 2018, has been mainly negative with very minor improvements, as evidenced by the linear trend line in the graph. From this, it can be concluded that Botswana's productivity growth rate, like that of the international scene, has not shown tangible improvements over time, as stated earlier. Like other countries, Botswana's annual average TFP growth after the global financial crisis (GFC) is lower than the growth rate experience prior to the crisis. The international slowdown and stagnation in TFP growth rates after the GFC has been attributed to, amongst other things, the fact that newer innovations are less effective in comparison to previous technological revolutions (Gordon and Sayed (2019)). Other explanations for the productivity slowdown are the mismatch of skills and declining real returns to skilled labour.

Between 2014 and 2018 Botswana's annual average TFP growth was -1.55%. However, it should be noted that the country recorded positive growths of 0.26% and 0.18% in 2017 and 2018, respectively. The positive growth obtained in these years were a result of the boost in the economy after the 2015 recession. While Botswana's productivity was positive in 2017 and 2018, COVID-19 is likely to reverse this trend due to the low levels of investment, both foreign and domestic, and weaker consumer demand, both locally and globally. However, strategies such as expediting digitalization, improving the business environment and developing productive infrastructure, pronounced in the ERTP, are expected to counter this in the long run.

The lowest growth was recorded in 2009 being -12.84%, which can highly be associated with the 2008/09 global recession. Other low growth rates were recorded in the years 1998 and the 2015 recessions, being -8.38% and -6.56% respectively. The performance of the country with respect to TFP mimics economic growth throughout the period of investigation. According to Dieppe et. al. (2020) the troughs for productivity growth have coincided with recessions or economic slowdowns even at the global level. This indicates that while productivity is an important determinant of economic growth, as shown by numerous empirical studies, economic growth is also an essential driver of productivity. This can be explained by the fact that increased economic growth enables a country to invest in technological advancements, human capital development and physical capital which further boosts productivity.

1. They compare output (real GDP) against only one input (i.e. Labour or capital) at any one point

Figure 1: Botswana's TFP growth



Source: BNPC (2019)

In order to gauge how Botswana's productivity growth is performing against other countries in the region of similar economic standing (Mauritius, Namibia, Rwanda and South Africa), TFP data obtained from the Penn World Tables 10.0 (2020) is utilized. Botswana's average annual TFP growth rate between 2011 and 2019, according to the Penn Table data was -1.37%, see Table 1. South Africa and Namibia also realized negative TFP growth rates during the same period, with an annual average growth rate of -1.51% and -1.38%, respectively. Overall, in the given period, Botswana's annual average TFP growth is the third highest after that of Mauritius and Rwanda. Examining and analyzing Mauritius and Rwanda's strategies and policies that facilitated and promoted such growth is suggested as an area for further research. Research in this regard could provide important lessons that Botswana could draw upon in order to increase productivity growth.

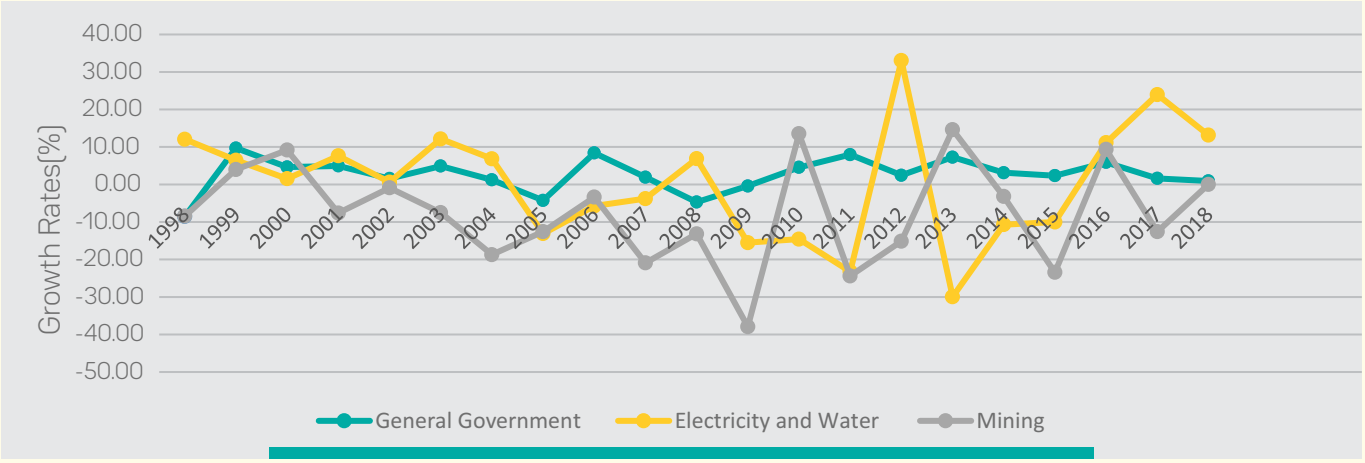
Table 1: Annual Average TFP growth rates for Selected Sub-Saharan Countries (2011-2019)

	Botswana	Mauritius	Namibia	Rwanda	South Africa
Average	-1.37	0.90	-1.38	1.22	-1.51

Source: Compilation based on Penn World Table 10.0 (2020)

In analysing TFP at sectoral level, lack of sectoral capital stock data allowed for the TFP indicators to be calculated for only three sectors, namely (1) water and electricity, (2) general government, and (3) mining. It is worth pointing out that the missing TFP sectoral indicators pose a serious limitation as policy decisions taken to promote development in these sectors will be extremely constrained and limited. Hence, it is highly recommended that Botswana prioritizes the collection of sectoral capital stock. Of the three sectors with the TFP indicator, general government outperformed the others with an annual average growth of 2.66% for the entire period (1998 to 2018). The water and electricity and mineral sector annual average growth rates were 0.43% and -7.58% respectively, in the same period. The mineral sector has the lowest TFP as it is the most vulnerable sector during recessions.

Figure 2: Sectoral TFP Growth



Source: BNPC (2019)

The sectoral TFP growth, shown in Figure 2, also indicates that the government sector has experienced the least fluctuations in TFP growth. When observing the last five years (2014-2018) general government experienced an annual average growth rate of 2,79%. Proposals to improve poor project implementation and the inefficient procurement process, as indicated by the 2020/21 and 2021/22 Budget Speech, would further improve the performance of the public sector. The online visa issuance system, the online business registration system and the online work and resident permits process are also welcome interventions that would spearhead productivity and efficiency in this sector.

2.2 Capital and Labour Productivity Trends

The labour productivity indicator is a partial measure which gauges how efficiently labour is used to generate output at any given point. Capital productivity, on the other hand, captures how efficiently capital is used to generate output, thus, basically gives an indication of the degree of efficiency with which assets are utilized. Like TFP, the overall movement of Botswana's capital and labour productivity also mimics the movement of growth in real output. Botswana's capital productivity has also generally performed poorly with many negative growth rates over the 1998 to 2018 period, as shown in Figure 3. Since the capital productivity growth trend mimics growth of output, its lowest annual growth rate of -14.99% was recorded in 2009 due to the GFC recession. For the last five years of the investigation period, an annual average of -2.65% was realized further demonstrating the poor performance.

In contrast to TFP and capital productivity, Botswana has experienced mainly positive and increasing labour productivity growth between 1998 and 2018, shown by Figure 3. Dieppe et. al. (2020) indicate that labour productivity growth has also slumped globally, like TFP, after the Global Financial Crisis. This, however, has not been the case for Botswana as the post GFC labour productivity annual average growth rate is higher than the pre GFC annual average growth rate. The annual average growth rates pre and post GFC are 1.48% and 4.35%, respectively. According to literature, growth in labour productivity is directly attributable to improvements in physical capital, new technology, and human capital.

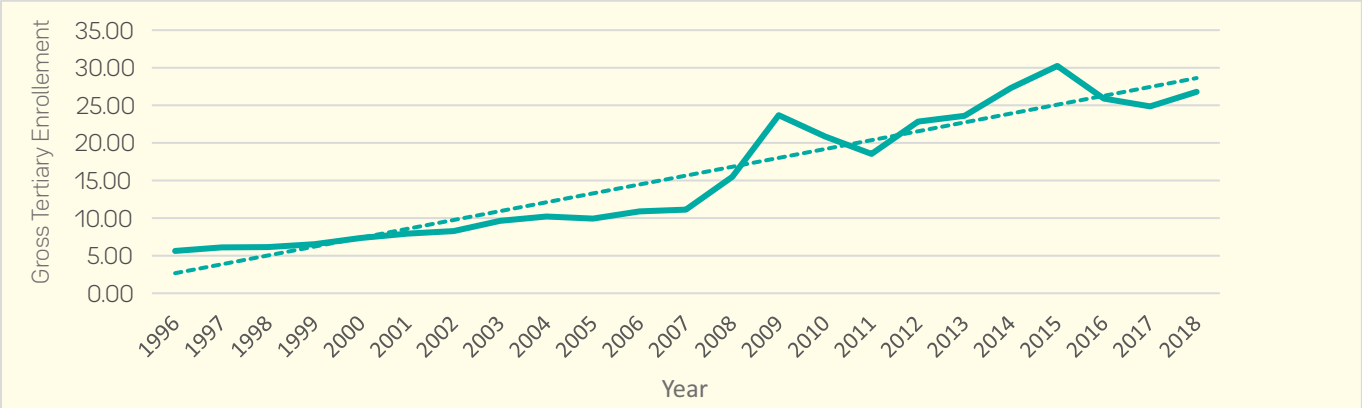
Figure 3: Labour and Capital Productivity Growth

Source: BNPC (2019)

While it is difficult to investigate the relationship between labour productivity to physical capital and new technology, due to lack of data, there could be significant developments in human capital, demonstrated by an increasing tertiary enrollment rate, that could be driving the increase in post GFC labour productivity.

Figure 4, shows Botswana's tertiary gross enrolment ratio since 1998. Where the tertiary gross enrollment ratio measures the total tertiary enrolment, regardless of age, expressed as a percentage of the eligible official tertiary age population in the given year. The graph shows that the gross tertiary enrollment ratio has improved significantly after 2007. By 2018 this ratio had increased by 100% from its 2007 rate, implying more tertiary graduates produced each year. This gives an indication of an overall increase in the level of education of the work force. Studies such as Barro and Lee (2000) and Dieppe et. al. (2020) and Loko and Diouf (2009) empirically demonstrate that a highly educated work force leads to increases in productivity. Hence improvements in the tertiary enrollment is likely to be one of the drivers that increase labour productivity in Botswana. Government expenditure on education has also improved significantly with the 2021/22 development budget allocation for tertiary education set for P2.26 billion.

Figure 4: Tertiary Gross Enrollment Ratio



Source: World Development Indicators (2020)

The five-year sectoral annual average between 2014-2018, presented in Table 2, shows that all the sectors performed well, in regards to labour productivity, all registering positive growth rates. Water and electricity outperformed all the sectors in this period, with an annual average growth of 18.01%, while the agriculture sector had the least growth with 0.70% annual average. The agriculture sector continues to perform poorly irrespective of programs like ISPAAD (Integrated Support for Arable Agriculture Development) that subsidize elements such as draft power that should ideally enhance labour productivity. However, it is worth mentioning that other factors such as rainfall also affect the performance of the agriculture sector. The large annual average growth of 18.1% in labour productivity for the water and electricity sector can be attributed to the fact that prior to 2014 this sector experienced serious constraints that challenged its ability to operate at full capacity. These constraints included drastic droughts, failures in the north south water carrier and constant breakdowns at the Morupule power plant. Massive recovery has only occurred in the past five years, hence the huge productivity growth rate for this sector.

Table 2: Sectoral Five (5) Years Average Labour Productivity Growth Rates (2014-2018)

SECTORS	PRODUCTIVITY	SECTORS	PRODUCTIVITY
All Sectors	2.32	Construction	4.51
Agriculture	0.70	Trade, Hotels & Restauranrs	4.85
Mining	3.40	Transport & Communications	5.03
Manufacturing	0.72	Finance and Business Services	2.44
Water & Electricity	18.01	General Government	2.62

Source: BNPC (2019)

3. Factors Affecting Productivity

In order to identify priority areas requiring urgent and sustained policy attention to improve Botswana's productivity growth and competitiveness, it is important to observe Botswana's performance in regards to the factors that determine productivity growth. Discussions in this section are highly dependent on the components of the Global Competiveness Report that provides important elements that drive TFP growth and competitiveness. An analysis of the determinants of TFP by Loayza and Kim (2017) reveals that innovation has the greatest impact on productivity, followed by physical infrastructure, financial systems, labour markets and the quality of institutional frameworks. Table 3, provides Botswana's rank and score of these particular variables in the 2019 global competitiveness report.

Table 3: Performance of Botswana's TFP Determinants in 2019 (Progress Score, Rank in brackets out of 141 countries)

	Botswana	Mauritius	South Africa	Nambia	Rwanda
Infrastructure	54 (108)	69 (64)	68 (69)	58 (94)	52 (111)
Institution	54 (70)	65 (29)	57 (55)	57 (56)	63 (36)
Innovation	31 (99)	38 (70)	45 (46)	36 (80)	31 (100)
Financial System	60 (72)	77(27)	83 (19)	69 (41)	56 (90)
Labour Market	60 (66)	59 (76)	61 (63)	64 (44)	64 (45)

Source: Global Competitiveness Report 2019

3.1 Innovation

Kale et al (2018) stress that innovation plays a significant role in influencing total factor productivity (TFP) growth. Findings of this study suggest that innovation-friendly policies such as the strengthening of intellectual property rights, R&D subsidies and innovation rebates may spur productivity growth, and hence, promote growth and prosperity. Unfortunately, according to Table 3, Botswana is lagging behind in terms of its ability to innovate when compared to other countries in the region. Even though, there are numerous funding opportunities such as the Youth Development Fund (YDF) and the Citizen Enterprise Development Agency (CEDA) which could fund innovation projects, Botswana is still characterized by relatively low resources devoted to innovation and research and development (R&D). The innovation performance is still below par irrespective of the establishment of Botswana's Innovation Hub.

The country has scored 31 out of 100 for innovation while three of her peers (South Africa, Mauritius and Namibia) scored higher. Interrogating Botswana's innovation capacity score further reveals that the research and development component of the pillar score was 21.4 with a country rank of 94 out of 141 countries. Botswana's R&D expenditure in 2019 was 0.5% of GDP against the international best practice recommended threshold of 2%. The Global Competitiveness Report also shows that zero patent applications were made in the country in 2019. Given this, there is indeed an urgent need to strengthen research and development especially pertaining to indigenous knowledge and technology with a view to finding solutions to local problems as proposed by the ETRP.

In addition to channeling more resources towards innovative ideas, researchers have also advised that much of Africa's strong growth over the last two decades has been driven by the production and sales of natural resources. Given this, new innovation should be directed towards creating higher movements on the value chain in these sectors. Rather than merely producing primary products in agriculture, as is mostly the case at the moment, Botswana should develop innovation solutions that could allow mass scale production of processed foods, which could then be exported. This will require investing in the creation of new technologies, certainly, but also in the adoption and adaptation of existing technologies for improving these industries.

3.2 Infrastructure

According to literature, there are sufficient indications that public infrastructure investment contributes significantly to productivity growth. De la Fuente (2010), in particular, argues that infrastructure provision is a key input for development policy. It is in this regard, that the ERTP is investing P2.9 billion in the provision of productive infrastructure between 2020/21 to 2022/23. According to Table 3, Botswana has scored 54 out of 100 for the infrastructure pillar. Regionally this performance was only better than that of Rwanda.

The Africa Infrastructure Development Index (AIDI) 2018 also show that Botswana lags behind in infrastructure development, as shown in Table 4. The higher the index, in the table, the higher the performance of a country, with the index taking values between 0 and 100. Botswana seems to be doing well in the water and sanitation index only. For all the indices showed, the country's performance is below that of South Africa and Mauritius.

Table 4: Botswana's 2018 Africa Infrastructure Development Index (AIDI) compared with that of her peers.

	Composite Infrastructure Index	Electricity Index	Transport Index	Water Supply and Sanitation Index
Botswana	36.79	21.52	22.29	80.82
Mauritius	76.78	39.86	38.40	97.52
South Africa	78.53	74.86	21.92	80.00
Namibia	28.65	10.54	15.50	63.34
Rwanda	20.77	0.77	12.95	65.02

Source:The Africa Infrastructure Development Index (AIDI) 2018

As shown by Table 4, Botswana faces a number of challenges with respect to infrastructure provision, with the most pressing being in the provision of power. The country lacks the capacity to generate all its power supply which exposes the economy to external power price shocks and load shedding. The recent 2021 Budget Speech states that a number of projects have been undertaken, in order to improve access and ensure reliability as well as to reduce the dependency of power imports. These initiatives will definitely increase national productivity in the long run. It's worth noting, however, that UNCTAD (2013) warns that African countries tend to put more focus on new infrastructure projects as opposed to getting more value out of existing infrastructure through more efficient use and better maintenance. Though the provision of new infrastructure is important, Botswana should not overlook the maintenance of existing physical infrastructure. According to a World Bank Working Paper by Garmendia and Pushak (2011), Botswana's international transport connections lag behind those of comparable countries. The paper goes on to recommend that Botswana can meet its infrastructure goals if it can reduce inefficiencies, increase public-sector receipts, and attract more public funding. It is also advisable for Botswana to leverage on the potential of its geographic location, which is at the center of the Southern African Development Community (SADC) region and expand its existing networks. This could allow the country to be more productive and competitive and become a more dominant player in regional trade.

3.3 Institutions

Empirical evidence has shown the importance of institutions in productivity growth. These studies suggest that the fundamental role of institutions consists of setting the right incentives and lowering uncertainty so that citizens can be confident in engaging in economic activities. Economic agents will invest only if they believe that they will reap expected benefits and returns without needing to spend excessive amounts of time and money to protecting their property. This depends, informally, on adequate levels of trust in society; it also depends, formally, on the existence of institutions capable of ensuring a basic level of security and enforcing property rights. This in turn relies on the institutions' political set-up and power structure, characterized by (1) the incidence of transparency, (2) efficiency of the public sector, and (3) the existence of checks and balances (WEF (2019)).

Botswana has achieved astonishing economic success and an impressive record of institutions that distinguishes it from many other African countries. It is considered as one of the most stable democracies in Africa and the judiciary is relatively independent. This is also evidenced by Botswana's scores on governance indicators, which are higher than most of her peers. (See Table 5). However, the country has obtained the lowest score amongst its peers with regards to institutions as indicated in Table 3. This is characterized by issues such as corporate governance, property rights, public sector performance still lagging behind and scoring low.

Table 5: Botswana's Governance Indicators compared with that of her peers. (2019)

	Regulatory Quality	Control of Corruption	Rule of Law	Government Effectiveness	Political Stability
Botswana	65.87	75.48	69.23	68.27	84.29
Mauritius	79.33	63.94	76.92	77.88	74.29
South Africa	61.54	59.62	50.96	66.35	40.00
Namibia	50.96	65.87	62.50	56.25	65.71
Rwanda	58.17	70.67	56.25	60.58	52.38

Source: Worldwide Governance Indicators, World Bank

Botswana's regulatory quality also needs to be improved. Cumbersome regulations have been cited amongst the stumbling blocks for doing business in Botswana. This, therefore, calls for a regulatory review to ensure the country gets rid of regulations that are outdated, unnecessary, or too costly so that it can improve the regulatory environment for businesses to be productive and competitive.

3.4 Financial Systems

King and Levine (1993) have argued that financial services can accelerate growth by improving the allocation of capital and enhancing the productivity of firms. Within this context, the quality of financial institutions in an economy might crucially affect innovation by mobilizing resources to finance promising investment projects, evaluating prospective entrepreneurs and allowing investors to diversify the risks related to uncertain innovative activities. Similarly, Bencivenga et al. (1995) argue that sound financial institutions result in efficient allocation of resources in an economy and, by doing so, they enhance long-run growth.

Botswana scored 60 which is an above average performance, however lower than that of Mauritius and South Africa (see Table 4). Within the region lessons could be drawn from South Africa (scored 83) which is considered a financial hub and has also been recognized for its well-developed equity, insurance and credit markets. Its banking sector has quickly evolved to meet the challenges of digitization and is characterized by well-regulated, highly capitalized, liquid and profitable financial institutions, supported by a robust regulatory environment and financial infrastructure (The Reuters (2019)).

Sekakela (2018) estimated the impacts of financial development on capital accumulation and total factor productivity (TFP) in order to establish if financial development impacts economic growth through these two channels in Botswana. The results suggest that financial development (private credit) leads to higher output through promoting the accumulation of assets and, hence, recommends further development of Botswana's financial market.

3.5 Labour Markets

There is some form of efficiency in the country's labour market as evidenced by a score of 60 out of 100 (See Table 3). Nonetheless, Botswana's labour market is characterized by joblessness, informality and skills mismatch. High unemployment rates among the youth, females and university graduates remain a critical challenge for the country with the 2020 budget speech indicating that the unemployment rate in the last quarter of 2020 was as high as 24.5 percent. It should be noted that some labor policies and laws are outdated and are being reviewed. For instance, the National Employment Policy is currently being developed. However, these initiatives need to be expedited. Even though, the country established the Botswana Labour Market Observatory (LMO), which is mandated to coordinate and harmonize labour market data, there is still need for more research to be conducted so as to inform human resource development strategies and prevent skills mismatch. The WEF Report (2020) also encourages countries like Botswana to rethink active labour market policies and expand investments in skills required for jobs of tomorrow's markets. The country is also encouraged to rethink labour laws for the new economy and use new talent management technologies to adapt to the new needs of the workforce.

4. Conclusion

While TFP and capital productivity growth respond to the global productivity slump by displaying negative growth rates between 1998 and 2018, labour productivity growth has been positive and increasing in the same period. This improvement can be attributed to the increase in tertiary training. In order to promote growth in productivity, it is recommended that Botswana strengthen and intensify research and development efforts with regards to indigenous knowledge and technology. A move of this nature will offer solutions that can adequately address local problems. Other initiatives, spelt out in the ERTP, such as expediting digitalization, improving the business environment and developing productive infrastructure should also be fast tracked and intensified. It is important that the country gets rid of regulations that are outdated, unnecessary, or too costly. This will improve the regulatory environment and allow businesses to be more productive and competitive. Improvements in project implementation and the procurement process would also enhance the performance of the public sector. In order to further promote developments in labour productivity, it is important that issues of skills mismatch and poor work ethic be urgently addressed.

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1

Climate Change Implications for Agriculture Productivity in Botswana.

By: Masedi Mosa-Sebele

"How resilient is the agricultural systems in the face of future socio-economic pressures and climate change challenges of the next decades?"

1. Introduction

Agriculture, rural livelihoods, sustainable management of natural resources and food security are inseparably linked within the climate change challenges of the twenty-first century. With the current projected population and socio-economic growth, food demand will double by 2050 (FAO, 2009). In the case of Botswana, the population is expected to grow by more than 40 percent (to about 3.4 Million) in 2050 (UNFPA, 2018). To level up with these developments, it is estimated that cereal production needs to increase by at least 40 percent, net irrigation water requirement must increase by at least 50 percent, and additional land of 100 to 200 Million hectors may be needed, largely in sub-Saharan Africa, Botswana included. Despite these existing pressures to level up food insecurity, climate change poses additional threats of failure in meeting the above requirements. In addition to this, there has been a persistent decline in the performance of Botswana's agriculture sector since independence.

Currently, Botswana's average rainfall varies from 200mm in the southwest to about 650mm in the northwest in the Okavango-Chobe region. Day temperatures are normally high, and evapo-transpiration exceeds rainfall especially in the sandveld. In Botswana, daily rates of open-water evaporation may reach 7.5mm (Darkoh ,1997). Droughts are endemic occurring every 7 to 12 years (Department of Metrological Services, 2011). With these continues changes in climate, weather conditions are expected to worsen in the next years by 2030. It is inevitable that climate change has become a common concern for all.

The decline in rainfall and rise in extreme weather events is a unique challenge to the agriculture sector as it puts to test many of the systems that have been in place over decades. The agricultural sector was identified as one of the most vulnerable to climate change in Botswana due to its heavy reliance on rainfall (Department of Meteorological Services, 2011). The crop subsector has proven to be the most vulnerable as a 30 percent reduction in maize and sorghum is expected under hotter and drier scenarios. The expected average real GDP growth rate in the agriculture sector is 0.7 percent, in the next five years (Republic of Botswana, 2016), with unfavorable weather conditions being one of the key attributors to this poor performance.

For policy makers, the major concern is "how resilient is the agricultural system in the face of future socio-economic pressures and climate change challenges of the next decades". To answer this, it is important to consider all relevant local, regional, and international aspects determining the food situation globally. The objective of this paper is to gather information on the implications that climate change could bring to the agricultural sector in sub-Saharan Africa, particularly in Botswana. Special focus is given to current and future possible approaches that can be implemented in Botswana to achieve sustainable agriculture. The rest of this paper is structured as follows: section 2 gives a background on Botswana's weather and climate patterns, this is followed by a review of the implication of climate change globally, regionally, and nationally (In Botswana) in section 3. The responding measures to climate change are compiled on section 4 and the concluding remarks are profiled in the last section, (section 5).

2. Weather and Climate Patterns in Botswana

Botswana's highly variable historical precipitation patterns are well-documented. Classified as arid to semi-arid, the historic average annual rainfall varies from 650mm in northern Botswana to 250 mm in the southwest, while remaining Botswana regions are prone to severe droughts or floods. Botswana has a subtropical desert climate characterized by great differences in day and night temperatures, and low humidity. It receives virtually no rainfall for six months of the year, with the wettest months being December to March. During these periods, most rainfall occurs in spells of 2 to 4 days (Department of Metrological Services (2011). Moreover, when temperatures and evaporation rates are at their highest of the year, open-water evaporation rates range from 1,900 mm to 2,200 mm per annum (FAO 2012).

This climatic environment means that the presence or absence of a few weather systems makes the difference between a wet or dry year. Given this, Botswana is prone to weather hazards, including floods, droughts, and veldt fires. This also results in relatively low annual rates of groundwater recharge and surface runoff, diminishing opportunities for storage. Storms can generally be characterized as local showers and convective thunderstorms (as opposed to large frontal systems), which also results in very high spatial rainfall variability (FAO 2012).

3. Climate Change Consequences for the Agriculture Sector:

3.1 Global and Regional perspective

By 2050, the world population is projected to be between 9 and 10 billion people, thus the global agricultural production must triple to meet the food demand and income growth according to Wik, et al. (2008). Despite the pressures from population and economic growth, climate change has a major bearing on agricultural systems as it affects both plant and animal health. Rising temperatures, (increasing total number of extreme hot days), along with changes in rainfall, are the central climatic variables affecting agriculture on the African continent. Though there still some uncertainties with regards to rainfall pattern projections, the projected temperatures give enough information which does not look pleasing for the agriculture sector for countries in Africa. Though the Intergovernmental Panel on Climate Change (IPCC) has estimated that crop productivity would increase considerably at mid- to high latitudes for local mean temperature increases of up to 3°C (depending on the crop), any temperature increases more than 3°C would have increasingly negative impacts on crop productivity in all regions (Easterling et al., 2007; IPCC, 2007). Moreover, for many developing countries it is projected that even small local temperature increases (1 to 2°C), would result in adverse losses in agriculture productivity. This would increase the number of people at risk of hunger. Climate change alone is estimated to threaten food security and increase the number of malnourished people to between 40 million and 170 million globally (Easterling et al., 2007).

In addition to temperature change, it is projected that the frequency and severity of extreme climate events, such as droughts and floods, will have more serious consequences. IPCC (2007) modelling suggests that increasing incidence of extreme climate events may result in crop losses due to temperature increase (Easterling et al., 2007). Likewise, with the impacts of extreme temperature rises, the IPCC projects that developing countries will bear high losses on crop production due to increases in the occurrence of droughts and floods than developed countries (IPCC, 2007).

Regionally, Sub-Saharan Africa land mass is estimated at total land area of 2,455 million hectors, of which 173 million hectors (about one quarter of the potentially arable area) are under annual cultivation or permanent crops (FAO, 2002). Majority of African economies depend on semi subsistence agriculture for both social and economic development. According to World Bank (2007) and Dixon et al. (2001), agriculture accounts for 20 percent of the continent's GDP, employs more than two thirds of the total labor force and is the main source of livelihood for most rural dwellers in the region. Yet a large proportion of farmers in Africa are small farm holders, farming less than 5 hectors, with about two-thirds having less than 1.5 hectors (Spencer, 2001). On the other hand, these small-scale farms account for over 80 percent of total agricultural production and support the food needs of about 600 million people in the continent (IFAD, 2015).

New studies confirm that Africa is one of the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity (IPCC, 2007). The continent's environment is closely linked with its climate such that climatic constraints are a major force in the development of vegetation, soils, agriculture, economic development, and general livelihood (Molua, 2003). Agriculture losses of between 2 to 7 percent of GDP are expected by 2050 in parts of the Sahara. With a 2 to 4 percent GDP loss expected for Western and Central Africa and 0.4 to 1.3 percent expected for Northern and Southern Africa. It is further projected that arid and semi-arid land could expand in coverage by 60-80 Million hectors (FAO, 2012).

3.2 Botswana and Southern Africa

IPCC projected increases in mean annual temperature by 2035 for the southern African region are 0.8°C, 0.9°C, and 1.00°C for the Representative Concentration Pathway (RCP) 4.5[1] mean model ensembles 25th, 50th, and 75th percentiles. Projections show that temperature changes will not be uniform over the region; the central, southern land mass extending over Botswana, parts of north-western South Africa, Namibia and Zimbabwe are likely to experience the greatest warming of 0.2 to 0.5°C per decade. The Under the RCP4.5 and 8.5[2] median scenarios in 2030, some models project increases in annual average rainfall along the northwestern Atlantic coast and southeastern Indian Ocean coast, with drying over the Atlantic coast of South Africa and up through the coast of Namibia and Botswana. For Botswana uncertainty for precipitation projections are still high. Given the recent recurring drought incidences in Botswana, the agriculture sector (which is predominantly rain-fed) is highly vulnerable to the impacts of climate change and variability.

1. Representative Concentration Pathway (RCP) 4.5 is a scenario of long-term, global emissions of greenhouse gases, short-lived species, and land-use-land- cover which stabilizes radiative forcing at 4.5 Watts per meter squared (W m- 2, approximately 650 ppm CO2-equivalent) in the year 2100.
2. RCP 8.5 refers to the concentration of carbon that delivers global warming at an average of 8.5 watts per square meter across the planet. The RCP 8.5 pathway delivers a temperature increase of about 4.3°C by 2100, relative to pre-industrial temperatures.

Botswana over the recent years has suffered decline in cereal production and there is also a decline on the livestock (cattle and goats) population. The livestock sector depends heavily on communal grazing and, therefore, hotter and drier scenarios are expected to surge low productivity in the sector (Statistics Botswana, 2018). This is mainly due to the fact that livestock productivity and stock numbers are threatened by the reduced quantity and quality of feedstock and water stress due climate change. The low agricultural production may result in more imports and increased food prices. Further details on the structure of Botswana's agricultural sector are provided in the box below.

Botswana Agriculture Characteristics

The agricultural sector is composed of crop (cereal production) and livestock production. In the crop-subsector, under both traditional and commercial farming, the predominant crops are cereals (sorghum, maize, and millet), pulses (cowpeas and beans) and oilseeds (sunflower and groundnuts) and watermelons (Statistics Botswana, 2012). In some instances, commercial farmers produce other crops such as wheat and finger millet. The total area planted to arable crops is usually in the range of 150,000 hector which is only around 20 percent of the total arable land. About 70 percent of rural households derive their livelihoods from dry land arable agriculture, through subsistence farming, which is dominated by small traditional farms with an average size of 5 hectares. About 63,000 arable farms fit under this category, while only 112 farms are larger than 150 hectares (Statistics Botswana, 2012).

3.3 Botswana Climate Smart Agriculture project

Climate-Smart Agriculture (CSA) is an approach to help people who manage agricultural systems respond effectively to climate change. The CSA approach pursues the triple objectives of sustainably increasing productivity and incomes, adapting to climate change, and reducing greenhouse gas emissions, where possible. This does not imply that every practice applied in every location should produce "triple wins". Rather the CSA approach seeks to reduce trade-offs and promote synergies by taking these objectives into consideration to inform decisions from the local to the global scales and over short and long-time horizons, to derive locally acceptable solutions.

CSA is not a set of practices that can be universally applied, but rather an approach that involves different elements embedded in local contexts. CSA relates to actions both on-farm and beyond the farm, and incorporates technologies, policies, institutions, and investment.

In 2019, The Botswana Institute for Technology Research and Innovation (BITRI) collaborated with the Ministry of Agriculture and Food Security and United Nations Development Programme (UNDP) in order to determine the risk factors to the attainment of food security by smallholder dryland arable farmers. The project identifies several lessons for implementation for holistic adaptation of farmers to climate change in the following initiatives.

National Policy on Agricultural Development; Goal is to improve food security at both household and national levels, as well as to conserve scarce agricultural and land resources for the future. The Policy emphasis on sustainable agriculture production for a self-reliant nation.

The Livestock Management and Infrastructure Development; Programme provides an opportunity for climate-smart pastoral farming through its fodder production and water development initiatives.

National Master Plan for Arable Agriculture and Dairy Development (NAMPAADD); Focuses on dairy, horticulture, and rain-fed farming, through Production and Training Farms (PTFs). And establishing Agricultural Service Centers at each PTF. These will be operated on a commercial basis and will provide the necessary inputs for the different sectors that the PTFs cover with extension services provided by Ministry of Agriculture staff.

However, there are currently some perverse incentives that undermine a CSA approach. For instance, the Integrated Support Programme for Arable Agriculture Development, still promotes conventional tillage versa minimum tillage especially during low precipitation seasons. Minimum tillage has the potential to increase yield through soil moisture conservation, while at the same time increasing soil carbon, especially during low rainfalls. There is also a need for demonstration sites in farmers' fields, that could be an option for early action on climate-smart agriculture in the country.

> "The low agricultural production may result in more imports and increased food prices."

4. Responding to Climate Change

Responding to climate change involves two possible approaches being (i) the reduction and stabilization of the levels of heat-trapping greenhouse gases in the atmosphere (mitigation) and/or (ii) the adaption to the climate change . This paper does not discuss the mitigation strategies but focuses mainly on the adaption approach.

4.1 Adaptation Strategies

The IPCC defines adaptation as adapting to life in a changing climate which involves adjusting to actual or expected future climates. Adaptation strategies are specific to a particular area and should be tailor made for each climate change, depending on the projected climate changes.

4.1.1 Cropping systems

Several strategies have been recommended for the mitigation of the adverse impact of climate change at a global level. However, not all strategies are conducive for Botswana's prevailing circumstances. The following cropping initiatives are recommendations that the country could consider adopting to effectively manage projected climatic and atmospheric changes.

- The alteration of crop varieties and species to those with more appropriate thermal time and verbalization requirement such as crops with increased resistance to heat shock and drought. Although Botswana's subsistence farmers prefer planting maize, drought resistant crop such as millet and sorghum would adapt better to the projected harsher climate conditions. Hence, planting of such crops should be widely promoted. It may also be important to assist farmers with techniques and technologies that enable the growing of certain crops in winter especially in the horticulture subsector.
- The alteration and change of fertilizer types to maintain grain or fruit quality could also provide a significant support to crops affected by climate change. It should be noted that currently, under ISPAAD, only one fertilizer is offer throughout the country regardless of soil type or crop planted. This is counterproductive especially in the face of climate change. Providing the right fertilizers for the right soil type and right type of crop could greatly lessen the impact of climate change on crop yields in the country.
- For Botswana's commercial farmers using irrigation, especially in horticulture, there is a need to alter the amount of water provided for crops, the times when such water is provided and other water management activities, to adjust them to the new weather patterns. Furthermore, using technology to improve water harvesting and computers to monitor the watering process would improve production and save water.
- Methods to conserve soil moisture (for example, through crop residue retention) should be adopted in Botswana's arable subsector. There is also the need to prevent water logging, soil erosion and nutrient and sediment transportation resulting from more extreme rainfall events that are experienced in the country in recent years.
- Altering the timing or location of cropping activities could also improve expected yields. Hence, planting crops according to their recommended agroecological zones should be strictly observed in Botswana. It should be noted, however, that timing alterations may require that research be undertaken to establish the changes in weather patterns in the past years in different areas in the country.
- Botswana could also encourage the diversification of income generating activities to include income from other farming activities, such as small livestock rearing and bee keeping, and non-farming activities.
- Improving the effectiveness of pest, disease, and weed management practices through wider use of integrated pest and pathogen management and development is also another desirable factor that Botswana should adopt. The use of varieties and species resistant to pests and diseases, would also help lessen the impact of climate change.
- It is also important to use climate forecasting to reduce production risk at national level.

4.1.2 Livestock Production practices

Adaptation responses to climate change in the case of field-based livestock that Botswana could investigate include the following.

- Taking additional care to continuously match stocking rates with pasture production,
- Altering the rotation of pastures and modifying the times of grazing,
- Altering forage and animal species/breeds to those more suitable to the climate change,
- Altering the integration within mixed livestock and crop systems including the use of adapted forage crops, reassessing fertilizer applications, ensuring adequate water supplies, and
- Using supplementary feeds and concentrates.

It is important to note, however, that there are often limitations to these adaptations, for example, more heat-tolerant livestock breeds generally have lower levels of productivity. Also, livestock-intensive industries in cold climates may have a reduced need for winter housing and for feed concentrates, whereas in warmer climates there might be an increased need for management and infrastructure to ameliorate heat stress-related reductions in productivity, fertility, and increased mortality. Furthermore, the capacity to implement infrastructural adaptation measures could be low in many tropical regions, whereas in the mid-latitudes, the risk of reduction in water availability for agriculture may limit adaptation options that require water for cooling.

4.2 Transformative Adaptation

In the context of agricultural systems, transformational adaptation has been defined as a response to climate risks usually in combination with other drivers such as redistribution of at least a third of the primary factors of production (land, labor, capital) and/or the outputs and outcomes of production (the types and amounts of production and consumption of goods and services arising from multi-functional agricultural systems) within a timeframe of 25 years.

It is evident that farmers in many places are experiencing rapid changes in weather patterns, such as the traditional start of the rains, planting dates, amounts and patterns of rainfall, and frequency of extreme weather events. While farmers accumulate a considerable amount of experience over their lifetimes (and the lifetimes of their forebears), in situations where the rate of change is relatively rapid, previous experience may be inadequate to adapt to novel conditions. To date, most attention on adaptation in agriculture has gone toward incremental adjustments that may enable better management of climate risks and opportunities in the near-term.

But incremental adjustments in agricultural systems may not be enough to deal with the challenges that current and future generations will face and, thus, more proactive and ambitious action will be required. A considerable literature has developed over the last few years on the concept of transformational adaptation in agriculture. What could governments and development partners do to improve the effectiveness of transformative adaptation leading to transformational outcomes becomes a central question which has to be constantly dealt with. A more comprehensive and long-term approach to adaptation planning could be undertaken. Actions could include the following:

- Expand the focus of adaptation planning to consider the multi-functionality of agriculture and a system-wide view of food production and consumption. In practical terms, this would entail visioning, planning, implementation, and evaluation of desired agricultural futures in terms of ability to supply benefits to nutrition, livelihoods and environment, over and above benefits to national level food security, monetary returns and balance of trade. It could also include outlook for technological breakthroughs, policy reframing, or disruptors on the demand-side.
- Apply the "stuck assets" thinking that has become well-established in the energy sector as a frame to encourage consideration of more transformative options for adaptation. For example, the re-siting or re-scaling of processing facilities, transport links and other infrastructure in major agricultural sub-sectors should be examined.
- Include arrangements for transformative adaptation in processes, such as the financing frameworks, insurance and fund, and development bank loan and grant frameworks.

5. Summary and Concluding Remarks

The complexity and urgency of climate change means that rather than sidestepping difficult issues, it is time to face them head on. Adaptation involves more than simply accommodating the impacts of climate change. It is also about confronting the societal context in which these changes are occurring. This means moving beyond impacts-oriented adaptation to tackle the underlying sources of vulnerability that are often determined by social, economic, and political relations. Critically, it involves challenging the processes and conditions that are creating vulnerability and risk including economic development models that undermine the cultural and material basis for community well-being and perpetuate reliance on fossil-fuel energy sources (Pelling 2011; Redclift 2012). It also necessitates challenging the ways of 'doing development'. Some of the suggestion to policy changes are as follows;

- Critically analyze the current National Policy on Agricultural Development to determine alignment with and opportunity for adaptive agriculture.
- Identify and eliminate perverse incentives that limit adaptation uptake among farmers and implement incentives that reward sustainable agricultural practices.
- Monitoring the impact and success of CSA projects to understand the potential of initiatives to contribute to agricultural transformation and livelihoods and attract increased investment.

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Impact of ISPAAD on Grain Production in Botswana

By: Zelda Okatch

> In 2008, the Integrated Support Programme for Arable Agriculture Development (ISPAAD) replaced the Arable Lands Development Programme (ALDEP) with the aim to resolve the persistent low productivity levels in the sector as well as to address other challenges facing the arable farmers.

1. Introduction

Centre for Applied Research (2005) indicates that the environment in which crop production takes place in Botswana is constrained by low and unreliable rainfalls, extreme temperatures and relatively poor soils, amongst other things. Irrespective, the arable sub sector still has the potential to play a critical role in addressing socio-economic issues, such as reducing poverty, inequality and unemployment, as the majority of people who are classified as poor live in rural areas and are dependent on subsistence farming for their livelihoods. Furthermore, the subsector also plays a significant role in improving nutrition and food security of rural households. It is in this regard that the government of Botswana has implemented a number of subsidy schemes as an attempt to boost arable production. In 2008, the Integrated Support Programme for Arable Agriculture Development (ISPAAD) replaced the Arable Lands Development Programme (ALDEP) with the aim to resolve the persistent low productivity levels in the sector as well as to address other challenges facing arable farmers. Unfortunately, BCA (2012) and Morapedi (2016) state that ISPAAD is merely a duplication of ALDEP and as such it is encountering the same challenges and problems that ALDEP experienced. This is an indication that not much thought or research was put into the design and delivery mechanism of ISPAAD. The 2021 Budget Speech indicates that ISPAAD is undergoing review and evaluation. It is anticipated that going forward, the subsidy will be tied to the achievement of output rather than simply subsidizing inputs, and lean more towards commercial agriculture. Indeed, this is a welcome initiative that has the potential to transform Botswana's crop sector. However, as the program is being revamped and reformulated, it is important to reflect on ISPAAD's impact, achievements and failures, thus far. It is in this regard that this article examines the impact of ISPAAD on grain production in Botswana's traditional sector. The discussions in this paper are structured as follows. Section 2 provides a brief overview of Botswana's traditional arable subsector, section 3 highlights the objectives of ISPAAD, section 4 outlines the evaluation approach, while the analysis of the impact of ISPAAD on grain production is given in section 5. The article is concluded in Section 6.

2. An Overview of Botswana's Traditional Arable Subsector.

Botswana's arable traditional sector, also commonly referred to as the subsistence sector, accounts for a larger share of land available for crop production in the country. The traditional sector has an allocation of 93% of the available arable land while the commercial sector accounts for the remaining 7%. Underutilization of land remains a serious issue in crop production as only 22% of the available land is being utilized for rain-fed crop production (Batlang and Nthoiwa (2015)). Batlang and Nthoiwa (2015) further indicate that 70% of rural households are subsistence farmers dependent on dry land arable agriculture with average farms of five (5) hectares. The crops grown under Botswana's rain-fed subsistence farming are grains (sorghum, maize and millet), pulses (cowpeas, bambara nuts and mung beans) and watermelons. Given their status as a staple food grains account for about 85% of the total local production of rain-fed crops.

As indicated the arable sector faces challenges, such as weather variations, climate change, poor soils, erratic and low rainfalls and endemic droughts, which render rain-fed production a risky and almost an unstainable venture in Botswana's traditional sector. As such, grain production and productivity indicators of the commercial sector are always significantly higher than those of the traditional sector. According to the 2015 Agricultural Census Report, the traditional sector attained yields of 185 and 84 kg/ha for sorghum and maize in 2015, respectively. On the other hand, the yield for the commercial sector for the same period was 549 and 784 kg/ha for sorghum and maize, respectively.

Between 2006 and 2017, the livestock, forestry and fishery subsectors contributed an annual average share of about 53% and 41% to the overall agricultural output in the country, respectively. On the contrary, the arable subsector's contribution was only 8%. In the same period, the livestock, arable, and forestry and fishery subsectors grew by an annual average of 1%, 23% and 6%, respectively. Grain production in Botswana's subsistence subsector still has a great potential to expand as the country is still heavily dependent on grain imports.

3. Objectives of ISPAAD

Botswana's crop subsector has continuously received government support since the late 1970s as a means to increasing production and productivity. Prior to the introduction of ISPAAD, ALDEP and the Accelerated Rain-fed Arable Program (ARAP) were used to support farmers in the crop traditional sector. Although most of the components of ALDEP, such as the subsidy on fertilisers, seeds and draught power and fencing, were maintained, ISPAAD was extended to include cluster fencing, facilitation of access to credit, the provision of portable water, and the establishment of agricultural service centres (ASC). Whilst ALDEP targeted only poor resource farmers, ISPAAD was not discriminatory in its eligibility criteria. Upon its introduction in 2008, ISPAAD was extended to all Batswana aged 18 and above with access to land.

ISPAAD has both a rain-fed agriculture and horticulture component. However, given that this article focuses on grain production only the rain-fed component of the program is discussed. The primary objectives of ISPAAD with regards to rain-fed agriculture were to:

- Increase grain production;
- Promote food security at household and national levels;
- Commercialise agriculture through mechanisation;
- Facilitate access to farm inputs and credit; and
- Improve extension outreach.

Generally, it can be said that the main objective of ISPAAD is to promote food security at household and national level. This, however, is to be achieved through increasing grain production. In turn, the increased grain production objective would be realized through the other ISPAAD objectives of facilitating access to farm inputs and credit, improving extension outreach and commercializing arable agriculture. Through ISPAAD, mechanisation of the agricultural sector was to be brought about by the establishment of 15 agricultural service centres (ASC) throughout the country. These centres were meant to be one-stop-shops for enhancing access to better inputs, knowledge and tools with the view to facilitate transition from subsistence to commercially oriented farming systems. They would also offer seeds, fertilizers, crop protection products, farm implements, spare parts for implements/equipment and veterinary supplies. To date, only a total of four agriculture service centres out of the 15 stipulated are operational in the following areas; Tonota, Parakarungu, Jwaneng and Sefhare.

Under ISPAAD traditional farmers are assisted to plough and plant a maximum of 5 ha for free. Ploughing and planting of land areas beyond 5 ha to a maximum of 16 ha attract a 50% subsidy. The program provided free seeds of open pollinated varieties of major grain crops (maize, sorghum, millet, and cowpeas) to plant a maximum of 16 ha. However, additional seeds could be attained at a 50% subsidy. Farmers who practice row planting are also given free fertilizer for up to a maximum of 5 hectares at a rate of 200 kg per hectare. Additional fertilizer can be supplied up to a maximum of 11 hectares at a 50% subsidy from government.

4. Evaluation Approach

In order to examine the impact of ISPAAD on Botswana's traditional grain production, this article mainly relies on descriptive trends analysis using secondary data obtained from various agricultural surveys and censuses published by Statistics Botswana. The article also uses primary data obtained through key informant interviews and focus group discussions conducted by the Ministry of Agriculture and Food Security (MOA) and the Botswana National Productivity Centre (BNPC) in 2020. Focus group discussions comprising of 15 participants were conducted separately for (1) farmers, (2) extension officers and (3) ISPAAD contractors and suppliers in all districts. The key informant interviews were held with ISPAAD program administrators, program implementers, policy makers, political representatives, local government representatives, other line ministries, public enterprises, the private sector and NGOs. The key informant interviews and focus group discussion used semi structured questionnaires and mainly provided insights on opportunities and challenges encountered by the program.

5. Analysis of Impact of ISPAAD on Grain Production

At inception, ISPAAD objectives were not specified in a specific and measurable manner. The program lacks design documents that clearly outline outcomes, outputs, activities, inputs and assumptions. In addition to this, baselines and targets were not quantified and specified with the exception of a vague productivity indicator. ISPAAD lacks a well-defined performance criterion which makes it difficult for other forms of evaluation and analysis to be conducted. Hence, this section adopts a trend analysis to establish the impact of ISPAAD on grain production. The impact of ISPAAD is examined in regards to area planted, grain production and grain productivity.

5.1 Impact on Area Planted

The area cultivated is an important indicator in arable farming as increases in production can either be achieved by employing more inputs, such as land, or by improving the efficiency of the production process. Hence, available arable land left fallow indicates an additional resource that can be used to further boost crop production. Upon inception and implementation, ISPAAD increased the area cultivated as it offered seeds and other inputs, at almost no cost to the subsistence farmer.

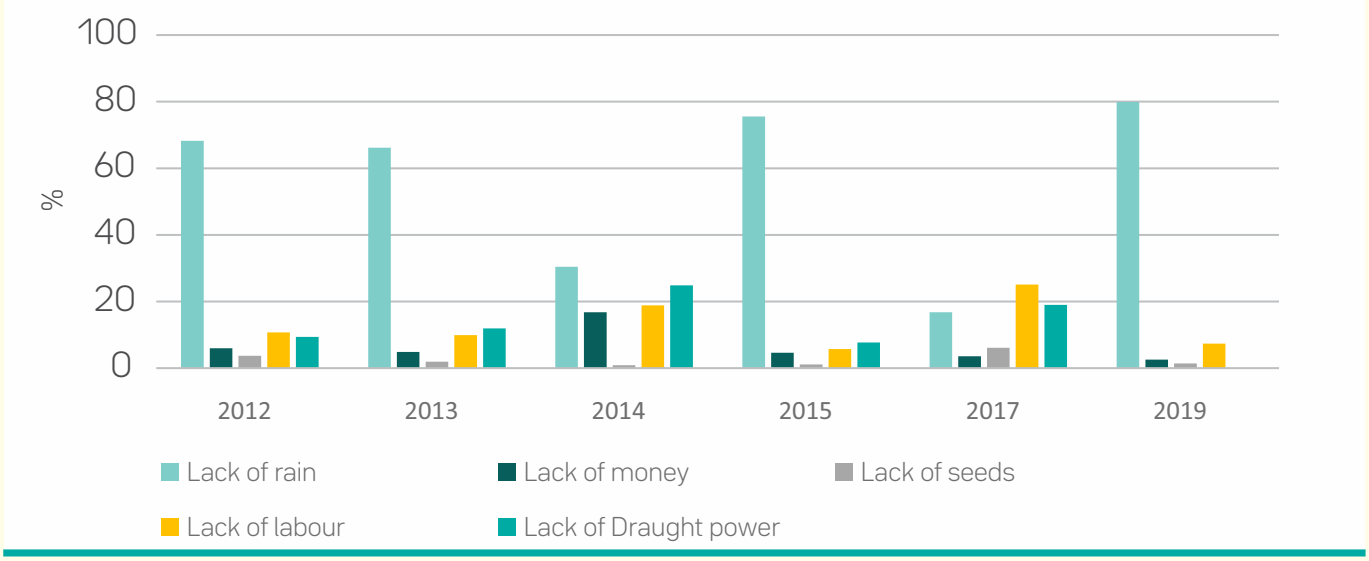
A review of the ISPAAD program conducted by BCA Consult (2012) indicated that the number of farmers engaged in subsistence arable agriculture in 2007/08, before ISPAAD was introduced, was 31000. However, the number of ISPAAD beneficiaries in 2008/09 was 96000, when the program started, and this increased to 11800 in 2010/11. The agricultural surveys further indicate that the area planted, in terms of hectares, almost doubled between 2007 and 2008 in the traditional sector. The area planted in 2007 and 2008 were 102285 and 203714 hectares, respectively. There was also an improvement in the proportion of land area planted to the total land available in the subsistence sector from an annual average of 66% between 1998 and 2007 to 84% between 2008 and 2015.

The increase in area planted is not surprising as, unlike its predecessor, ALDEP, that targeted only resource poor farmers, ISPAAD was not discriminatory in its eligibility criteria as it offers blanket coverage to all those who have access to land. In addition to this, unlike ALDEP that required a 15% down payment, ISPAAD requires no farmer contribution for 5 hectares or less. Indeed, the almost 100% subsidy across various component of ISPAAD with no down payment requirements offered a real incentive for individuals to take up arable farming. Unfortunately, the initial increase in the area planted after the implementation of ISPAAD was not sustained in the long term. The area planted started dropping after 2011. In fact, the data reveals that the area planted has never exceeded its 2011 value of 261967 hectares. In 2017 and 2019 the area of total land planted in the country was recorded at 126821 and 88288 hectares in the traditional sector, respectively.

The agriculture survey and census conducted by Statistic Botswana provide some insights on why the area planted fell after 2011. Most farmers indicated that the main reason for not ploughing after 2011 was due to inadequate rainfall especially at the right time of the season, as shown by Figure 1. This particular constraint was mainly cited in 2012, 2015 and 2019. Lack of rainfall does not only prevent farmers from ploughing but it also impacts the production and yield of those that ploughed using the ISPAAD package. Lack of labour still appears to be a significant reason despite the high levels of unemployment in the country. However, the shortage of labour could be caused by conflicting government programmes such as Ipelegeng and Tirelo Sechaba as well as the fact that the agriculture sector has the lowest minimum wage in the country.

Despite the fact that ISPAAD provides draught power, this was still indicated as a significant constraint by farmers who did not plough. The stakeholder interviews revealed that private contractors, who are charged with ploughing fields for farmers, get discouraged due to late payments which can sometimes take up to a year to process. Late payments have been attributed to, amongst other things, poor monitoring and evaluation, inefficient budgeting systems and the poor management of funds. For instance, tractor owners are allowed to plough and plant for farmers without any checks and balances made against the actual available funds at a given point in time. Such inefficiencies in the ISPAAD system allow for depletion of funds before all claims are made. In many cases payments are delayed until money is available in the next financial year.

Figure 1: Why Farmers did not Plough During some ISPAAD Years



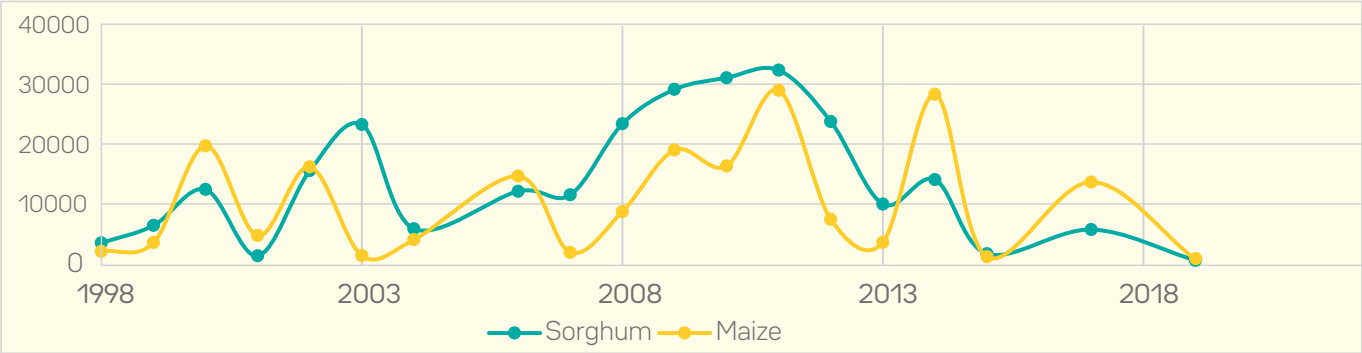
Source: Various Agriculture Surveys and Census

Another major challenge affecting the potential area of land planted that ISPAAD can achieve is access to land. As previously stated only 22% of the land designated for arable crop production in Botswana is currently being utilized. Sadly, only those with land or those who can afford to lease land can benefit from ISPAAD. This is a serious concern as many willing to participate like the youth don't own land nor can they afford to lease it. BCA (2012) indicates that only 8% of the beneficiaries of ISPAAD are age between 18 and 29 years. The low participation of youth in arable agriculture will in the long run affect the achievement of food security. It is important that interventions are built into ISPAAD to encourage more youth to actively participate in arable agriculture in order to fill up the vacuum that will be created as the ageing farm population retire.

5.2 Impact of on Grain Production

Upon the introduction of ISPAAD, production of maize, sorghum and millet in the traditional sector increased by more than 100% from 14464 metric tons in 2007 to 34237 metric tons in 2008. Increases in grain production continued and reached an all-time high of 64339 metric tons in 2011. It is worth mentioning, however, that the increase in the production of maize in 2011 could be due to the fact that the average BAMB prices for maize increased from P1260 per ton in 2010/11 to P2195 per ton in 2011/12. Like in the case of area planted, the increase in grain production was generally not sustained after 2011, see Figure 2. The figure does not show millet production as this is relatively low in the subsistence sector. The increases in maize and sorghum production in the early ISPAAD years can be attributed to increases in the area planted by subsistence farmers due to the introduction of the program. Overall ISPAAD has not significantly increased grain production beyond the historical production levels prior to its inception.

Figure 2: National Grain Production (Maize and Sorghum)



Source: Various Agriculture Surveys and Census

As stated earlier, one of the objectives of ISPAAD was to achieve food security in line with the 1991 National Policy on Agricultural Development. Generally, food security requires that all Batswana should have access to sufficient quantities of food at affordable prices whether through local production, imports or food aid. However, ISPAAD's objective of achieving food security hinges on the importance of local grain production in providing a reliable and stable food source both at household and national level. Local production is highly valued as it stabilises domestic prices by reducing imported inflation. COVID 19 has also demonstrated the need for a boost in domestic production as border controls used to curb the spread of the disease have resulted in slow movements in imported goods.

Table 1 shows the total domestic grain production for maize and sorghum versus the country's imported grain between 2006 and 2019. However, it should be pointed out that the domestic production includes both production by the commercial and traditional sector. The data shows that the national demand for the major grains, sorghum and maize, continues to be satisfied mainly through imports during ISPAAD years. The highest proportion of domestic production to national demand was in 2014 and 2017. This was largely due to good rains that were experienced in these years. In terms of satisfying domestic grain demand ISPAAD has a long way to go as Botswana is still highly dependent on grain imports.

Table 1: Domestic Grain Production Vs Grain Imports

Year	Total Domestic Production	Total Imports	Percentage of Domestic Production to National Demand
2006	59837	143583	19
2007	14464	76155	4
2008	43000	73262	14
2009	56000	328678	17
2010	54500	388441	16
2011	61796	291510	18
2012	52607	304459	13
2013	33755	280810	8
2014	215000	248923	72
2015	90317	256165	30
2016	54597	247748	18
2017	128075	518010	43
2018	76929	499287	26
2019	44518	363857	15

Source: Statistics Botswana (2015) , MoA Administrative Data (2019)

While harsh climate is an unavoidable constraint, stakeholders are of the view that ISPAAD could be failing to increase grain production, and even productivity for that matter, given the flaws and inefficiencies in its design and delivery mechanism. Many stakeholders alluded to the fact that domestic grain production is not increasing as expected, as ISPAAD's design fails to address an extremely important aspect which is the mindset of the farmer. Since 2008 the same farmer has been assisted over and over again with no exit strategy or graduation plan. This encourages dependency and provides no need for improvement on the part of the farmer. Although one of the objectives of the program is to achieve commercialization, in reality there is no incentive for a subsistence farmer to move to commercial farming. ISPAAD offers a 100% input subsidy to subsistence farmers while emerging and commercial farmers receive a 35% and 30% subsidy, respectfully. If the overarching aim is to turn subsistence farmers into viable commercial entities, these figures need to be reviewed. An exit strategy or an output based subsidy, as opposed to an input based subsidy, would encourage farmers to become more viable entities and increase grain production in the long run. This would also control the costs of the program and promote its sustainability.

ISPAAD implementers, extension officers and private contractors indicated that efforts of ISPAAD are eroded, in terms of grain production, as farmers neglect their fields after benefiting from the program. Morapedi (2016) indicates that some beneficiaries do not weed their fields nor scare birds. In some instances, fields are completely abandoned after ploughing with owners only reappearing at harvest time. This basically means that government does its part, by providing draft power, seeds, fertilizers and other inputs, but most farmers are not meeting government half way by carrying out their required responsibilities. ISPAAD's open eligibility criteria could somewhat be blamed for this as it permits even weekend farmers, individuals who pursue farming as a hobby and farmers who are not serious to participate in the program. Although, the ISPAAD guidelines have a provision to disqualify farmers due to farm negligence, in reality this is yet to be implemented. According to stakeholders, ISPAAD's effectiveness is also hampered by noncompliance, fraud and corruption. Hence, going forward the new ISPAAD could address these by revamping the poor monitoring and evaluation of the program and imposing stricter enforcement of rules and regulations.

5.3 Impact on Productivity

Due to numerous factors, such as droughts, lack of fencing and consumption by birds and animals, not all land that is planted is normally harvested in Botswana's traditional sector. This hampers productivity as resources and inputs are invested but no yield is acquired. As evident from Table 2, the annual proportion of total harvested area to planted area averaged 52% between 1998 and 2015. In this period the traditional sector's harvested area to planted area averaged 49% while for the commercial sector the average was recorded at 94%. The huge difference between the commercial and traditional sector's total harvested area to total planted area is worrisome as the latter utilizes a relatively larger share of the available arable land in the country. The subsistence sector experienced a slight improvement from 46% before ISPAAD (1998 to 2007), in the area harvested to the area planted, to 48% after the implementation of ISPAAD (2008 to 2015). While it has been noted that the introduction of ISPAAD contributed substantially to the improvement in the proportion of land area planted in the traditional crop production sector, the same cannot be said about the proportion of harvested area to area planted as shown in Table 2.

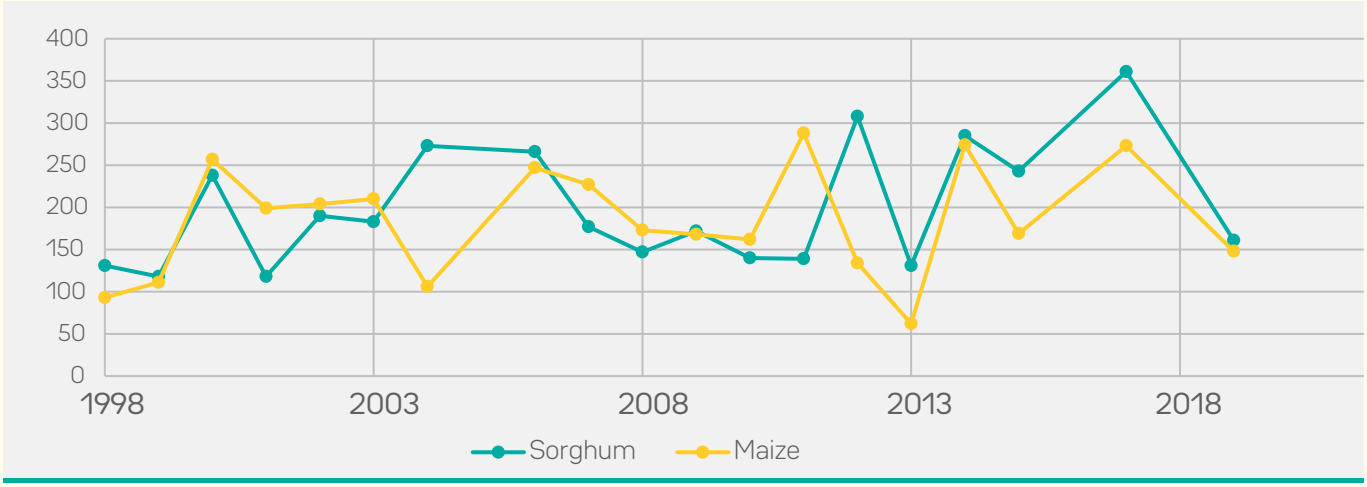
Table 2: Proportions of land area harvested

	1998 -2015	1998 - 2007 Before ISPAAD	2008 - 2015 During ISPAAD
Total (commercial + traditional)			
Total area harvested to total planted area	52%	49%	53%
Traditional			
Total area harvested to total planted area	47%	46%	48%
Commercial			
Total area harvested to total planted area	94%	96%	92%

Source: Various Agriculture Surveys and Census

Figure 3 shows that the introduction of ISPAAD in 2008 did not result in initial increases in productivity in terms of yield per hectare harvested as was the case for area planted and grain production. In fact, the yield per hectare harvested for sorghum fell from 177 Kg/ha in 2007 to 147 kg/ha in 2008 while that of maize fell from 227 kg/ha in 2007 to 173 kg/ha in 2008. Similar declines are obtained even when observing the yield per hectare planted. On the contrary yield per hectare harvested only started increasing after 2013. Unfortunately, this indicates that the initial boost in production and area planted brought about by ISPAAD where not accompanied by an increase in productivity.

Figure 3: Grain Yield per Hectare Harvested



Source: Various Agriculture Surveys and Census

Though yields have gone up after 2013, there is no significant difference between yields attained before ISPAAD was implemented and that acquired after ISPAAD was implemented. At inception, the program guidelines stated that ISPAAD's grain productivity targets for subsistence farmers participating in the program would be a yield of 1 ton/ha while that of commercial farmers would be 2.5 tons/ha. This translates to a targeted yield of 907 kg/ha for the subsistence farmer.[1] These target is considered to be vague as, firstly, no timelines were specified for this to be achieved in. Secondly, the target was for all grains yet maize, sorghum and millet have different acceptable yields per hectare. Nonetheless, on average traditional farmers were only able to achieve about 20 % of the ISPAAD target yield in all grains. Commercial farmers, on the other hand, have achieved a minimum of 80 % of the target yield.

One possible reason why yields remain low could be due to the fact that ISPAAD support is not aligned to the country's agro ecological zones. The program distributes seeds and provides support for even crops that have been proved not to be suitable for a particular region in terms of agro-ecological zones and land suitability. Botswana experiences extreme temperatures but according to specialists, from the former Department of Agriculture Research, maize, sorghum and millet can only withstand maximum temperatures of 28, 32, and 38 degrees, respectively. These temperatures need to be strictly observed if maximum yields are to be obtained. Millet and sorghum seems to be more well suited to Botswana's temperatures. However, statistics shows that unlike commercial farmers, farmers in the traditional sector allocate a larger proportion of their land to maize production as opposed to sorghum and millet. The rational for this being that maize requires less bird scaring as the grain is naturally protected by husks unlike millet and sorghum whose seeds are openly exposed. ISPAAD data also shows that maize is the most popular grain seed given to subsistence farmers. Sadly, this is counterproductive as the yield of maize will be low given Botswana's harsh temperatures in some regions. It is in this regard, that it is strongly recommended that ISPAAD should strictly observe the country's agro-ecological zones. Production of millet and sorghum should be encouraged in hotter regions, even though it's for export purposes. In fact, during drought years the maize seed should not be distributed at all.

Stakeholders undertaking agriculture research further indicated that extension of the ploughing seasons due to late rains under ISPAAD results in low yields and reduces the overall effectiveness of the program. They strongly emphasized that planting seasons should never be extended beyond 31st January in the southern part of the country and around mid-February for the northern part, irrespective of whether rains are delayed. This argument is based on the premise that crops require a maximum of 12 hours of day light and warm temperatures in order for the best yield to be attained, other factors being held constant. As autumn and winter approaches the day length shortens and the temperatures drop. This stunts the growth of the crop and affects the yields. Extension of ploughing beyond the recommended dates is more or less a waste of resources.

1. There is a difference between tons and metric tons. Ton is a unit of mass in Imperial and US Customary systems of units, whereas metric ton is a unit of mass that has been defined using the international system "SI" of units. 1 ton equals 907kg while one metric ton equals 1000kg

ISPAAD provides free fertilizers to subsistence farmers, who practice row planting, for up to 5 hectares. However, the agriculture survey conducted in 2019 indicates that 23% of subsistence farmers still broadcast seeds and are, therefore, excluded automatically from this component of ISPAAD. A 2016\17 Monitoring and Evaluation ISPAAD Assessment Report conducted by MoA also reveals the issue of low fertilizer uptake. Out of the1334 ISPAAD beneficiaries interviewed for this report, only 331 farmers registered for fertilizers. From the registered 331, only 269 received the fertilizers. The interviewed farmers indicated that they do not use fertilizers in their fields as this increases weeds. BCA (2012) indicates that fertilizer shortages were experienced during the first three years of the program and in most cases they did not reach beneficiaries at the right time. According to agriculture surveys and censuses, Table 3 shows that only a percentage of arable holdings used fertilizers. It is also worth noting that, under ISPAAD, only one type of fertilizer is issued throughout the country regardless of the nutrient status of the soil, the crop type and the stage of development of the crop. It is no doubt that these inadequacies in the provision of fertilizer, negatively impacts the overall grain productivity that could be acquired under ISPAAD.

Table 3: Percentage of Holding that used Fertilizers

Year	Percentage
2012	9.4
2013	9.2
2014	8.7
2015	25.7
2017	24.1
2019	14.4

Source: Various Agriculture Surveys and Census

Another important attribute that affects ISPAAD's ability to increase grain support is extension outreach. Currently there are about 250 extension officers serving about 97000 farmers country wide. In some instances, extension officers have to cover more than 4 villages. The role of such an officer is to assist and advise farmers on crop issues in order to improve crop production and productivity. Sadly, under ISPAAD the few available demonstrators are now also tasked with the processing of ISPAAD applications, supplying fertilizers and seeds and measuring fields in addition to their normal extension services. These duties have been overwhelming to agricultural demonstrators such that the core mandate of advising farmers on productivity and production issues are neglected. This has implications on the effectiveness of ISPAAD. The interviews and focus group discussion further revealed that the extension workers, who are actually the implementers of ISPAAD in communities, lack the required resources to execute their duties effectively. They lack transport, communication facilities like a telephone and even equipment for measuring the fields. This requires that the farmer provides resources like transport in order to have their claims submitted. The diversion of the core duties of the extension officers to ISPAAD administrative work indirectly has implications on Botswana's grain productivity. Going forward ISPAAD needs to have designated and well-resourced administrative officers in the districts, as was the case in ALDEP.

Conclusions

ISPAAD led to an increase in the area planted and an increase in grain production in the first few years of its implementation. Grain yields, on the other hand, only slightly improved in the later years of the program's implementation. Overall ISPAAD has not resulted in an increase in the area planted, production and productivity of grains in Botswana's subsistence sector. The failure of ISPAAD to increase grain production could be attributed to the fact that the program encourages a dependency syndrome and provides no need for improvement on the part of the farmer, given that there is no exit strategy. Building an exit strategy in the program or an adoption of an output based subsidy, as opposed to an input based subsidy, would encourage subsistence farmers to become viable entities and increase grain production in the long run. Inadequacies in issuance of fertilizers and the extension of ploughing seasons beyond acceptable dates also erode the size of yield that could be attained by the program. Going forward the new ISPAAD should encourage fertilizer usage and consider offering a wider range of fertilizer for different soil types. It is also strongly recommended that planting seasons should never be extended beyond 31st January in the southern part of the country and around mid-February for the northern part, irrespective of whether rains are delayed, as this has implications on yields. Furthermore, productivity and effectiveness can be improved if support is aligned to the country's agro ecological zones and designated well-resourced administrative ISPAAD officers are employed in the districts. Employing ISPAAD administrative officers would allow the few extension officers on the ground to carry their core duty of advising farmers on issues that could improve grain production and productivity.

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Impediments To Productivity In Botswana

By: Letsogile Batsetswe and Motshabi Kgotlaesele

> Since the early 2000s, productivity growth has declined in many countries. The slowdown in productivity has been particularly pronounced since the global financial crisis. Slowing productivity, not declining employment, has been the principal factor behind slowing GDP per capita (OECD, 2016).

Introduction

In today's knowledge-based economy it is difficult to evaluate people's performance by just using productivity as its basis, where people are elements in a production line, measured by the amount of time it would take them to produce a single item. There are a whole host of productivity challenges that the world is now facing (Maier, 2018). The factors that constrain productivity are constantly changing with economic development.

Since the early 2000s, productivity growth has declined in many countries. The slowdown in productivity has been particularly pronounced since the global financial crisis. Slowing productivity, not declining employment, has been the principal factor behind slowing GDP per capita (OECD, 2016).

The evidence suggests that both cyclical and long-term structural factors are responsible for the current low productivity growth. The following four factors are likely to be part of the explanation: weak aggregate demand since the global financial crisis, declines in business dynamism, increased dispersion in productivity growth between the best-performing and other firms and misallocation of capital (OECD, 2016).

The Conference Board Total Economy Database shows that global productivity growth has remained weak in 2018 and will continue to be slow through 2019. Globally, growth in output per worker was 1.9% in 2018, compared to 2% in 2017 and projected to return to 2% growth in 2019. The latest estimates extend the downward trend in global labor productivity growth from an average annual rate of 2.9% from 2000 - 2007 to 2.3% from 2010 – 2017 (Productivity Statistics Report, 2019).

Botswana's Vision 2036 focus is to achieve prosperity for all. Prosperity can increase only if inputs of production are used in smarter and more efficient ways to fulfil constantly evolving human demands. One of the ways in which Botswana can gauge its progress against its goal for prosperity for all by 2036 is by measuring its level of productivity. Sustained long-term economic growth comes from increases in productivity. Productivity gains are vital to long-term growth because they typically translate into higher incomes, in turn boosting demand. Increased productivity increases the power of an economy through driving economic growth and satisfying more human needs with the same resources.

Nevertheless, the unfolding COVID-19 crisis is challenging people, households, and firms in unprecedented ways. Containing the pandemic and protecting people is the top priority. But disrupted supply chains, containment measures that are limiting economic and social interactions and falling demand put people's jobs and livelihoods at risk. (OECD, 2020).

The COVID-19 pandemic has plunged the global economy into its deepest recession since the Second World War. Per capita incomes are expected to decline in about 90 % of countries in 2020, the largest fraction in recorded economic history, and many millions will be tipped into poverty (World Bank 2020). The pandemic is also likely to leave lasting scars through multiple channels, including lower investment, erosion of human capital because of unemployment and loss of schooling, and a possible retreat from global trade and supply linkages. These effects may lower productivity and limit the ability of economies to generate growth of real incomes in the long-term.

The main objective of this paper is to give a brief on some of impediments to productivity in Botswana. The paper consists of an introduction and four separate sections. The introduction gives a brief background along with the significance of this research. Section I gives a summary of the economic and productivity growth of Botswana. In Section II, possible impediments to the country's productivity are assessed. The main factors that this article discusses in detail are technology and innovation and human capital. In Section III, key considerations to address the challenges are discussed. Finally, there will be a conclusion to sum up all the discussions on the previous sections.

BOTSWANA'S PRODUCTIVITY PERFORMANCE

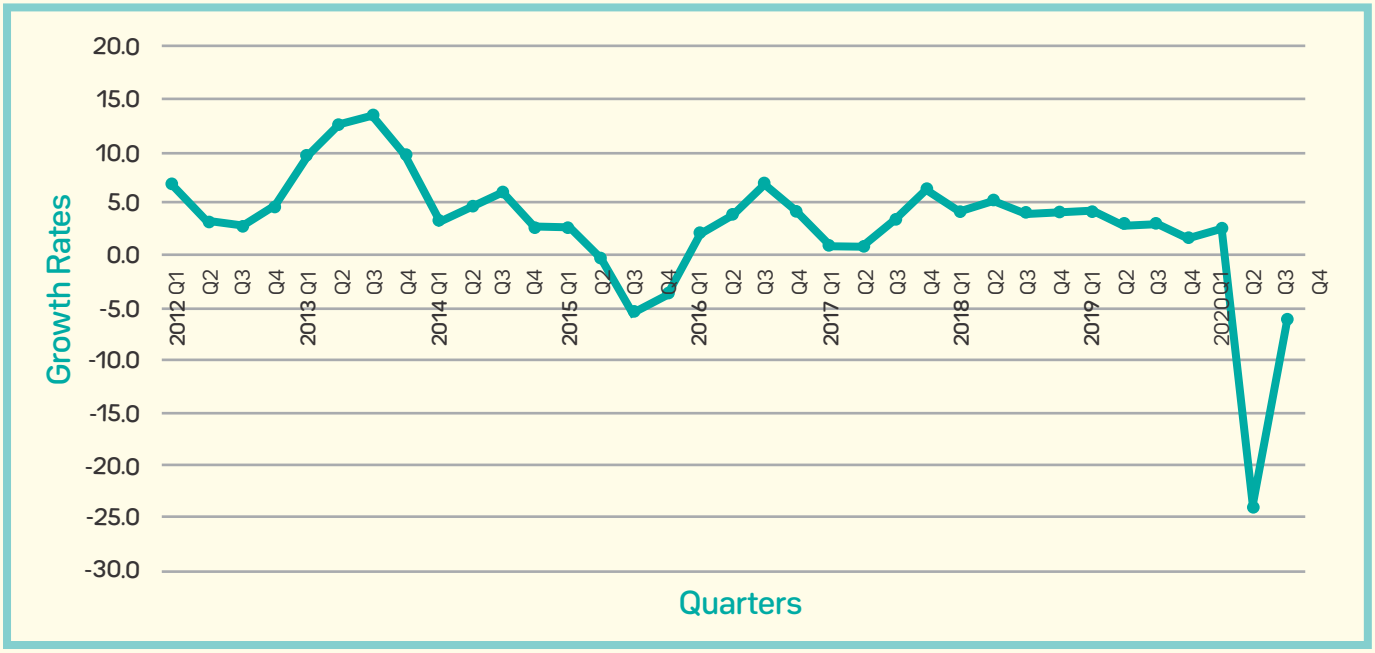
Productivity is one of the most widely used tools for evaluating, monitoring, and improving the performance of industries and national economies. At a national level, productivity indicates how well an economy uses its resources in producing goods and services. A decline in productivity can lead to slow economic growth and high inflation. On the other hand, improved productivity can lead to a higher rate of economic growth and higher living standards for a nation. Below is a summary of Botswana's economic and productivity growth over the years. The so not pleasing results justifies why it is important to investigate the impediments of productivity in the country. Improvement in productivity ultimately lead to improvement in the country's economic growth.

Botswana's Economic Growth

The Botswana economy is expected to contract by at least 8.9% in 2020 as COVID-19's impact on global demand, travel restrictions and social distancing measures constrain output in key production and export sectors. The outlook for the domestic economy is, however, positive, with a growth rate of 8.8 % projected for Botswana in 2021. Achieving this positive growth will depend on the trajectory of the recovery of the global economy and the successful implementation of policies, programmes and projects outlined in the Mid -Term Review of National Development Plan 11 (NDP 11). With the implementation of the Economic Recovery and Transformation Plan (ERTP) and other Government initiatives, the country is expected to achieve a robust recovery in 2021 (Budget Speech 2021).

Though the economic activity in the second quarter of 2020 was 24.0 % lower than in the same period in 2019, figure 1 shows that Real GDP for the third quarter of 2020 decreased by 6.0% compared to a deep contraction of 24.0% registered in the previous quarter. The improvement in the third quarter reflected continued efforts to reopen businesses and resume activities that were postponed or restricted due to the COVID-19 pandemic (Statistics Botswana).

Figure 1: GDP Growth Rates (2012 – 2020)



Source: Statistics Botswana

Table 1 shows that most of the sectors experienced negative growth during the second quarter of 2020 because of the stringent but necessary containment measures implemented during the 2020 country lockdown combined with a sharp fall in international economic activities. Amongst the hardest-hit sectors were Mining, Trade, Hotels & Restaurants, Construction, and Manufacturing.

Table 1: Annual % Change in Real GDP by Economic Activity

Economic Sectors	2017	2018	2019	2020		
				Q1	Q2	Q3
Agriculture	1.9	2.6	-0.1	0.3	3	3.1
Mining	-11.1	7.6	-4.1	-6.2	-60.5	-15.2
Manufacturing	2.2	3.4	2.8	3.6	-31.2	-5.3
Water & Electricity	39.9	11.3	8.4	15	1.3	45.2
Construction	3.5	3.7	3	3.2	-36	-7.6
Trade, Hotels & Restaurants	9	3.6	4.5	4.5	-40.2	-15.3
Transport & Communication	4.7	6.4	5.1	2.5	-17	-9
Finance & Business Services	4.1	5	5.9	6.2	-11.9	-1
Government	1.5	3.4	3.7	4.1	2.1	2.5
Social and Personal Services	2.8	3.6	3	2.8	-13.3	0.8
Total GDP	2.9	4.5	3	2.7	-24.0	-6.0

Source: Statistics Botswana; (Q stands for Quarter)

Botswana's Productivity Growth Rates

The COVID-19 pandemic happened at a time when international productivity growth rates have either been stagnant, low or slowing down over time. Overall, there have been fluctuations in Botswana's productivity growth rates since 1998, as measured by the Multi Factor Productivity (MFP), the labour productivity and the capital productivity indicators (see Figure 2). Generally, Botswana seems to be performing better in terms of labour efficiency in comparison to capital efficiency.

Figure 2: Botswana's Productivity Growth (1998 – 2018)

Irrespective of the erratic fluctuations in the indicators, closer observations reveal that on average productivity growth, between 1998 and 2018, has been mainly negative with very minor improvements, as evidenced by the MFP linear trend line shown in Figure 2. This shows that Botswana's productivity growth rate, like that of the international scene, has not shown tangible improvements over time.

It is important to note that, the global financial crisis resulted in negative growth rates for all indicators in 2009, as shown by Figure 2. Given that, the Ministry of Finance and Economic Development has revised economic growth forecast downwards to -8.9% for 2020, this is likely to also translate to negative productivity growth rates. This can be expected as inputs such as labour and capital will lie idle and, thus, not be optimally utilized in the production process, due to imposed lockdowns, business liquidity challenges, lower sales, and other restrictions.

IMPEDIMENTS TO PRODUCTIVITY

For a country to be productive, there must be a balance of so many factors that contribute to economic growth. Below is the discussion of technology, innovation, human capital, and COVID-19 as some of the obstacles to increasing productivity in Botswana.

-8.9%

"The Ministry of Finance and Economic Development has revised economic growth forecast downwards to -8.9% for 2020, this is likely to also translate to negative productivity growth rates."

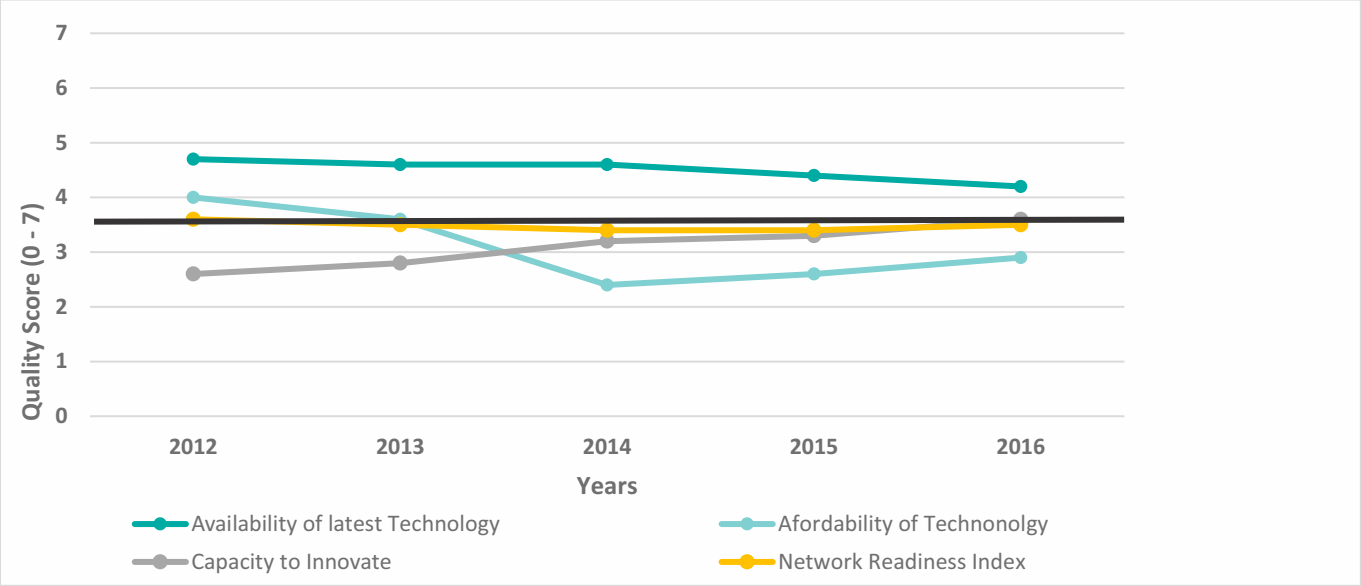
1. Technology and Innovation

Technological learning and innovation are essential for economic growth and development and are major determinants of long-term improvements in income and living standards. Long-term, "technological" drivers of productivity accounted for a large portion of labour productivity variation in the period 1980 – 2018, about 40 % of the one year ahead forecast error variance of labour productivity and 60 - 75 % of the five to ten year ahead forecast error variance of labour productivity. The cyclical, non-technological component of productivity growth accounts for the remainder and largely reflected volatile total factor productivity growth (World Bank, 2020).

Firms today face a changing environment characterised by the rapid advance of globalisation, the emergence of new competitors and the diversification of demand. In this context, firm's innovative capabilities depend not only on their internal competencies, i.e. Research and Development (R&D) activities, but also on their capacities to develop organizational strategies for managing their innovation processes. Considering this need, the use of Information and Communication Technologies (ICT) could be a "part of a larger system of technological and organizational change that increases firm-level productivity over time" (Brynjolfsson and Hitt [2003], 805).

Over the years, Botswana has been marked as below par regarding the Network Readiness Index by the World Economic Forum's Global Information Technology Report (GITR) (see Figure 3). The quality score for the index has always been below the average score of 3.5. In 2016, the quality score went slightly above average. This was mainly due to efforts by government to provide a conducive environment like the 40% reduction of wholesale internet prices by Botswana Fibre of Networks (BOFINET).
Figure 3 also shows that out of the best score of seven (7) Botswana has been rating between 4 and 5 in terms of availability of the latest technology. This means to some extent technology is available, but the challenging factor is that of affordability where it has been rating below average over time. This has also crippled the country in terms of its capacity to innovate. Factors contributing to Botswana's technological readiness are investigated below.

Figure 3: Botswana's technological Readiness (2012 -2016)



Source: Global Information Technology Reports (2012 – 2016)

a) Technological transfers

Technology transfer entails transferring new technologies invented at public research organizations to the private sector through commercialization of those technologies. It is a key ingredient to strengthening industry and global competitiveness. Botswana enterprises have little capacity for independent technological innovation. They own few intellectual property rights and rely on foreign countries for important or large equipment. The key technologies used in industries with huge production capacities, such as information technology and telecommunications, are owned by foreign enterprises. Technology transfer must support and upgrade existing technologies or replace it by suitable alternatives. Some of the technology transfer constraints in Botswana are as follows.

· *Poor communication of technology information* - Industries may be aware of the technology requirements for established products, but the possibilities of expansion or diversification are usually unknown. Even if the manufacturer is aware of technology opportunities, it is still difficult to obtain or develop new product designs.

· *Lack of relevant skills* – The skills gap coupled with low level of education particularly among entrepreneurs, makes diversification difficult to achieve with unfamiliar or new technology.

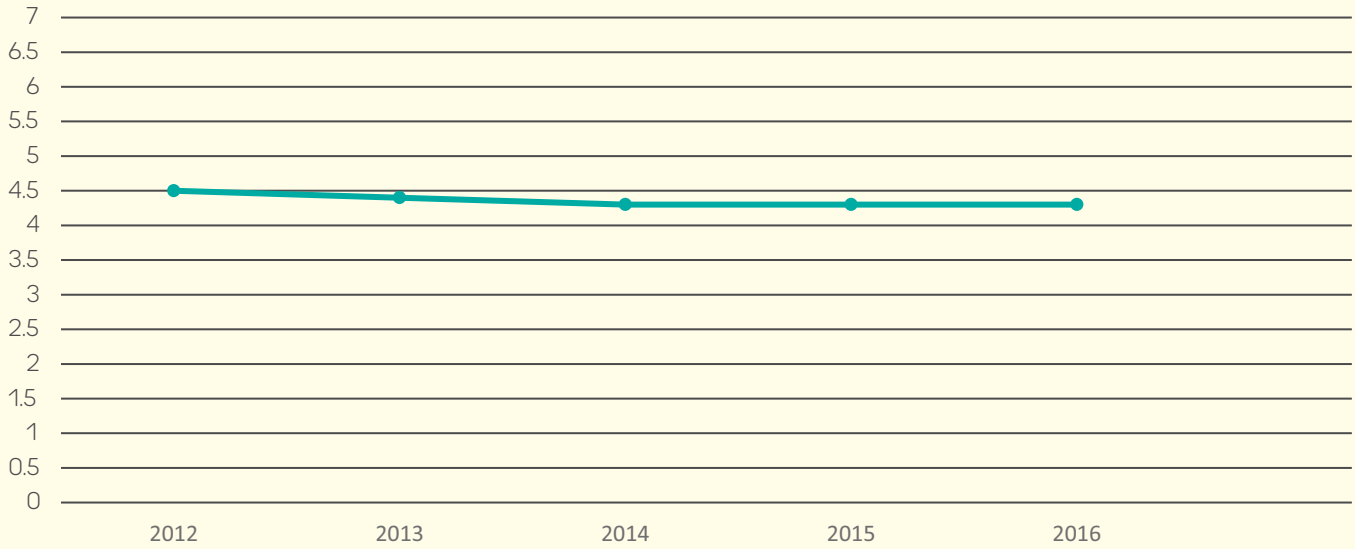
· *Infrastructure development* – This needs to be a step ahead of the industrial development. It should be a forerunner before technology transfer. For example, lack of laboratory testing equipment, is a constraint experienced by the country during COVID-19 crisis.

b) Technological absorption

Technological absorption determines if and to what extent a firm, an industry or, an economy, can use existing and new knowledge to compete. The process of technology transfer and the evolution of absorptive capacity for technology are interlinked and interdependent. Thus, enabling technology transfer involves developing absorptive capacities through, among other things, investing in a skilled workforce, guiding skills formation in strategically important sectors, and supporting the interaction between academic institutions and firms in order to target and incentivize for potential skills in demand (UNCTAD, 2011).

According to World Economic Forum (WEF), the firm level technology absorption in Botswana has somehow been satisfactory over time registering the highest score of 4.5 out 7 in 2012 (Figure 4). The provision of the of two (2) undersea fibre optic cable systems being the East Africa Submarine System (EASSy) and West Africa Cable System (WACS) contributed to the better absorption of technology by firms.

Figure 4: Firm-Level Technology Absorption (2012 – 2016)



Source: Global Information Technology Reports (2012 – 2016)

Usually technological opportunities for innovation do not materialize ready for immediate implementation rather, they may be ambiguous, unstructured and difficult to assimilate. The prior technological knowledge base determines the ability to make, recognize, adapt, adopt and generate value using new knowledge or technology. Thus, the economy's existing knowledge base is very important in driving technological absorption.

Innovative capacity is strength or the proficiency of a set of organizational practices for the development of new products/processes. Technological innovations in products and processes include the implantation of technologically new products and processes and substantial technological improvements in products and processes (OECD, 2004).

The escalating rise in the transfer of technology without a corresponding rise in the eventual deployment of the received technology, indicates that there is a gap in the technology diffusion process in Botswana. Owing to cultural, governance and legal barriers in several African countries, the full-scale adoption, diffusion and assimilation of technologies and innovation have remained complex endeavours across Africa including Botswana. African countries must do much more to address the continent's current technology gaps by removing legal, institutional and governance barriers to the smooth absorption of climate technologies. Key obstacle to technology absorption and assimilation in Africa is the weak legal protection for intellectual property rights (IPRs) (Damilola, 2017).

c) Research, Innovation and Development

Research and Development (R&D) is crucial in transforming Botswana into a knowledge-based economy. The emphasis should be on research and innovation encompassing indigenous knowledge and technology with a view to finding solutions to local problems. The government should strengthen policy tools for increasing the rate of return for new technology and encouraging its development. These policies should include direct government funding and tax incentives for R&D, protection of intellectual property in addition to forming cooperative relationships between universities and the private sector.

Efforts by the University of Botswana (UB) and the Botswana International University of Science and Technology (BIUST) have demonstrated that domestic innovation and R&D is possible. According to the 2019 UNESCO statistic, these two universities are the country's most active research universities, producing 328 Web of Science (WoS) articles in 2018. Work by these institutions has shown that there is untapped potential in the country that needs to be nurtured and promoted.

Improving the allocation of funding to R&D is key. The 2019 GCR indicates that the R & D expenditure as a percentage of GDP for Botswana is 0.5. R&D needs to be prioritized to guide in the development of solutions that can improve the country's productivity and competitiveness. This will help in coming up with prospects for productivity growth in the long run.

NDP 11 has dedicated chapters on research, innovation and development and establishes main priority areas including health, mineral processing, energy, etc. Despite these initiatives, very little is happening in the sector of competitive research development and innovation. For example,

- There have been very few calls for competitive grants for research projects.
- There have been a few calls for innovation proposals through the Botswana Innovation Hub (BIH),
- There has been limited funding for R&D

d) Information Communication and Technology (ICT)

The Fourth Industrial Revolution (4IR) has forced economies to prioritise Information Communications Technologies (ICTs) as the catalyst for the next wave of economic development. To this end, the government of Botswana has developed the National Broadband Strategy (NBS), which will provide a holistic and coordinated approach to the implementation of the ICTs ecosystem in the country with a view to achieving long-term strategic outcomes. The overall vision of the NBS is to connect every citizen, business, and community to a high-speed broadband infrastructure at appropriate quality of services and affordable prices.

ICT is critical in driving economic transformation. However, leveraging on ICT for the digitization of the economy requires its faster adoption. During his 2020 Budget Speech the Minister of Finance and Economic Development mentioned that, as part of the efforts to expand access to the broadband internet services, Government, through BOFINET, started rolling out Fibre-To-The-Business and Fibre-To-The-Home in Gaborone during the financial year. Government will also capitalise on the demand for digital skills by focusing on implementation of e-services across its delivery models, as part of the fourth industrial revolution.

2. Human Capital

Human capital consists of the knowledge, skills, and health that people accumulate over their lives. As such people's health and education have undeniable intrinsic value. Human capital also enables people to realize their potential as productive members of society. More human capital is associated with higher earnings for people, higher income for countries, and stronger cohesion in societies as well as higher levels of productivity. It is a central driver of sustainable growth and poverty reduction (HCI, 2020).

The Government remains committed to improving human capital skills and knowledge as they are critical inputs to private sector development and industrialisation. In addition to availing financial resources towards the building of human capital, more measures will be taken to reform the entire education sector as part of the transformation agenda (MFED, 2020).

Table 2: The Global Human Capital Index (2015 – 2017)

YEAR	HCI SCORE	RANKING (# of countries)
2015	60.81	88 (124)
2016	60.50	96 (130)
2017	57.56	91 (130)

Source: Global Human Capital Reports, 2015 -2017.

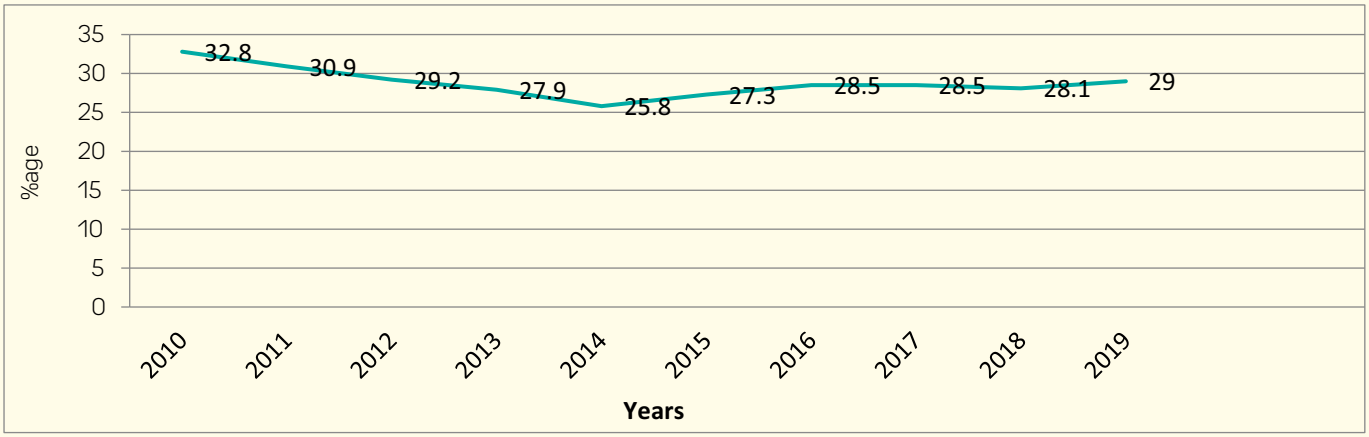
Table 2 shows an assessment by the World Economic Forum (WEF) using the Human Capital Index (HCI) on how Botswana is developing and deploying its human capital over time. The score, which is out of 100 shows that there is still a lot to be done by Botswana to improve on its human capital. There has been a drop in the score since 2015. Below is an analysis of education and health as some of the key components of human capital that impact on productivity of Botswana.

a) Education and skills development

The Botswana government considers education a vital tool that can be used to transform the economy. This is evidenced by how much of the national annual budget is invested in education, which is about two-thirds (Malejane et al 2019). However, there has been a decline in the performance of the education system which has far-reaching implications for the country, one of them being the negative impact on productivity. Noticeably, the country's education system is faced by a lot of challenges such as the following.

- *Poor results.* The results have been declining for years now in a row with a slight improvement after 2015. See figure 5 for the overall BGCSE results over time.

Figure 5: BGCSE Overall performance (2010 -2019)



Source: Botswana Examination Council Website, 2019

1. They compare output (real GDP) against only one input (i.e. Labour or capital) at any one point

- *Poor programmes* - The system is also suffering from the negative effects of the past poor programmes which included a two-year junior certificate as well as the double shift programme and automatic progression of standard seven students, among others. The effects of the programmes are already felt as the country experiences the extraordinary effects of crime and other social ills. (Malejane et al 2019). Currently double shifts have been introduced as way of decongesting schools during the COVID-19 crisis. The results for will be realised in the coming years.

Vocational training has shown to be extremely significant and to some extent more powerful than tertiary education, as it provides hard skill in comparison to tertiary institutions that just teach theory. Vocational graduates can easily become self-employed in comparison to tertiary graduates who need to be employed mainly in the formal sector. However, the market still focusses on those who possess tertiary education qualification because of the believe that tertiary education has a greater comparative advantage when it comes to accessing different sources of information, technology adoption, learning by doing and the ability to learn from experience.

Virginiah Ndung'u (2014), in her study on employability of tertiary institutions graduates and the impact on work ethic in Botswana, concluded that the Botswana education system is weak in practical experience. It was also concluded that the syllabus was not flexible and industry participation in training is minimal despite the training levy rebates. This has resulted in a mismatch between the employees' skills and knowledge with the jobs they perform. Some graduates may be overqualified for the positions they hold while others may be underqualified. Whatever the case, this mismatch leads to job-related stress thus impacting on their productivity, earning potential and progression potential.

According to Botswana's National Human Resources Development (NHRD) Strategy and the Monitoring and Evaluation Plan Report by the Human Resources Development Council (HRDC), part of the skills mismatch issue in Botswana's labour market is that the economy needs elementary skills and other low to middle level blue-collar skills while the training is skewed towards training at slightly higher white collar level. The plan is expected to address the graduate skillset being the imbalance between hard and soft skills, quality of training and skills mismatch.

b) Health

Many studies show a direct link between productivity levels and the general health and well-being of the workforce. Worker's well-being is a key factor in determining an organisation's long-term effectiveness. Black (2008) recognizes that, there is strong and growing evidence that work, health and wellbeing are closely and powerfully linked and need to be addressed together. In addition, more progressive organizations are increasingly recognizing the need to take the well-being of their workers seriously because they appreciate that human resources are their most important resources.

Botswana has made strides in improving geographical access to health services, including almost universal access to provision of antiretrovirals (ARTs) and prevention of mother to child transmission (PMTCT). It has qualified to be one of the countries earmarked for elimination of malaria, among other achievements. Progress has been made towards achieving most of the Sustainable Development Goal (SDG), the greatest of which is in SDG 3 regarding health and wellbeing. The Ministry of Health and Wellness is now focusing on improving quality of services in the next National Development Plan and strengthening of all the pillars of the health system will be crucial, while tackling the dual burden of communicable and noncommunicable diseases (WHO, 2016).

Nevertheless, the health sector is still faced with some challenges that can inversely impact on its productivity. The following are some the challenges;

- *Low after-hour services* by most facilities except for those offering maternal and outpatient services.

- *Weak supply chain management* with shortage of commodities, staff and equipment shortages as well as poor skill mix of health workers.

- *Weak health management information systems* necessary for planning and timely interventions as well as monitoring and evaluation.

- *Low capacity in health statistics* as evidenced by the late publication of the Health Statistics Report.

- *Epidemic diseases.* Black (2008) notes that, epidemic diseases have important implications for size, structure, and productivity of labor and therefore for the growth performance of an economy. COVID -19 as one of the epidemic diseases, has become a major threat to employment objectives and labor market efficiency worldwide. The loss of workers and work-days due to COVID - 19 can result in significant declines in productivity, loss of earning, and erosion in skills and experience.

- *Lack of vaccine or effective pharmaceutical treatment against COVID-19.* Botswana resorted to nonpharmaceutical interventions to slow the virus's spread. These interventions included country wide lockdown, restrictions on movement, work from home initiatives, imposing curfew to the nation, etc. These measures further amplified the disruptions that COVID-19 brought to supply chains and global trade, adding to the already dramatic economic dimension of the health crisis. The 2020 World Bank Human Capital Index report forecast for GDP in 2020 predicts a global drop of 5.2 %, the worst recession in eight decades, which is likely to push 100 million more people into poverty.

3. COVID -19

COVID-19 has impacted negatively on productivity through isolation, contact restrictions and economic shutdowns. Workplaces continue to face major disruptions in the form of remote work and non-traditional work schedules. Research shows that, productivity may be slowed down due to employees working fewer hours, exhausted by stressors like media overstimulation or a hectic home life or even due to illnesses.

The crisis threatens gains in human capital that countries have achieved through decades of effort. A renewed, society-wide commitment is needed to protect human capital in the immediate and to remediate the looming losses in the long run. Challenges range from crafting context-sensitive school re-opening protocols to deeper reforms that will promote children's learning at all stages: starting from cognitive stimulation in the early years, then continuing to nurture relevant skills throughout childhood and adolescence.

While the global economy is projected to decline by 3% (IMF, April 2020), which is far worse than a decline experienced in 2008 after the global financial crisis, the Botswana economy is expected to also contract by an estimated 8.9 % due to COVID-19 with economic sectors affected as in Table 3.

Table 3: Sectoral growth during COVID-19 Crisis

SECTOR	IMPACT (% Growth)
Mining	-33.6
Trade, hotel and restaurants	-32.2
Manufacturing	-10
Social & personal services	-4.8
Transport & Communication	-4.1

Source: IMF, 2020

Botswana has a doctor to population ratio of 5.27 doctors per population of 10,000, representing half of the WHO recommended 10 doctors per 10,000. The inevitable rationalization and equitable distribution of healthcare workers in response to COVID-19 in a country already facing shortage of skilled health workers will very likely impact the continuity and productivity of essential health services. (UN 2020).

KEY CONSIDERATIONS TO IMPROVE PRODUCTIVITY IN BOTSWANA

From the discussions above, it shows that leaders should take proactive steps to entrench transformative policies, bold investments, and new ventures into the future. There must be clear priorities for making Botswana more productive, sustainable, and inclusive. Such an approach requires courageous vision and a balance between the short- and long-term priorities. The following are some key considerations to improving productivity for Botswana as per the discussions above.

- **Skills** mismatches, talent shortages and increasing misalignment between incentives and rewards for workers are among the key issues identified for Botswana. There is need to fast track the implementation of the National Human Resource Development Plan (NHRDP) to address this concern.

- Botswana needs to rethink active **labour market policies** and investment expansion in the skills needed for jobs in "markets of tomorrow". In parallel, the country also needs to rethink **labour laws** for the new economy and use new talent management technologies to adapt to the new needs of the workforce.

- To effectively support the recovery and transformation process government needs to strive to **enhance service delivery mechanisms**, including digitisation of public services. In the long-run the government needs to ensure that public institutions embed strong governance principles in-order to regain public trust.

- **ICT adoption/usage** had been identified as one of the weakest links even prior to the COVID pandemic. The COVID pandemic exposed the need to address this area and accelerate digitisation of the economy.

CONCLUSION

It has emerged that technology, innovation and development and human capital are very important in improving the productivity of a country, thus if they are not enhanced there can be a stumbling block to productivity improvement. This article looked at how these factors affect the productivity of Botswana. The recent COVID-19 pandemic has also shown that it has a negative impact to productivity.

Policies and strategies that accommodate the new demand for skills, caused by the natural shift in demand of certain skills, ought to be fast tracked. Companies needs to reform their business processes and equip workers with new skills in line with current demand. The Fourth Industrial Revolution calls for a technological mind-set change in terms of skills, application and development of products and services Possible sources of growth for Botswana's productivity include the productive potential created by institutional reforms, and the improvement in productive efficiency brought about by several factors such as the import of technical expertise and human capital.

The technological gap between Botswana and developed countries will continue to widen unless Botswana firms are able to increase their core competitiveness through independent innovation. Innovation is not a decision but an ecosystem that is a foundation for knowledge-based societies and sustainable development. Botswana needs tools to map the landscape of research, innovation and development in order to strengthen national frameworks and take sharper decisions.

PRODUCTIVITY:

Key to Global Competitiveness and Sustainable Development

PRODUCTIVITY INSIGHT 2020

1. They compare output (real GDP) against only one input (i.e. Labour or capital) at any one point

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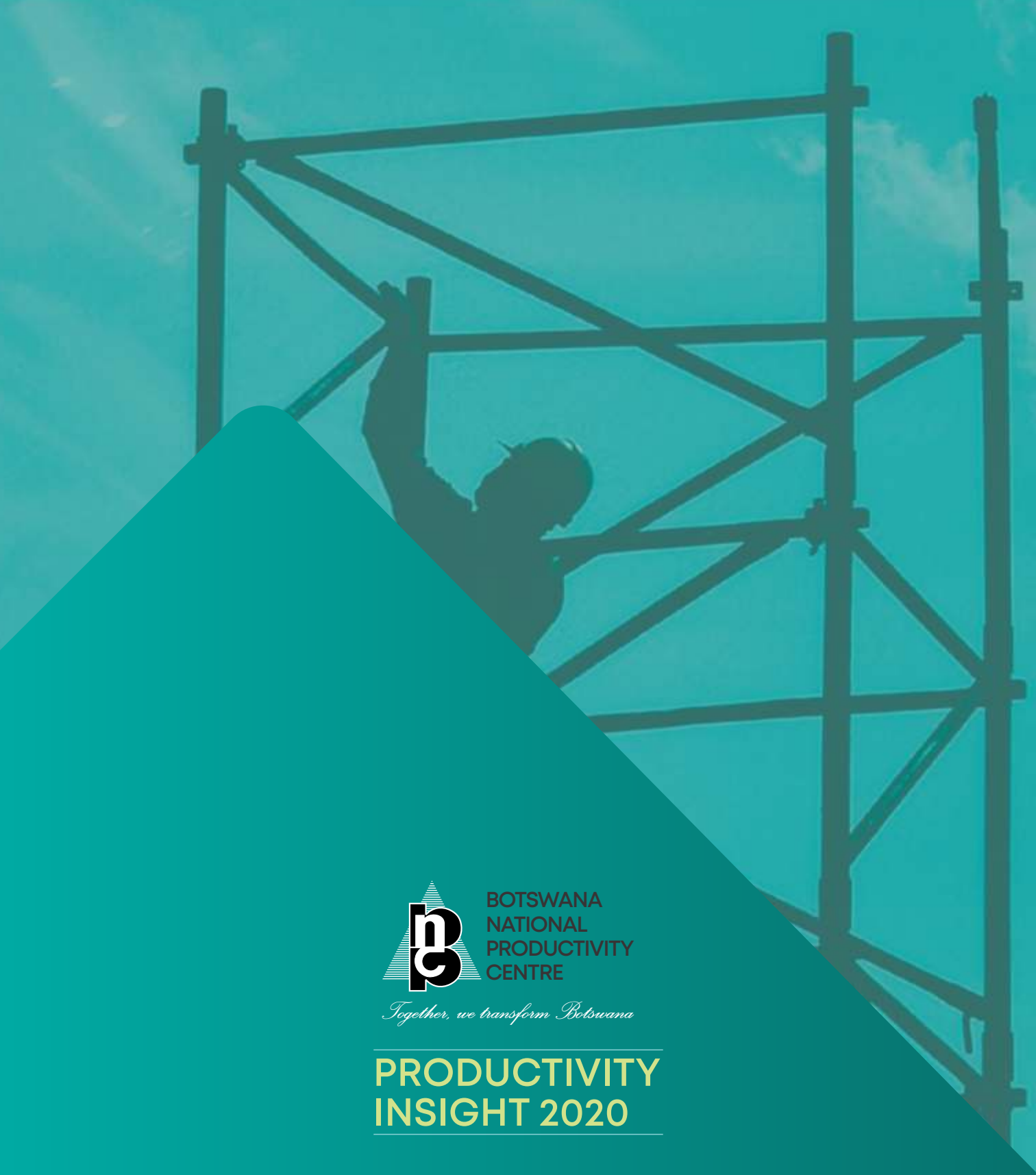

BOTSWANA NATIONAL PRODUCTIVITY CENTRE

Together, we transform Botswana

PRODUCTIVITY INSIGHT 2020

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