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The 2019 drought in Namibia: An overview

Rosemary N. Shikangalah*

Abstract

Namibia is one of most vulnerable countries to the effects of climate change due the aridity to most parts of the country. Events resulting from climate changes such droughts drive the majority of population to poverty when they occur. Drought spells have become a common feature in Namibia. In 2019, another drought hit Namibia and several resultant impacts made news. This study aimed at providing an overview of the drought impacts from the 2019 news headlines. The study employed an online survey on reported events based on both national and international news reports. The study found that the rainfall during the 2019 drought was the lowest recorded in Windhoek since 1891 and the drought was the worst in the last 90 years in Namibia. A combination of poor, sporadic rainfall and low soil moisture has led to very low agriculture production and an extreme shortage of water, affecting several communities across the country. As a result, at least one-third of the Namibian population was left without adequate food supplies and thousands of livestock perished due to drought. The study concluded that there is a need to adopt and use various drought survival mechanisms on a permanent basis rather than only implementing them when drought occurs. This would largely reduce the dependency on the interventions. Budgetary planning could focus for instance on establishing the required desalination plants and infrastructure for pumping water from the coast to distant needy communities.

Introduction

Climate change is one of the greatest challenges that the world is currently facing. During the twentieth century, the average temperature increased by at least 0.6˚C and it is expected to increase further by at least 1.4˚C in the 21st century.[1] The changes in temperature and rainfall patterns impact on water resources, affecting socio-economic

* Rosemary Ndawapeka Shikangalah is a Senior Lecturer in the Department of Geography, University of Namibia, Namibia. Her research interests are on rural and urban socio-eco-hydrological challenges and the influence of climate change on geo-biophysical cycles, with a focus on soil conditions and related ecological dynamics. E-mail: rshikangalah@unam.na

[1] Ministry of Environment and Tourism (MET), "National Policy on Climate Change for Namibia-2011", MET, 2011, http://www.met.gov.na/files/files/National%20Policy%20on%20Climate%20Change%20for%20Namibia%202011.pdf [accessed 28 October, 2019]; United Nations Development Program (UNDP), *Sustainable Management of Namibia's Forested Lands (NAFOLA)*, UNDP-GEF Project, 2014-2019, UNDP, 2019: 1-87.

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and biophysical environments, and hydrological cycles.[2] It is estimated that nearly half of the global population will face the problem of water shortages by 2030.[3] In 2019, the impacts of climate change resulted in drought that severely affected areas such as north-eastern China, North Korea, North Ontario in Canada, Southern Australia, Angola, Botswana, Namibia, Zambia, South Africa and Zimbabwe.[4] According to Denise Garcia, vulnerability to climate change depends on geographical positioning in relation to the equator, the level of dependence on agriculture sectors, and gaps in managing the socio-economic, financing, rate of poverty and population growth rate.[5] Africa has been recognised as most vulnerable to climate change, with impacts severely affecting poor communities in Southern Africa Development Community (SADC) countries.[6]

In southern Africa, the drought has led to an almost complete lack of rainfall during the planting season in regions such as Central Mozambique, Southern Angola, Southern Zambia, Namibia, Botswana and Zimbabwe.[7] In 2019, the annual agricultural output in Namibia and Botswana was estimated to have fallen to below 50% and lower than 40% in Zimbabwe than the 5 year average.[8] By the end of October 2019, up to 45 million

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[2] Siri E. H. Eriksen and Helene K. Watson, "The dynamic context of southern African savannas: investigating emerging threats and opportunities to sustainability", *Environmental Science & Policy*, 12 (1), 2009: 5-22 Eriksen & Watson, 2009; Samuel Kusangaya, Michele L. Warburton, Emma Archer Van Garderen and Graham P. W. Jewitt, "Impacts of climate change on water resources in southern Africa: A review", Physics and Chemistry of the Earth, Parts A/B/C, 67, 2014: 47-54; Francis Davison Yamba, Hartley Walimwipi, Suman Jain, Peter Zhou, Boaventura Cuamba and Cornelius Mzezewa, "Climate change/variability implications on hydroelectricity generation in the Zambezi River Basin", *Mitigation and Adaptation Strategies for Global Change*, 16 (6), 2011: 617-628.

[3] Karrie Lynn Pennington and Thomas V. Cech, *Introduction to Water Resources and Environmental Issues*, Cambridge, Cambridge University Press, 2010; Pierre Van Rensburg, "Overcoming global water reuse barriers: the Windhoek experience", International Journal of Water Resources Development, 32 (4), 2016: 622-636.

[4] Famine Early Warning System Network (FEWS NET), "Poor rainfall since late January strengthens dryness across Southern Africa", FEWS NET Global Weather Hazards Summary, 07 March 2019, https://reliefweb.int/report/world/global-weather-hazards-summary-march-01-07-2019 [accessed 12 October, 2019]; National Aeronautics and Space Administration (NASA), "Drought harms corn crops in Southern Africa", NASA Goddard Space Flight Center, 28 February 2019, https://earthobservatory.nasa.gov/images/144704/drought-harms-corn-crops-in-southern-africa [accessed 12 October, 2019].

[5] Denise Garcia, "The climate security divide: bridging human and national security in Africa", *African Security Studies*, 17 (3), 2008: 1-17; Thulani Dube, Philani Moyo, Moreblessings Ncube and Douglas Nyathi, "The impact of climate change on agro-ecological based livelihoods in Africa: A review", *Journal of Sustainable Development*, 9 (1), 2016: 256-267.

[6] John M. Callaway, "Adaptation benefits and costs: are they important in the global policy picture and how can we estimate them?", *Global Environmental Change. Human and Policy Dimensions*, 14, 2004: 273-282; Kusangaya et al., "Impacts".

[7] NASA, "Drought harms".

[8] Food and Agriculture Organisation (FAO), "Southern Africa: Emergency Response Plan 2019–2020", The Food and Agriculture Organization of the United Nations, 31 October 2019, http://www.fao.org/emergencies/resources/documents/resources-detail/en/c/1241365/ [accessed 31 October, 2019].

people across the 16 countries in the SADC region were found to be severely vulnerable to food insecurity, and this led organisations such as the International Federation of the Red Cross (IFRC) to seek around 3.5 million Swiss francs to assist Zambia and the EU to assist Zimbabwe with € 53 million.[9] The severity of the drought in 2019 meant that drought-related issues from across the region made news headlines. This paper therefore aimed at providing an overview of drought-related impacts that made news headlines in 2019, with a specific focus on Namibia. Such an overview helps to identify what measures are needed to reduce the impacts that are faced by the communities.

Literature review

Namibia is one of the driest countries in Africa. The country lies between two deserts, the Kalahari to the east and the Namib in the west. Typical of arid areas, the country is water stressed, characterised mostly by low and highly variable average annual rainfall, with exceedingly high evaporation rates of 83%.[10] The annual evaporation is estimated to be six times higher than the mean annual rainfall and 100 times higher in arid areas.[11] Namibia is prone to natural disasters and the country battles with flooding and drought events. The reoccurrence of droughts is currently a norm in most parts of the country, which led to the development of the National Drought Policy and strategy in 1997.[12] In recent decades, drought periods occurred from 1980 to 1984, 1992/1993, 2012/2013 and in 2019.[13] According to Richard Moorsom et al., the 1992/93 drought

[9] Food and Agriculture Organisation (FAO), "As climate shocks intensify, UN food agencies urge more support for Southern Africa's hungry people", The Food and Agriculture Organization of the United Nations, 31 October 2019, http://www.fao.org/news/story/en/item/1242784/icode/ [accessed 31 October, 2019]; International Federation of Red Cross and Red Crescent Societies (IFRC), Emergency Appeal Zambia: Drought (Food Insecurity), 29 October 2019, https://reliefweb.int/sites/reliefweb.int/files/resources/MDRZM012do.pdf [accessed 31 October, 2019]; European Commission, "EU to step up its support to Zimbabwe with a new package of €53 million", European Union Press Corner, 28 October 2019, https://ec.europa.eu/commission/presscorner/detail/en/IP_19_6170 [accessed 30 October, 2019].

[10] Brenda Bravenboer, *Windhoek: Capital of Namibia*, Windhoek, Gamsberg Macmillan, 2004; Marelize Mostert, *Urban water supply and demand management: a case study of Windhoek*, Namibia, PhD Diss., Stellenbosch, Stellenbosch University, 2017.

[11] Peter J. Jacobson, Kathryn N. Jacobson and Mary K. Seely, *Ephemeral rivers and their catchments: sustaining people and development in western Namibia*, Windhoek, Desert Research Foundation of Namibia, 1995; Mary Seely, Judith Henderson, Piet Heyns, Peter Jacobson, Tufikifa Nakale, Komeine Nantanga and Klaudia Schachtschneider, "Ephemeral and endoreic river systems: Relevance and management challenges", in: Anthony Turton, Peter Ashton and Eugene Cloete, (eds.), *Transboundary Rivers, Sovereignty and Development: Hydropolitical Drivers in the Okavango River Basin*, University of Pretoria, African Water Issues Research Unit, 2003: 187-212.

[12] National Drought Task Force, *Towards a drought policy for Namibia. A discussion document prepared by the National Drought Task Force for a workshop at Neudamm Agricultural College 11-13 March 1997, Namibia*, Windhoek, National Drought Task Force, 1997.

[13] Annelie Coleman, "Breeding cattle that thrive in Namibia's arid regions", *Farmer's Weekly*, 18 October 2019, https://www.magzter.com/article/Business/Farmers-Weekly/Breeding-Cattle-That-Thrive-In-Namibias-Arid-Regions [accessed 18 October, 2019]; Stephen Devereux and Trine Naeraa, "Drought and survival in

saw rainfall levels just below normal, and hence was not so extreme.[14] However, the drought of 2012/2013 was thought to be the worst of the decade as around 42% of the total population experienced food insecurity. The Namibian government declared a state of emergency requested $33.7 million of international support.[15] Both rainfall and temperature in Namibia were significantly influenced by the El Niño Southern Oscillation (ENSO), and below average rainfall was experienced during the ENSO.[16] Average annual rainfall for almost two-thirds of the country is 250mm in normal rainfall periods and lower during the ENSO.[17] With such low average rainfall, the country relies heavily on groundwater systems for supplies for both the rural and urban population.

Observations and analyses made over the last decade showed that there has been a continuous rise in temperatures and decrease in the annual rainfall from December to March, resulting in shorter seasons in Southern Africa.[18] Moreover, a further decline in rainfall of up to 5% is expected over the southern African region.[19] Projections for the Namibian climate showed that there will be a further drop in the amount of rainfall and that it will also be highly variable, leading to drier conditions and further water shortages as well as reduced yields from rain-fed agricultural activities.[20] Recent studies have shown that for each 1% change in rainfall, there is an effect of 1.2 to 1.6% on carrying capacity. With rainfall estimated to decline by about 10% by 2050 in the Southern Namibia, a decline in carrying capacity of 10% in southern and 15% in central Namibia is expected.[21]

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rural Namibia", *Journal of Southern African Studies*, 22 (3), 1996: 421-440; Azad Essa, "Namibia battles worst drought in decades", Aljazeera, 09 October 2019, https://www.aljazeera.com/indepth/features/2013/10/namibia-battles-worst-drought-decades-201310851010116562.html [accessed 12 October, 2019]; Richard Moorsom, Jutta Franz and Moono Mupotola, *Coping with Aridity: Drought Impacts and Preparedness in Namibia-Experiences from 1992/93*, Frankfurt am Main, Brandes & Apsel, 1995.

[14] Moorsom et al., *Coping with Aridity*: 32.

[15] Essa, "Namibia battles".

[16] Hannah Reid, Linda Sahlén, Jesper Stage and James MacGregor, "Climate change impacts on Namibia's natural resources and economy", *Climate Policy*, 8 (5), 2008: 452-466.

[17] MET, "National Policy".

[18] Intergovernmental Panel on Climate Change (IPCC) Core Writing Team, Rajendra K. Pachauri and Leo A. Meyer, (eds.), *Climate Change 2014 Synthesis Report. Contributing of Working Groups: I, II and III to the Fifth Assessment Report of the International Panel on Climate Change*, Geneva, Switzerland, 2015, https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_wcover.pdf [accessed 31 October, 2019]; Kusangaya et al., "Impacts"; Waturu Morishima and Ikumi Akasaka, "Seasonal trends of rainfall and surface temperature over southern Africa", *African Study Monographs, Supplementary Issue*, 40, 2010: 67-76.

[19] Martin Hoerling, James Hurrell, Jon Eischeid and Adam Phillips, "Detection and attribution of twentieth-century northern and southern African rainfall change", *Journal of Climate*, 19 (16), 2006: 3989-4008.

[20] Dube et al., "Impact"; Reid et al., "Climate change".

[21] UNDP, *Sustainable Management.*

Settings

Current state

Namibia covers 825,419 km² (318,772 sq. mi.). Of the total area of the country, 22% is classified as hyper-arid (desert), 33% as arid, 37% as semiarid, and only 8% is sub-humid (Fig. 2c).[22] The country has an average annual rainfall of 250mm, with less than 10mm in the hyper-arid areas (mainly desert) and 600mm in sub-humid areas of subtropical and savanna lands, while the temperatures range between 16˚C in coastal areas to 22˚C in subtropical areas (Fig. 2a & b).[23] According to Adel El-Beltagy and Magdy Madkour, Yoshihiro Hirooka et al., and Michael Zika and Karl-Heinz Erb, the impact of climate change is expected to be severe in semi-arid and arid ecosystems and the already difficult conditions become more acute.[24]

The population was estimated to be 2.1 million population in 2011 but currently estimates put it at 2.5 million.[25] The majority (62%) of the Namibian population lives in rural areas, from which one can deduce that there is a heavy dependence on farming systems and thus vulnerability to any negative changes.[26] The population depends largely on natural resource sectors that are climate sensitive (agriculture and fisheries), and depends heavily on rain fed agriculture.[27] Subsistence farming suffers most under climate change, and this has become a great concern for Namibia as close to two-thirds of the population live from this form of agriculture.[28]

Groundwater is the most important water source in Namibia with around 80% of the country depending on it during drought periods.[29] About 65% of the water supply is obtained from groundwater systems such as boreholes and wells, and only 35% is from

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[22] National Drought Task Force, *Drought Policy .*

[23] Robert Mendelsohn, Kerry Emanuel, Shun Chonabayashi and Laura Bakkensen, "The impact of climate change on global tropical cyclone damage", *Nature Climate Change*, 2 (3), 2012: 205-209.

[24] Adel El-Beltagy and Magdy Madkour, "Impact of climate change on arid lands agriculture", *Agriculture & Food Security*, 1 (3), 2012: 1-12; Yoshihiro Hirooka, Koichi Shoji, Yoshinori Watanabe, Yasuhiro Izumi, Simon K. Awala and Morio Iijima, "Ridge formation with strip tillage alleviates excess moisture stress for drought-tolerant crops", *Soil and Tillage Research*, 195, 2019: 104429; Michael Zika and Karl-Heinz Erb, "The global loss of net primary production resulting from human-induced soil degradation in drylands", *Ecological Economics*, 69 (2), 2009: 310-318.

[25] National Statistics Agency (NSA), *Namibia 2011. Population and Housing Census. Preliminary Results*, Windhoek, 2011; World Population Review, "United Nations population estimates and projections", Worldpopulationreview.com, 07 June 2020, http://worldpopulationreview.com/countries/namibia-population/ [accessed 07 June, 2020].

[26] MET, "National Policy".

[27] Ibid.

[28] Reid et al., "Climate change".

[29] Namibia Agricultural Union (NAU), "The effect of bush encroachment on groundwater resources in Namibia: A desk top study", Windhoek, NAU, 2010, http://www.agrinamibia.com.na/wp-content/uploads/2018/02/ [accessed 12 October, 2019]; United Nations Framework Convention on Climate Change (UNFCCC), *Namibia second national communication to the United Nations framework convention on climate change*, Windhoek, Republic of Namibia, 2010.

surface water sources such as dams and other means of harvesting from the catchments.[30] However, only 1% of the rainfall goes to groundwater recharge as 2% is surface overflow, 14% returns to the atmosphere through evapotranspiration and 83% of the rainfall evaporates.[31] A small reduction in the amount of rainfall due to climate change can significantly affect the recharge of aquifers, affecting the water situation not only for human, livestock and wildlife populations, but also for the associated functions and processes of the ecosystems in Namibia.

Figure 1: Namibia location[32]

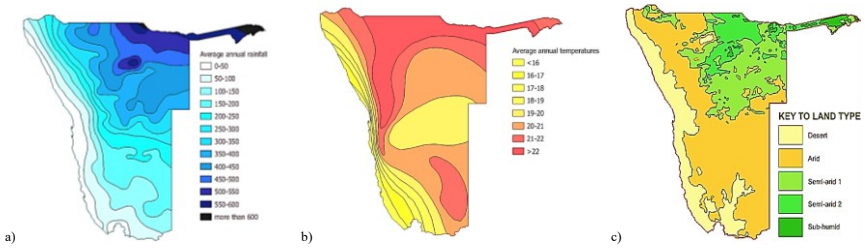


[30] Namibia Water Corporation, "NamWater Annual Report", NamWater, 2017, https://www.namwater.com.na/images/docs/Namwter_Annual_Report_2017.pdf [accessed 30 October, 2019].

[31] Ibid.

[32] Richard F. Logan and George B. Silberbauer, "Kalahari Desert", *Encyclopaedia Britannica*, 24 December 2019, https://www.britannica.com/place/Kalahari-Desert [accessed 08 October, 2019].

Figure 2: a) Rainfall, b) Temperature[33] and c) Land type regions[34]



Material and methods

According to Katiuscia Fara, the past decade has witnessed an increasing interest in disasters largely because of increased media reporting of disaster events such as drought.[35] This research paper is based on reports from the online version of news, taking after many scholars that have explored climate change related research based on news headlines.[36]

The search was conducted in two steps. In the first step, only the headlines were considered because headlines serve as a cognitive shortcut to draw the readers' attention more than the texts do.[37] The second step looked into the text of the articles to remove the articles that did not relate to water or drought related impacts, although their titles / headlines seemed to suggest so. A total of 63 news headlines for the 2019 drought in Namibia were used in this study. Most of them (42) are listed in Table 1.

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[33] Mendelsohn et al., "Impact".

[34] Vilho Mtuleni, *Comprehensive environmental plan for road transportation of sulphuric acid along Trans-Zambezi (Walvis Bay – Wenela Border), Namibia,* Walvis Bay, Ministry of Environment and Tourism, 2019.

[35] Katiuscia Fara, "How natural are 'natural disasters'? Vulnerability to drought of communal farmers in Southern Namibia", *Risk Management*, 3 (3), 2001: 47-63.

[36] Maxwell T. Boykoff and Jules M. Boykoff, "Climate change and journalistic norms: A case-study of US mass-media coverage", *Geoforum*, 38 (6), 2007: 1190-1204; James D. Ford and Diana King, "Coverage and framing of climate change adaptation in the media: A review of influential North American newspapers during 1993-2013", *Environmental Science & Policy*, 48, 2015: 137-146; Robert J. Lennox, David A. Crook, Peter B. Moyle, Daniel P. Struthers and Steven J. Cooke, "Toward a better understanding of freshwater fish responses to an increasingly drought-stricken world", *Reviews in Fish Biology and Fisheries*, 29 (1), 2019: 71-92; Brian Miles and Stephanie Morse, "The role of news media in natural disaster risk and recovery", *Ecological Economics*, 63 (2-3), 2007: 365-373; Marc Agon Pacoma, "Environmental realities: evaluating climate change coverage of Philippine online news media", *Jurnal Studi Komunikasi*, 3 (1), 2019: 1-26; Nancy W. Smith and Helene Joffe, "Climate change in the British press: The role of the visual", *Journal of Risk Research*, 12 (5), 2009: 647-663; Tammy Speers, "A picnic in march: media coverage of climate change and public opinion in the United Kingdom", Springer, *GeoJournal Library*, 81, 2005: 121-135.

[37] Blake C. Andrew, "Media-generated shortcuts: Do newspaper headlines present another roadblock for low-information rationality?", *Harvard International Journal of Press/Politics*,12 (2), 2007: 24-43; Sara Leckner, "Presentation factors affecting reading behaviour in readers of newspaper media: an eye-tracking perspective", *Visual Communication*, 11 (2), 2012: 163-184 (169).

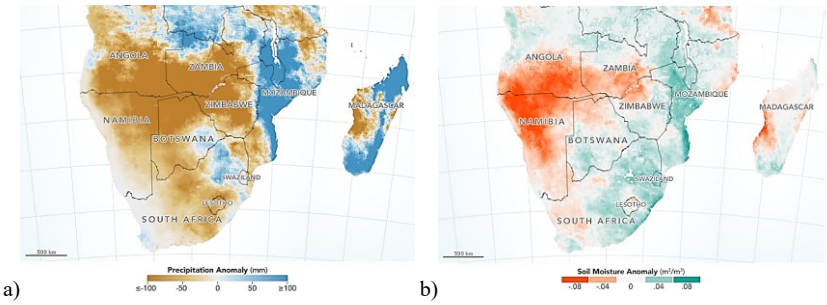
Search words included: drought in Namibia 2019, drought in Namibia, water crises in Namibia 2019 and water shortage in Namibia. The aim was to get reports of drought cases that have been reported in Namibia from January to October 2019. The search was carried out only in October because the rainfall season usually starts then and rain was reported to be expected from then onwards.[38] The search was carried out repeatedly until no more accessible new headlines were showing. The way the news is presented in this study does not mean that one newspaper or news platform had reported the issue more than the others, it all depended on which newspaper the author found the topic first. Further reports on the same topic in other newspapers were ignored to avoid duplication. While the result section concentrated on the reported cases of drought, the discussion section focused on survival during the drought period.

Results

Early warning of drought over Southern Africa 2019

Figure 3 shows the drought conditions at the prime time (cultivation time) in Southern Africa. The whole Namibia had an overall deficit in precipitation anomalies (Fig. 3a). About one-third of the country showed a deficit of -100mm, another one-third showed a deficit of -50mm while the last one-third had better results, showing a deficit of -25mm to -0mm. This was, however, in the driest part of the country in general, with arid to hyper arid areas. The soils were found to be very dry, especially over entire area of Namibia and Southern Angola. At least half of Namibia had soil moisture of -0.08m3/m3 while the rest of the country had -0.04m3/m3 from December 2018 to January 2019 (Fig. 3b). According to FEWS NET and NASA, these conditions intensified over time and persisted until mid-March, which is the end of the cultivation time in Namibia.[39]

Figure 3: Anomalies: a) Rainfall (mm) and b) Soil moisture (m3)[40]



a) b)

[38] National News, "Promising rainy season forecasted amidst drought", *The Namibian*, 10 October 2019 https://www.namibian.com.na/194072/archive-read/Promising-rainy-season-forecast-amidst-drought [accessed 26 October, 2019].

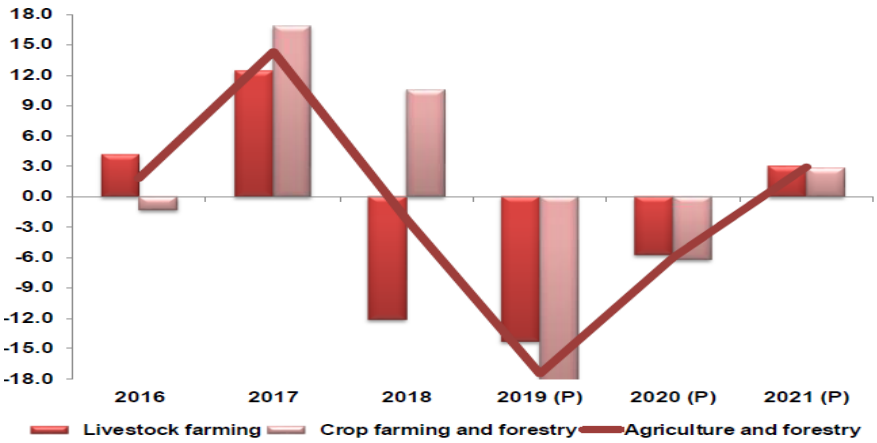
[39] FEWS NET, "Poor rainfall"; NASA, "Drought harms".

[40] NASA, "Drought harms".

Drought and agriculture activities

The agricultural sector is one of the primary industries. According to the Bank of Namibia, the overall output of primary industries in Namibia was expected to decline in 2019.[41] Due to extremely low rainfall in 2019, production in the sector fell by 17.5% (Fig. 4) and crop growing was most severely affected. As the area planted was smaller in 2019, output declined from a positive 10% in 2018 to a minus18% in 2019 (Fig. 4). Moreover, livestock production was already in minus in 2018 and this declined further in 2019.

Figure 4: Annual percentage (%) changes of farming activities, "P" stands for projection[42]



While overall crop production fell in 2019 (Fig. 4), cereal production in particular was estimated to be 53% lower than in 2018, and 42% lower than the 20-year average.[43] Figure 5 below shows the difference between the availability of cereals and the required amount of cereals from 2014 to 2019. The highest deficit occurred in the year 2018/2019. The table shows improvements during the 2019/2020 year period. This could be attributed to more forecasted rainfall for that period, which covers the end of 2019 and the beginning of 2020, and which could improve cultivation during the 2019/2020 period.

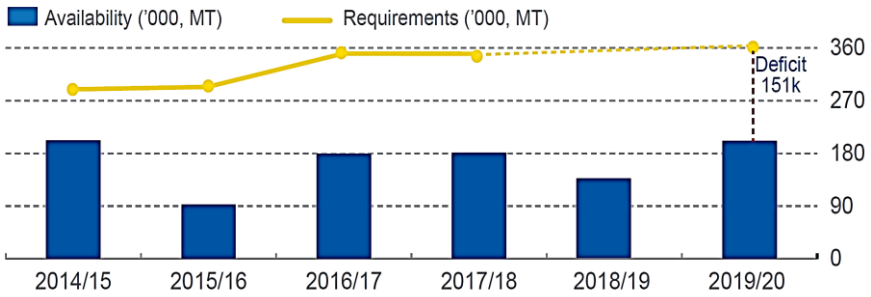
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[41] Bank of Namibia, "Economic Outlook – July 2019", Media Release, 27 August 2019, https://www.bon.com.na/CMSTemplates/Bon/Files/bon.com.na/f0/f0f40ed8-c16d-420b-8534-38ef1bd1f4b9.pdf [accessed 11 October, 2019].

[42] Ibid.

[43] Southern African Development Community (SADC), "Namibia: Vulnerability assessment committee results 2019", SADC Regional Vulnerability Assessment and Analysis Programme, 31 July 2019, https://reliefweb.int/report/namibia/namibia-vulnerability-assessment-committee-results-2019 [accessed 16 October, 2019].

Figure 5: Cereal availability and requirement[44]



Drought headlines

News headlines on drought started as early as April 2019, in both national and international newspapers and on other media platforms. Table 1 shows a list of headlines gathered in this study. Lack of drinking water for both humans and animals (livestock and wildlife) was treated as a more serious threat than concerns about crop production, which made only a few headlines.

Apart from the drought being the most severe in the last 90 years, the rainfall during the 2019 drought was the lowest recorded in Windhoek since 1891.[45] The drought was also declared a national emergency. The 2019 drought spell left around one third of the Namibian population depending on drought relief support systems with more than one third (36%) found to be exposed to food insecurity, while 8.64% were estimated to be from rural areas.[46] During this drought, lives were also lost during attempts to dig wells to reach groundwater and at least 90,000 livestock died, mostly as a direct result of thirst, but also due to the resultant deterioration of the grazing areas. Furthermore, the government sold off wildlife in an attempt to save it from the effects of drought, particularly thirst, and loss of pastures and vegetation.

The 2019 drought led to calls to support Namibia and various interventions were provided, mostly monetary donations but also of food and other goods. Despite this support, the drought relief efforts could not provide the necessary assistance to the affected communities by October 2019 and the state of emergency was extended for a further six months, to March 2020. This study opted to not list the contributions because many interventions and contributions may not always have been made public and/or made headline.

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[44] Ibid.

[45] New Era, "Namibia's devastating drought: Our strategy so far", *New Era*, 07 June 2019, https://neweralive.na/posts/namibias-devastating-drought-our-strategy-so-far [accessed 16 October, 2019].

[46] SADC, "Namibia".

Table 1: News headlines

Category	Publication Date	Publisher	Headline	Remark
General	06/05/2019	The Namibian	Drought declared national emergency	President Hage Geingob declared a state of emergency in Namibia as a result of the drought the country is facing
	07/05/2019	BBC news	More than 500,000 at risk in drought-hit Namibia	The lack of rain has already left 500,000 people - one in five Namibians without access to enough food
	12/07/2019	New Era	Water remains a daunting task	Water management and supply in Namibia remains a daunting task
	13/08/2019	Namibian Sun	Not out of the woods yet	Drought recovery will the biggest challenge for the next 3-5 years for the agricultural sector
	15/08/2019	Namibian Sun	Save water before summer	Saving target is met for July, but more effort is still needed
	21/08/2019	Namibian Sun	Namibians dread worsening drought	Worst drought in history
	03/10/2019	Namibian Sun	Third of Namibians on drought aid	More than 1/3 of population on drought relief
	03/10/2019	The Namibian	State of drought emergency extended	State of drought emergency extended for six months, to March 2020
	09/10/2019	NBC	Government says drought relief funds not enough for all affected communities	Drought relief insufficient despite contributions from local and international donors
	07/11/2019	The Southern Times	Namibia's worst drought in 90 years	Current drought worst in the last 90 years
	22/11/2019	New Era	Drought exacerbates cable theft in the south	A rise in copper cable theft
Household level	17/06/2019	Namibian Sun	Buried alive	Well collapses while digging for water
	30/06/2019	We.com.na	New water restrictions in full force	Water restriction effective on 1 July 2019. Use no more than $25m^3$ per household

	02/07/2019	New Era	18000 Oshikoto households drought hit	Drought worsens - A total of 18677 households are severely affected
	19/08/2019	The Namibian	Khomas hit by severe food, water shortages	Severe shortage of food and water in the Windhoek rural constituencies
	17/09/2019	Namibian Sun	Windhoek's water situation dire	The city issued an urgent warning for reduction on water consumption
	19/09/2019	The Namibian	Ovitoto faces water shortage	Farmers in Ovitoto face severe water shortages for both human and animals
	01/10/2019	Namibian Sun	Hardap is running dry	Farmers in Hardap to cut back irrigation by 40% to save water
	25/10/2019	The Namibian	Conservancy comes to farmers' rescue	The Ehirovipuka conservancy purchased 353 bales of lucerne to support members to make it through the current drought
	29/10/2019	www.news.cn	Namibian capital still in severe water scarcity category	Windhoek exceeds the weekly water saving target of 7%
Crops	25/04/2019	The Namibian	Namibia: Poor rainfall impacts country' agricultural production	Aggregate cereal production falls to 53% of 2018, and 42% below the average production
	02/05/2019	FAO: GIEWS	Dry weather conditions severely affected cereal production in 2019	Cumulative season rainfall volumes were 60-70% below the average
	04/10/2019	The Namibian	Drought pushes farmers to the edge	No harvests for two years
Livestock	26/04/2019	The Namibian	Drought kills about 64000 animals in 6 months	Deteriorating grazing conditions being experienced as rainfall levels drop below average
	28/05/2019	The Namibian	A farmer's plight amid the drought	Small scale farmer loses half of his cattle head and appeals for assistance
	11/09/2019	New Era	Over 30,000 drought-related cattle deaths recorded in seven months	Over 30,000 drought-related cattle deaths between October 2018 and April 2019, rainfall period

	11/06/2019	The Namibian	Otjozondjupa loses 7,700 livestock to drought	Between October 2018 and March 2019, Okahandja, Okakarara, Tsumkwe and Omatako constituencies lost large and small livestock due to drought
	04/09/2019	Namibian Sun	90,000 livestock perish	Close to 90,000 died between October 2018- June 2019 due to drought
	11/09/ 2019	The limited times	In eastern Namibia, a historic drought starves men and beasts	No rain has fallen in two years, animals eating plastic detritus
	12/09/2019	The Namibian	Namibia farmers raise concern over livestock predation due to drought	Communal farmers in the Kunene region say they have had a significant increase in livestock predation by lions
	10/10/2019	New Era	Drought fuels stock theft in Zambezi	A rise in stock theft incidences, affecting communities with livestock
Wild animals	06/06/2019	The Namibian	Drought worsen human-wildlife conflict	7 injured by hippos, 3 by crocodile, 1 by lion and 1 by leopard, 1246 lost animals to predators and 1400 hectares of crops to elephants
	19/06/2019	An elite Cafemedia publisher	Drought in Namibia so bad, Parks are auctioning their wild animals	Namibia selling 1000 wild animals from national parks
	14/08/2019	Namibian Sun	Lifeline for stranded Chobe hippos	68 hippos are stranded in the drying river
	16/08/2019	Gondwana's newsroom	Drought in Etosha park causes headaches	Rainfall on average yield only 30% of the Etosha normal rainfall, and part of the park has been experiencing drought for the last 3 years.
	12/09/2019	The Namibian	Drought makes livestock easy prey for predators	Communal farmer who lost 25 of the 44 goats killed by lions
	02/10/2019	Save the Rhino	The black rhinos surviving Damaraland's drought	Euphobia damarana bush used by rhino when other vegetation died out.

Call for support	02/04/2019	New Era	Namibia: Call to support Namibian drought disaster fund reaches SA	Namibia is suffering the worst drought in recent history
	05/08/2019	NBC	President Geingob calls on Namibians to put measures in place to mitigate effects of drought	Mitigation for both human and animals
	12/08/2019	NBC	Prime Minister appeals for coordination among donors to the drought affected communities	Private donors to coordinate with government to avoid duplications
	27/09/2019	New Era	Foresight needed to remedy recurrent drought	Status quo will continue for a long time to come.

Discussion

Making it to 2020

In the year 2019, another wave of drought affected the country and this is now described as the worst in the last 90 years in the country.[47] From the onset of 2019, the rainfall was extremely poor, sporadic and erratic, and accompanied by high temperatures and evaporation so that soil moisture levels were very low. As a result, dam lakes and other reservoirs were extremely low and several boreholes across the country dried up, especially in communal farming systems such as in Erongo, Omaheke, Otjozondjupa and //Kharas regions.[48] Grazing land conditions were also observed to have deteriorated to a very poor state in many parts of the country leading to severe pressure on the grazing and to several livestock mortalities due to starvation. Thus, the drought for 2019 was declared a national disaster and a national drought emergency on 6 May 2019.[49] This was in accordance with the Disaster Risk Management Act 10 of

[47] Tiri Masawi, "Namibia's worst drought in 90 years", *The Southern Times*, 07 October 2019, https://southerntimesafrica.com/site/news/namibias-worst-drought-in-90-years [accessed 11 October, 2019]; National Aeronautics and Space Administration (NASA), "When drought threatens crops: NASA's role in famine warning", NASA's Earth Science News, 01 July 2019, https://climate.nasa.gov/news/2888/when-drought-threatens-crops-nasas-role-in-famine-warnings/ [accessed 12 October, 2019].

[48] Office of the Prime Minister, "Drought Response Plan, Disaster Risk Management", Windhoek, Office of the Prime Minister, 2019, http://www.opm.gov.na/documents/108506/674201/Drought+response+plan/9cdad581-517c-4739-9095-07f7098845d1 [accessed 10 October, 2019].

[49] Kuuzeko Tjitemisa, "President declares state of emergency over drought", *New Era*, 07 May 2019, https://neweralive.na/posts/president-declares-state-of-emergency-over-drought [accessed 16 October, 2019].

2012, part IV, section 30, point 4 which states that the President can declare a National Disaster when there is "a situation that requires immediate action to prevent, reduce or mitigate a danger of major proportions that could result in death or serious harm to persons or substantial damage to property or the environment."[50]

For the government to mitigate the drought impacts (i.e. food, water shortages & poor grazing conditions) a Drought Response Plan was established and implemented countrywide.[51] Interventions included food provision for the needy and drought affected communities, livestock marketing incentives (such as support for lease of grazing, transport to and from grazing, fodder and licks subsidies to sustain small stocks and core breeding herds), water provision through water tankers, certified seed provision and health and nutrition (i.e. drought relief food, comprising of grains, maize meal, cooking oil and tinned fish). Several calls for support were made to local and international supporters.

Drought, policy and practices

The priority during drought periods is survival. Consequently, a number of policies to protect the environment and communities from the impact of climate change and drought have been developed in Namibia. This includes the National Drought Policy 1997 that guided the National Climate Change Strategies and Action Plan 2013-2020, and the objective of which is to facilitate the building of adaptive capacity to increase climate change resilience and to enhance mitigation prospects to the benefit of sustainable development.[52] Recommendations to the government since the early drought of 1992/93 include working on drought preparedness and management, infrastructure development, pastoral development, alternative livelihood systems, and on policies and management.[53] A recent report by the Bank of Namibia, outlined what has so far been possible and implemented, the challenges, opportunities and policy priorities.[54] On food the report highlighted the need to improve crop growing and promote feedlots, health and training. On water, the report stressed the need to direct

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[50] Disaster Risk Management Act, "Namibia: Disaster Risk Management Act, 2012 (act no. 10 of 2012)", Office of the Prime Minister, 2012: 34, https://www.preventionweb.net/english/professional/policies/v.php?id=28778 [accessed 06 October, 2019].

[51] Office of the Prime Minister, "Drought Response".

[52] Ministry of Environment and Tourism (MET), "National Climate Change Strategies and Action Plan 2013 - 2020", MET, 2015, http://www.met.gov.na/files/files/National%20Climate%20Change%20Strategy%20&%20Action%20Plan%202013%20-%202020.pdf [accessed 28 October, 2019]

[53] Moorsom et al., *Coping with Aridity*.

[54] Bank of Namibia, "Feeding Namibia: Agricultural Productivity and Industrialisation", Windhoek, The Research Department of the Bank of Namibia, 21 September 2017, https://www.bon.com.na/CMSTemplates/Bon/Files/bon.com.na/52/52c35978-5912-4429-9052-3c8f5cc7971e.pdf [accessed 06 October, 2019].

50% of water resources to food production, and the other 50% to human, animal and industrial use, where the 25% of the 50% for food production should be allocated to fodder production for feedlots. However, the water sources recommended were rivers, surface dams and boreholes. These are already in use in Namibia, and have failed during drought periods, especially dams and boreholes. Considering that the suggestion on water sources was made against a backdrop of climate change, aridity and reoccurring drought in Namibia, it is clear that the impacts of droughts has yet to be comprehensively understood.

Hope during future droughts?

For the government to reduce drought vulnerability and enhance capacities of locals to survive future drought periods, strategies should focus on measures that are more long term, and that can be applied with few as limitations and challenges as possible once the systems have been set up. This could include: For the water sector, (1) extending the use of desalinated water, through using solar power pumping mechanisms as the country has long hours of sunshine and over 1500km of coastline. Currently the desalination plant only supports activities at the coast such as mining. According to the National News, a minimum of three desalination plants could cater for the needy areas across the country, as at the moment the plant can produce up to 30,000 litres which is enough for 300 families.[55] Extending the use of desalination services to the rest of the country would not be without cost challenges due to high elevations (up to 2000m in some areas, Fig. 1a), but this could be a permanent solution to the water crises during drought periods once it is set up. (2) The use of rainwater harvesting systems for the little rain that falls to the ground. The cost of adapting existing structures and new houses may be prohibitive, and particularly for the poor in the case of roof water harvesting, which requires permanent additional structures. Some estimates and suggestions for potential ways of rainwater harvesting have been made by scholars for many parts of Namibia.[56] (3) Tapping the recently discovered aquifer pools, especially in the northern part of the country.[57] However, this must be undertaken with great caution

[55] National News, "Namibia: Desalination to water crises", *The Namibian*, 20 June 2019, https://www.namibian.com.na/189790/archive-read/Desalination-solution-to-water-crisis [accessed 26 October, 2019].

[56] Alexander Jokisch, Oliver Schulz, Isaac Kariuki, A. Krug von Nidda, Jutta Deffner, Stefan Liehr and Wilhelm Urban, *Rainwater Harvesting in central-northern Namibia*, Frankfurt am Main, Institute for Social-Ecological Research (ISOE), 2015; Festus Panduleni Nashima, Martin Hipondoka, Inekela Iiyambo and Johannes Hambia, "The potential of rainwater harvesting: A case of the city of Windhoek, Namibia", *Journal of Water Resources and Ocean Science*, 2 (6), 2013: 170-174; Rosemary N. Shikangalah and Benjamin S. Mapani, "Precipitation variations and shifts over time: Implication on Windhoek city water supply", *Physics and Chemistry of the Earth, Parts A/B/C*, 112, 2019: 103-112; Laura Woltersdorf, Alexander Jokisch and Thomas Kluge, "Benefits of rainwater harvesting for gardening and implications for future policy in Namibia", *Water Policy*, 16 (1), 2014: 124-143.

[57] Edgar Brandt, "Nearly N$6 million to fund Ohangwena aquifer", *New Era*, 03, September 2018, https://neweralive.na/posts/nearly-n6-million-to-fund-ohangwena-aquifer [accessed 14 October, 2019];

because during dire drought spells, excessive abstraction is likely to lead to hydrological alteration which can critically affect the ecosystems the pools support, and can lead to groundwater contamination. For the agriculture sector, (1) Using of hydroponic gardens for human consumption and hydroponic fodder production for animals. While the benefits of hydroponic gardens for human consumption are commonly known, benefits for animals include lower use of water, minimal labour, high yield and high control of quality, reduction of the need for the transportation of feed, lower use of fertilisers and sometimes pesticides and herbicides.[58] (2) Replacing cattle with small livestock, and using cattle breeds that are more drought resistance such as the Afrikaners species. According to the Annelie Coleman, the advantages of farming Afrikaners include the fact that the breed is an indiscriminate grazer and even resorts to browsing during drought periods, is highly mobile so that it can use the available grazing area optimally, is low maintenance, and has good resistance to diseases and internal and external parasites.[59] (3) Supplying more drought tolerant seeds for crops, legumes and vegetables to communities so that they can adopt these on a more permanent basis and not only when drought has occurred. (4) Conservation Agriculture (CA), which for various reasons including the consecutive drought years, has not been very successful in Namibia so far should be encouraged in the interests of better food security.[60] If drought survival mechanisms are practised as ongoing solutions, the country is likely to be drought ready to a certain extent when the next drought occurs.

Conclusion

Namibia is largely semi-arid to arid (70%) and the country is marginal for agricultural production. With such environmental conditions, the effects of climate change are likely to exacerbate the variability of precipitation and magnify the existing impacts. This will in turn severely affect the ecosystems and reduce the country's capacity to adapt to the challenges of climate change. Namibia has experienced several flooding and prolonged drought spells in the last decade and these have most severely affected the roughly 70% of the population that relies on the agricultural sector. A combination of lack of rainfall and low soil moisture led to a severe and prolonged drought in 2019 which was ranked as the most severe drought in the last 90 years. It resulted in real hardship and significantly affected many livelihoods, especially among the most vulnerable communities.

National News, "The underground water source in Ohangwena region discovered in 2007 is said to be of great value", *The Namibian*, 24 February 2015, https://www.namibian.com.na/index.php?page=archive-read&id=133948 [accessed 16 October, 2019].

[58] Meat Corporation of Namibia, "Hydroponics Fodder Production? A glimmer of hope farming", www.meatco.com.na, 30 August 2019, https://www.meatco.com.na/news/559/Hydroponics-Fodder-Production-a-glimmer-of-hope-for-farming/ [accessed 07 October, 2019].

[59] Coleman, "Breeding cattle".

[60] Deon Schlechter, "Conservation agriculture still struggling after thirteen years", *New Era Farmer Forum*, 03 July 2019, https://neweralive.na/posts/conservation-agriculture-still-struggling-after-thirteen-years [accessed 12 October, 2019].

The drought led to significantly reduced crop yields, so that at least one third of the country's population was without adequate supplies of food.

All hope was not lost as interventions were put in place. However, by the last quarter of 2019, the food relief was still not sufficient to feed the affected population. There is still hope for the future as there are various measures that can be taken to navigate through drought periods. With practice, and with more suggestions and lessons from other countries that are facing the same situation, Namibia could learn to survive the long drought periods, especially at the household level – practice makes perfect. This study concluded that the 2019 drought was a major warning that the country should start planning ahead, and put more effort into training people to survive the situation. Climate change projections anticipate more frequent, more intense and longer drought spells. Therefore, survival should be the main focus.

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