International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Drought as a Disaster in the Namibian Context

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Abstract: ***Drought is one of the most significant and challenging natural disasters across the globe. In Southern Africa, the phenomenon has become more frequent and severe, with devastating impacts particularly on livelihoods of Namibian communities, their farming activities and availability of water resources. This study provides an overview of drought in a Namibian context, with special presented cases from the north central region. The study mainly employed secondary data from various existing in publications to explore the concepts, causes and forecasting of drought. Furthermore, relevant newspapers were reviewed to assess the impacts of the recent drought whilst interviews were conducted with key informants on drought prediction using indigenous knowledge. It is revealed in the study's findings that Namibia's climate and rainfall abnormalities are influenced by the interplay of the dominant Subtropical High Pressure Zone (SHPZ), the Temperate Zone and Intertropical Convergence Zone (ITCZ). Thus, drought susceptibility of livelihoods often prevails and was traced in this study as far as 1911, during which thousands of people died largely due to famine. Although not as this many human lives were lost during the 2019 drought, three people instantly died as the wall of the dug well collapsed, at least 90 000 of livestock were reported to have died of thirst while one-third of the country's population was affected as the staple cereal production depreciated significantly. The study recommends improved early warning systems, possibly by merging the Remote Sensing and Geographic Information System (GIS) analysis with relevant indigenous knowledge. Meanwhile, strategies on sustainable harvesting of groundwater from the discovered "Ohangwena II aquifer" - need to be prioritized to support the affected livelihoods in the country.***

Keywords: drought, disaster, Namibia, livelihoods, early warning system, indigenous knowledge, water, communities

1. Introduction

Drought is one of the significant natural disasters that affect various regions globally. Currently, countries such as Northeastern China, North Korea, North Ontario in Canada, Southern Australia, Angola, Botswana, Zambia, South Africa, Zimbabwe and Namibia are reported to be experiencing drought (NASA, 2019; FEWS NET, 2019). In Southern Africa, up to 45 million people did not have food security in 2019 due to drought. The ongoing drought is described as one of the worst to be recorded in 90 years (NASA, 2019; Southern Times, 2019). By February 2019, Namibia and the southern part of Angola were reported to have received a significantly below average rainfall (FEWS NET, 2019). The shortage of rainfall resulted in poor and below average pasture conditions, less water availability for citizens and livestock, as well as an increase in drought-related livestock diseases (such as foot and mouth diseases) and death in these countries.

In Namibia, drought has been prevalent for a long period of time, with variations in severity per seasons. Although climatic conditions of Namibia are distinctive between regions in the east, west, north and south, the country is renowned as the driest country in Sub-Saharan Africa, with a short irregular rainy season (Kapolo, 2014; Rothauge, 2001). The yearly average rainfall received in Namibia is reported by Foissner to be under 250 mm with annual mean evaporation of up to 3700 mm (as cited in Lua, Wanga, Panb, Kaseke & Lia, 2016, p.67). This means that the evaporation rate could be almost 15 times higher than the precipitation rate received in the form of rain on some occasion. Even with the recounted average of rainfall in a year, not all parts of the country receive such an amount. In fact, the 825, 615 km² sized country is highly dominated by arid conditions of certain scales. The Namib Desert, which is located to the west, as well as the Kalahari Desert, which predominates the southeastern part of the country, forms parts of regularly very arid to arid parts of Namibia. According to Seely (1994), 16% of the country's land is regarded as a true desert without any agricultural activities, 49% as arid, 32% as semi-arid and 3% as sub-humid. On the other hand, Turpie, Midgley, Brown, Barnes, Pallett, Desmet, Tarr & Tarr (2010) gave an approximate of 22% of Namibia's land as desert, 70% arid to semi-arid and only 8% is regarded as dry sub-humid. Both sources highlight that a larger part of the country does not always receive sufficient rain therefore sometimes leading to a shortage of water, which affect the livelihoods of people, animals and plants. Therefore, this paper discusses the various definition, causes and impact of drought, its prediction through spatial analysis and indigenous knowledge. The paper gives a special overview of the impacts of the 2019 drought on the country's socio-economic developments and its effects on livelihoods.

2. Data Collection Methods

This study principally used secondary data of existing knowledge collected from previously published articles, theses, books, websites, newspapers, and other various research reports. The purpose of this method was to extract relevant information from previous studies including meteorological data, descriptive facts and statistics on the cause and impact of drought in Namibia. Meanwhile, due to limited available literature on the prediction of drought using indigenous knowledge, in particular, in-depth interviews were conducted with three knowledgeable community

members to support the existing and availably documented knowledge.

On the impact of drought in 2019, drought-related headlines in online news reports were chronicled. This method was adopted from various scholars, who explored the aspects of climate change-related research based on news headlines (i.e. Ford and King, 2015; Lennox, Crook, Moyle, Struthers & Cooke, 2019; Llasat, Llasat-Botija, Barnolas, López & Altava-Ortiz, 2009; Miles and Morse, 2019; Pacoma, 2019). Therefore, online words search using keywords, namely: "drought, water, food, crises, Namibia and 2019", for national cases that made it to news headlines - was conducted. This was largely done on Google general search in order to find all possible articles, from both national and international online media. Google Scholar, in particular, was also used although its output from its searches only availed articles that were based on previous years' data; article based on 2019 data appeared to be solely available from 2020. Only articles written between January 2019 and October 2019, with indicated the above-mentioned keywords – were analyzed. This is due to the fact that a new rain season starts after October. The searches were carried out repeatedly until no more new headlines around the given timeframe showed up.

2.1 Geographic location of Namibia in relation to rainfall abnormalities

Namibia is located in the south west part of Africa, sharing borders with Angola to the north, Zambia and Zimbabwe to the north-east, Botswana to the east, South Africa to the south and the Atlantic Ocean to the west. The country's coastline, which is all desert, stretches for 1, 570 kilometers, between the exclusive two perennial rivers mouths of Kunene and Orange, which mark the northern border with Angola, and southern borders with South Africa respectively (Mendelsohn, Jarvis, Roberts, & Robertson, 2002). The Coastline and this part of the Atlantic Ocean play a significant role in Namibia's climatic conditions.

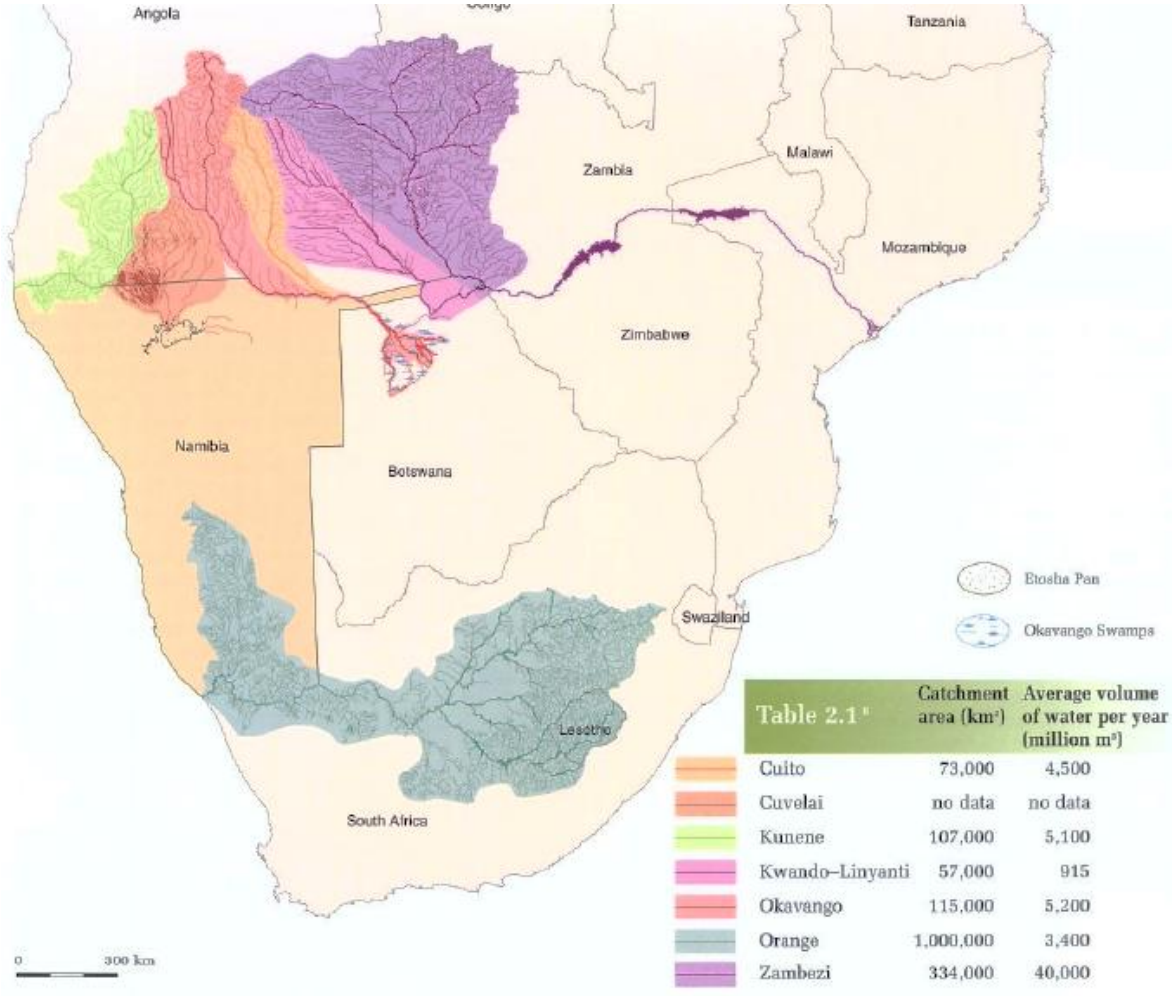

Table 2.1 *

	Catchment area (km²)	Average volume of water per year (million m³)
Cuito	73,000	4,500
Cuvelai	no data	no data
Kunene	107,000	5,100
Kwando–Linyanti	57,000	915
Okavango	115,000	5,200
Orange	1,000,000	3,400
Zambezi	334,000	40,000

Figure 1: Location of Namibia in relation existing perennial rivers in Southern Africa (Mendelsohn et al, 2012)

Namibia's climate is influenced by three major climatic systems/zones, namely: Subtropical High Pressure Zone (SHPZ), Temperate Zone and Intertropical Convergence Zone (ITCZ). The amount and type of precipitation received depends on the position of three systems in relation to the country. The location of the system is relative to the season and obliquity during summer and winter as shown in *Figure 2* below (Mendelsohn et al, 2002).Periodically and along with the High Pressure Systems is the El Niño-Southern Oscillation phenomenon (ENSO) that team up against the ITCZ, causing drought conditions in Central Namibia and other parts between 20 to 25° S (Turpie et al., 2010). The recurrence of ENSO phenomena has intensified since 1970 and has since lowered the water levels of the main river

basins of Namibia in northeastern Namibia (Turpie et al, 2010). This means that even the areas of Namibia that are most humid (eastern Namibia) are threatened by drought-like conditions, which could lead to a significant reduction in the amount of rainfall received in these areas and have a further effect on water scarcity in the country.

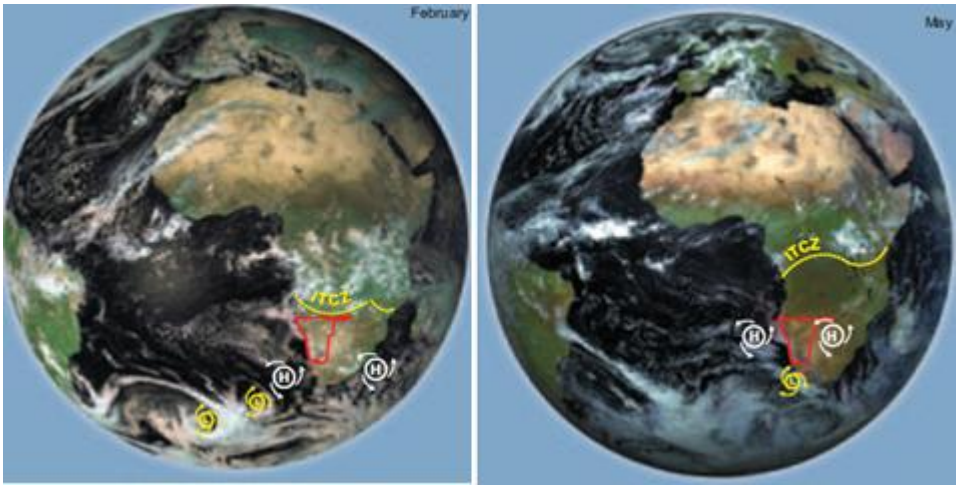

Figure 2: Seasonal position of the three major climatic systems in relation to geographic location of Namibia: H – anticyclones, L – cold fronts and cyclones, ITCZ – of Inter-tropical, Convergence Zone
Source: (Robertson, Jarvis, Mendelsohn & Swart, 2012)

2.1.1 The subtropical High Pressure zone (SHPZ)

Namibia is mainly sandwiched by two High Pressure cells: the South Atlantic and Botswana anticyclones. These two anticyclones cause dry climatic conditions in the country (Mendelsohn et al, 2002).The Atlantic Anticyclone above the Atlantic Ocean along with the cold ocean Benguela Current, brings cold air that is too heavy to rise up and develop rain-bearing clouds inland during any season (Turpie *et al*, 2010).Equally, the Botswana Anticyclone has significant climatic effects during winter as it blows 50-60 kilometres / hour strong east (Berg) winds from its position over Botswana all the way until the Namibian coast (Robertson et al, 2012). Because these cells are associated with cold and dry winds that also hinter the flow of moist air from upper northern regions making larger parts of the country arid or semi-arid (Mendelsohn et al 2002; Lua et al, 2016).

Although the South Atlantic Anticyclone may not be the initial reason for the formation of the world's oldest desert; the Namib, reported to have been a rid for a minimum of 55 million years (Barnard 1998), its (Anticyclone)existence is predicted to be the same age as Antarctica's ice sheet, about 40 million years old (Evers, 2012). It is likely that this Anticyclone played a significant role in expanding the desert margins to areas that were once inhabitable. Conversely, the conditions of Botswana Anticyclone are also impactful to the Kalahari (also written as Kgalagadi, which means "the great thirst", for its dry climates)where the High Pressure cell is predominantly situated leading to desertification in the country (Haddon, 2005) and often threatening the regular livelihoods of wildlife and Southern Africa's first indigenous people –the San people, among other groups in the area.

The distribution of life especially along the coast, where the average rainfall within 40 kilometres inland - is less than 20 millimetres per year (Robertson et al, 2012), is very sparse with often endemic species and remarkable people who have adopted various way of surviving the prolonged water scarcity in the area. Therefore, fog is the most crucial source of water for survival, especially for plants that sustain both the animals and people. Mendelsohn et al (2002: 45) notes that coastal areas such as Walvisbay, Luderitz and Oranjemund record 146, 127 and 87 days of fog respectively every year. It is worth noting that even though water scarcity is regular in this area, drought conditions may still be experienced when the usual amount of precipitation is anomalous.

2.1.2 Temperate zone

During Namibia's summer (see *Figure 2*), the South Atlantic Anticyclone obstructs Low Pressure fronts of the Temperate Zone to move in from further south, thus blocking the moist air brought by these fronts (Robertson *et al*, 2012).In winter, however, as Atlantic anticyclone moves further north, the Low Pressure fronts successfully bring cold moist air and infrequent and short winter rains to southern coastal areas (Robertson et al, 2012). In fewer times including this year, such winter rains are also received in central parts of the country. Although winter rains are rare and thus not a reliable source of water, such rains help to sustain the lives of plants and animals that are often threatened by potential drought particularly in occasions where the previous rainy season (summer) was not effective.

2.1.3 Intertropical Convergence Zone (ITCZ)

The ITCZ is the climatic cell that brings high to moderate rainfalls in northern Namibia after its relocation from northern hemisphere through the equator. These Low Pressure cells, which is sometimes referred to monsoon trough increases as the earth tilts towards the sun, drawing warmth and moist air through Hadley Cell circulation (warm air rising near the equator and sinks as cold air towards the poles) (Collier & Hughes, 2011).Most of Namibia's rain is therefore received in northeastern Namibia especially in the

first months of the year (see Figure 2) because that is where and when the ITCZ is almost overhead or closest to the landmass of Namibia. Since the warm and moist air gradually decreases from the Equator down south and from east to west (due to the dominant High Pressure cells explained above), the southern and western parts of Namibia receive less rain. This happens as a result of remnants of moisture that is no longer sufficient for condensation to take place for the occurrence of rain in these areas (Robertson et al, 2012).In extended occasions of rain or precipitation shortage, drought becomes a seriously life-threatening, especially when Hadley Cells have not picked up enough moisture at the Equator to be progressively transported to Namibia in the form of rain by ITCZ.

2.2 Drought as a Namibian disaster

Drought by way of definition by Child (1987) is "an extended period of abnormal dryness due to below-average or badly timed rainfall that causes a pronounced decrease in forage yield relative to what is expected in an average year" (as cited in Botha, 1999). Drought as a (natural) disaster is determined by its degree of harshness, duration and spatial extent, as well as its effect on human activity (Maybank, J., Bonsai, B., Jones, K., Lawford, R., O'Brien, E.G., Ripley, E.A. & Wheaton, E, 1995). It is important to note the degree of dryness as categorized in four types by Eklund & Seaquist (2015), namely: meteorological, hydrological, agricultural and socio-economic in order to understand drought as a disaster. Botha (1999) supports this notion by approving that regular droughts have been experienced and have threatened the country's economy and food security, in addition, bringing environmental degradation. Aridness and drought are not always defined synonymously. As a result, certain degrees of measurements of water insufficiency are used to distinguish between the two concepts. Botha (1999) distinguishes aridity as permanent dry condition from drought: temporary conditioning that occurs when rainfall received is below the normal rate. He further argues that it is not useful to talk about the drought in the Namib and permanently arid regions. However, such differentiation and argument fail to put into account the impact of land degradation, desertification and overall climate change on areas that were once not regarded as "permanently arid", as they develop desert-like conditions due to consistently decreasing or no rainfall. It also fails to acknowledge the reduction of other forms of precipitation that sustain human activities in arid areas, as well as the impact of what he recognizes as drought in areas that rely on ephemeral rivers and underground waters such as the Namib Desert.

Without an existing drought monitoring system to reduce the burden it brings; drought has been a disaster in Namibia for a long period of time. By disaster, Maybank et al (1995) indicates that droughts are mostly disastrous through their environmental and socio-economic consequences, such as food shortages that lead to an undernourished population. For Namibia, the earliest documentation of drought disaster encountered for this study - are images of the famine of the year 1911 in north central Namibia (Figure.3). This drought-led famine is reported to have killed thousands (Wahanen, 1911). In 1998, a disaster action plan and policy were implemented by the government for suitable response systems, procedures and resources needed in times of disaster to support and empower the victims (Republic of Namibia, 1998).However, it was indicated in the draft report of United Nation Disaster Risk Reduction (UNISDR) (2009) that Namibia's drought policy had to be amended in 2005 to shift such responsibility from the government because declaring drought as a disaster in a country that is regularly dry and prevalent to frequent drought was expensive for the government could generate dependency and promote resource deprivation through unfitting assistance. Regular financial assistance and food security interventions for both commercial and communal farmer were therefore reserved in the extreme event of drought as a disaster.

Figure 3: Famine of October 1911: mother and son photographed by a Finnish missionary, Maria Wahanen, and the first dam construction in Owambo in 1954, photographed by Van Warmelo, Nicolaas Jacobus.
Accessed from: Nakambale Museum; http://hdl.handle.net/10210/1504.

2.3 Early warning system

In its National Disaster Plan document, the Government of Namibia defined early warning system as: "the rapid dissemination of information concerning imminent disaster threats to institutions and the population at large" (Republic of Namibia, 1998; 39). Apart from drought, early warning systems are commonly essential for different types of disasters that occur in the country including floods, wild (veld) fires, epidemics, etc. For drought, which is regarded as slow-onset disaster, such dissemination of information is required to contain a formalized collected data. Lua et al. (2016) states that data such as satellite-based rainfall is necessary for correlation with ground-based observations are significant although rarely used in the previous analysis done. Without the usage of satellite imagery, the Ministry of Agriculture designed an early warning system for an impending food shortage, identification of both deficit and surplus producing areas, management of regional food shortages and national food security (Republic of Namibia, 1998). On the other hand, meteorologists have been analyzing local and global weather since 1998, based on the extremely severe gradients measured in line with the impact of El Niño (Rothauge, 2001). However, such weather forecast may be subjectively and inaccurately interpreted and therefore may give incorrect early warnings. Although Rothauge (2001) argues that global early warning systems may also not be reliable unless with strong local capacity to gather reliable information, early warning for the drought in Southern Africa in 2013/2014 was raised in December 2012 by World Food Programme (WFP) with a specific warning about the crisis in Namibia February of 2013 (WFP, 2013). It was not until May 2013 that the then President of Namibia, Hifikepunye Pohamba declared a national emergency appealing for international aid after the drought had killed 4 000 livestock and affected over 300 000 people due to food insecurity in rural areas (New Era, 2013).

2.3.1 Remote and GIS for drought monitoring

Spatial datasets and its analysis are one of the significant components that help us to detect early stages of drought. This is done by observing and recording abnormal weather and other climatic conditions. The application of remote sensing and Geographic Information System (GIS), using the daily available satellite imageries, provides a substantial potential to develop drought monitoring systems in time (Linés, Werner and Bastiaanssen, 2017). The international leading provider of early warning and analysis of acute food insecurity known as FEWS NET (the Famine Early Warning Systems Network) combines existing highly effective technology (such as NOAA, NASA, and USGS) with remote-sensing satellite imagery to monitor vegetation cover and rainfall throughout the African continent, with special focus on 22 drought-prone countries including Namibia (UNISDR. 2009). Furthermore, FEWS NET overlays livelihood zones to such imageries for vulnerability assessment and coping capacity of local communities (UNISDR. 2009).This means that spatial analysis for change detection in an environment prevalent to drought could facilitate the monitoring of rainfall irregularities for better and early warning mechanisms to communities at risk. However, alerts from international organizations for drought monitoring may not be reliable for Namibia as data and information may not always be accurate and timely. Wilhite (2002) discusses the importance of existing regional drought monitoring centres in eastern and southern Africa; they have been collecting and disseminating drought forecasts and information to various regional users over a period of time. This helps the regions to cooperatively prepare for drought conditions.

Since 2016, a follow-up initiative, the African Monitoring of the Environment for Sustainable Development (AMESD) called MESA (Monitoring for Environment and Security in Africa) – has installed satellite stations in Namibia. The initiatives are designed for African users at continental, regional and national levels, covering 5 African Regions and 50 countries (where satellites stations are installed).The initiatives focus on the use of earth observation for direct data and information for environmental management and sustainable development, forecast weather, measure land-use change, predicts climate change among other concerns for adaptation purposes and to monitor vegetation, soil moisture and determine drought conditions as a guide for decision-making (Marumbwa, Borstlap, Kusane, Siwela, Kroese & Farrington, 2015).

2.3.2Prediction of drought using indigenous knowledge

Drought has not only been scientifically documented in various literatures but has also been often recited through indigenous narratives by knowledgeable senior individuals who have survived such conditions from young ages. Due to the prevalence of drought in Namibia, where indigenous communities engage in subsistence farming and rely on rainfall for livelihoods, such communities have acquired knowledge on how to predict the drought through weather condition related patterns, irregular behaviors of plants and animals, and other events.

The dominant Mopane tree (*Colophospermum mopane*) is one of the plants that are used to forecast drought in the north central region of Namibia. The flowering of the Mopane trees is seen as a sign of drought in the north central region of Namibia. These trees seldom produce fruits (*omakoti*). However, when the Mopane bear fruits, a year of drought is expected by the Ovawambo people, who dominantly live in this region as agro-pastoralists. According to Hoffmann (2015), for unknown reasons, large territories of Mopane woodland do not flower or bear fruit from time to time for several consecutive years. The flowering which supposedly takes place from November to January coincides with the first months of rain seasons.

Another way of predicting drought through indigenous knowledge of Ovawambo people is there location of Red-billed Quelea (*Quelea quelea*) birds seemingly in search of food in other regions. It is believed that such birds would either fly north-ward or south-ward of Namibia in search for food and no other direction. The migration directions of such birds could work in relation to climatic conditions discussed earlier in the parts of this paper. Considering that the western part of Namibia is predominantly dry if not an absolute desert, it is logical for birds not to fly toward the west. It is also possible that birds would not fly toward the east because if the ITCZ which is responsible for rain in north central Namibia did not produce enough rain in that

area, chances are that the east is also dry. It is therefore logical for the birds to fly toward Angola and Equatorial rainforest, where rain is largely sufficient, or toward South Africa, where other climatic systems/zone are effective in producing rainfall. The oriented migration of these birds to wetter areas is supported by the work of Jones, Cheke, Mundy, Dallimer & Venn (2000), who designed schematic representation of Red-billed Quelea migration patterns in southern Africa presented in Figure.4.

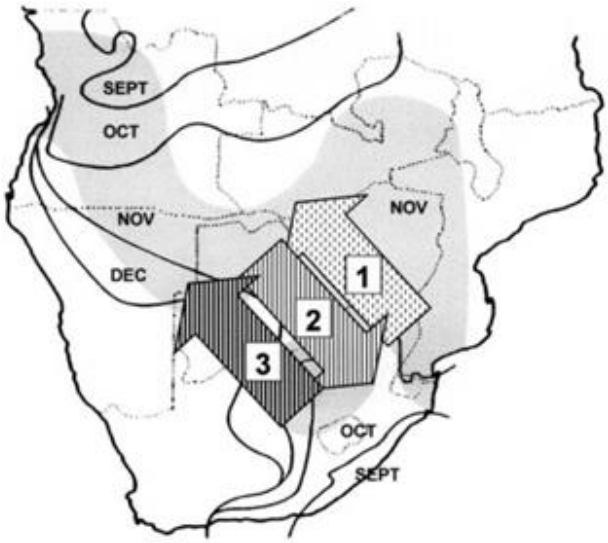

Figure 4: Arrows representing seasonal migration pattern of the Red-billed Quelea with grey shaded area indicating the approximate breeding:
Arrow 1: birds head to the earlies rain-front as rains begin
Arrow 2: birds undertaking an 'early-rains migration' over the advancing rain-front;
Arrow 3: birds return to areas of successively later rainfall on 'breeding migration'.

Other indigenous ways of predicting drought in the area are based on rare events such as when the rainfall fills up some specific water ponds (*Eendobe*) the first day of the rain season. Such an occasion is uncommon, probably because the rain is usually light at the beginning of its season (usually around November but often delayed) as the ITCZ approaches the region and gradually increases. Therefore, when high rainfall is received earlier, chances are that the rainy season has been shortened and the first day of rain would be the highest rain to be ever received for that season.

All these three indigenous methods could serve as dependable predictions or early warnings signs of drought; governments and communities at large could benefit from such knowledge if disseminated appropriately.

Meanwhile, it is highlighted by Masinde (2012) that some indigenous knowledge-based weather and climate patterns predictions are often intertwined with their cultural and religious beliefs that could not be transferred into conventional reasoning of modern science. An example of this is the rain-making ceremony, a belief in the tradition of Ovawambo people in northern central Namibia. In summer, after prolonged weeks of no rainfall, a group of Ovawambo people would travel to Evale (in Angola), where their ancestors initially settled, some died and buried before others migrated to what today makes up northern Namibia. The voyagers would do this for indigenous weather forecasting and rain-making cultural event. According to Nampala and Shigwedha (2006), the Ovandonga, a sub-group of Ovawambo - would make a payment for the best weather forecasters in Evale to predict rain for them. It is believed by the Ovandonga that the forecaster gets a vision of the rain from the ancestors by communicating with them through *onghinda/onkinda* (a special kind of calabash). On the other hand, Ovakwanyama, another subgroup of Ovawambo – would have their own local weather forecaster. The forecast is done by filling water in clay pots (*oitoo*), the possibility of good rains or drought is determined based on the amount of water that evaporates from the pots; it is only when such attempts fail and the anticipated rain does not arrive that they then travel to Evale to go "fetch" rain from the ancestors (Nampala and Shigwedha, 2006). Clearly, these practices may not be scientifically proven or consistent, but indigenous communities often recite that when such practices were done, either the rain comes while those who travelled to Evale are on their way home or a few days after returning back home.

2.4 Drought and livelihoods vulnerability

The recurrence of drought in Namibia often threatens the livelihood of the people and the economy at large. The death of livestock, wilting of crops and drying up of dams and other sources of water in drought-prone areas creates livelihood vulnerability, especially in rural communities. Densely populated communal areas in north central and northern western appear to be the most affected among the rest. According to Kapolo (2014), among the affected is the (1) Agricultural Sector, which is reliant on rainfall and where the majority of the Namibian population depends on through subsistence farming of crop and livestock; (2) Water Sector, drought further reduces the water availability not only for household purposes but also for industrial, mining and agricultural enterprises and (3) women and children are the most vulnerable groups to drought, particularly while living as subsistence farmer, with most men leaving for urban areas for work, women and children are left to cultivate fields and rear livestock. Kapolo (2014)further notes that in the pastoral community in the Kunene region, children often drop out of school as their family migrates to search for pasture and water.

2.4.1 Impact of Drought on Rural livelihoods

In the New Era report by Schlechter (2016), around729 000 people in rural areas, equivalent to 60 %of the total rural population in Namibia - were affected by drought in 2016. About 596 000 of the affected people needed urgent humanitarian assistance, particularly in the Kunene Region (north-western Namibia). Rural population are the mostly affected by drought as they highly depend on crop and/or livestock farming on communal land.

The majority of the Namibian population lives in rural/communal areas, covering only 38% of Namibia's land while accommodating 57% of the total national population (Mendelsohn, Shixwameni & Nakamhela, 2012; Namibian Statistic Agency, 2012).Rural communities experience significant environmental and socio-economic impacts of

land degradation especially during drought period. High dependence on natural resources for human needs for the majority of the rural communities make them vulnerable to food insecurity, economic losses and civil strife (Imbamba, 2002).

The impacts of drought in rural areas push rural settlers to desperately migrate to urban areas in search of better living conditions. Such rural-urban environmental migrants seek to diversify their incomes, a strategy to enter into the cash economy for survival as their degraded and unsustainable rural environments can no longer support their livelihood (Liber, 1998). In 1992, the disastrous agricultural drought resulted in substantial crop failure and loss of livestock while food aid for the severely affected 20% of the Namibian population was unfairly distributed causing part of household members to migrate to urban centres (Liber, 1998). On the other hand, a study in 2011 ranked Namibia as the seventh most at-risk country globally in terms of agricultural production losses due to prevailing drought that makes it difficult for sustainable agriculture, especially for rural subsistence farmers (Olivier, 2016). It is therefore probable that in few years to come, rural settlers may no longer rely on farming for livelihood as drought becomes even more frequent. This would be regardless of institutions put in to place to distribute and govern the water for communities. During2012 to 2014 drought, institutions of water governance restricted mobility of pastoralists in Kunene regions by fixing group boundaries, confining the cattle, goats, and sheep (the heaviest water consumers) of nearly 90 000 rural inhabitants who rely on pastoralism for livelihood (Schnegg & Bollig, 2016).

In addition to the water scarcity in rural areas, bad soil quality for water retention capacity and Namibia's history of land dispossession has further restricted the majority of rural inhabitants to have access to suitable land for agricultural production (Liber, 1998). Besides drought, the livelihood of the spatially confined rural inhabitants is equally obstructed by soil and land degradation.

2.4.2 The catastrophic cases of drought in 2019

Reports of drought started as early as April 2019, on both national and international newspapers and other media platforms. By May 2019, the drought was already declared a national emergency, where various cases of the effects of drought across the country were reported, from domestic cases to crops, livestock and wildlife (Tjitemisa, 2019). The domestic cases included reposts from the capital city to enforce new water restrictions of water consumption of no more than $25m^3$ per household by 01 July 2019. By September, the Windhoek City issued another urgent warning for further reduction on water consumption (Namibian Sun, 2019; Hattingh, 2019). Whereas in October, the City's water consumption had exceeded the weekly water-saving target of 7% (Xinhua, 2019).

The drought spell of 2019 put around one-third of the Namibian population (36%) at the risk of hunger and dependence on drought relief support systems (Reliefweb, 2019). Of this 36% affected population, 24% were estimated to be located in rural areas. With regard to the effects on crops, the impact of poor rainfall on the country's agricultural production is noticed through the aggregated cereal production depreciated with 53% from 2018 to 2019, and 42% below the average production (Reliefweb, 2019). Dry weather conditions severely affected cereal production in 2019 as cumulative season rainfall volumes were 60-70% below the average (FAO, 2019).

The amount of rainfall received during the drought 2019 was the lowest recorded in Windhoek since 1891 (Masawi, 2019). While in the entire country, NASA (2019) indicates this drought to be the worst in the last 90 years. In domestic reports, about18000 households in Oshikoto alone were hit by drought, whereas the Hardap Dam was reported to be running dry and farmers had to cut back irrigation by 40% to save water (Namibian Sun, 2019; New Era, 2019).The struggle of surviving the drought effects pushed the communities to look at alternatives and other possibilities of accessing water in their surroundings. This has led to several lives being lost as people attempt to dig water wells or traditional oases (Omufima) for both human and livestock consumption. In two particular cases, three people were reported to have died after a well wall collapsed on them while digging (Nampa, 2019; Informante 2019). In addition, at least 90 000 livestock died mostly as a result of thirsty while others due to the resultant deterioration of the grazing areas (Namibian Sun, 2019).

Furthermore, drought spell drove the government to sell wildlife from National parks, as a way to save them from the effects of drought and lack of pasture and vegetation for them to browse (Illeka and Ngutjinazo, 2019). The effects on wildlife included at least 1000 herds of game auctioned while 63 hippos were trapped hippos in muddy pools of the drying Chobe river (The guardian, 2019; The Namibian, 2019).

3. Conclusion

Namibia is regarded as the driest country in Sub-Saharan Africa due to the short and irregular rainy season that results from dominant High Pressure systems in the country. About 97%of the country is often at high to medium risk of experiencing one or more types of drought (meteorological, hydrological, agricultural and/or socio-economic) because of its aridity conditions. With the prevailing drought in semi-arid areas of the country, there is a need for improving the early warning system; merging spatial data analysis with indigenous knowledge may be the best way to support the observation and detection of drought threatening weather conditions at early stages.

The drought disaster has been documented in Namibia as early as 1911, whereby thousands of people were reported to have died and many were affected by famine. Although drought disasters of recent years have not been reported to have directly killed people, the desperate situations of seeking for other alternative sources of water have claimed lives while thousands of livestock died of hunger or thirst. Moreover, drought reduced the contribution of agricultural activities to the country's economy.

The reported cases showed the extent to which agricultural activities and livelihoods are affected. Even though the

drought has been reoccurring, its effects in recent years appear to have been felt more in 2019. This is demonstrated by the number of human and animal lives that have been reported to have perished due to drought-related conditions in 2019 compared to previous years. In addition, no urgent sales of wildlife based on drought were made during other drought seasons. Efforts to mitigate and relieve the effect of the 2019 drought spell were made; however, they were insufficient (Colemann, 2019; Kuhanga, 2019; Schlechter, 2019). Consequently, the state of emergency was extended for a further six months, from October 2019 to March 2020 (Kahiurika, 2019).

4. Recommendations

It is reported in this paper that the known reoccurrence of drought, particularly in Northern Namibia where the occurrence backdated to the year 1911. Efforts to cater for drought need to be multiplied especially for the rural households and farmers. It is therefore herein recommended that the government of Namibia invest in the search for and exploitation of alternative water sources for its people.

A large aquifer, referred to as "Ohangwena II aquifer", was discovered in Ohangwena Region, in 2007 (Nembwaya, 2015). The discovery was made under the project "Groundwater Management in the Cuvelai – Etosha Basin (CEB)" between the Geohydrology Division of the Ministry of Agriculture, Water and Forestry and the German Federal Institute for Geosciences and Natural Resources. Shapwanale, (2018) narrates that the aquifer stretches 75km from the Ondobe constituency towards the east, and about 40 km towards the Angolan border, and holds 20 billion m^3 of freshwater. It is estimated that the aquifer can feed the population (affected by the drought) for some 400 years without recharge (Brandt, 2018). The study herein recommending that a just, ethical and sustainable exploitation of underground waters in the region be recognized as a national priority, under which farmers and households may put up boreholes to access water without putting their life at risk. The utilization of aquifer as the source of water has the potential to make this region not only the food basket of Namibia but also to attract new industries in the area. This could lead to more employment opportunities and improve food security in Namibia.

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