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"If It's Yellow, Let It Mellow, If It's Brown, Let It Drown": Examining the Health Effects of Drought-Induced Water Rationing for Sanitary Needs

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ABSTRACT
This paper focuses on the impacts of water stress on health outcomes. It specifically investigates the health effects of insufficiency of water for sanitary needs in drought-affected households. A focus group discussion that drew medical experts from such fields as medicine, virology, and microbiology was conducted to collect data. The findings of the study show that there is a possibility of vulnerability to negative health outcomes such as Cholera, Diarrhea, and respiratory problems by households that lack the necessary levels of water for domestic, sanitation, and hygiene uses. It is therefore important that individuals and households susceptible to the vagaries of drought be aware of this relationship so that they may forge necessary adaptive measures such as the use of purifiers, hand and surface sanitizers, and disinfectants to mitigate the health effects of a drought that are related to inadequate water use for sanitary purposes.

KEYWORDS: Drought, Health, Water, Hygiene, Sanitation, Cape Town.

1. INTRODUCTION

South Africa is a drought-prone country. The first known and widely reported drought episode in South Africa occurred in 1921. It was a severe drought, and it is used as a yardstick for measuring the severity of the droughts that have occurred after it (Rouault and Richard, 2003). Since 1921, there have been several episodes of drought with untold hardships on households, homesteads, and industrial activities (Kilimani *et al*., 2018; Azadi *et al*., 2018). The water crisis was so acute in Gauteng Province in 2014 that substantial water needs in Johannesburg were met by water imports from Lesotho—a sister country to South Africa (Mellisa, 2020). In Western Cape Province, water stress is a well-known phenomenon. In Cape Town, Western Cape, for example, dry spells and intensely low rainfalls necessitated the need for the promulgation of a bylaw that strictly regulated water use by households and agro-allied and industrial businesses. These regulations became expedient as the city geared up to the possibility of being the first city to experience the anticipated Day Zero - a day that water would stop flowing from taps. As predicted by the Mayor of Cape Town, that day would be in March 2018. So, for the 2015–2018 period, household water use per individual was pegged at 30 liters of water daily as against the normal 50 liters. These curtailments made washing of cars and hosing sidewalks difficult, if not impossible, for many residents. In addition, businesses like gardening and car washing suffered ineffable constraints. The bylaw also contained rules about the use of personal boreholes that make using water from the boreholes on other days other than Tuesday and Thursday illegal. For agriculture, the impact of water stress in 2017 and 2018 was such that it reduced the supply of water for commercial farming by sixty 60% lower than in the pre-drought years (Verge, 2018). These curtailments had serious impacts on farmers' outputs and caused some seasonal workers to be laid off. The drought of 2015–2018 in Cape Town bit quite hard because Cape Town's water supply comes from six major reservoirs which are largely rainfed, and which were dangerously low during that time.

A deviation from the water restrictions attracted fines and prosecution by the South African Police Service(SAPS). To meet up the water demands for households, residents of Cape Town had to improvise means of wastewater conservation in their household for possible reuse. Businesses were given a daily quota of water that could not be exceeded. "If it is yellow, let it mellow, but if it's brown, let it drown" is one of the popular maxims adopted by organizations—hotels, schools, recreation centers, etc.—to conserve water. The city however managed to escape that threat in March 2018 and other dates predicted by government officials for 2018. Although Day Zero never happened as expected, there is no reprieve as there is awareness by residents that water shortfall remains an existential issue. The people are in constant awareness of the possibility of water unavailability. Hence, they inadvertently are conscious of the water rationing rules even after the bylaw is no longer in effect. This is the locus of the study; to analyze the health effects of domestic water rationing for hygiene requirements.

2. STUDY SETTING AND DESIGN

Western Cape is a South African Province situated in the southern end of the African continent and its capital is Cape Town which serves as the country's legislative capital. It covers an area of 49,986 square miles (129,462 square km) and the population, based on the last enumeration, is 5,356,900 (Augustyn *et al*., 2019). The Province was initially part of the former Cape of Good Hope Province until 1994 (Bradlow, 1989). The Province, to the North, borders Northern Cape Province, to the east, Eastern Cape Province, and by coastline fronting the Atlantic and Indian oceans, Western Cape shares boundary to the west and south, respectively. Western Cape Province lies close to the south of the great interior plateau (Highveld) of southern Africa with the southward edges of this plateau forming a conspicuous rocky escarpment extending roughly along the northern border of the Province (Tribe, 2005). The center of the Province is composed of the semiarid highlands of the Karoo region, which are divided by east-west-running mountain ranges—including the Great Swart Mountains—and stretch as far south as the Lange Mountains. The narrow coastline which is south and west of the Karoo has shifting shifted relief from which the sandy Cape Columbine stretches to the west and the rocky Cape of Good Hope stretches to the southwest. It is where the flat-topped Table Mountain, looking over Cape Town and Table Bay, is a prominent landmark. Western Cape is drained by the Olifants, Berg, Breë, Gourtis, and other small rivers. The Province is endowed with a rich diversity of plant life and boasts several sites that compose the Cape Floral Region Protected Areas (designated a UNESCO World Heritage site in 2004).

The coastal regions have a maritime climate and accompanying, while much of the remainder of the land to the north has a Mediterranean climate changing to semi-arid as one goes farther to the north. The Province is one with the inadequacy of rainfall as the mean annual precipitation over most of the Province sums to less than 15 inches (380 mm), and parts of the northwest receive less than 5 inches (125 mm) (Schulz, 2001; Rouault and Richard, 2003; Swift *et al*., 2008). The daily maximum temperatures in inland areas usually range from 68°F (20°C) in winter (July) to 90°F (32°C) in summer (February) (Augustyn *et al*., 2019).

In terms of population composition, roughly one-half of the population in the Province is of mixed ethnicity (previously referred to as "colored" under the apartheid regime), while one-fourth is black, and one-fifth is white. The remainder of the population is Asian of mostly Indian descent. Most of the people in the Province reside in urban centers of which most of the people reside mostly in the city of Cape Town. The most widely spoken language in the Province is Afrikaans, and this is followed by Xhosa (Dyer, 1999), and English which bridges the language gap in the Province existing between indigenous languages spoken by South Africans and many other African languages spoken by a relatively small percentage of the population.

Western Cape has a strong and thriving agricultural sector which has contributed significantly to South Africa's Gross Domestic Product (GDP) (Conradie *et al*., 2009; Sirami *et al*., 2013). The Province boasts the production of a chunk of South Africa's wool, wheat, alfalfa (lucerne), hay, and fruit (including apples, pears, apricots, and peaches), and almost all its wine (Takadi and Moraba, 2018; Venter, 2018; Kemp and Burns, 2016; Burger, 2018; Visser, 2016). Owing to high productivity, the Province has a thriving export trade system for fresh fruit, table grapes, wine, brandy, and canned goods (Mabin, 2017; Fransen and Helmsing, 2016). To a reasonable degree, pastoral activities, such as sheep- raising (in the interior region) and ostrich raising, which provides for export in terms of ostrich meat and feathers, are thriving in the Province. Timber production, especially in the area east of Mossel, is a valuable production engagement in Western Cape (du Toit *et al*., 2018). Rich Atlantic fishing grounds, which cut across Cape Agulhas go as far north as Namibia, provide for an important fish meal and canning industry (Augustyn *et al*., 2019). Western Cape's manufacturing activities include textiles, clothing, footwear, motor vehicles, tires, fertilizers, pesticides, and pharmaceuticals. The Province also boasts of marine engineering and ship repair services along the coastline.

The study adopted qualitative methods of data collection and analysis. A focus group discussion (FGD) was conducted to elicit an expert opinion from experts from the fields of medicine, microbiology, and virology about the effects or otherwise of water rationing for hygiene purposes. A total of six discussants covering the above fields of study were selected for the study. The participants—three doctors, two microbiologists, and one virologist—were purposively selected for this study from Cape Town, South Africa. The FGD was conducted using the telephonic feature of WhatsApp.

3. LITERATURE REVIEW

In this section, the extant literature on drought impacts and vulnerability, drought drivers, and other relevant nuances will be reviewed.

3.1. EL NIÑA AND EL NIÑO PHENOMENA AS DROUGHT DRIVERS

There are two other key intervening variables that determine the extent to which drought may be severe or otherwise namely: El Niño and La Niña (Pandey *et al*., 2019; Cook *et al*., 2017; McCabe *et al*., 2008). El Niño, which is the Spanish phrase for

"'Christ Child"' (Dijkstra, 2006), has different definitions and lacks a widely accepted, universal definition (Vikas and Dwarakish, 2015). There is a multiplicity of views as to what El Niño, as well as El Niña, means. Pandey *et al*. (2019) refer to El Niño as a large-scale climatic interaction that exists between ocean and atmosphere which is associated with episodic warming in sea surface temperatures(SST) across the central and east-central Equatorial Pacific (Pandey *et al*., 2019). Philander (1990) defined the El Niño phenomenon, as a blend of anomalously warm sea temperatures, stronger than the normal southward coastal current, high rainfall, and floods in Ecuador as well as in northern Peru. Regardless of variance and multiplicity of opinion on globally acceptable definition, there is some agreement that El Nino is characterized by unusually warm waters at the ocean surface in the tropical pacific (Vikas and Dwarakish, 2015). Even though El Niño originates in the tropical Pacific, it has very serious worldwide effects on seasonal weather and climate ecological, social, and environmental sectors (Jiang and Fortenbery, 2019; Vikas and Dwarakish, 2015; Jury, 2000; Singh, 2006).

El Nino occurs every 2 to 8 years and the last one was between 2015 and 2016, which was reputed to be very strong (Jiang and Fortenbery, 2019; Vikas and Dwarakish, 2015). El Nino is believed to be the major driver of drought and the phenomenon which makes drought experience more severe in some parts of the world, including Southern Africa where some scholars believe that most of the droughts have occurred in El Nino years (Mason, 2001; Misra, 2003; Fauchereau *et al*., 2003). For instance, Julio *et al*. (2014) argued that the 2005 drought which severely affected grape yield in Western Cape, South Africa was propelled by the El Nino Southern Oscillation (ENSO). However, there is another school of thought that believes that there is no relationship between rainfall deficiencies in Southern Africa and the El Nino phenomenon (Blamey and Reason, 2007). Some other studies have posited that there are other general circulations that may have strong impacts on rainfall in Southern Africa other than El Nino events (Manatsa and Matarira, 2009; Manatsa *et al*., 2012).

Conversely, La Nina is an event that is associated with the episodic cooling of ocean sea surface temperature(SST) in the central and east-central equatorial Pacific (Pandey *et al.*, 2019). When central and eastern tropical Pacific Ocean temperatures are below the long-term average, the globe is affected by La Niña events (Jiang and Fortenbery, 2019; Jury, 2000; Singh, 2006). Whereas El Niño events usually last no more than one year, the La Niña events can last from one to three years and are said to be of more impact and severity than El Nino (National Ocean Service, 2018). For global climate, La Niña impacts tend to be opposite those of El Niño impacts and have more impacts on drought than El Niño and may lead to twice the production loss compared to El Niño events. La Nina, just like El Nino, has been argued to be a relevant phenomenon as far as drought occurrence is concerned.

3.2. DROUGHT IMPACTS AND VULNERABILITY

Drought vulnerability, according to Naumann *et al*. (2013), is about highlighting the socioeconomic and biophysical features of the region that make it predisposed to the adverse effects of drought. The level of vulnerability or exposure to the vagaries of drought depends on a number of factors including population, technology, policy, social behavior, land use patterns, water use, economic development, and diversity of the economic system and cultural arrangement (Naumann *et al*., 2013; Turner *et al*., 2003; Wilhite and Svoboda, 2000). Naumann *et al*. (2013) have argued that the vulnerabilities to drought may result, because of inadequate structures and poor management, constraints of technology and the economy, and environmental problems. An example of the place of technology in the level of vulnerability that a society may be exposed to during a drought season is that of Sub-Saharan Africa where 90% of the farming activities are rainfed (Rosegrant *et al*., 2002).

Rainfed agricultural activities remain the principal source of livelihood for more than 70% of the population. Consequently, the sub-region's population - up to 60 percent - is vulnerable to frequent and severe drought (Hellmuth *et al*., 2007; Esikuri, 2005). Hellmuth *et al*. (2007) also highlighted such other issues as the size of the farm–, which may be influenced by historical land appropriation policies-, provision or lack of credit incentives for diversification options, farming on marginal lands, knowledge of possible farming options, presence or lack of local industry for off-farm supplemental livelihood opportunities, and government policies as vulnerability indicators. For Turner *et al*. (2003), they believed that the factors responsible for the level of vulnerabilities are largely social ones such as faith or lack of it in a new way of doing agriculture, the costs of the new methods, and cultural belief.

3.3. IMPACTS OF DROUGHT ON THE ECONOMY

Globally, the impacts of natural disasters on economic activities have tripled from US$40 billion in the 1960s to US$120 billion in the 1980s (Domeisen, 1995). As argued by Carolwicz (1996), in the 1990s, natural disasters resulted in significant acceleration of economic damage with attendant costs reaching upward of US$400 billion through 1996. Between 1992 and 1996, losses consequent upon natural disasters in the United States averaged US$54.2 billion per week (Carolwicz, 1996). Drought, which is seen to be second only to a hurricane in impacts (Wolchover, 2014), is one of the key natural hazards that have caused huge economic costs globally. This section will first look at different perspectives as to what constitutes economic costs of drought and then provide statistics of economic costs across the world and in South Africa particularly.

Economic losses consequent upon drought cover non-structural losses on one side, and indirect and indirect or high-order losses on the other (Mysiak and Markandya, 2009; Benson and Clay, 2003). The non-structural impacts involve the decline of land value or failure of agricultural yield (Mysiak and Markandya, 2009). The indirect losses are also described as second-order or induced effects pertain to water-use sectors affected by the drought such as the agricultural sector, hydro- and cooling-water reliant energy production, water navigation—such as for travels, water-intensive manufacturing, and domestic water needs (Benson and Clay, 2003). During drought seasons, the directly impacted sectors are predisposed to decreasing and rationalizing their activities and production, collecting fewer revenues, disengaging their staff, and postpose all investments except the most unavoidable ones (Mysiak and Markandya, 2009). Mysiak and Markandya argued that direct losses have spin-off effects and set off a sequence of reactions that every concerned party—suppliers and consumers consumers—are affected by.

Ding *et al*. (2011) also looked at the economic costs of drought and gave three areas the impacts of drought impinge on the economy. The areas where drought impacts according to Ding *et al*. include the agricultural sector, non-agricultural sector, and secondary effects of economic costs of droughts. For the agricultural sector, Ding *et al*. posited that drought is most impactful in the sector with the resultant effects and common signs being dried crops, abandoned farmland, and withered and yellow pastureland. According to them, protracted soil moisture shortages due to drought cause damage to crops and pastures which losses are the primary direct economic impact of drought within the agricultural sector. In the non-agricultural sector, drought is considered to also cause substantial economic impacts through its impacts on water supplies including stream flows, reservoirs, wetlands, and groundwater. They listed a number of non-agricultural sectors impacted by drought and they include, tourism and recreation, public utilities, horticulture and landscaping services, navigation, and other industries/businesses that have a very high dependence on water consumption. The third aspect of economic costs of drought as espoused by Ding *et al*. (2011) has

to do with the secondary effects of drought. The secondary effects of drought, coupled with other natural disasters, are attributed to the interactions and transactions among industries and sectors. A symbiosis exists among agro-linked sectors where the outputs from one industry/sector turn into inputs of other industries/sectors. Consequently, the direct economic impacts of drought on an individual industry may spread through the upstream or downstream linkages to other industries, resulting in secondary impacts. They illustrated the fact that crop losses incurred by farmers decrease their supplies to the agro-allied, downstream industries, such as food processors and ethanol plants. The downside of this, according to Ding *et al*., is that these industries would be left to decide between bidding a higher price for the inputs or otherwise reducing their production for the lack of inputs. In turn, their downstream patrons may be forced to do the same. These types of effects, according to Ding *et al*., are called downstream or forward effects.

On the other hand, farmers may decrease their input necessities such as fertilizer from the upstream suppliers, which may, according to Ding *et al*., lead to upstream, or backward, effects. They refer to both the upstream and downstream effects together as indirect effects. Decreased land prices, loss and/or failure of agro-allied industries, loss of employment from drought-related declines, the strain on the financial institution with regards to credit risks, and reduction in economic losses are some of the drought economic impacts (Ngaka, 2011).

Salamia *et al*. (2008) argued that the 1999–2000 droughts in Iraq resulted in disaster amounting to US$1.605 billion of direct costs, having a 12.7% reduction in the animal products and had as high as 4.4% reduction in the gross domestic product(GDP). In a study conducted by Hayes *et al*. (2005), they found that the economic costs and/or damage occasioned by drought in eastern and central United States in 1988 amounted to $39.4 billion and the United States' drought-loss estimates collected by them for the 2002 drought that affected many States states in the US United States summed up to $13 billion. Howitt *et al*. (2009) estimated the economic damage and short-term job loss associated with the 2009 drought in California to be as high as $2.2 billion and 80,000 jobs, respectively. In a survey conducted by the European Commission's Directorate of General Environment (DG ENV) in 2006 2006–2007 in Europe, the economic impacts of drought over 30 years were found to have hit as much as 100 billion Euro, and they found that the annual costs of drought impacts have reached 6.2 billion Euro.

In Australia, the "Millennium Drought" (2002–2010) Australia triggered unexpected losses to important services provided by hydrological ecosystems in the Murray–Darling basin—as well as air quality regulation, waste treatment, erosion prevention, and recreation (Crausbay *et al*., 2017). The costs of these losses were in excess of AUD 800 million, as huge resources were spent to replace these services and methods of adaptation to new drought-impacted ecosystems (Banerjee *et al*., 2010). The 2006–2007 drought in Australia reduced gross domestic product(GDP) by close to one1%—unlike the 2002 drought that reduced it by 1.6%—however, the gross domestic product with regards to farm production fell by 20% (RBA, 2006). According to International Rice Research Institute (IRRI) (2009), rainfed rice production in South and Southeast Asia is seriously threatened as about 23 million hectares of land used for rainfed rice is most vulnerable to drought.

In terms of drought frequency, Africa is worst hit as it has, especially in the Sahel, The Greater Horn, and Southern Africa, which experienced a total of 382 reported drought events that have affected 326 million people between 1960 and 2006 (Brown *et al*., 2011; Gautam, 2006). Resultantly, drought has exacerbated household vulnerabilities, undercut the continent's development gains, and reduced the potentials of national economies (Hellmuth *et al*., 2007; Hansen *et al*., 2004). Economies of a good number of Subsub-Saharan African countries are especially susceptible to the effects of drought because they depend on rainfed agriculture and have low levels of income per capita (Hlalele *et al*., 2016). A good number of countries in Subsub-Saharan Africa face the risk of a 10%–40% probability of failed seasons during the major cropping calendar (Shiferaw *et al*., 2014).

In South Africa, a study was undertaken by Theunissen (2005) in South Africa designed to compare the drought impacts of 2003 and 2004, showed that wheat yield was 39% lower, the area where it was planted 12% lower, major dam water levels 25% lower with other dams empty. In forestry, which accounts for about 5% of South African gross domestic product, water stress events have had serious, negative impacts in slowing down the growth of trees (Jury, 2002). The government of South Africa expended R285 million on drought relief across the Provinces during the 2007–2008 drought (Ngaka, 2011). 2015–2016, similar to the one of 1992–1995, was quite severe in intensity and reputed by national authorities to be the worst in 23 years in South Africa, resulting in significant declines in harvest (Baudoin *et al*., 2017; DAFF, 2016). Smith (2018) cited the Western Cape's Minister of Economic Opportunity as saying that the most recent drought in Western Cape (2015–2016) vis-à-vis the one of the previous season, is estimated to have reduced aggregate income after costs in the agriculture sector in Western Cape by up to R5.9bn. This is due to lower output as a result of drought. Smith (2018) argued that agriculture and agro-processing contribute a combined R54 billion to Western Cape and account for 52% of all the Province's exports. This risk inherent in this drought situation is that of job cuts which, as indicated by research, will lead to about 30,000 job loss by the rural, unskilled, semi-skilled farming workforce—which constitutes about 22% of the Province's rural jobs—who may find access to other sectors' or formal employment difficult, if not impossible (Smith, 2018).

3.4. DROUGHT-NEXUS

Climate change—as evidenced by drought—erodes livelihoods and increases the spread of infectious diseases. In 2008, over 230,000 deaths were recorded as a result of natural disasters, over 211 million individuals were affected, and extreme weather conditions made worse the existing vulnerabilities by disrupting harvests (General Assembly, 2010). Drought as an environmental security challenge has been argued to lead to exposure to health and/or personal hazards such as diarrhea, cholera, and dysentery because of water scarcity which forces people to drink water from unhygienic sources (US Global Change Research Program, 2018; Sena *et al*., 2017; Calow *et al*., 2010). According to a research finding by Achakulwisut *et al*. (2018), drought is linked to soil-derived particles in the Southwest of the United States that endanger air quality which may lead to significant public health problems.

The exposure to health hazards occasioned by drought may just have more wide-ranging impacts than one may be able to account for. For instance, there is scholarly evidence in the literature that finds that in utero exposure, —that is, exposure of yet-to-be-born children—to environmental hazards may negatively affect their health when they are born, and educationally, later in life (Almond *et al*., 2009; Banerjee *et al*., 2010; Shah and Steinberg, 2014). These studies put forward the fact that the conditions in the pre-birth period and early childhood have an enduring impact on life expectancy, earnings, adult health, and cognitive development. Scholars have used famine (Lindeboom *et al*., 2010) and extreme weather shocks (Rocha and Soares, 2015) to estimate the instrumental relationship between in utero exposure and later-life conditions and life chances. It is quite disturbing that the impacts of drought reach as far as altering the life-course of unborn children. Some scholars have also argued that parts of the multiple health impacts of drought, which are often not recognized, are such health outcomes as vector-borne diseases, nutritional problems, mental health conditions, and respiratory diseases (Sena *et al*., 2017; Kumar *et al*., 2016; OBrien *et al*., 2014). Initially, the linkage between mental health conditions and the phenomenon of the drought was merely speculative rather than based on empirical evidence. World Health Organisation Organization (2004) had posited that mental health resilience, the capability to cope with harsh conditions and to avoid mental health challenges when threatened by stressors, can come under uncontrollable stress in the presence of sustained drought. The WHO's position, however, was not backed by empirical data. The quantification of the linkage between mental health conditions and the drought phenomenon by OBrien *et al*. (2014) is perhaps one of the most significant contributions made so far on the discourse around the impacts of drought. In a study carried out by Obrien OBrien *et al*. in Australia which used household, income, and labor dynamics in Australia to determine the relationship between drought and mental health conditions, the results revealed that, during seven 7 years of major and pervasive drought, one pattern of relative dryness (extreme cumulative number of months in drought culminating in a recent period of dryness lasting a year or more) was connected with greater distress for rural but not urban dwellers. The increase in distress was said to be at 6.22%, based on 95% confidence intervals. Therefore, the study showed the possibility of quantification and identification of the relationship between patterns of drought and mental distress.

The effects of rising food prices alongside climate change problems have generated a sharp increase in the number of people living without sufficient and dignifying food (General Assembly, 2010). The United Nations' Secretary-General submitted that for the first time in history, more than 1 billion people are facing hunger, with more than 17,000 deaths of children every day as a result of hunger, one every five 5 seconds, totaling 6 million a year (General Assembly, 2010). The Report also discussed the vagaries that women, children, refugees, and the displaced are exposed to as they are the most severely impacted as far as the rising food prices are concerned. These communities and groups, according to the Report, suffer serious losses to their human security as they consume fewer and less nutritious foods, and the frustrations over food insufficiency and/or insecurity have also led to socio-political instabilities in some communities in as many as 30 countries.

4. RESULTS AND DISCUSSION

The findings elicited from the experts who participated in the FGD will be presented and discussed under the following headings: (a) Drought and water, sanitation, and hygiene (WASH)-attributable deaths in infants and adults; (b) Water stress, hygiene, and respiratory diseases; and (c) Suggestions for water-stressed households.

4.1. DROUGHT AND WASH-ATTRIBUTABLE DEATHS IN INFANTS AND ADULTS

From the discussions held with the experts used for the study, there was a high degree of unanimity that water, sanitation, and hygiene (WASH) are is critical to health and well-being. They all posited that households with extreme water stress are likely to have negative health outcomes such as diarrhea and cholera. Their view was that bacteria and other organic particles thrive in unhygienic environments, and they may lead to negative health outcomes. These health outcomes, according to the discussants, affect not only adults but also children. A discussant submitted that *Diarrhea is a number one killer disease facing children globally, and it is second only to Malaria*. One of the discussants succinctly opined thus, *households with inadequate levels of water for hygiene purposes are prone to Cholera and Diarrhea. These bacterial diseases are rife in unsanitary environments, and drought can contribute to their spread*. Essentially, the discussants believed that drought is capable of constraining water use, thus leading to sanitation and hygiene issues. This speaks to the importance of water for hygiene and/or sanitary needs (Maina *et al*., 2019; Mackinnon *et al*., 2019; World Health Organization, 2019; Ramesh *et al*., 2015). Improved public health, access to safe drinking water, effective sanitation systems, and good hygiene practices (WASH) play a huge role in the global movement towards achieving the Sustainable Development Goals (Whitley *et al*., 2019).

4.2. WATER STRESS, HYGIENE, AND RESPIRATORY DISEASES

Another consequence of inadequate and/or rationed water use in toilets highlighted by two of the discussants is that it may lead to respiratory diseases. They had posted that the toilet environment is where organic particles such as bacteria, fungal spores, etc. which are transported by air may be found. Breathing in these organic particles, according to the discussants, may lead to respiratory problems. *It is important that the toilet is properly cleaned after urination or defecation to avoid inhalation of these particles*, said a discussant. The quality of air a person breathes may have an impact on the well-being of such a person (Huda *et al*., 2012; Clarke, 1987).

4.3. SUGGESTIONS FOR WATER-STRESSED HOUSEHOLDS

In closing, some of the discussants made some suggestions that could help water-stressed households—constrained to ration water for hygiene needs—to lessen their exposure to health challenges. One of the discussants recommended the use of purifiers in their toilets and the entire house. According to the discussant, *purifiers help to eliminate bacteria and improve air quality*. Another discussant recommended the continual use of hand and surface sanitizers so that bacterial infections that can cause Cholera and Diarrhea may be avoided. *Homes that lack the required amount of water for toilet use should not lack hand and surface sanitizers*; said the discussant. Purifiers have been found to be effective in improving air quality in the home (Cheek *et al*., 2021; Cooper *et al*., 2021; Brągoszewska *et al*., 2019). In the same vein, the use of hand and surface sanitizers and disinfectants is believed to help prevent diseases (Dicken, *et al*., 2020; Sexton, *et al*., 2018).

5. CONCLUSION

This paper has looked at an important climate change phenomenon - drought - and its impacts on individuals. It has specifically explored the drought-nexus through the examination of the link between water stress, sanitation, and hygiene. The qualitative data gathered through an FGD point to the likelihood of negative health outcomes in households with insufficient levels of water for sanitary purposes. It is therefore important for households and communities experiencing dry spells to be aware of this situation so that they may forge the necessary adaptive measures.

CONFLICT OF INTEREST

None.

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