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SPECIAL REPORT

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Climate Change and Conflicts in South Sudan

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Summary
South Sudan has experienced decades of protracted conflicts, some of which might have been caused in part or exacerbated by climate change and variability. Climate change causes scarcity of resources and forces communities to raid their neighbors or migrate to a new area to look for opportunities, which brings new arrivals into competition with the landowners, leading to conflicts (Homer – Dixon, 1994; Raleigh & Kniveton, 2012; Tiitmamer et al., 2017). Local level climate induced stresses feed into national level political instability, which causes or exacerbates violent conflicts (Detges, 2016; Rüttinger et al., 2015). While Funk et al., (2011) have documented climatic changes in South Sudan, little is known about the extent to which such contribute to conflicts. This study investigates the extent of climate change, variability and the incidents of climate disaster events and links with conflicts in South Sudan. Using meteorological data, records of conflicts, floods and droughts, we find (1) decrease in rainfalls and increase in temperature in South Sudan since 1970s, (2) increase in flood and drought disasters in South Sudan since 1900, (3) insignificant link between climate change and conflicts, and (4) conflicts occur after floods or droughts, implying that climate change has been contributing to conflicts in South Sudan. We recommend to the government and partners to (1) invest in climate information services, (2) promote a better understanding of rain-fed agriculture/pastoralism/conflict nexus, as well as focus on conflict resolution mechanisms, (3) cultivate communal dialogue around natural resource management at local levels, (4) integrate climate change adaptation and adaptation measures into peace processes, (5) build communal assets (e.g., dykes and irrigation systems), and (6) invest in conflict data to better understand its key drivers.

1. Introduction

South Sudan has for decades faced protracted violent conflicts, resulting in displacements and deaths. Ending such conflicts needs understanding the role climate change plays in causing or exarcerbating them. Evaluating climate change-conflict nexus in South Sudan is crucial because climate change has become a significant driver of conflicts in places where communities mostly depend on natural resources (Bronkhorst, 2011).

South Sudan has witnessed decreases in rainfall by 10-20 % and increases in temperatures by more than 1°C since the middle of the 1970s (Funk *et al.*, 2011). The country's rainy season, which begins in March/April and continues until November, has increasingly become unpredictable (Funk *et al.*, 2011). Rain-fed agricultural areas have decreased in several of the country's livelihood zones (Funk *et al.*, 2011). Thus, South Sudanese agrarian communities face unpredictable rains and floods, with delayed farming or destruction of already planted crops as a result.

While rainfalls have varied considerably, sometimes with decreasing amounts, temperatures have been rising, resulting in a warming rate of 1.3 degree Celsius over the past century (Funk et al., 2011). These conditions vary regionally, with the northern territories of the country, especially the flood plains ecological zones, experiencing more floods and severe droughts (Funk et al., 2011). Typically, the flood plains ecological zones receive roughly a 1000 mm of rainfall annually. Temperature increases in South Sudan are consistent with the global average temperature increase (IPCC, 2012, 2014), which have increased since the industrial revolution. Most of the temperature increase has occurred since 1970, with 10 of the last 12 years becoming the hottest (Peterson et al., 2009). The period of temperature increase also coincides with the period of increase in the emissions of anthropogenic greenhouse gases (IPCC, 2007, 2014). Temperature increases have affected global weather systems and have affected the resources on which people depend.

These climatic patterns enormously affect communities' relations, especially in areas whose availability of natural resources depends on rain water (Lam, 2011). Climate extremes, especially floods and droughts, influence the level of available resources, thus predictably motivating resource conflicts (Raleigh & Kniveton, 2012). Natural resources at risks of climate change, and whose degradation can cause or exacerbate conflicts in South Sudan, include water and pastures. Communities that depend on these resources are increasingly becoming vulnerable to climate induced conflicts as they violently clash with other communities in search of these resources. For example, Rezeigat and Baggara in Sudan and Dinka Malual in Northern Bhar el Ghazal region in South Sudan have sometimes faced violent competition over limited water and pasture resources due to severe pressure from climate induced shocks and stresses (Suliman, 1994; UNEP, 2007). Lou Nuer, who inhabit areas with scarce water, clash with Dinka and other Nuer sections during the dry season in search of water and pasture. Luanyjang in Tonj State and Agar-Pakam in Western Lakes State have often fought due to competition over scarce water during the dry season[1]. Ethnic communities in former western and central Equatoria States have clashed

[1] Mayom, M. (2010). Lakes' Agar-Pakam and Warrap's Luanyjang sign peace. Sudan Tribune.

with Dinka pastoralists who left their original areas and settled in Equatoria because they could no longer find sustainable pastures year round as they used to.

While more work has gone into documenting climatic changes (Funk et al. 2011), little is known about the extent to which these changes contribute to conflicts in South Sudan. The unpredictability of climate variability makes it difficult for policy makers and households alike to plan accordingly in ensuring sustainable livelihoods. To help South Sudan develop its capacity so as to predict and mitigate the effects of climate variability or change, there is need for a measured analysis into these, both nationally and regionally and focusing on the extent to which these cause conflicts. The results could be used to advance policies on how to mitigate and create resilience against climate induced disasters such as floods, droughts, and conflicts. More specifically, this study aims at (1) determining the extent of climate change, variability and increase in the incidents of climate disaster events (e.g. floods & droughts), (2) establishing if there is a substantial link between these climate stresses and shocks and conflicts in South Sudan, and (3) providing a menu of policy options on how to address these consequences.

2. Conceptual and Theoretical Framework

This section reviews key conceptual and theoretical links between climate change and conflicts. Drought and flood are some of the climate events in South Sudan whose frequency can determine whether the country is witnessing a climate change or a normal climatic variation. We define drought within the context of this study as deficiency in precipitation during a rainy season below the amount that can sustain livelihood activities. There are four types of drought, namely hydrological drought (deficiency in river/stream water flow), meteorological drought (deficiency in rainfall), agriculture drought (soil moisture deficiency) and socio-economic drought (deficiency in supply of and demand for economic goods) (Hisdall & Tallaksen, 2000). In this study, we focus on meteorological drought. Flood is a flowing of water in excess amount to areas considered normally dry. Increase in flood frequency can be an indicator of climate change. We consider conflict in this context as a violent clash between communities over resources.

Neo-Malthusians use resource scarcity theory as the main tool to explain the connection between climate change and conflict. They argue that environmental changes due to their ability to cause scarcity through degradation or destruction of resources pose great danger to human security through conflicts (Bernauer et al., 2012). Homer-Dixon (1994), considered as one of the main ideologues behind the resource scarcity theory, outlines three key components of resource scarcity, namely (1) supply induced scarcity due to depletion of renewable resources at a rate faster than their regeneration rate, (2) demand induced scarcity due to population growth and consumption increase per capita, and (3) structural scarcity as a result of unequal allocation of resources. The three components interact to produce two social processes, namely resource capture and ecological marginalization (Homer –Dixon,1994; Theisen, 2008). Resource capture is a situation which results when few powerful elites grab scarce resources at the expense of the rest of the society (Homer –Dixon, 1994, Theisen, 2008). They grab resources by designing policies and laws in their favor and at the expense of the rest, which weakens the institutions and civil liberties leading to weak civil society. The resultant limited access to resources exacerbates population's frustrations with elite controlled authorities, which, coupled with weakened institutions and civil society, eventually engenders conflicts (Bernauer et al., 2012). Ecological marginalization occurs when communities threated by climate induced resource scarcity in their original areas get displaced to fragile ecosystem, creating further scarcity, competition and conflicts with host communities (Bernauer et al., 2012; Theisen, 2008).

The link between climate change and conflict is seemingly contested. Hauge and Ellingsen (1998) found that land degradation, freshwater scarcity, population density and deforestation exacerbate the conflict chances. Esty et al. (1998) could not find direct link between environmental scarcity and indicators of state failure; however, they somehow found some indirect connections between environmental scarcity and state failure in least developed countries. Theisen (2008) found that the findings by Hauge and Ellingsen (1998) could not be replicated using the same data and method. However, they found only extreme level of land degradation exacerbates civil strife, concluding that resource scarcity has a "limited explanatory power in terms of civil violence." Raleigh & Urdal (2007) also found a strong relation "between low freshwater availability, land degradation, population growth and conflict in a global analysis using subnational measurements in some models." Meier et al. (2007) found that resources scarcity increases the incidents of conflicts in Karamoja area in Uganda, even though water and forage scarcity did not increase conflicts. While Urdal (2005) did not find any link between high pressure on cropland and civil war, he found that a combination of population growth and density exacerbates conflict risks, particularly in the 1970s.

Hsiang et al (2011) observed that climatic changes double the rise of new conflicts during El Nino years compared to La Nina years in the tropics. Burke et al (2009) found temperature increases between 1981 and 2002 in Africa were significantly connected to the start of civil war as "a 1 C temperature increase boosts the risk of civil war by 4.5% points during the same year" (Bernauer et al, 2012). Severe drought in the Syrian fertile crescent valley which occurred between 2007 and 2010 contributed to the uprising and start of conflict in Syria in 2011 (Kelley et al., 2016). Changes in precipitation, according to Miguel, Satyanath & Sergenti (2004), significantly reduce economic growth, which heightens chances of armed conflicts. In addition, a study by Hendrix & Glaser (2007) found "that the lagged percentage change in rainfall relative to the previous year increases the risk of onset of conflicts in Sub-Saharan Africa, whereas soil degradation has no effect and the more water per capita, the higher the risk." Burke et al. (2014) established that changes in climate conditions prepare the ground for conflicts, even though they cannot, on their own, cause conflicts. These changes include increase in temperatures and decrease and increase in rainfalls, increase in the frequency of floods, droughts and storms (Odoh and Chigozie, 2012). Burke et al. (2014) likened the relationship between conflicts and climate change to rise of accidents during snow or rainy season. This demonstrates that while conflicts are natural and may be induced by other factors, climatic changes exacerbate them. Even though the results are mixed as can be seen with this review, context matters. For example, deterioration in climate conditions can lead to violent conflicts in a country that is characterized by weak institutions, dependency on rain-fed agriculture (Salehyan & Hendrix 2014; von Uexkull 2014), poor infrastructure (Detges 2016), politically marginalized groups, ethnically divided citizens (Schleussner et al. 2016), and lack of respect for democratic processes (Von Uexkull et al. 2016; Couttenier and Soubeyran 2013; Fjelde and von Uexkull 2012). Based on this, climate induced conflicts are more likely to erupt when a country experiences frequent severe climate hazards, has weak institutions, weak mechanisms for resolving conflicts and lacks basic services (Detges, 2016, Raleigh & Kniveton, 2012). This also demonstrates that climate induced shocks and stresses are risk multipliers because they contribute to and exacerbate the conflicts (Rüttinger et al., 2015, Raleigh & Kniveton, 2012).

Notably, environmental changes cause resource scarcity in form of deforestation, land/soil degradation, fish depletion, water scarcity, wildlife extinction and pasture degradation. Climate change causes the above impacts through a combination of different factors. For example, increases in temperature creates increases in water evaporation from water bodies, soil and vegetation (Odoh and Chigozie, 2012). High temperatures, coupled with decreases in rainfalls, lead to droughts, which degrade the environmental resources. Degradation reduces the resources that communities depend on (Homer – Dixon, 2001). Water scarcity leads to environmental degradation in form of soil dryness and pasture destruction due to droughts. This reduces the resource availability and forces the communities to look for them elsewhere.

In South Sudan, the search for scarce resources has been in the form of an invasion of a nearby community to raid cattle and other resources, or a migration to a new area to look for opportunities, which brings new arrivals into competition with the land owners (Tiitmamer et al., 2017). Example of a migration to a new area as a result of climate-induced displacements include migration of Jonglei Agro-pastoralists to Equatoria region which has caused conflicts with farmers in the region since the 1990s. Scarcity of resources in rural areas as a result of drought and floods, has forced people to migrate to towns, in turn increasing socio-economic stresses that sometimes fan political upheavals. As mentioned early, the 2011 violent political uprising in Syria is attributed to the 2007 – 2010 severe drought that led to the collapse of agricultural production in the Syrian Crescent Fertile Region, which exacerbated the uprising (Kelley et al., 2016).

In summary, the empirical evidence on climate change conflict nexus is mixed. One of the reasons the results are mixed is because scholars have used mixed tools and conceptualization of research design and the use of data from different temporal and spatial scales (Salehyan, 2014). Variables they often use include land degradation, freshwater scarcity, deforestation, fish depletion, temperature increase, rainfall decrease, increase in the incidents of floods and droughts. In our case, we focus on the latter variables to measure the link, as these are the only data available at our disposal.

3. Methods, Materials, and Empirical Strategies

We used (1) rainfall and temperature records from four meteorological stations of Juba, Wau, Renk and Raga from 1970 to 2015, (2) flood and drought records from the media and literature from 1900 to 2017 and (3) Armed Conflict Location and Event Data (ACLED) from 1997 to 2016. We obtained the meteorological data from South Sudan Meteorological Department (SSMD), recorded in two Agro-climatic zones in the three regions of Bhar el Ghazal, Equatoria, and Upper Nile. SSMD records rainfalls and temperatures on daily basis using rain gauges and air temperature thermometers in the mentioned three stations. South Sudan had 43 meteorological stations distributed across the country (Tiitmamer, 2015). However, only 5 stations remain after the civil war started in 1983. While the meteorological data drawn from 5 locations only provide necessary information into precipitation and temperature, they do not comprehensively tell the whole story as they do not cover the whole country. We use media sources and academic literature to bridge this gap.

The media and academic literature data were obtained from different sources, namely a study of flood history in the Upper Nile Region by Douglas Johnson, from the 1820s to 1991. Media records of floods and droughts going as far back as 1900 are also used. Johnson (1992) obtained his data from various sources, including monthly records by former district commissioners in the Upper Nile Region and interviews with elders from the region. To obtain these data, we conducted search in JSTOR and Google Scholar to locate relevant information and sent e-mail enquiries to knowledgeable individuals to point us to possible sources of the data we needed. We also reviewed Sudan Open Archives which has kept past records of various incidents, including floods, droughts, and conflicts.

Both climate and conflict data are recorded on monthly basis, forming reasonably large panels. Thus, our matched sample comprises 475 regional-months, and 4,101 conflict-months. To determine the extent to which climate change or variability or climate disasters have contributed to conflicts, we used both quantitative and qualitative analyses. We used the data from ACLED project spanning the period from 1997 to 2016 to determine the link between climate change and conflict. The ACLED data present information on conflict episodes by location, actor, and year. The data are regularly updated as the new information of conflict becomes available. The data cover rebellions, communal fighting, political demonstrations, and rioting. We ran a regression analysis to determine the connection between conflict and changes in rainfall and temperature. We use the random effects model to determine the contributions of climate change to conflicts. A random-effects model depends on a number of key motivations. First, climate and conflict spells seem to occur at random. The random-effects model adequately estimates random variations in an outcome. Second, we assume that space specific dynamics are uncorrelated with climate variability, the predictor variable. Any correlation between individual effects and predictor variable biases the partial estimates. Unlike the fixed-effects model, which accounts for unobserved, invariant differences for each unit of analysis, the random-effects model estimates the effects that describe the distribution from which the individual intercepts are drawn, consequently producing efficient estimates. The random-effects model captures long-term random variations in the outcome variable.

4. Results

4.1. Extent of Climate Change and Variability

This section determines the extent of climate variability and change in South Sudan using data from three meteorological stations of Juba, Wau and Renk. These areas are located in Ironestone Plateau and Eastern Flood Plain Ecological Zones in Northwest, Northeast and Southern parts of the country, respectively. Data from these zones provide a glimpse into what is happening in other parts of the country as these ecological zones, (sometimes known as livelihood zones), stretch across most of the country. Climate conditions in the Eastern Flood Plains are almost the same with climate conditions in Western Flood Plains, which occupy most parts of the Northern States of South Sudan that are vulnerable to both droughts and floods. Also, conditions in Ironstone plateau are almost the same any where within the zone from Raga in the northwest to Juba in the South.

According to the results, on average, rainfall in South Sudan declines in November and picks up in April. This is anticipated, as November and April ordinarily mark the beginning of two different seasons, dry and wet. The heaviest rain occurs in July and August, reflecting longstanding seasonal variants in the country. Rainfall is quite variable annually, averaging between 53 (1990) and 85 millimeters (2014). On average, the national rainfall stands at 69 millimeters over the 45-year period. Regionally, Renk received the lowest amount of rainfall, at 43 millimeters, compared to 84 in Wau and 80 in Juba, respectively. Combining the three stations, the national average temperature stands at roughly 35 degrees. The monthly average temperature has varied between 32.11 (in August) and 38.25 (in March) degrees. Annual presentation of the same information yields a range of closely clustered values, indicating a minimal variation in the temperature. Similarly, there are virtually negligible variations among the three ecological zones, as temperature ranges between 34 (in Renk) and 35 degrees (in Juba and Wau).

While rainfall has been fluctuating from below normal to above normal in Wau, overall, there has been about 19 millimeters decrease in rainfall amount since 1971 (see figure 1). Rainfalls also fluctuated considerably in Wau between 1970 and 2015 (see figure 2). The deviations reflect the changes from normal annual average shown in figure 1. The year that has received the highest amount of rainfall since 1971 in Wau is 2013. This is not surprising because 2013 witnessed the heaviest flood that submerged 7 out of the 10 states, leading the President to declare a state of emergency. Juba also saw a decrease in rainfall by about 12 millimeters while Renk saw a slight increase by about 4 millimeters.

The meteorological data from Juba, Wau and Renk indicate temperature increase by roughly 0.5 and 1 Degree Celsius since 1970, suggesting that droughts or famines in the region could be a manifestation of climate change (see Figures 3, 6 & 7). This increase is almost in line with existing evidence (Funk et al., 2011).

Figure 1. Rainfall deviations from normal in Wau, 1971 -2014

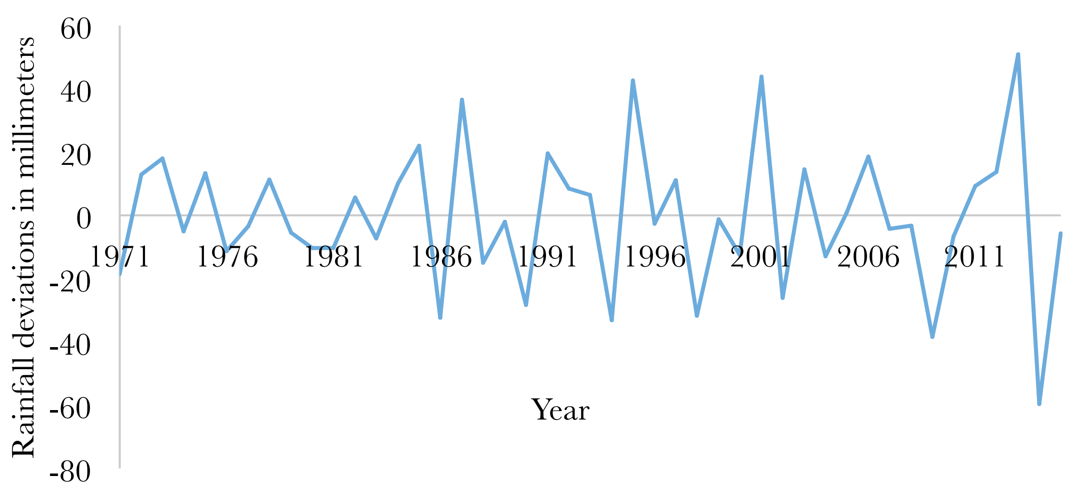


Figure 2: Average rainfall in Wau,1970-2015

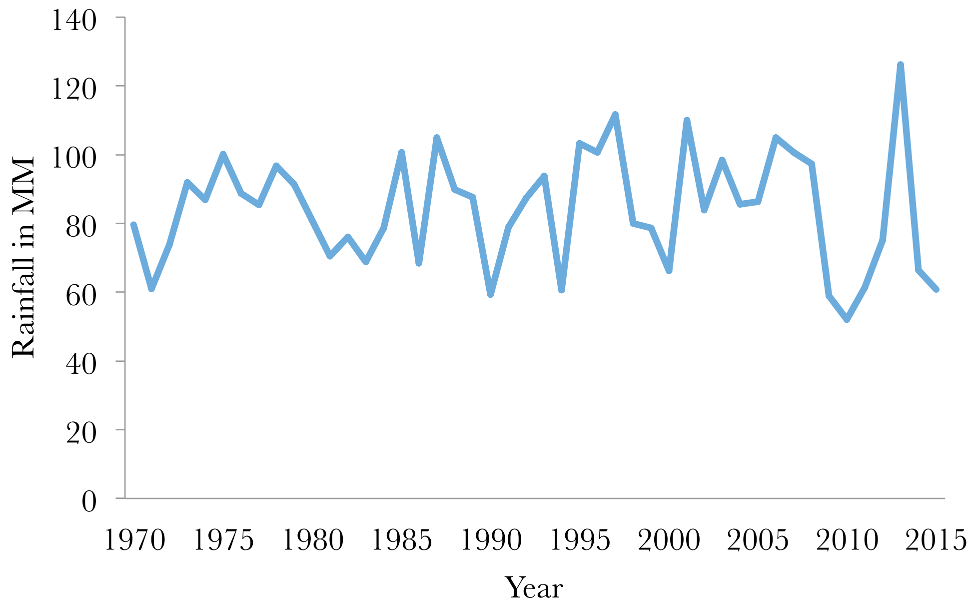


Figure 3. Temperature trends in Wau, 1970 -2015

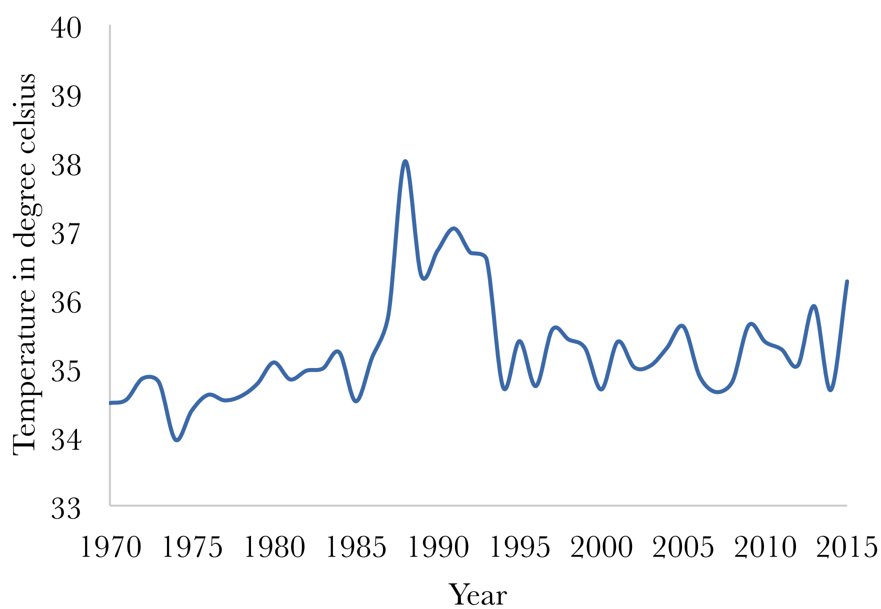


Figure 4. Rainfall deviations from normal in Juba, 1971-2015

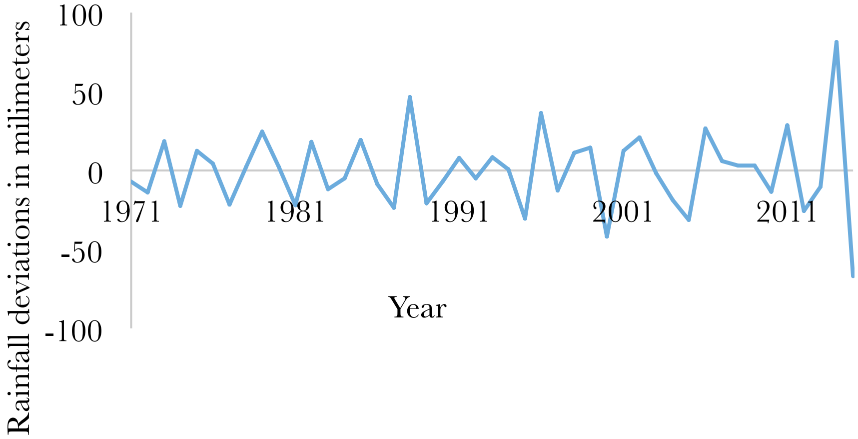


Figure 5. Rainfall deviations from normal in Renk,1971 - 2015

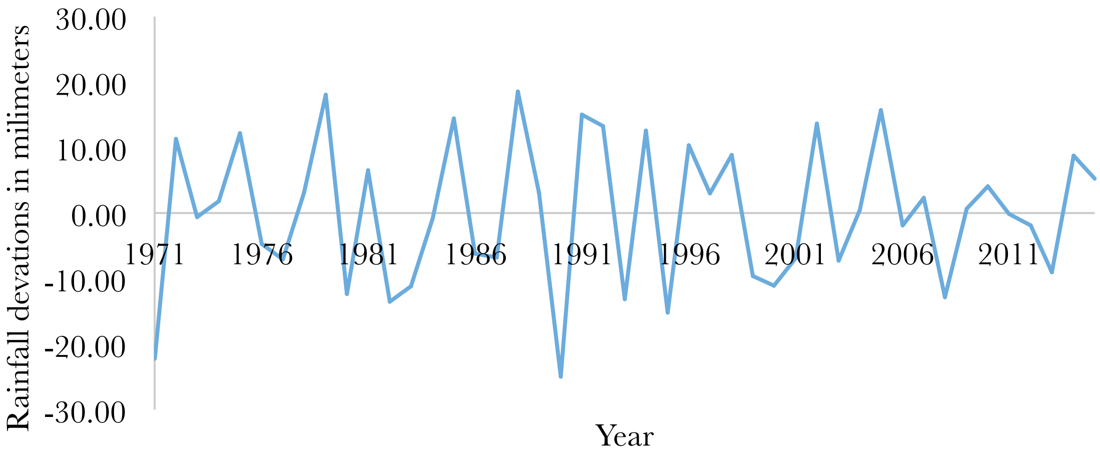


Figure 6. Temperature trends in Juba, 1970-2015

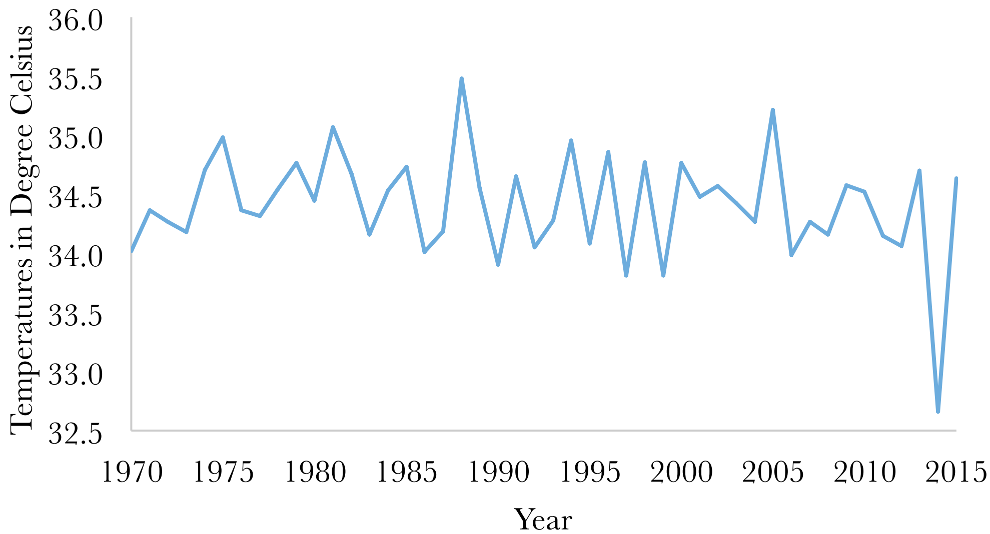
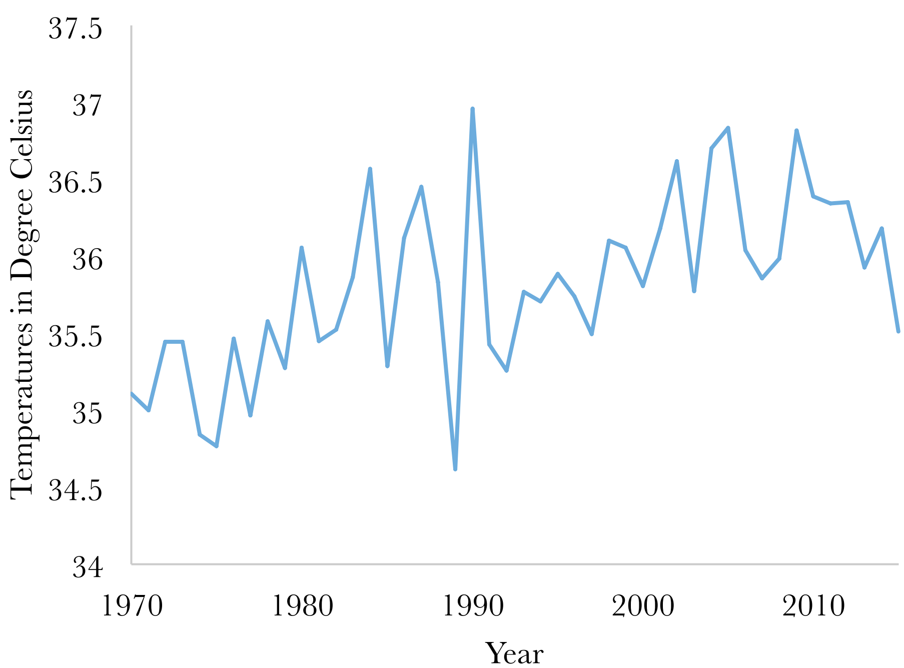


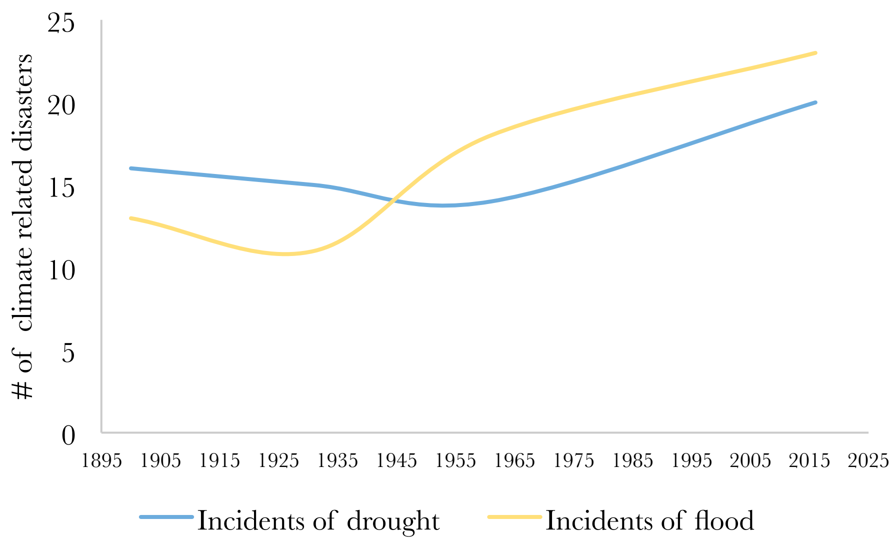
Figure 7. Temperature trends in Renk, 1970-2015



4.2. Extent of Occurrences of Climate Disasters

To map the incidents of floods and droughts over time in South Sudan, we reviewed the existing literature and compiled related records since 1900. We grouped these incidents into 30-year period to evaluate changes over time. A 30-year window is the threshold for establishing the prevalence of climate change. We found a total of 65 flood incidents over a period of 117 years, averaging 16.25 every 30 years. Based on these records, floods frequency has increased in the last 60 years, with the last 30 years witnessing the highest outcomes (see figure 8).

Figure 8. Incidents of floods and droughts in South Sudan, 1900 - 2017



In addition, the period equally witnessed 65 incidents of drought. Like the flood, drought incidents have also increased in the last 30 years. These findings are consistent with what Funk et al (2011) found—that there have been increases in the incidents of floods and droughts over time. These also reflect the regional experience.

4.3. Climate Change–Conflict Nexus

This section attempts to answer the question: do climate change and variability influence conflicts in the South Sudanese context? Considering the assumptions outlined previously, we assess this question using the random-effects model, consequently predicting the average number of conflict episodes in a particular region as a partial function of climate change or variation. Before estimating our model, we assess whether the individual effects are indeed uncorrelated with climate dynamics, temperature and precipitation using the Hausman specification test. Essentially, the test determines whether the random-effects is truly preferable to the fixed-effects. As predicted, results suggest that the random-effects model is more appropriate.

The net result suggests that an increase in both temperature and rainfall reduces armed violence by 0.29 and 0.01, respectively. However, these results are statistically insignificant, implying no evidence to suggest that there is indeed a plausible relationship between armed violence and climate variability in the South Sudanese context. What appear to be more significant are regional climatic and political factors. For example, regional climatic conditions seem favorable for the Ironstone Plateau (Wau and Juba) than for Eastern Flood Plain (Renk).

While the three stations represent two different ecological zones located in different geographical locations, they also represent the former three regions of Bhar el Ghazal, Equatoria and Upper Nile. As expected, Upper Nile experienced on average 12.26 conflicts, twice as high as in the other two regions. On average, this means 6 fewer conflicts for Bahr el Ghazal and 4 fewer conflicts for Equatoria over the eighteen-year period. Flood Plains, namely Western and Eastern, located in most of former Jonglei, Upper Nile, Unity, Warrap and Lakes States, get hard hit by frequent floods and droughts. It is therefore unsurprising that the Eastern Flood Plain experiences more conflicts in response to climate shocks.

These findings reflect what the previous studies have found—mixed empirical evidence on the connection between climate change and conflicts. In our case, we do not establish such a nexus. However, lack of evidence does not mean lack of connection (Detges, 2016). Lack of statistical significance could be attributed to the inadequacy of the data, particularly spatial under-representation.

While the random-effects model suggests an insignificant evidence, a look at historical record reveals that conflict occurrence is correlated with climate shocks. Johnson (1992) used both oral and written histories to account for how ecological change influences social change. He concluded that flood greatly influenced the timing of the battles between various tribes. For example, Johnson explains that four major floods recorded in the 19th century, namely Amol Magook, Nyoc Bor Mogogh, Nyoc Mut Roal and Nyoc Mut Mandoang, were associated with battles between Nuer and Dinka in the areas around Khor Fulluth, Pading, and Duk Ridges. These battles occurred due to climate induced competition over scarce resources. Interviewees in Aweil and Tonj told us also that communities clash after climate shocks related displacements (See Tiitmamer et al., 2017).

Major floods of the 20th century have also been associated with conflicts. There are a number of cases of conflicts associated with floods and droughts worth mentioning. These include Pastoralist–Farmer Conflict in Equatoria and Dinka–Nuer Conflict, among others. While these conflicts have been caused by other factors, climate induced stresses and shocks in the form of floods and droughts have played significant roles either in triggering or exacerbating the hostilities.

Our analysis of the conflicts and climate induced disasters reveals that areas prone to floods and droughts are the same areas that are also prone to conflicts. In particular, the flood plains appear to have more conflicts and floods and droughts compared to other areas. This suggests the importance of environmental conditions to stability. That is an environmental scarcity in a country with inadequate institutional capacity can be a recipe for political instability and violent conflict.

Case Study 1: 1960s Floods and Pastoralist–Farmer Conflict in Equatoria

One of the causes of the conflict between Dinka pastoralists and Equatoria farmers can be traced to the devastating flood of the 1960s, which destroyed homes, crops and pastures in the then Bor and Yirol Districts. Pastoralists, mostly from Bor areas, chose to migrate to Equatoria, which has highlands with good pastures almost all year round. Tensions emerged as herds of Dinka cattle began to stray and devour the crops in Equatoria. The farmers' grievances fed into the political grievances of Dinka domination in the regional government in Juba and led to the Kokora, which was a campaign to decentralize Southern Sudan so that each group could go to their own administrative region (Willems and Deng 2015). As the conflict heightened, the region was divided into three administrative regions and Dinka pastoralists went back to their original areas, marking a temporary end of conflict between Dinka pastoralists and Equatoria farmers. Like in many cases of the climate change conflict nexus, climate stresses in the case of the Dinka pastoralists–Equatoria Farmers' Conflict acted as both a root cause and a multiplier (*(Rüttinger et al. 2015,* Salehyan & Hendrix 2014, von Uexkull 2014).

Case Study 2: 1991 flood and Nuer – Dinka Conflict

While the catastrophic Dinka – Nuer Conflict of 1991 was caused by multiple political and historical factors, including the SPLM/A split, one important climate related factor is worth mentioning as having played a multiplier effect. We argue that the devastating flood of 1991 that destroyed crops and livestock in most parts of Upper Nile played a role. The destruction of crops and livestock left the civilians vulnerable and therefore prepared a fertile recruitment ground for the civilians to join the warring sides following the SPLM/A split. The conflict presented an opportunity to compensate through cattle raiding what was lost to the floods.

The interests of civilians converged with the interests of the SPLM/A faction elites. Civilians wanted to get livestock and SPLM/A factions wanted to get recruits to defeat their political opponents. These convergence of interests exacerbated the conflict and led to unimaginable destruction of lives and property. This is in line with studies elsewhere that demonstrate that chances of a flood or a drought causing conflict are higher with communities that depend on rain-fed agriculture and livestock and even the highest with communities that have weak conflict resolution mechanisms or that traditionally carries out cattle raids against their neighbors (Salehyan & Hendrix 2014, Von Uexkull 2014, Raleigh & Kniveton, 2012). Chances of climate stresses causing conflicts between communities can be reduced with strengthening of dialogue and peaceful conflict resolution mechanisms among the communities.

Case Study 3: 1991 floods and Dinka pastoralist- Equatoria farmers' conflict

The floods of 1991 and the subsequent destruction of Bor areas by the White Army militia forced the Bor Dinka pastoralists to again migrate to Equatoria. At first, the floods forced a small number of cattle camps to move to Gemeza and Mongalla. These cattle camps survived the invasion by the White Army and formed the nucleus of the many Dinka cattle camps that would cause conflicts in Equatoria in the 1990s, 2000s, and 2010s. While various efforts have been made to return the pastoralists to their original homelands, so little has been achieved. The Dinka pastoralists continue to prefer Equatoria because of access to water and greener pastures all year round in comparison to their original areas that have experienced increase in the frequency of unreliable rainfalls, sometimes either excessive or very little.

Conclusion

We have looked at the extent to which the climate has changed or has varied in South Sudan and how this has influenced conflicts. Records of rainfall and temperature from three weather stations in Wau, Juba and Renk demonstrate decreases in rainfall and increases in temperature since 1970. We found no causal links between conflicts and climate shocks. However, the insignificant relationship may be a result of few meteorological stations used and the distance between these stations and conflict prone areas. While the meteorological data demonstrate a lack of link, historical records relate conflicts to climate induced disasters.

Policy recommendations

1. The government should mainstream climate change mitigation and adaptation measures in its policies, establish institutional frameworks to address climate induced floods and disasters, and design mechanisms to reduce or peacefully resolve conflicts.
2. The government and its partners should also prioritize the following:
    i) Investment in climate services, especially in areas of protracted conflict, as a matter of urgency.
    ii) Promotion of a better understanding of rain-fed agriculture/pastoralism/conflict nexus, as well as a better understanding and application of conflicts resolution mechanisms.
    iii) Cultivation of communal dialogue around natural resource management at local levels.
    iv) Integration of climate change into peace processes (e.g. National dialogue, 2015 peace revitalization process).
    v) Building of communal assets (e.g., dykes, irrigation system).
    vi) Development of conflict data as well as conflict drivers' data infrastructure in South Sudan.

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About Sudd Institute

The Sudd Institute is an independent research organization that conducts and facilitates policy relevant research and training to inform public policy and practice, to create opportunities for discussion and debate, and to improve analytical capacity in South Sudan. The Sudd Institute's intention is to significantly improve the quality, impact, and accountability of local, national, and international policy- and decision-making in South Sudan in order to promote a more peaceful, just and prosperous society.

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