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A Closer Look at Climate-Induced Human Migration from Seven African Nations to Seven OECD Nations

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The intersection between climate change and human mobility is increasingly examined in development studies literature. Certainly, it is an important nexus to reflect on since climate change is irreversible, and subsequent shifting human migration patterns have amplified its effects. The consequences of climate change, for example, rising sea levels, the melting of the permafrost and ice caps, and increasing global sea and land temperatures, have implications as drastic as leading to the submersion of entire island nations due to the increase in sea levels (Reuveny, 2007). Once the planetary temperatures surpass the universally agreed upon tipping point by two degrees Celsius, catastrophic effects increase dramatically (Reuveny, 2007). One expected consequence is the increased forced external and internal displacement of humans worldwide. The Environmental Justice Foundation (EJF) estimates that in 2008 over 20 million people were displaced by climate-related natural disasters (Environmental Justice Foundation [EJF], 2014). Furthermore, EJF projects that 150 million climate refugees will migrate to other countries in the next 40 years (EJF, 2014). These observations imply long term ripple effects for environmental migrants. Such effects range from direct to indirect impacts in situations of both external and internal migration.

External displacement will affect migrating populations in terms of political security and conflict over resources (Lister, 2014). Moreover, internal displacement may result in threats to economic livelihoods and self-determination (CREP, 2016). In this instance, an indirect impact of climate change on internal displacement can be illustrated in the increased intensity and frequency of droughts, resulting in the displacement of farm workers and their likely migration to nearby cities in order to find employment (Chang, 2009). A direct consequence of climate change on external displacement can be observed in the example of the Darfur conflict in Sudan (Verhoeven, 2011). Known as the first "climate war," shifts in rainfall led pastoralists to migrate south of the Sahara for improved grazing for their herds, but they encountered farmers who denied them access to grazing lands, contributing to a resource-based conflict (Verhoeven, 2011). Combined with deeply entrenched post-independence ethnic divisions and corrupt governance, competition over resources escalated and resulted in the migration of over 200,000 refugees across the border to Chad (Verhoeven, 2011). From the example of Darfur, it is evident that varying political, economic and social consequences arise from environmentally fueled human migration in different settings.

The urgency of climate-induced migration as a development issue emerges along Global North and South lines. In the Global South, the combination of increased vulnerability and a lack of resources to adapt functions to situate the attendant human migration push within the context of critical development. According to the 2014 Intergovernmental Panel on Climate Change (IPCC) Synthesis

Report, populations lacking resources for voluntary migration experience higher exposure to extreme weather events and are also largely concentrated in the Global South (IPPC, 2014). Thus, environmental migration is related to development as the slow onset of changes, such as extreme weather events and rising sea levels, all contribute towards creating new adaptation strategies. These strategies affect the socio-economic conditions of vulnerable populations such as women, the elderly and children (Lister, 2014). Therefore, the inevitably heightened vulnerability of the Global South to the impacts of climate change, along with an absence of adaptive mechanisms, makes displacement all the more important to mitigate.

Projections of global population density demonstrate that environmental migration will also continue to affect the Global North. The human population is expected to reach nine billion in 2050, and the majority of society will live in megacities mostly located along coasts (International Organization for Migration [IOM], 2016). Climate change will thus place pressures on urban and rural societies, but at varying degrees depending on available resources and adaptive capacities. It is therefore vital to analyze the serious implications of this issue as its extreme impacts have and will continue to have far reaching consequences, directly and indirectly, on every inhabitant in the world.

The absence of a legal framework attending to climate-induced migration also exemplifies why it is a development issue of paramount importance. Climate refugees are not conferred protection under existing international agreements (Wyman, 2013); there are no treaties nor protocols that provide assistance to climate migrants. Even though current international humanitarian law may be applied to some cases of environmental displacement, relevant refugee rights, such as the right to return, does not apply (Wyman, 2013). Hence, in the absence of binding legal agreements, these displaced populations have nowhere to go (Kibreab, 2009). It is also noted that the concept of environmental refugees is not a recent concern. Fears of mass migration resulting from climate change impacts were first voiced in the 1980s (Kniveton, Smith & Black, 2012).

When the UN *Intergovernmental Panel on Climate Change* (IPCC) released its First Assessment Report in 1990, it was suggested that large-scale global migration resulting from climate change might represent the 'greatest single impact' on world security (Kibreab, 2009). It is therefore, at once, an issue of sustained urgency with, paradoxically, little to no representation in international law. The potential for environmental migrants to receive no protection makes climate-induced displacement even more critical. It is also worth noting that climate change and human migration have habitually been discussed separately in literature, falsely suggesting little connection between the two variables.

Similarly, the 2007 IPCC report confirmed its earlier predictions that the earth's climate system is warming at an unprecedented level (Kibreab, 2009). Evidencing this, current scholarship on climate change references visible changes in the earth's physical environment. According to the National Aeronautics and Space Administration (NASA), satellite sea level observations show that sea levels are currently at 85.6 mm as of July 2016, compared to 82.2 mm in July 2015 (NASA Global Climate Change [NASA GLC], 2016). Moreover, anthropogenic warming is currently responsible for roughly 75% of the global moderate temperature extremes on land, and 18% of the global moderate precipitation extremes (Fischer & Knutti, 2015).

Regarding current human migration trends, roughly 3.4% of the world's population lives outside their countries of birth (World Bank Group [WBG], 2016). Together, the current state of knowledge regarding the environment-migration nexus claims that gradual and sudden environmental changes are resulting in increased human mobility (IOM, 2016). Certainly, more research into the relationship between migration and the impacts of climate change needs to be undertaken, so as to better inform adaptation and mitigation mechanisms, policy interventions at varying scales and international climate governance. Overall, the contributions of climate change impact to the increasing forced movement of people underscores the urgency of the issue at hand.

These issues notwithstanding, there are international organizations that have been receptive to reflecting on the link between environmental change and human migration and have formulated policies that are inclusive of climate migration concerns. Three of these UN policies will be evaluated in this paper. Under Goal 13 of the United Nations (UN) *Sustainable Development Goals* (SDG), targets 13.1 and 13.3B can be extended to address climate-induced migration by targeting the preparedness, mitigation and adaptation strategies of countries that are most affected by environmental disasters. These efforts would function to reduce the forced displacement of people (United Nations [UN], n.d). Target 13.1 specifically looks at two variables: increasing adaptive capacity and the onset of climate-related disasters. Target 13.3B looks at a slightly different pair of variables: preparedness for consequences of climate change impacts and the dependent population in developing countries. Related, at the United Nations Climate Change Conference (COP19) in November 2013, the *United Framework Convention on Climate Change* (UNFCCC) created the *Warsaw International Mechanism for Loss and Damage*. Action Area 6 is aimed at incorporating issues of migration, displacement and human mobility within the broader development framework (UNFCCC, n.d). Finally, endorsed by the UN General Assembly in 2015, the *Sendai Framework for Action on Disaster Risk Reduction* calls for increased "transboundary cooperation [...] to build resilience and reduce disaster risk, including [...] displacement risk" (The Advisory Group on Climate Change and Human Mobility [AGCCHM], 2015).

Methodology

In order to evaluate these three policies, I will analyze the effect of climate change on the displacement of people. As an indicator for climate change, I will be looking at extreme weather events, specifically flood frequency. The scope of this analysis will be limited to the African continent as this is the region of the world most vulnerable to climate change impacts (Lister, 2014). In this paper, I will be investigating the following question: does the displacement of Africans to nations in the Organization for Economic Cooperation and Development (OECD) change as a function of increasing flooding frequency in Africa between 2014 and 2016?

At first glance, flooding events seem like an insignificant predictor of migration based on the sheer number of landlocked countries, the uneven precipitation trends and increased desertification on the continent (Perch-Nielsen, Bättig & Imboden, 2008). However, statistics demonstrate otherwise since flooding events constituted the largest sample size of natural disaster data between 2014 and 2016 in the chosen datasets. Furthermore, flooding is a pressing concern since many countries in Africa achieved independence only in the latter half of the 20th century, thus postcolonial governments face the unanticipated challenge of having to manage the climate-induced movement of people across arbitrary colonial borders (Barrios, Bertinelli & Strobl, 2006). For these reasons, the independent variable is flood frequency and the dependent variable is the number of displaced Africans.

The following datasets will be used to assess the aforementioned policies as well as to quantify these two variables. I will be looking at the "significant disaster-related displacement events - provisional events database," which produces data on environment-related displacement events per country between 2014 and 2016 (Internal Displacement Monitoring Centre [IDMC], 2016). This dataset comes from the Internal Displacement Monitoring Centre (IDMC) (2016). IDMC is part of the Norwegian Refugee Council

(NRC), an independent, non-governmental humanitarian organization (IDMC, 2016).

I will also be looking at one dataset detailing net migration inflow, and another that catalogues natural disaster frequency. The first is the International Migration Database containing the total number of foreign migrants per OECD country from 2000 to 2016 (Organization for Economic Co-operation and Development [OECD], 2016). This dataset is from the Organization for Economic Cooperation and Development (OEDC) (2016). The OECD is a forum where governments from 34 democracies and 70 non-member economies collaboratively promote economic growth and sustainable development (OECD, 2016). The second is the EM-DAT database containing the frequency of various climate-related natural disasters between 2000 and 2016 (Centre for Research on the Epidemiology of Disasters [CRED], 2016). In this directory, droughts and wildfires are categorized as climatological natural disasters, and 'flooding' is categorized as 'hydrological.' Moreover, flooding is further broken down as riverine flood, coastal flood and flash flood. EM-DAT is maintained by the Centre for Research on the Epidemiology of Disasters (CRED) at the School of Public Health in the Université Catholique de Louvain (CRED, 2016).

These datasets include different types of data. The region and countries being evaluated constitute a type of categorical nominal data. The region is the African continent and the seven countries included in this study are: Democratic Republic of Congo (DRC), Ethiopia, Kenya, Malawi, Mozambique, Niger and Sudan. The period of time in which flooding events have occurred will be measured in years. Years represent quantitative continuous data. Based on the available data, the data points will be from 2014 to 2016. There are also three variables that fall under the category of quantitative discrete data: the number of flooding occurrences in Africa, the number of Africans externally displaced, and the number of foreign migrants in OECD countries.

The relationship between the independent and dependent variables can be illustrated through the following alternative hypothesis: an increase in the frequency of flooding events in Africa causes a greater displacement of Africans. Contrastingly, the null hypothesis is that the displacement of Africans is unrelated to the frequency of flooding events in Africa. In order to draw a conclusive statement on the relationship between the variables, I will perform a hypothesis test using the following types of analysis. I will begin by using descriptive statistics to calculate the standard deviation, the standard error and the range of data for each dataset. I will use standard deviation as a measure of spread for the scatter plot. Following this, I will perform a regression analysis by displaying a trendline in the scatter plot, finding the r-squared value and calculating the equation of the line. Finally, I will either accept or reject the null hypothesis by performing an analysis of variance on the data. This entails using the ANOVA tool in Microsoft Excel to determine the p-value.

Findings

My original datasets required sorting in order to filter for only the data needed to satisfy my independent and dependent variables. For instance, I filtered the type of climate disaster to flooding events. There were also differences between my datasets that required making new columns. For instance, in the IDMC dataset the unit for location was countries, while in the EM-DAT dataset location was organized by continent. I therefore took all the country values in the IDMC dataset and identified their region according to the following continents: Europe, North America, South America, Asia, Africa and Oceania. I then filtered the location in both datasets to Africa. Now that all the data points aligned, I noted that certain countries had multiple flooding events from 2014 to 2016, resulting in multiple data points for a single country. Therefore, I calculated the average number of displaced people for each country exceeding one flooding event. As a result, there was a huge range in data: seven displaced people from Seychelles to 159,040 people from Sudan. I therefore split the data in half and found that countries displaced either greater than or less than a baseline of 100,000 people. I used values greater than 100,000 displaced people because it represented the severity of the most extreme conditions caused by flooding. This reduced the sample size of my dependent variable to the following seven countries: DRC, Ethiopia, Kenya, Malawi, Mozambique, Niger and Sudan. I then matched these data points with the seven OECD countries that have taken in at least 100,000 foreign migrants: Austria, Belgium, Chile, France, Netherlands, Sweden and Switzerland. Hence, the sample size for both my independent and dependent variables is seven.

The measure of central tendency for each of my variables is calculated by taking the average. The average number of displaced Africans between 2014 and 2016 is 71,332. The average number of flooding events between 2014 and 2016 is 2.64 (or 2). The average number of foreign immigrants in OECD countries from 2014 to 2016 is 115961.74 (or 115961). The variation of my three datasets are illustrated in the table below.

	RANGE	STANDARD DEVIATION	STANDARD ERROR
IDMC	55,040 displaced Africans	+/- 85102.1427 displaced Africans	+/-32165.5865 displaced Africans
EM-DAT	6 flooding events	+/- 3.44087098 flooding events	+/-1.300527 flooding events
OECD	62023 immigrants	+/- 174640.337 immigrants	+/- 66007.8431 immigrants

In order to improve the representation of African migrants, I took both the immigration and emigration flows into account. Hence, the seven final data points for my dependent variable were calculated by taking an average of the seven data points in the IDMC dataset (number of outflow of Africans), in addition to the seven data points in the OECD dataset (number of inflows of foreign migrants), divided by two. Hence, I also calculated a new standard deviation of +/- 89842.524 displaced Africans. In the scatter plot below, the average number of displaced Africans in DRC, Ethiopia, Kenya, Malawi, Mozambique, Niger and Sudan resulting from the average number of flooding events between 2014 and 2016 is plotted (*Figure 1.1)*.

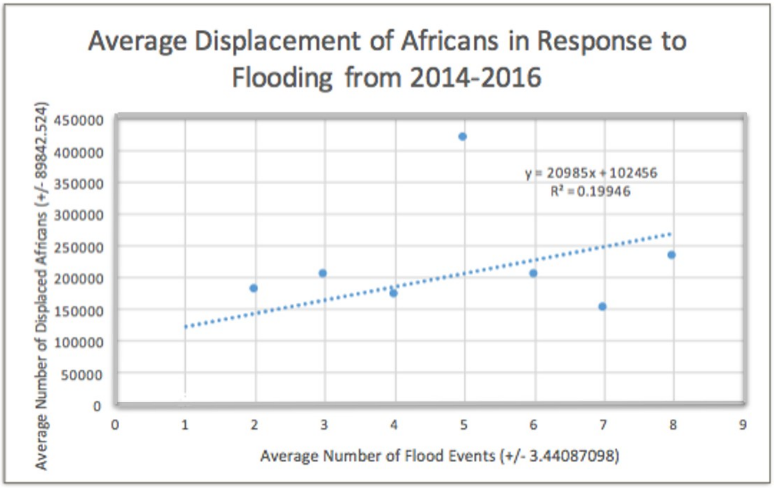

Figure 1.1

There is a positive linear correlation between the independent and dependent variables. This is indicated by the equation of the trend line which has a positive slope value of 20 985. The level of correlation between both variables is indicated by the R-squared value of 0.199. This shows little correlation between the number of flood events and number of displaced Africans. However, to either reject or accept the null hypothesis requires an analysis of variance, therefore I applied an ANOVA single variance test as shown below in *Figure 1.2*.

Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Frequency	7	18	2.57142857	4.28571429		
Average	7	1575119	225017	8071679047		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1.7721E+11	1	1.7721E+11	43.9091358	2.4424E-05	4.74722535
Within Groups	4.843E+10	12	4035839526			
Total	2.2564E+11	13				

Figure 1.2

As the P-value is less than 0 (2.44E-05), and therefore does not exceed the 0.05 critical point, I reject the null hypothesis while stating that there is a weak relationship between the independent and dependent variables.

Discussion: Data Interpretation, Data Limitations and Policy Recommendations

The implications of the data results indicate how climate migration policies should be assessed. The weak correlation between flood frequency and the number of displaced Africans suggests that other environmental factors may be stronger causes of displacement in Africa between 2014 and 2016. Within the category of climate-induced disasters, the frequency of droughts, forests fires and wet mass movement constitute other key contributors to displacement (EJF, 2014). Moreover, within the broader framework of climate change, the increase in temperature may also constitute a valuable independent variable. Clearly, flood frequency is just one part of the bigger picture. This shows how difficult it can be to identify a measure of climate change when deciding on an independent variable. Each region of the world will therefore have different indicators of climate change that specifically pertain to the migration flows of their citizens. This level of complexity speaks to the diverse list of environmental factors causing human migration. Hence, in support of Action Area 6 of the *Warsaw International Mechanism for Loss and Damage*, it is indeed vital to enhance our understandings of the impacts of climate change on human mobility, in order to identify the most relevant environmental-migration factors for any given region.

In addition, by continuing to use natural disasters as a measure of climate change, it is important to note that certain events are long term and therefore may not have a definite beginning and end. This is a characteristic of droughts, which are an important cause of displacement in Africa since desertification and uneven rainfall promotes emigration. Given that such natural disasters do not have a specific time frame, in terms of how long they last, there is relatively little data collected as researchers cannot estimate when exactly these events will end. Thus, the divide between the data available for sudden-onset disasters like flooding, versus slow-onset disasters like droughts, limits the possible pool of independent variables. As a consequence, variables left out, such as droughts, could be significant causes of migration.

On another note, the weak correlation between the independent and dependent variables also speaks to the under-representative aspect of the dataset. The small sample size of seven countries significantly under-represents the African continent. Certainly, there is a lack of data readily available for 2014 to 2016, and an even bigger deficit of data that accounts for phenomena earlier than 2014. A possible solution to both the uneven collection of data for all natural disasters due to their differing durations and the small sample size used in this study, can be the use of *Geographic Information Systems* (GIS) in order to record migration updates in real time. For instance, while researching databases I noticed that the UNHCR Population Statistics Database has employed GIS methods for tracking asylum seekers and refugees across all continents, and this has resulted in a better-informed database. Hence, based on the data currently available and the resulting sample size, I do not believe the results of this study can be extrapolated to other regions of the world. However, by changing the data collection method and using tools such as GIS, the sample size can begin to reflect the overall population.

The inability of the dataset to represent entire populations also makes the case for the inclusion of qualitative data, rather than solely quantitative data. For instance, anecdotal evidence and personal stories can provide important insights that numbers alone fail to consider. Some of these missing observations include whether an increase in flooding events between 2014 and 2016 has changed the daily lives of people across different countries. Furthermore, questioning the elderly population across countries affected by multiple flooding events about changes they have observed over their lifetime, may provide more insight into the projection of migration in their nations. Hence, it is important to situate the movement of humans within the context of climate change, and concomitantly humanize climate science by collecting qualitative data in addition to quantitative data.

It is also important to note that the EM-DAT database includes data derived mainly from UN agencies, insurance companies and non-governmental organizations. The sources of data highlight an important limitation, which is that the accuracy of the numbers provided within them is entirely dependent on the methodology employed by the original organizations from which the data has been extracted. The reputability of the EM-DAT database can be improved if the organizations it derived its information from employed a mixed-methods approach, valuing both primary and secondary sourced quantitative data. For instance, collaborating with insurance companies, who collect information related to the amounts of people affected by a range of disasters, would create the perfect opportunity for a private-public multilateral partnership to enable the compilation of more holistic and representative datasets. It is important to note that the trend line and the equation of this line indicate a small yet positive increase in the number of displaced Africans resulting from flooding events. In support of SDG targets 13.1 and 13.3B, this therefore implies that it is still necessary to improve the adaptive capacities and mitigation strategies of African states. Specific to flooding events, identifying African governments' lack of relevant resources, while also equipping them with the proper knowledge and technology, is important as the number of displaced continues to increase. Looking at migration at a state level allows for the extrapolation of regional trends. This can then lead to the application of micro-level strategies at a macro-level. For instance, international financial institutions can partner with less economically developed countries, identify those being impacted the most by a particular natural disaster, and equip them with the necessary material to reduce population displacement. Combining interventions is likely to be much more impactful than providing general funding with no specific expert or technological assistance. In support of the *Sendai Framework for Action on Disaster Risk Reduction*, it is therefore vital to embrace trans-boundary cooperation as a mitigation strategy.

At the same time, an important critique of all three policies examined is that none of them explicitly mention climate-induced migration. This policy gap reflects how there is still no explicit global agreement that seeks to address climate-induced migration. This study demonstrates that this lack of recognition may be partly due to the difficulty in quantifying the relationship between migration and climate change since there is limited data available, even as climate-induced migration was first recognized in the 1980s. But it is clear that the numbers of climate-induced migrants are increasing, evidencing the need to recognize this issue in stand-alone policy.

Overall, this study's main finding is that there is a weak yet positive relationship between increased flood frequency and the increase in displaced Africans. Interpreting this data result in terms of policymaking is indeed achievable and requires a broad consensus. In this regard, collaborative efforts between the least vulnerable and largely responsible countries of the Global North with their Global South counterparts is vital to tackling this problem that requires collective action. Furthermore, human displacement should be viewed as both an adaptive and mitigatory strategy; something done in reaction to certain impacts of climate change as well as to anticipate the fallouts of climate disasters.

To these ends, policy at the state-level for both origin and host countries must be oriented towards monitoring the mass movement of climate migrants, both before and after climate change impacts occur. Furthermore, climate change and migration require common policy responses. Policy makers need to be empowered at the national, local, regional and international levels, and also strive to partner with a cross section of actors in order to address the complex nexus of migration and climate change. Therefore, this study shows that climate migration is on the rise, making it imperative to explicitly acknowledge this issue in stand-alone policy and treat the subsequent negative consequences through collaborative practices.

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