Dataset of 195 surveys with micro, small and medium enterprises (MSMEs) in sub-Saharan Africa that explore their their experiences of urban flooding (Nairobi, Kenya, n=60), water supply disruption (Gaborone, Botswana, n=57) and disruption to electricity supplies from hydroelectric load shedding (Lusaka, Zambia, n=78) during the 2015/2016 El Niño. The surveys were conducted in August 2016 in Lusaka, in September 2016 in Nairobi, and in November 2016 in Gaborone.

The main sectors included within the sample were:

Gaborone: Service sector hospitality industry (accommodation and food and beverage outlets) and hair salons

Lusaka: Agribusiness, textiles and tailoring, food and beverage outlets, trades (plumbing/ carpentry)

Nairobi: Transportation and agribusiness, including sale and distribution of produce (retail).

The median size of MSME surveyed was 8 employees (Gaborone = 8 employees; Lusaka = 15 employees; Nairobi = 7 employees).

The surveys include open and closed-ended questions which are structured in 10 sections.

The first four sections of the survey are the same for each country:

Section A: Interview identifier information (e.g. date of survey; the location of the business surveyed).

Section B: Interviewee identifiers and personal details (e.g. gender of respondent; respondent job title).

Section C: SME identifiers (e.g. nature of business activities; size of business/number of employees; whether business is formally registered)

Section D: Obstacles to business operations. This section includes obstacles identified in the World Bank Enterprise Survey datasets for each country (the latest version of the dataset available at the time of the study), as well as the specific obstacles (water supply disruption, electricity supply disruption, flooding) under consideration.

In Lusaka\* the remaining sections were structured as follows:

Section E: Business electricity usage (e.g. questions about: business activities that require electricity; experience of power outages; frequency of power outages over the prior 12 months; the months when disruption was most severe).

Section F: Business impacts of power outages (e.g. questions about: experience of operations being halted due to power outages; changes to demand for business commodities, products, services and/or crops; impacts of disruption on the size of workforce)

Section G: Coping with power outages (e.g. questions about: dependence on alternative sources of energy at times of power outages; business access to a generator; changes to business hours of operation as a result of power outages)

Section H: Cost of power outages to business (e.g. questions about: respondents perception of business losses and changes to annual profits as a result of disruption).

Section I: Awareness and learning (e.g. questions to assess awareness of El Niño; timing of warnings of disruption; use of load shedding timetables; future coping strategies that business would adopt).

Section J: Water shortages and floods (a subset of questions asked to MSMEs in Gaborone about water shortages and MSMEs in Nairobi about floods).

\* Some of the questions within the Zambia survey were designed to build on data collected by Scott et al., (2014). [Scott, A., Darko, E., Lemma, A., & Rud, J. (2014). How does electricity insecurity affect businesses in low and middle income countries? Overseas Development Institute Report. London, UK: Overseas Development Institute].

In Gaborone the remaining sections were structured as follows:

Section E: Business water usage (e.g. questions about: business access to a piped water supply; business uses of a piped water supply)

Section F: Business impacts of water shortages (e.g. questions about: experience of operations being halted due to water shortages; changes to demand for business commodities, products, services and/or crops; impacts of disruption on the size of workforce)

Section G: Coping with insufficient water supply (e.g. questions about: dependence on alternative sources of water at times of water supply disruption; changes to business hours of operation as a result of water supply disruption; sale of business assets to cope with water supply disruption; business diversification arising from disruption to water supply).

Section H: Cost of water shortages to business (e.g. questions about: respondents perception of business losses and changes to annual profits as a result of disruption).

Section I: Awareness and learning (e.g. questions: to assess awareness of El Niño; timing of warnings of disruption; use of water supply disruption timetables; future coping strategies that business would adopt).

Section J: Power outages and floods (a subset of questions asked to MSMEs in Lusaka about electricity supply disuption and MSMEs in Nairobi about floods).

In Nairobi the remaining sections were structured as follows:

Section E: Business experience of flooding (e.g. questions about: duration, frequency, severity and timing of flooding business experienced).

Section F: Business impacts of flooding (e.g. questions about: damage to business inventory or assets; impacts of flooding to business supply chain; impacts of flooding on the size of workforce).

Section G: Coping with flooding (e.g. questions about use of flood defences; changes to business hours; business diversification; and changes to business investment decisions related to experience of flooding).

Section H: Cost of flooding to business (e.g. questions about: respondents perception of business losses and changes to annual profits as a result of flooding).

Section I: Awareness and learning (e.g. questions to: assess awareness of El Niño; timing of warnings of flooding; future coping strategies that business would adopt).

Section J: Water shortages and power outages (a subset of questions asked to MSMEs in Gaborone about water supply disruption and to MSMEs in Lusaka about electricity supply disruption).

In all countries, the survey then featured questions for the enumerators to respond to regarding their perception of the respondents reply (e.g. respondents approximate age and level of engagement with the survey).

Some of the responses to some of the closed ended questions were recorded through a defined coding schedule. These coding schedules are also provided within the files uploaded, alongside copies of the survey tool used in each country.

KEY INFORMANT INTERVIEWS WITH RESOURCE MANAGERS

In addition to the MSME survey dataset, this research project also elicited new primary data sets of interviews that explore perceptions of impacts and management responses among key informants and resource managers.

These data were derived from semi-structured interviews with key informants. Relevant local and national government departments, NGOs and other expert informants were approached for interview and a snowball approach was used to extend the sample. A total of 41 respondents were consulted across the three case studies, through interviews lasting between 45 minutes and 2 hours. This included:

- Gaborone, Botswana: 12 key informants, including from Dept. of Meteorological Services; Dept. of Water Affairs; National Disaster Management Office; Water Utilities Corporation.

- Lusaka, Zambia: 14 key informants, including from Zambia Red Cross; Dept. of Energy and Water Development; Disaster Management and Mitigation Unit; Zambia Meteorological Dept.

- Nairobi, Kenya: 15 key informants, including from Ministry of Water and Irrigation; KenGen; Kenya Meteorological Dept.; National Disaster Operations Centre; Kenya Association of Manufacturers.

Each interview was captured through a transcribed audio recording and/or written notes. Interviews were used to guide the design of the MSME survey and to contextualise and triangulate MSME perceptions of the El Niño event. Given challenges reliably anonymising expert elicitations, consent was not obtained to upload this data to a public database. However further details of these interviews can be obtained by contacting k.e.gannon@lse.ac.uk or gri@lse.ac.uk and access to these may be able to be granted if a clear case for use – within the confines of consent obtained – can be established.

SECONDARY HYDROLOGICAL DATA

This research also employed a range of secondary datasets of hydrological data. These have not been uploaded since they are available elsewhere and owned by other entities. However, these secondary datasets are summarised under the heading ‘Related resources’ in the section on ‘data sourcing, processing and preparation’.

Data collection method:

The survey administered to micro, small and medium enterprises had quantitative and qualitative components, structured through a range of open and closed questions, as well as both quantitative and qualitative elements. It was designed to allow quantification, while prioritising depth and detail. The approach retained sufficient flexibility to permit the emergence of unanticipated findings and it was intended to allow research informants to construct a meaningful characterization of their experience of El Niño associated disruption and its challenges for their business.

To increase comparability, some of the questions within the surveys were informed by earlier survey tools [e.g. the World Bank Enterprise Surveys; and Scott, A., Darko, E., Lemma, A., & Rud, J. (2014). How does electricity insecurity affect businesses in low and middle income countries? Overseas Development Institute Report. London, UK: Overseas Development Institute].

The questionnaire was piloted, following which small adjustments, for example in the language used, were made to the survey instrument, to ensure that, in the collection of objective information – such as the number of power outages a business had experienced – all respondents had the same understanding of what was to be reported. However, the qualitative components of the survey were designed to be more open-ended, and to avoid implying a particular style of response is required, which could prematurely close down participants’ responses. Indeed, in some instances a degree of ambiguity in the open-ended questions was permissible, helping to increase the opportunity for participants to be able to react to questions on their own terms and to provide more meaningful accounts. As in the case of the key informant interviews, these qualitative survey components were designed to provide opportunities for participants to raise their own agenda through the survey and to signal personally salient experiences and insights, that we might not otherwise have known to ask about.

Reflecting the key informant interview design, the MSME survey first sought to pursue more general lines of questioning that would ‘set the scene’ for analysis. As such, to allow for a more realistic assessment of the degree of importance MSMEs afforded different challenges, at the start of the survey MSMEs were asked more general questions about their business and the challenges they faced in their business environment. Only then were they asked more specifically about their experience of water supply disruption/electricity supply disruption/flooding. Equally, information sheets provided to participants at the start of the research, to share contact details of the research team, did not reference water/electricity supply disruption/flooding directly, to avoid framing the research around particular issues early in the interview process. With the same aim, the survey was enumerator administered, to ensure that participants did not have the opportunity to skim the entire survey – and then become unduly influenced by later questions – before answering these early questions.

Enumerators were also trained to take care to minimise these framing effects with respondents in the early stages of respondent recruitment and questioning. Indeed, to increase consistency within the data set more broadly, enumerators participated in day-long training sessions on the aims and administration of the interview protocol. This also included training on the scope of the study, and the design of the survey tool, as well as on sampling, processes of consent and how to record both closed-ended questions through codes, and qualitative data in response to more open-ended questions. Feedback from the teams following these training sessions and from their initial piloting of the survey, was instrumental to refining the survey tool and this training also allowed enumeration teams in each country to demonstrate a methodical and consistent approach to data collection. Nevertheless, in order to identify any inconsistencies, gaps or instances of enumerator error, the research teams also went through the survey line-by-line and sought clarification from enumerators where necessary.

Through administering the surveys, the enumerators inevitably had potential to attain a greater qualitative understanding of business experiences of load shedding/water supply disruption/flooding than could be accessed from the survey results alone. Recognising this, we also encouraged the enumerators, most of whom were educated to Masters level in related disciplines, to act more broadly as researchers and to record their own qualitative reflections, to ‘fill in the gaps’, to help us to understand why the respondent may have answered the questions on the survey in the way they did. This additional interpretative insight was collected alongside each survey, however enumerators also completed their own post-enumeration survey; the responses of which were used to triangulate themes, alongside the qualitative data from the key informants and the survey itself.

Because of the diverse nature of MSMEs, in order to examine country specific consequences of El Niño and to gain broader overall insight into the scope of El Niño impacts, in this research we selected nationally salient sectors of the economy to survey. Selection criteria included anticipated exposure to disruption, contribution to the national economy, importance to national economic strategic direction and contribution to female employment. Across sub-Saharan Africa, agribusinesses make important contributions to GDP and to the region’s value added in manufacturing and services. Estimated to contribute around 20% of GDP to the Zambian economy and 26% to the Kenyan economy, agribusinesses therefore formed the primary focus of the sample in Lusaka and Nairobi. In Lusaka, this sample was supplemented by a number of other processing, retail and trade businesses, while in Nairobi, MSMEs within the transport sector were also included. Although still very important to the livelihoods of the rural poor, agriculture makes a more limited contribution to GDP in Botswana. Here the service sector was prioritised, and – since tourism is believed to be one of the most important avenues for achieving the national priority of economic diversification and makes a large contribution to service exports and female employment – accommodation and hospitality industries were given particular consideration. Final sector selection was informed by key informant interviews, as well as literature review.

The survey was administered by a team of enumerators in each city, in the months following El Niño: in August 2016 in Lusaka, in September 2016 in Nairobi, and in November 2016 in Gaborone. Following the approach used in the World Bank Enterprise Surveys, for each sector in Gaborone and Lusaka a simple random sample was derived from a sample frame of a full list of eligible firms obtained from government agencies that monitor or administer programmes for MSMEs. In Botswana, we sampled MSMEs from a list of accommodation enterprises obtained from the Department of Tourism as well as from a list of hair salons and restaurants obtained from Gaborone City Council. In Zambia, a list of eligible agribusinesses was obtained from the Central Statistics Office (CSO), as well as a list from the Patents and Companies Registration Agency (PACRA). In the time available to allow near-real time consideration of MSME experience of disruption, in Nairobi it was not possible to obtain a suitable list of businesses to derive a true random sample. Enumerators therefore developed a sample frame of businesses in different areas of the city, to achieve a good geographical distribution. Because of the dependence on sample frames from government agencies, in Botswana and Zambia, businesses surveyed in this research mostly reported operating within the formal sector. Economies in sub-Saharan Africa are typically characterized by a small number of medium and large enterprises and a large number of micro and small enterprises and our sample broadly reflected this structure. Where possible, surveys were conducted with business owners or with senior business managers.

Data sourcing, processing and preparation

In Gannon et al., (2018), analysis of the quantitative dimensions of the survey is presented through descriptive statistics. Qualitative data meanwhile were incorporated into a coding schedule structured around five main categories: Impacts; responses; warnings and climate information; confounding and compounding factors; and references to other extreme/El Niño events.

Quality checks were conducted on the survey data by UK and in-country research teams, following data input, to identify gaps and inconsistencies. Every effort was made to fill gaps at the time. However, some gaps remain and these are reflected within the files uploaded.

Personal data (including the name, address and geographic coordinates of the respondents) have been removed from the survey dataset, to preserve anonymity of MSME respondents. These columns are now empty within the spreadsheets uploaded.

RELATED RESOURCES:

1) Hydrological Data: Secondary datasets

We traced the hydrological response in four steps:

- Seasonal precipitation totals were analyzed for locations in, or near, each of the capital areas; Nairobi for Kenya, Gaborone for Botswana and Choma-Batoka, in between Lusaka, the capital of Zambia, and Lake Kariba, the country’s major source of hydropower. Annual data were aggregated over the July to June period to capture the complete cycle of precipitation; parts of Kenya experience bimodal seasonality, with precipitation maxima during March to May, known as the long rains, and October to December, known as the short rains, while in the relevant areas of Botswana and Zambia precipitation is unimodal. Cumulative precipitation over the 2-year period was also calculated.

- Precipitation anomalies over the contributing river basin (in case of the Zambezi) or the whole country (in the cases of Botswana and Kenya) were assessed through the “Weighted Anomaly Standardized Precipitation” (WASP) index (Lyon & Barnston, 2005), based on the monthly CHIRPS precipitation product. WASP gives an estimate of the relative deficit or surplus of precipitation for different time intervals ranging from 1 to 12 months. To compute the index, 3-monthly precipitation departures from the long-term average (here 1986 – 2015) were obtained and then standardized by dividing by the standard deviation of monthly precipitation. For Kenya a more detailed comparison was made with the notorious 1997/1998 El Niño, using a 6-month WASP for the October to March period.

- River flows upstream of the main reservoirs integrate precipitation anomalies in the upstream catchment areas and were used to assess the extent of hydrological impacts. Although these observations exclude information on water storage in reservoirs, they are independent of management practices that influence reservoir volumes. Daily river flows were aggregated to monthly sums (for Zambia only).

- Lake and reservoir levels are an important indicator for hydropower and drinking water shortages. They are influenced by river flows, reservoir management and direct abstractions. Outliers in daily lake levels, shown mostly as sudden drops in the remote sensing derived data, were filtered using a Tukey smoothing (Tukey, 1977) with standard parameterization as provided by the R-package “smooth.” Data were then aggregated to monthly values for the analysis (for Botswana and Zambia only).

A range of secondary data sources were used to complete this analysis:

- The Oceanic Niño Index (ONI), a 3-month running mean of sea surface temperature anomalies in the Niño 3.4 region (5∘N–5∘S, 120–170∘W), has become the standard for identifying El Niño (warm) and La Niña (cool) events in the tropical Pacific. Data were downloaded from the Unites States National Weather Service Climate Prediction Center (www.cpc.ncep.noaa.gov).

- Recent precipitation data for indicator stations in each country were obtained directly from the national meteorological office in the case of Kenya (Wilson airport station) or downloaded from the Climate Data Online (CDO) portal (www.ncdc.noaa.gov/cdo-web/datasets) in the case of Botswana (Gaborone station) and Zambia (Choma-Batoka station). Longer time series were generated using monthly station data (Harris et al., 2014). For better spatial coverage, the “Climate Hazards Group InfraRed Precipitation with Station” data (CHIRPS) were used. CHIRPS is a 30+ year quasi-global precipitation dataset, spanning 50∘S–50∘N, available from 1981 to the near-present. CHIRPS incorporates 0.05∘ resolution satellite imagery of infrared Cold Cloud Duration observations, with in situ station data to create gridded precipitation time series (Funk et al., 2015).

- River discharge data for the Zambezi, flowing into Lake Kariba, were derived from the Zambezi Water Resources Management system of the Zambezi River Commission (zamwis.zambezicommission.org) for the Victoria Falls Big Tree station, which has a record of almost 50 years of daily flows. After excluding years with missing data a 45-year time series remained.

- Lake level variations for many large lakes around the world are observed using satellite radar altimeters. In Zambia, Kariba lake levels are routinely monitored as part of the G-REALM lake level project by the U.S. Department of Agriculture’s Foreign Agricultural Service in cooperation with the National Aeronautics and Space Administration, and the University of Maryland (Birkett et al., 2011). The Gaborone reservoir in Botswana is not included in this dataset and hence reservoir levels were obtained from the Botswana Department of Water Affairs.

Google Trends Data and Nightlight data:

We extended our analysis of hydrological impact pathways through google trends data and nightlight data. Monthly average radiance composite images using night-time data from the Visible Infrared Imaging Radiometer Suite (VIIRS) Day/Night Band (DNB) was used to illustrate the economic impact of power outages over Lusaka. Nightlight data were obtained from the Earth Observation Group, NOAA National Geophysical Data Center. RISF data on the El Niño event were obtained from the Google trend website (www.google.co.uk/trends), using the search term “El Niño” for each of the three countries.

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