Powerless: Equity in Resource Distribution in Times of Scarcity

Patrick E. Shaw, Brown University

Introduction/Topic

In August 2022, South Africa began implementing mass power cuts across the country to address a growing energy shortage. These cuts, known as loadshedding, grew to a crisis and have lasted for more than two years and are likely to continue for the foreseeable future. South Africa manages its electricity distribution through the state-run power company Eskom, which has been embroiled in controversy for decades (see, for example, *License to Loot* (Hofstatter 2018), *Eskom: Power, Politics, and the (post) Apartheid State* (Ballim 2023)), raising questions about how the power cuts (i.e. *risk*) are being distributed, particularly in a context of enduring and deep-seeded inequality across race, class, and space.

To achieve effectiveness, governments provide resources that are critical to modern-day life, including basic needs such as water and functional needs such as electricity in addition to income redistributive measures. When there are shortages in these resources, age-old questions arise about who gets it and who doesn't, and these questions are complicated further in contexts of high inequality. How do governments distribute resources in these conditions? Specifically, how do governments distribute collective *risk* equitably when the capabilities of their citizens are highly unequal? In this paper, I use the context of South Africa to examine this question empirically. This paper contributes to our knowledge and understanding of inequality in environments of resource scarcity, especially shocks resulting from government decision-making processes, and how risk is correspondingly distributed. It will become increasingly important as the world deals with the effects of climate change and corresponding urbanization.

Background/Theoretical Focus

The introduction of electricity, or electrification, is widely accepted as the pathway to modern economic[1], educational (Khandker et al. 2012), and social opportunity (Dinkelman 2011), particularly in rural areas in developing country contexts. Accordingly, scholars have frequently examined the implications of electrification for societal development and individual livelihoods (see, for example, Cabraal, Barnes, and Agarwal 2005, Eberhard, Dyson, and Uttamchandani 2020). The findings from these types of studies generally agree that electrification leads to myriad positive development outcomes, such as improved household incomes, expenditures, and education outcomes (Khandker 2012). The subsequent, long-term unreliability of electricity distribution has been less examined. Byrd and Matthewman (2014) summarize both the understandings and the gaps in the literature, attributing the relative lack of

[1] https://data.undp.org/insights/achieving-universal-electricity-access/development-impact-electrification

data to the unpredictable nature of blackouts and the resulting difficulty of data collection. They highlight harmful impacts that blackouts have on household finance, food safety, crime, public transportation, and environmental outcomes, and note that this issue will only get worse with time due to "growing uncertainties in supply and growing certainties in demand." (p 85).

Few scholars have closely examined *inequities* in the distribution of blackouts. In a large study across thirty-six African countries, Aidoo and Briggs (2019) found that poorer people and communities that are connected to the electric grid experience lower electricity supply than richer people, due to both economic and political factors. More recently, Eledi Kuusaana et al. (2023) examined the "spatially uneven rationing of electricity" in Tanzania and the implications on adaptation to blackouts for different populations. Thus, existing evidence suggests that power distributors unevenly ration electricity and that populations do not have access to the same levels of electricity during blackouts, but we have had difficulty documenting these processes and patterns empirically due to the unpredictable nature of blackouts and general data limitations in developing country contexts. Addressing this knowledge and evidence gap will help us to examine patterns around the variability of electricity rationing across geography and populations and identify which groups are more susceptible to these experiences while providing useful quantifiable evidence of these occurrences.

Data

For my analysis, I have begun compiling a large multi-source time series dataset. An overview of the data sources is provided in Table 1 below. The main novel data are the August 2022 to August 2024 loadshedding data, which provide a complete picture of how Eskom (the state-owned power company in South Africa) rationed electricity across time and geography. These data are conjoined using two primary sources – the set of loadshedding announcements and the loadshedding schedule, both of which are provided by Eskom. At the time of writing, I have the full set of announcements pulled from Eskom's Facebook page as well as their website and am working with the developers of the EskomSEPush app to add available data detailing the loadshedding status as provided by the app over the same time period.

The loadshedding schedule is a static table that assigns 2-hour time slots, during which the power is turned off, based on the geographic "zone" the household is in and the intensity "stage" that the loadshedding is operating on. Combined with the loadshedding announcements, these sources represent complete data detailing the duration of loadshedding experienced for each geographic "zone" throughout the entire two-year period. A geographic "zone" is a geographically dispersed set of small areas, typically at the level of neighborhood or suburb. Each municipality in South Africa is divided into zones, and corresponding zones across South Africa experience loadshedding on the same schedule. I link additional power distribution data (sourced from Eskom) to this data to measure aggregate usage during the same period.

Table 1 Description of data used for analysis for Paper 1

Source	Description	Years	Data Type
Eskom [a]	Loadshedding announcements	2022 to 2024	Time series
Eskom [b]	Loadshedding schedule	-	Schedule
Stats SA	South African 2022 census	2022	Census
Stats SA	South Africa small area layer polygons	2022	Shape files

[a] Pulled from Eskom's website (https://loadshedding.eskom.co.za/) and Facebook page

[b] Pulled from Eskom's website (https://loadshedding.eskom.co.za/)

I map the loadshedding "zones" to the political geography of South Africa using shape files from StatsSA. To examine demographic variation across loadshedding areas, I link 2022 South African census data to the loadshedding data aggregated at the electoral ward level. Available census variables include population overall, age, gender, race, education, housing type, energy source for lighting/cooking (e.g., from electric grid), and other measures along these themes. Notably, while Stats SA will not release the income or labor data derived from the census, I link income data from the Income and Expenditure Survey 2022/23 and from the Quarterly Labour Force Survey. Additional potential sources of data, which would mainly be used to provide context to the time and space during which people experienced blackouts, will include daily temperatures, hours of daylight, and night light satellite data.

Research/Analytical Methods

The main goal of this analysis is to examine how loadshedding has been distributed across geography and population and analyze whether the distribution of risk has in fact been equitable. To achieve this goal, my analysis has three main parts. First, to assess the completeness of data and investigate the basic distribution of the load-shedding crisis over the national geography, I create spatial heat maps at the electoral ward level of analysis of four different measures of loadshedding, including i) average frequency of outages; ii) average duration of outages; iii) proportion of daytime outages; and iv) intensity of outages. As a fifth measure, I derive a standardized index using these four variables that represents an overall impact variable. Second, I examine the association between these loadshedding measures and the underlying sociodemographic and economic composition of electoral wards. Statistically, these associations will be measured using simple OLS models and spatial regression models. Rather than *predict* blackouts, I extract statistically significant associations between demographic composition and measures of blackouts to highlight the unequal distribution – and corresponding unequal experience – that have characterized the last two years. Finally, to investigate how scale affects these results, I run equivalent analyses on the major metropolitan areas and their surrounding areas.

Expected Findings

I anticipate this analysis will show the inequitable rationing of electricity over the course of the two-year period marking the current crisis. There are several ways this may show up in the data: i) spatially, indicating that certain geographic clusters experienced longer or more frequent outages; ii) demographically, indicating that certain groups of people experienced longer or more frequent outages; or iii) economically, indicating that lower income communities experienced longer or more frequent outages, or more frequent outages during peak usage periods. These findings will inform additional research I am currently conducting on the crisis, including its effect on families and well-being and households' varying adaptation responses.

Aidoo, Kobina, and Ryan C. Briggs. 2019. "Underpowered: Rolling Blackouts in Africa Disproportionately Hurt the Poor." *African Studies Review* 62(3):112–31. doi: 10.1017/asr.2018.78.

Ballim, F. (2023). *Eskom: Power, Politics, and the (post) Apartheid State.* Jacana Media.

Byrd, Hugh, and Steve Matthewman. 2014. "Exergy and the City: The Technology and Sociology of Power (Failure)." *Journal of Urban Technology* 21(3):85–102. doi: 10.1080/10630732.2014.940706.

Cabraal, R. Anil, Douglas F. Barnes, and Sachin G. Agarwal. 2005. "PRODUCTIVE USES OF ENERGY FOR RURAL DEVELOPMENT." *Annual Review of Environment and Resources* 30(1):117–44. doi: 10.1146/annurev.energy.30.050504.144228.

Dinkelman, Taryn. 2011. "The Effects of Rural Electrification on Employment: New Evidence from South Africa." *American Economic Review* 101(7):3078–3108. doi: 10.1257/aer.101.7.3078.

Eberhard, Anton, Gabrielle Dyson, and Pritisha Uttamchandani. "What is the impact of investing in power." *Practical Thinking on Investing for Development* (2020).

Eledi Kuusaana, Joyce A., Jochen Monstadt, and Shaun Smith. 2023. "Toward Urban Resilience? Coping with Blackouts in Dar Es Salaam, Tanzania." *Journal of Urban Technology* 30(2):79–101. doi: 10.1080/10630732.2022.2153318.

Hofstatter, S. (2018). *License to Loot: How the plunder of Eskom and other parastatals almost sank South Africa.* Penguin Random House South Africa.

Khandker, Shahidur R., Douglas F. Barnes, and Hussain A. Samad. 2012. "The Welfare Impacts Of Rural Electrification in Bangladesh." The Energy Journal, Policy Research Working Papers, 33 (1): 187–206. https://doi.org/10.1596/1813-9450-4859.