Journal of Environmental Economics and Management ■ (■■■■) ■■■–■■■

Contents lists available at ScienceDirect

Journal of Environmental Economics and Management

journal homepage: www.elsevier.com/locate/jeem

Water scarcity and rioting: Disaggregated evidence from Sub-Saharan Africa ☆

Christian Almer [a,*], Jérémy Laurent-Lucchetti [b], Manuel Oechslin [c,d]

[a] Mannheim Institute of Public Health, Social and Preventive Medicine, Medical Faculty Mannheim, Heidelberg University, Ludolf-Krehl-Strasse 7-11, 68167 Mannheim, Germany
[b] University of Geneva, Department of Economics, Bd du Pont d'Arve 40, 1211 Genève, Switzerland
[c] University of Lucerne, Department of Economics, P.O. Box 4466, 6002 Lucerne, Switzerland
[d] CentER, Tilburg University, The Netherlands

ARTICLE INFO

Article history:
Received 14 January 2016

JEL classification:
D74
O13

Keywords:
Small-scale conflict
Riots
Water shocks
Disaggregated data

ABSTRACT

It is often purported that unusually dry weather conditions provoke small-scale social conflict—riots—by intensifying the competition for water. The present paper explores this hypothesis, using data from Sub-Saharan Africa. We rely on monthly data at the cell level (0.5×0.5 degrees), an approach that is tailored to the short-lived and local nature of the phenomenon. Using a drought index to proxy for weather shocks, we find that a one-standard-deviation fall in the index (signaling drier conditions) raises the likelihood of riots in a given cell and month by 8.3%. We further observe that the effect of unusually dry weather conditions is substantially larger in cells with a lower availability of water resources (such as rivers and lakes), a finding that supports the significance of the competition-for-water mechanism.

Introduction

Competition for access to water is often considered to be an important factor behind social conflict in less advanced economies. A typical example of extensive violence over water was observed in 2012 in Kenya, where more than hundred people died in riots involving farmers and cattle herders (Gleick and Heberger, 2014). This conflict was part of a long-running dispute between the Pokomo people—mostly farmers near the Tana River—and the Orma people, who are semi-nomadic cattle herders. Back in 2001, at least 130 people were killed in a string of clashes between the same two communities over the access to a river. There is a worry that we will see a rise in the frequency of such sub-national conflicts. For instance, Peter Gleick, president of the Pacific Institute—an institute tracking instances of conflict over water resources—recently stated:[1]

☆ An earlier version of this paper circulated under the title "Agricultural Shocks and Riots: A Disaggregated Analysis". We thank two anonymous referees, Nicolas Berman, Mathieu Couttenier, Graham Brown, seminar participants at ETH Zurich, the Graduate Institute, University of Lucerne, the 2014 EAERE Conference as well as Kelsey Jack, the editor, for very helpful comments. Laurent-Lucchetti acknowledges financial support from the FNS grant 100018_172814/1. The usual disclaimer applies.

* Corresponding author.
E-mail addresses: christian.almer@medma.uni-heidelberg.de (C. Almer), jeremy.lucchetti@unige.ch (J. Laurent-Lucchetti), manuel.oechslin@unilu.ch (M. Oechslin).

[1] See *The Guardian* article "Why global water shortages pose threat of terror and war" (Feb 9, 2014).

http://dx.doi.org/10.1016/j.jeem.2017.06.002
0095-0696/

> "I think the risk of conflicts over water is growing—not shrinking—because of increased competition, because of bad management and, ultimately, because of the impacts of climate change. […] The biggest worry today is sub-national conflicts: conflicts between farmers and cities, between ethnic groups, between pastoralists and farmers in Africa, between upstream users and downstream users on the same river."

This paper investigates the link between water shocks and small-scale social conflict using geo-referenced data from Sub-Saharan Africa over the 1990-2011 period.[2] In our empirical analysis, we use data on the level of rioting to construct proxies for small-scale social conflict; a riot is a distinct and violent action waged by a group of (non-government) actors against a distinct other group or government authorities. Water shocks, on the other hand, are captured by a drought index that indicates by how much the current drought situation deviates from the long-run average. Sub-Saharan Africa is particularly vulnerable to negative water shocks in the form of unusually dry weather conditions: as much as 95% of the crops that are cultivated are rain-fed, while only 5% of all cultivated land is suitable for irrigation (UNEP, 2007); moreover, according to the UN World Water Development Report (UNESCO, 2009), 340 million people lack access to clean drinking water. Unusually dry weather conditions can therefore quickly increase the competition for access to water—and hence induce conflict between various groups of water users that try to secure access to a dwindling resource base.

Investigating potential causes of small-scale social conflict, among them competition for water, is important for a variety of reasons. *First*, small conflicts are a relatively frequent phenomenon. Our dataset suggests that in the 1990-2011 period, Sub-Saharan Africa saw 1738 events of rioting (compared to 41 civil conflicts or wars, according to the UCDP/PRIO Armed Conflict Dataset). *Second*, riots are often associated with a high number of fatalities. We observe at least one fatality in about 52% of the cases, with a median of 6 and an average of 66 deaths per event. *Finally*, apart from the cost in terms of human lives, riots are also costly in economic terms. They disrupt private economic activity and basic government functions; as a result, frequent rioting may be a severe obstacle to economic development, particularly in poor places.

In using geographically and temporally disaggregated data, our empirical strategy follows the seminal work by Harari and La Ferrara (2016). These authors examine the question of whether negative water shocks lead to conflict by reducing agricultural incomes. To do so, they construct a dataset in which the cross-sectional units of observation are subnational cells of 1×1 degrees (geographical disaggregation) and that includes an original measure of agriculture-relevant shocks, i.e., shocks that occur during the growing season of the main crop in a cell (temporal disaggregation). The study by Harari and La Ferrara (2016) mainly focuses on the impact of agriculture-relevant shocks on a broad measure of conflict that includes big conflict events (like battles) as well as smaller conflict types (like riots).[3] The present paper, by contrast, is specifically interested in the immediate impact of water shocks on *small-scale social conflict* and focuses on a channel—competition for water—that is not necessarily restricted to the growing season but may be active *in any month of the year*. We therefore deviate from Harari and La Ferrara (2016) by relying on a finer geographical disaggregation (cells of 0.5×0.5 degrees) and by working with monthly data (instead of concentrating on shocks during the growing season). This combination of a very fine temporal and geographical resolution allows us to tackle the specifics of small-scale social conflicts: while potentially occurring throughout the year, small-scale social conflicts tend to be short-lived and spatially confined events. Using geo-referenced data from the Social Conflict in Africa Database (SCAD), we see that riots—our empirical proxy for small conflicts—tend to flare up spontaneously and abate quickly: about 70% of all riots in our sample last only for one day, and 91% of all riots do not last for longer than a week. Moreover, riots are local events: when there is a riot in one cell, 94.3% of neighboring cells have no incident reported in the same month and 98.2% of neighboring cells have no incident reported in the preceding month. There is thus no evidence for spatial effects to play a dominant role in our data.

The empirical question we are interested in is how deviations of the current drought situation from the long-run average affect the level of rioting in a cell. Following a recent series of papers (among them Couttenier and Soubeyran, 2014 and Harari and La Ferrara, 2016), we use a drought index to capture the current drought conditions. Our main explanatory variable is the Standardized Precipitation-Evapotranspiration Index (SPEI) constructed by Vicente-Serrano et al. (2010). As the name implies, SPEI is a drought index reflecting the climatic water balance, i.e., the monthly difference between precipitation and potential evapotranspiration. SPEI is expressed in units of standard deviations from the long-run average, so that a positive (negative) value in a given month indicates an above (below) normal water balance. Of course, omitted variables (constant or time-varying) could co-determine drought conditions and local violence. Therefore, in addition to SPEI, our main explanatory variable, most specifications include cell, time, region-by-month and country-by-year fixed-effects. As a result, our identification strategy relies on the exogeneity of the SPEI index at the local (cell) level after controlling for potentially confounding factors including climatic differences, global time-varying factors such as resource prices, or seasonality.

Our dataset covers all 0.5×0.5 degree cells in Sub-Saharan Africa. However, riots hardly occur in thinly-populated zones, in which the formation of crowds with coordinated beliefs is highly unlikely.[4] Therefore, in addition to the estimates based

[2] While our data on small-scale social conflict covers the period from 1990 to 2012, our main explanatory variable—a drought index capturing current drought conditions—is only available until 2011.

[3] Their main indicator of conflict, the dummy variable 'ANY EVENT', is equal to one if at least one conflict event of any type (battle, violence against civilians, riot, rebel recruitment) occurs. However, Harari and La Ferrara (2016) also work with more disaggregated conflict indicators, including indicators that capture protests and riots. See Section 3.1 on how the riot data we use to capture small-scale social conflict differs from the protests and riot data used by Harari and La Ferrara (2016).

[4] When it comes to individual rioting decisions, coordination in beliefs is important: an agent decides to incur the cost of rioting only if many others are doing so as well.

Please cite this article as: Almer, C., et al., Water scarcity and rioting: Disaggregated evidence from Sub-Saharan Africa. Journal of Environmental Economics and Management (2017), http://dx.doi.org/10.1016/j.jeem.2017.06.002