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Abstract: A rapidly growing body of research examines how weather variability, anomalies and shocks influence economic and societal outcomes. This study investigates the effects of weather shocks on African smallholder farmers in British colonial Africa and intervenes in the debate on the mediating effect of cash crops on resilience to shocks. We employ a dual research strategy, involving both qualitative and econometric analysis. We analyse original primary evidence retrieved from annual administrative records and construct a panel dataset of 151 districts across West, South-central and East Africa in the Interwar Era (1920-1939). Our findings are twofold. First, we qualitatively expose a range of mechanisms leading from drought and excessive rainfall to harvest failure and social upheaval. We then test the link econometrically and find a robust U-shaped relation between rainfall deviation and social upheaval, proxied by annual imprisonment. Second, we review a long-standing and unsettled debate on the impact of cash crop cultivation on farmers' resilience to environmental shocks and find that cash crop districts experienced lower levels of social tension and distress in years of extreme rainfall variability.

Keywords: Environmental and economic history, Africa, colonialism, tropical agriculture, social upheaval

JEL Codes: N17, N57, Q17, F54, D74

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1. Introduction

"*...the year had gone mad. Rain fell as it had never fallen before. For days and nights together it poured down in violent torrents, and washed away the crops [...] The blazing sun returned, more fierce than it had ever been known, and scorched all the green that had appeared [...] He watched the sky all day for sign of rain clouds and lay awake all night. In the morning he went back to his farm and saw the withering tendrils.*"

Chinua Achebe [Things Fall Apart (1994) p. 16]

Over the past years, scholars and policy makers have become increasingly aware of the short and long-run impact of climatic factors on economic, social and political outcomes (Hsiang et al. 2013; Dell et al. 2014). The adverse impact of erratic rainfall on societies is particularly pronounced in developing countries, with sub-Saharan Africa being the most vulnerable region (Ahmed et al. 2009; Barrios et al. 2010; Bruckner & Ciccone 2011; Miguel et al. 2004). This is not surprising as a large share of the population depends on rain-fed subsistence agriculture and less than 5% of the cultivated area is irrigated (Schlenker & Lobell 2010). Indeed, in an African context, harvest failures and food insecurity arising from climatic factors appear to be tightly related to social destabilization. Several studies have shown that climatic factors trigger social conflict (Fjelde & von Uexkull 2012; Hendrix & Salehyan 2012) and full-blown civil war (Blattman & Miguel, 2010), but also processes of democratization (Bruckner & Ciccone 2011). Rather than accepting a static link between climate and social outcomes, a key challenge is to understand which conditions aggravate or mediate the impact of environmental shocks. It is especially crucial to learn more about the local determinants of resilience to the vagaries of climate (Adger 2000; Folke 2006; Gallopin 2006). Africa's rising population densities, pervasive climate change and resurging socio-political instability contribute to making this a most pressing concern.

This study offers a number of contributions. First, it provides novel evidence on the impact of weather shocks on social outcomes in tropical Africa from a historical perspective. While this link is subject to a wide range of studies, the number of sources is relatively thin, and the debate far from settled (Dell et al. 2014; Hsiang et al. 2013; Klomp & Bulte 2013). Exploiting the extensive and consistent administrative records that remain from Britain's African empire, we provide new material on a region for which systematic data collection is notoriously difficult. Moreover, our focus on the interwar era (1920-1939) contributes to a considerable expansion of the time horizon (cf. Papaioannou 2014; Christian & Fenske 2015). Our argument is based on both qualitative evidence and econometric analysis. Initially, we use colonial administrative accounts to expose the

mechanisms that lead from extreme weather shocks to higher levels of social upheaval.[1] These accounts, in line with the environmental scarcity literature, strongly suggest that extreme weather events bring about crop and harvest failures which, in turn, increase competition over scarce resources and ultimately lead to higher levels of social tension and distress (Homer-Dixon 1999, Kahl 2006). Interestingly, they also suggest that the impact of weather shocks is U-shaped: both *drought* and *excessive rainfall* adversely affect agricultural outcomes (Papaioannou 2015).

To test the weather-to-distress link econometrically, we construct a novel panel dataset at the *district-level* obtaining observations on annual rainfall and imprisonment. We argue that imprisonment rates are a highly suitable proxy for social upheaval, as colonial prisons were used to lock-up destitute and deviant elements of society. As will be discussed in more detail later, both categories can be expected to increase in years of social tension and distress. Our dataset consists of *151 districts* for a *20 year period*. Running a dynamic panel data specification (using system-GMM), with both time and district fixed effects, we find a robust *U-shaped* effect of weather shocks on social tension and distress.

Second, this study investigates the extent to which social upheaval resulting from weather shocks is mediated by smallholders' cash crop cultivation. The issue whether the introduction of cash crops by farmers was beneficial, or detrimental to vulnerable rural communities is the subject of a multifaceted, heated and long-standing debate among policy makers and social scientists (Hopkins 1973; Myint 1958; Rodney 1978; Maxwell & Fernando 1989; Austin 2014). A key issue at stake in this debate pertains to the impact of cash crops on rural communities' ability to cope with exogenous shocks. Some maintain that the introduction of cash crops made rural communities more *vulnerable* to social tension and distress, by diverting attention away from subsistence production, undermining 'traditional insurance mechanisms' and facilitating exploitation and extraction (Vaughan 1987; Watts 1983). Others, instead, have argued that access to export markets made such communities more *resilient* to social tension and distress, providing them with the ability to spread risk, smoothen consumption and profit from infrastructural and institutional investments (Bryceson, 1980, 1988; Fafchamps 1992b; Maxwell & Fernando 1989).

Resilience and vulnerability are widely used and ambiguously defined concepts (Adger 2000; Folke 2006; Gallopin 2006). We define resilience and vulnerability as two opposite, relational concepts (i.e. more resilience is less vulnerability). We conceptualize resilience as the ability of societies to absorb short-term exogenous shocks without suffering major social upheaval.

[1] We conceptualize social upheaval as heightened levels of social tension and distress, which manifests itself in resource scarcity, income shortages and population displacements, which ultimately may result in higher levels of crime, socio-political unrest and poverty.

We argue that in years of weather shocks districts with lower spikes of social upheaval are more resilient, i.e. having stronger coping abilities to prevent widespread social tension and distress. Since we define resilience as the short-term ability of societies to deal with exogenous shocks, we do not aim to address the long-term impact of cash crops on resilience.

Based on primary sources, we propose a range of mechanisms that reveal the mitigating effect of cash crops on societies' abilities to cope with weather shocks. Our econometric analysis corroborates this argument. To the best of our knowledge, we are the first to construct a new cross-sectional, district-level index which captures smallholders' involvement in the export crop economy; we named this index *cash crop intensity*. We demonstrate that districts with relatively higher levels of cash crop cultivation were significantly more resilient to weather shocks than those with less cash crops. We perform a number of robustness tests to explore the extent to which the link between cash crop cultivation and resilience is causal ('horse-race' tests).

We justify our case study of interwar British colonial Africa on a number of grounds.[2] First, Britain administered a vast African empire. The colonial state's key preoccupations were related to law and order as well as agricultural production, coinciding with our key variables of interest. The extensive bureaucratic legacy has allowed us to construct a consistent district-level dataset spanning approximately one-fifth of Africa's landmass and one-third of its population in this period. Second, our geographic scope provides us with the necessary variation to exploit. On the one hand, some of the areas in our dataset experienced considerable smallholder-based agricultural commercialization. These areas were mainly exporting cash crops to the world market. On the other hand, livelihoods in areas without cash crops tended to depend heavily on subsistence farming. Hence, a study of interwar British colonial Africa enables us to compare the heterogeneous impact of weather shocks on social upheaval between subsistence-based and commercialized rural economies. Third, our temporal scope encompasses the interwar period, which is generally considered more tranquil and peaceful than the period of violent early-colonial conquest and the highly politicized post-war road to independence (Killingray 1986). Thus, linking levels of social tension and distress to harvest failures (rather than political upheaval) is most plausible in this period.

The remainder of the paper is organized as follows. Section two deals with the impact of climate shocks on social tension and distress. It introduces the literature and provides evidence, based on original qualitative sources, to reason that rainfall shocks are tightly related to harvest failures, and in turn to social tension and distress; it justifies the key variables, it formulates the

[2] Name of colonial territory (name of present-day country): Gold Coast (Ghana), Nigeria Protectorate and Colony (Nigeria), The Gambia, Sierra Leone, Bechuanaland (Botswana), Northern Rhodesia (Zambia), Nyasaland (Malawi), Kenya Colony (Kenya), Uganda Protectorate (Uganda), Tanganyika Territory (Tanzania) and Zanzibar (Tanzania).

testable hypotheses and it presents the main results on the robust curvilinear (U-shaped) relation between weather shocks and social tension. Section three follows a similar structure. It provides both qualitative and quantitative evidence to show that districts with cash crops were more resilient to weather-induced scarcities, and argues that this effect is likely to be driven to a considerable extent by cash crops. Section four concludes and suggests directions for further research.

2. Do weather shocks lead to social tension and distress?

2.1 The debate

Over the past decade, the scholarly debate on the societal impact of climate on societal outcomes has expanded considerably. Weather variables have been linked to economic outcomes, health, agriculture, crime and conflict (for a good overview of this body of literature, see Hsiang et al. 2013; Dell et al. 2014). Whereas such an effect of weather may not always be present in wealthy, stable countries (Dell et al. 2012), it seems particularly pronounced in tropical Africa (Barrios et al. 2010; Bruckner & Ciccone 2011; Miguel et al. 2004; Papaioannou 2015). While some scholars dispute the evidence linking climate to conflict (Klomp & Bulte, 2013), most find support for the existence of a causal relation, especially in low-income settings (Hsiang et al. 2013). Moreover, the literature has been radically divided with regard to the *mechanisms* that explain the climate-to-conflict nexus (Buhaug 2010; Klomp & Bulte 2013). To resolve such issues, the literature would profit from more fine-grained analysis and an extension of the time period.

Among those who take precipitation as the key independent variable, some find that drought is the prime driver of conflict (Maystadt & Ecker 2014; Christian & Fenske 2015), while others argue that the relationship is U-shaped, with extremes on both ends (drought and excessive rainfall) leading to higher conflict incidence (Papaioannou 2014; Fjelde & von Uexkull 2012; Hendrix & Salehyan 2012). The impact of weather deviations on societal outcomes runs through an intermediate *mechanism*, for which harvest failure (leading to lower incomes and agricultural deficiencies) appears to be a prime candidate, especially in low-income settings, where people's livelihoods tend to rely more heavily on (rain-fed) farming and where small deviations in crop yields can have devastating effects (Barrios et al. 2010; Bruckner & Ciccone 2011; Miguel et al. 2004; Schlenker & Lobell 2010). However, the debate on mechanisms to explain the weather-conflict link is not resolved.

The impact of extreme climatic anomalies on economic outcomes can be framed in terms of an *opportunity cost model*. One can argue that, as (agricultural) productivity declines as a result of climatic anomalies, engaging in unrest or crime becomes more opportune relative to participating in

'peaceful' economic activities. At the same time, however, it has been argued that *abundance*, rather than scarcity, encourages conflict, as there is more to gain from conflict in abundant rather than meagre years (Witsenburg & Adano 2009). Moreover, some argue that certain weather conditions affect behaviour directly, through psychological mechanisms (see for references Crost et al. 2015; Anderson 1989). The impact of climate can also be explained in terms of an *environmental scarcity perspective*, which sets out to explain how weather anomalies disturb people's livelihoods, creating conditions that are more prone to increase social tension. Such conditions include population movements and intensified competition over scarce resources, such as wells and pasture land (Homer-Dixon, 1999; Kahl, 2006).

In an *African context*, numerous studies have found that weather extremes lead to tension and conflict (Almer & Boes 2012; Buhaug 2010; Burke et al. 2009; Couttenier et al 2011; Fjelde & von Uexkull 2012; Hendrix & Salehyan 2012; Miguel et al. 2004). Most studies use a binary indicator of conflict, for example based on the ACLED database which records conflict events in states affected with civil war (1960 – 2004), or the UCDP/PRIO Armed Conflict Dataset on armed conflict (1946 – present), which captures only large-scale outbreaks of unrest, violence or conflict, and omits subtler forms of social tension and distress. A number of recent contributions have begun to investigate different time periods (Papaioannou 2015, Christian & Fenske 2015), employ a more fine-grained, sub-national scope (Harari et al. 2013; Papaioannou 2015; Raleigh & Urdal 2007; cf. Jia 2014) and use more non-binary indicators of conflict intensity (Papaioannou 2015). Moreover, a number of studies have employed detailed case study analyses to uncover the key mechanisms leading from weather to conflict (Adano et al. 2012, Benjaminsen et al. 2012; Ember et al. 2012; Witsenburg & Adano 2009). We contribute to these new explorations by providing a new indicator on more subtle forms of social tension and distress.

2.2 Qualitative evidence:

2.2.a Rainfall shocks and harvest failures under British colonialism

Our sources provide a unique opportunity to engage with the different perspectives in the debate on the effects of weather anomalies on African societies. The British colonizers set up an extensive system of administration in their African dependencies. Territories were subdivided into provinces and districts. Local administration was left to African native rulers, who operated under supervision of British administrative officers.[3] Elaborate administrative accounts were kept. Local officers reported on a regular basis to their superiors on a range of issues. Each colony produced a series of

[3] This system of 'indirect rule' had existed in practice since the early days of colonial rule, but was formally instituted only during the 1920s and early 1930s.

departmental annual reports concerning a wide range of issues. In this paper, we use such annual reports obtained from the departments of agriculture, native affairs, police, justice and prisons, as well as the annual *Blue Books of Statistics*. These reports are rather consistent in their coverage of issues over time and across colonies and give us a uniquely comprehensive insight into local conditions across a wide area and a considerable timespan. The goal of this section is to i) investigate whether the relationship between weather and agricultural outcomes should be conceptualized as linear or U-shaped, and ii) explore the mechanisms that explain the relationship.

The impact of weather conditions on agricultural outcomes is extensively discussed by colonial administrators. Reports make regular notice of weather induced agricultural failure, resulting in higher levels of distress, and in the more extreme cases, subsistence crises and famines. Frequently mentioned negative results of ***droughts*** include:

(a) Crop damage and failure: In a context of rain-fed agriculture, lack of precipitation prevents seeds from germinating, slows down plant growth and diminishes yields.[i] In severe cases, drought is also associated with complete crop failure, dust storms and soil erosion.

(b) Livestock starvation: Drought diminishes water supply to wells, leads surface water and pastures to dry up, negatively impacting upon the water and food supply of livestock. In extreme cases the failure of the rain "caused enormous losses among stock [and] ruined the crops."[ii] To prevent starvation, cattle has to be moved, which in turn increased their susceptibility to disease and further weakens underfed herds.

Regular mention is also made of the adverse effects of ***excessive rainfall*** on agriculture. The adverse effects of excessive rainfall run via a number of specified mechanisms:

(c) Crop damage and failure: Excessive precipitation and subsequent flooding has the potential to seriously damage, or even completely destroy the harvest.[iii]

(d) Worsened phyto-pathological conditions: Heavy rainfall and the resulting humidity increases the likelihood of outbreaks of plant diseases, the spread of parasitic organisms, such as weevils,[iv] and the arrival of locusts (the latter especially when rainfall has been preceded by a drought spell).

(e) Logistical problems: Excessive rainfall impedes farmers' from cultivating[v], storing[vi] and transporting[vii] their produce. During a wet spell in central Kenya, 1930 the weather made it "difficult to dry the crops sufficiently for export", while "transport was disorganized and many cases great delay was experienced in getting the crop away from the farm"

It is important to note, however, that abundant rainfall, albeit in a much more limited number of cases, also seems to have had benevolent effects. In some cases, above average rainfall appears to have been 'generous' rather than 'excessive', bringing about good harvests and abundant pasture[viii],

and feeding rivers that could be used for irrigation and transport.[ix] Interestingly, excessive rainfall at times resulted in diametrically opposed effects simultaneously. Plenty rainfall could lead to bountiful harvests and plentiful pasture in one district, while causing floods and crop failure in a neighbouring district.[x] Although the effect of excessive rainfall was not entirely unambiguous, mechanisms (c), (d) and (e) were much more commonly noted, suggesting that agricultural outcomes were not only adversely affected by droughts but also by excessive rain.

It is important to note in this context that British colonial Africa encompassed a wide variety of agro-ecological settings, including arid regions, as well as areas with abundant rainfall.[xi] Examples of the negative impact of droughts as well as excessive rainfall can be found in both very wet and very dry regions. Even though dry districts, in some cases, seem to have profited from a season of plenty rainfall leading to an extension of pastures and cropland, heavy showers are also reported to have had negative results, for example in cases dry soils were incapable of absorbing the precipitation, resulting in run-off, floods and waterlogging.[xii] Hence, we conclude that our qualitative evidence supports a U-shaped conceptualization of the link between weather and agricultural outcomes.[4]

2.2.b From harvest failures to social tension and distress

Once we have established that rainfall deviations led to diminished harvest or even provoked failure, we should investigate to what extent these agricultural outcomes, in their turn, provoked social tension and distress. Turning to the source material, we observe and propose several plausible mechanisms to argue that the recorded impact of extreme rainfall deviations on agricultural production was indeed substantial for local communities and resulted in actual hardship:

(f) Scarcity, price spikes and speculation: Harvest failures are frequently reported to have resulted in spectacular food prices hikes and resultant social tension and distress.[xiii] Likewise, colonial officers sometimes explicitly attributed the absence of tension to low prices due to favourable weather.[xiv] It is important to note that such price spikes were not always the result only of environmental scarcities, but were aggravated by human intervention. In some instances of (impending) harvest failures, speculators were said to stock food crops to further drive up prices and make high profits.[xv] Speculation had the potential to cause distress and to certainly increase levels of social tension.[xvi] Drought-induced stock mortality resulted in an increased

[4] It should be mentioned here that both positive and negative deviations from any long-term rainfall mean affect farmers across a wide range of agro-ecological settings is not surprising, especially when realizing that smallholders build their farming systems around an expected level of rainfall. The choice of the crop mix and farming methods are calibrated on the basis of this expectation.

incidence of petty crime, as well as more serious stock raids and thefts in adjacent areas.[xvii] In extreme cases, rainfall-induced scarcity was so serious as to result in fatal local famines.[xviii]

(g) Population movements: Adverse weather conditions forced people to get on the move. In some cases such movements were motivated by a desire to earn an income elsewhere to compensate for lost harvests[xix] or to find pastures for their cattle.[xx] In other, more acute cases people wandered in search of food, out of pure desperation or because severe flooding had destroyed their homes.[xxi] Pastoralist groups were reported to engage in drought-induced migration, which carried an increased risk of clashes with neighbouring groups over grazing pastures and water.[xxii] In some cases, violent clashes indeed seem to have erupted,[xxiii] while in other cases they were reported to have been averted.[xxiv]

(h) Unrest: Conflicts arising out of dissatisfaction of local groups with colonial authorities have also been argued to have erupted due to drought conditions.[xxv]

These mechanisms indicate that weather fluctuations could have a direct impact upon human societies. At the same time, however, we must also acknowledge that we find some instances where the administrators link depressed incomes to lower, rather than higher, levels of social tension, as adverse conditions forced people to focus all their attention to agriculture.[xxvi]

2.3 Imprisonment as a measure of social upheaval

While the administrative accounts are rich and enable us to identify a range of mechanisms running from rainfall deviations through agricultural outcomes to social upheaval, they suffer from considerable limitations. British colonial services tended to be understaffed, and local administrators had to operate on a shoestring and were hardly capable to administer the vast territories they were supposed to control.[xxvii] Moreover, their accounts reveal strong prejudice[xxviii] and paternalistic[xxix] and derogatory[xxx] attitudes towards local populations. On top of that, previous scholars have pointed out that civil servants, to brush up their achievements and benefit their own careers, had incentives to focus on 'progress' and paint a rosy picture to superiors, which may have affect the reliability of local administrative accounts (Killingray 1986).[xxxi]

As a result of these factors, coverage of events in colonial reports may be incomplete and their representation biased. For this reason, we have found it necessary to identify a less subjective and more consistent district-level indicator of social tension and distress. In a superficially administered African colonial context, such indicators are scarce. Annual crop yields, rural food prices, or statistics on mortality and fertility are not available or inconsistently reported. Data on social unrest is scarce as well. Notable exceptions are the studies of Huillery (2011), who collected data on conflict, using colonial reports to sample binary district-level data on unrest in French West

Africa for 16 years between 1906 and 1956 and that of Papaioannou (2014), who collected annual province-level indicators of conflict (imprisonment, court cases and homicides) in colonial Nigeria for 33 years between 1912 and 1945. We argue that colonial imprisonment statistics, which are consistent and annually reported, can serve as a suitable proxy for social upheaval.

The colonial penal institutions, grafted upon penal codes and using imprisonment, fines and, in some cases corporeal punishment, as its major instruments, were essentially foreign to most parts of sub-Saharan Africa (Milner 1969; Killingray 1986; Bernault 2003; 2007). One of the key aspects of colonial rule consisted of the establishment of 'law and order', to increase the governability of the territories. Colonial penal systems were established and served to maintain social order and strengthen colonial domination (Bernault 2007; Hynd 2011; Killingray 1986). The newly established penal systems were used to incarcerate deviant and destitute elements of society. According to the official statistics, most cases of imprisonment resulted from crimes related to theft or offences against the person.[xxxii] Another considerable number of imprisonments was the result of debt and tax defaulting, and transgression of a range of colonial ordinances (Hynd 2011). Prison was not the only method of punishment at the hands of the authorities. Death penalties existed for the most serious crimes, and in some places corporeal punishments were common (Hynd 2008). Moreover, fines, being a much cheaper punishment for minor offences, were regularly awarded. In case a convicted person was unable to pay the fine, the sentence would be commuted into imprisonment (McCracken 1986; Coldham 2000). Hence, poverty could lead to imprisonment.

In most cases, administering justice (i.e. applying the penal code) happened at the discretion of the district officer (who had enjoyed only minor legal training) or, for minor breaches of law, native authorities (Milner 1969). As such, penal systems were sensitive to abuse. In settler dominated territories such as Southern Rhodesia and Kenya the penal systems partly served the interests of expatriate farmers to discipline labour and reinforce their property rights (Anderson 1993; Deflem 1994; Branch 2005). In other places, the majority of imprisonments resulted from trials in relatively autonomous native courts, which were, in their turn, not entirely free from manipulation by local elites (Killingray 1986; McCracken 1986). Moreover, some authors argue that colonial states used imprisonment to generate cheap convict labour (Bernault 2003; 2007). In general, the definition of 'crime' is highly contentious in a colonial setting with imposed 'alien' penal institutions (Kercher 1981). At least a share of the cases of imprisonment resulted from civil disobedience and rebellion rather than activities that were, at the time, commonly accepted by African populations as crimes (Branch 2005).

Considering the fact that the legitimacy of the colonial penal system can be questioned, and because not only crime, but also poverty or civil disobedience could result in imprisonment, we do

not approach them as a proxy for crime or conflict. However, we argue that, exactly because prisons harboured a mix of criminals, rebels and the poor, annual imprisonment fluctuation is a highly suitable proxy for social upheaval. Each of these channels lead us to hypothesize that in years of social tension and distress we should see increased incarceration.

(1) Some types of crime, especially petty crimes such as stealing, are likely to be more prevalent in conditions of hardship and desperation.
(2) Challenges to authority (rebellion, civil disobedience) are more likely in times when leaders become unable to provide people with a basic level of security and income.
(3) Debt and tax default increase in times of hardship and depressed incomes.
(4) Fine default (leading to imprisonment) increases in times of hardship and depressed incomes.

Two additional factors are likely to result in imprisonment spikes in the face of distress.

(5) Prisoners in colonial British Africa were fed an adequate subsistence diet. As a result, some destitute persons might seek out imprisonment as a last resort. Indeed, this seems to have been the case: for "the very poorest members of Kenyan society, [...] a short period of detention became adapted to survival techniques during times of extreme hardship" (Branch 2005: 259).
(6) Taking stock of adverse conditions and fearing increased levels of unrest, authorities may have moved first and have pre-emptively incarcerated destitute (vagrants and beggars) and deviant elements (speculators, agitators) of the population to prevent escalation. However, as incarceration was costly (prisoners had to be fed and guarded), and as local administrators were not eager to admit to their superiors that there was some kind of anticipated unrest in their district, such pre-emptive strike were not likely to be common, let alone *random*, but only occurred when the fear of escalation was grounded in reality, such as early signs of increased tension (Killingray 1986).

Finally, it should be noted that incarceration rates varied considerably across districts and colonies, reflecting differences in levels of coercion and state capacity. It is important to stress that our analysis does not intend to capture differences in *absolute levels* of imprisonment across colonial districts, but to use *annual fluctuations* of imprisonment to investigate the match between conflict spikes and rainfall shocks.[5]

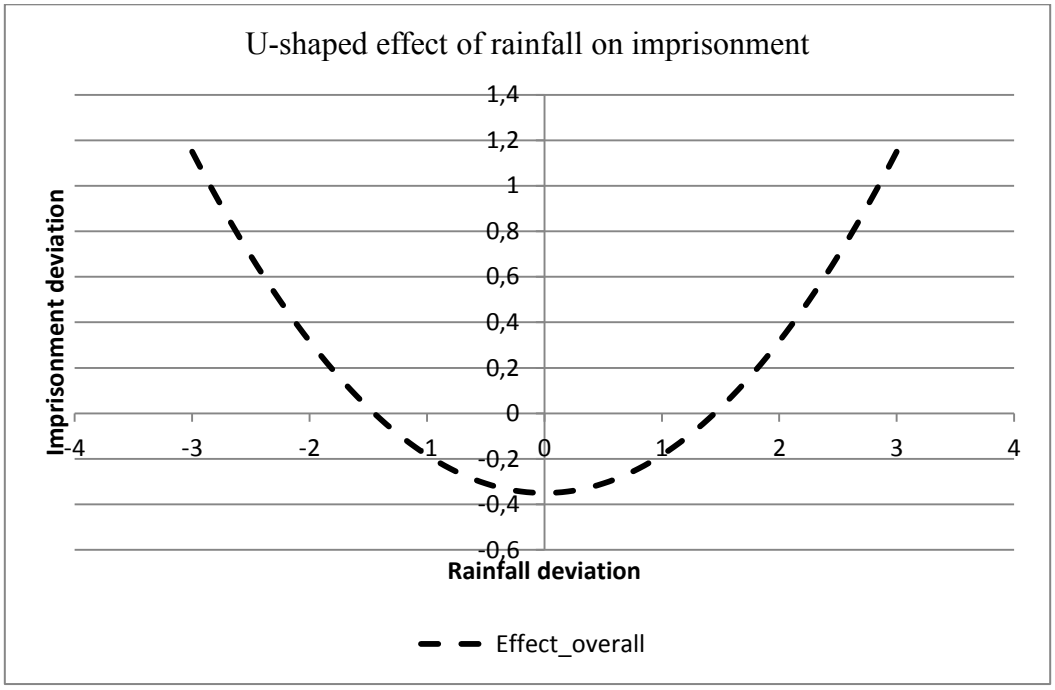
[5] Some scholars have pointed out that in the long run high absolute levels of social tension and unrest may provoke democratic transitions (Bruckner & Ciccone 2011). In an African context, conflict rose during the post-war road to independence such as the Mau Mau uprising in Kenya, and the Nyasaland emergency in 1959. However, such long-run outcomes of conflict are beyond the scope of this paper.

2.4 Hypothesis #1: rainfall and social tension

Based on the above qualitative evidence, we propose the first testable hypothesis about the expected curvilinear (U-shaped) impact of weather shocks on social tension and distress (figure 1):

***Hypothesis #1*: Deviation from the long-term rainfall mean (both *drought* and *excessive* rainfall) increases the level of social tension and distress (proxied by imprisonment)**

Figure 1. *Weather shocks and social upheaval*



We also make a few qualifications to this hypothesis. First of all, we want to find out if the impact of drought and excessive rainfall on social tension and distress was equally severe. To test the symmetry of the effect econometrically, we define the following sub-hypothesis:

***Hypothesis #1a*: Drought and excessive rainfall have a symmetrical impact on social tension and distress**

We also want to find out if districts which were already subjected to unfavourable rainfall in previous year(s) experience higher levels of social tension and distress in case of the next shock. We find at least some qualitative evidence that accumulating and prolonged shortages seem to have aggravated the impact of the next failure.[xxxiii] We test for the impact of consecutive shocks with the following sub-hypothesis:

***Hypothesis #1b*: Higher levels of social tension and distress arise from consecutive years of drought and/or excessive rainfall**

2.5 Data

As our main dependent variable we use annual imprisonment rates and as our primary independent rainfall deviations. Moreover, a set of observable and unobservable controls (fixed effects, time dummies, district-specific effects etc.) was included in the analysis. The summary statistics are presented in Table 1 below.

Table 1. *Summary Statistics: District by Year Data*

Variable	Obs.	Mean	Std. Dev.	Min	Max
Panel (a): Dependent variables					
Total prisoners	2730	412.74	521.62	0.00	5572
Prisoners st.dev.	2714	0.00	1.00	-2.60	3.70
Debt	2688	8.69	29.61	0.00	426
Safe custody	2688	109.88	172.28	0.00	3377
Penal imprisonment	2729	296.17	377.01	0.00	3523
Less than 3 months	2671	190.93	319.27	0.00	3335
More than 3 months	2672	106.68	169.28	0.00	1344
Panel (b): Independent variable of interest					
Rainfall long-term mean	2900	46.91	24.12	15.80	144.10
Rainfall st.dev.	2529	0.00	1.00	-3.20	3.30
Rainfall st.dev. squared	2529	1.00	1.32	0.00	10.89
Rainfall alternative st.dev.	3200	0.00	1.00	-3.50	3.30
Rainfall alternative st.dev. squared	3200	1.00	1.33	0.00	12.25
Positive rainfall shocks	1225	0.83	0.62	0.01	3.27
Negative rainfall shocks	1289	-0.79	0.56	-3.16	-0.01
Panel (c): Control variables (continuous)					
Population density (persons per square mile)	3260	52.98	74.60	0.13	801.44
Whites per 1000 of the population	3240	5.28	20.37	0.00	395.10
World market prices of relevant export crops	2176	100.76	40.12	31.00	303.00
Panel (d): Control variables (time-invariant)					
Rainfall coefficient of variation (CV)	2900	0.22	0.01	0.10	0.40
Pre-colonial chiefdom or state	3180	2.45	0.94	1.00	4.00
Railway	3260	0.41	0.49	0.00	1.00
Settler agriculture	3260	0.17	0.37	0.00	1.00
Export crop value (£) per capita	3220	0.52	1.47	0.00	10.10
Livestock units per 1000 of the population	3260	706.27	2197.98	0.00	13528.70
Cocoa cultivation	3260	0.07	0.26	0.00	1.00
Rainy season overlaps two years	3220	0.57	0.50	0.00	1.00
Consecutive shocks (>1 std. dev.)	243	1.00	0.00	1.00	1.00

2.5.a Imprisonment rates

For the dependent variable we use the (standardized) annual number of imprisonment per district (see section 2.3 for justification). In the robustness section we break down imprisonment into those admitted for debt, safe custody and penal imprisonment. The latter category is further refined by

distinguishing penal imprisonment up to three months, and above three months. The summary statistics of the weather conditions are presented in panel (a) of Table 1. Moreover, we introduce the main independent variable of interest, i.e. rainfall deviations, and several control variables. The data on imprisonment rates, rainfall and the control variables are available at the district level between 1920 and 1939. We therefore created a strongly balanced panel dataset with n=151 and T=20. Our variables are all original and obtained directly from colonial sources, except if stated otherwise.

2.5.b Rainfall deviations

Historical precipitation data come from meteorological stations, which were first introduced in British colonial Africa in the late 19th century. The data is consistent throughout the period of interest. Each district we include has at least one meteorological station within its borders. If more than one was present, we took the average of them. To fit econometric purposes, we use the following formula to construct our measure for weather shocks:

$$(X_{i,t} - \ddot{X}_i) / \sigma_i \,, \qquad (1)$$

where $\ddot{X}_i$ is the long-term mean of each district, $X_{i,t}$ is the annual rainfall in time t for district i, and σ_i is the standard deviation of each panel, that is for every i. The summary statistics of the weather conditions are presented in panel (b) of Table 1.

Both the *quantity* and *distribution* of rain seem to have been key determinants of agricultural failure or success. In some cases, the average annual rainfall was close to the long term mean, but the distribution was very abnormal, leading to crop failure nonetheless. In other cases the total rainfall was far off, but the distribution favourable.[xxxiv] The result might be that some harvest failures are not captured by the annual rainfall statistic, and that our rainfall figures predict a failure whereas it has not taken place. Despite the fact that they do not capture the distribution of rainfall within years, annual rainfall figures are commonly used in the literature. The crude nature of annual rainfall figures is unlikely to result in unduly significant results (i.e. finding a relation when there is none), but rather to underestimate the results. The selected model specification (i.e. regressing a dynamic panel data model) with the use of nearly 2,500 observations (n=151, T=20) substantially increases the reliability of our findings.

2.5.c Continuous control variables

Next to our main dependent and independent variables, we construct few continuous controls. Annual total population is estimated on the basis of colonial native census data, and expressed in terms of population density (per square mile).White population is estimated on the basis of non-

native censuses, and express per 1000 of the population. World market prices of relevant export prices is taken from Wageningen African Trade Database (see panel (c) of Table 1).

2.5.d Time-invariant control variables

In our estimation we distinguish between *observable* and *unobservable* time-invariant controls. In the *former* category we control for the interaction of several *observable* district-specific characteristics (for example: the presence of livestock) with a linear time trend to take into account for their impacts over time. We would expect districts with high presence of livestock to be more resilient in 1939 than in 1920, due to stock accumulation. Livestock per 1000 of the population per district (average 1920-1939) is estimated on the basis of livestock censuses.[6] Coastal and railway dummies were created on the basis of colonial maps. Pre-colonial chiefdoms and states were measured using the classification proposed by G.P. Murdock (1967) for "Jurisdictional Hierarchy beyond Local Community" (Variable 33, Gray 1999). Pre-colonial chiefdoms and states are defined as places with more than one level of jurisdictional hierarchy beyond the local community.

In the *latter* category we control for any other *unobservable* characteristics that we would expect to change over time. This set of controls is estimated by interacting each district with a linear time trend. We call these unobservable controls as district-specific effects (*DSE*).[7] In this way, we control for the possibility that (a) colonial authorities have become more efficient in inhibiting social tensions (or instead have extended their punitive capacity) over time and that (b) previous conflicts have promoted distrust among certain social groups in a way that this distrust may affect future attitudes and conflict intensity between particular groups, (c) regions with higher incomes are better off over time because they are able to store wealth, (d) conflict may have been attenuated by the gradual expansion of public infrastructure such as roads and railways. The summary statistics for these variables are reported in panel (d) of Table 1.

Finally, in all estimations we have controlled for spatial correlation (cross-sectional dependence) by adjusting standard errors following Conley (1999). This way we deal with the issue of migration and spatial spill-overs of tension. Even though most population movements commonly happened *within* a district, we control for any potential spillovers and allow this effect to decay smoothly with distance.

[6] We use the concept of 'tropical livestock units' to weigh cattle (weight = 0.7), sheep (0.1) and goats (0.1).
[7] Given that *observable* characteristics are redundant once district-specific effects (*DSE*) are included, in section 3 we present the results only after controlling for DSE. Including *observable* characteristics instead of DSE does not change the results.

2.6 Estimation Strategy

To test the effect of rainfall shocks on social tension and distress, we estimate the following specification:

$$Y_{i,t} = \gamma Y_{t-1} + \beta_1 rainfall\_deviation_{i,t} + \beta_2 rainfall\_deviationSQ_{i,t} + \delta Z'_{i,t} + \nu_i + \mu_t + \gamma X_i t + \lambda X_i t + \varepsilon_{i,t}$$

$$i = 1,...,151 \text{ and } t = 1,...,20 \qquad (2)$$

where $Y_{i,t}$ denotes the (standardized) annual rate of imprisonment. Y_{t-1} is the lag of the dependent variable. Excluding the lagged dependent variable can bias the estimates (Dell et al. 2014). $Rainfall\_deviation_{i,t}$ denotes the rainfall deviation of each district i from the historical long-term mean of the same district. We included the square term of $Rainfall\_deviation_{i,t}$ (denoted in model (1) as $Rainfall\_deviationSQ_{i,t.}$) in order to estimate the hypothesized non-linear condition. This way we test for both linear and curvilinear relationships between rainfall shocks and the incidence of social tension and distress. $Z'_{i,t}$ denotes a vector of institutional and economic determinants of tension which we control for in order to avoid any potential omitted variable bias. Under 'institutional' we include the continuous variables of population density and white population per 1000 of the population, and under 'economic' we include the annual world market prices for export crop.

ν_i and μ_t are district and year fixed effects, respectively. We use these to control for omitted heterogeneity at the level of districts and time periods. These controls are quite crucial in controlling for factors that may affect the levels of prisoners across all districts in the same year. For example, we might expect higher levels of imprisonment in a given year with extremely low export prices (such as during the Great Depression). To address autocorrelation concerns of weather shocks, the standard errors are clustered by district.

Moreover, $\gamma X_i t$ denotes the *observable* district specific characteristics when interacted with a linear time trend (t). To give an example, we expect that the presence of the railway to be a mitigating factor of the intensity of weather-induced scarcities, because food supplies can be distributed to the affected district at a relatively faster pace. $\lambda X_i t$ denotes the *unobservable* district-specific effects (*DSE)*, i.e. an interaction term between district characteristics (ν_i) and a linear time trend (t) (for more see section 2.5.c & 2.5.d). ε_{it} is the error term. Finally, in all estimations we have controlled for spatial correlation (cross-sectional dependence) by adjusting standard errors following Conley (1999). In practice, we allow correlation to decay smoothly with distance.

The equation is estimated using the system Generalized Method of Moments (system-GMM) developed by Bond (2002), because it appears to be the most suitable method for dealing with dynamic panel data models (Roodman 2006; 2009). This method takes into account the inclusion of a lagged dependent variable among the explanatory variables, the time series dimension of the data, the non-observable district specific effects and the possibility that all explanatory variables are endogenous.

2.7 Main Results

Table 2 presents our main results. The results overall indicate that there is a robust and significant curvilinear effect of weather shocks on social tension and distress. The rainfall deviation square variable yields a positive sign and holds a highly statistical significant coefficient throughout all columns. Column 1 shows the system-GMM results without controlling for any fixed effects. Column 2 shows the results after controlling for district and year fixed effects. Column 3 shows the results after controlling for the interaction of *observable* district characteristics and a linear trend ($\gamma X_i t$), whereas column 4 yields a similar result after controlling for *unobservable* district-specific effects (*DSE*). Column 5 reports the results after adding the continuous variables and column 6 controls for the t-1 effect of weather shocks. On average, a standard deviation increase (or decrease) in rainfall causes a 0.1645 standard deviation increase in social tension.[8] This result is crucial not only for its statistical significance but also for its economic significance; a 0.1645 deviation increase in social unrest implies an increase, on average, of 68 additional prisoners per district (on top of an average 413 prisoners).[9] A two points standard deviation in rainfall leads to an increase, on average, of 192 additional prisoners and so on.

In column 7, we test the *H#1a* related to the symmetry of the effect and conclude that the drought shocks (negative rainfall coefficient: +0.2181) are moderately more acute and give rise to higher degrees of conflict intensity as compared with the excessive rainfall shocks (positive rainfall coefficient: +0.1611). Using the separate estimated coefficients, we argue that on average, holding all other variables to their mean, one standard deviation decrease in rainfall (i.e. drought) causes a higher increase in additional prisoners – 90 prisoners, as compared to 67 in the occurrence of excessive rainfall shocks. Finally, in column 8, we conclude that the longer episodes of rainfall shocks (defined as >1 deviation from the mean) do not lead to more social tension and unrest (*H#1b*).

[8] Calculated as follows: 0,1249 x 1.3178 =0.1645
[9] Calculated as follows: 412.74 x 0.1645 = 67.89

Table 2. *Weather shocks and imprisonment*

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(5)
Prisoners st.dev									
Prisoners st.dev. lagged (t-1)	0.4698	0.4585	0.4449	0.3947	0.4451	0.4001	0.4651	0.4333	0.4001
	[6.51]***	[6.19]***	[6.33]***	[6.48]***	[6.32]***	[6.51]***	[6.27]***	[6.22]***	[5.92]***
Rainfall st.dev.	-0.0171	-0.0812	-0.0825	-0.0881	-0.0834	-0.0799		-0.0448	-0.0799
	[-0.11]	[-1.02]	[-0.44]	[-0.18]	[-0.69]	[-1.42]		[-0.76]	[-1.42]
Rainfall st.dev. squared	0.1249	0.1386	0.0932	0.099	0.0868	0.1211		0.1245	0.0648
	[3.11]***	[2.82]***	[3.05]***	[2.91]***	[2.30]**	[2.45]**		[2.35]**	[2.33]**
Prisoners st.dev. lagged (t-1)						-0.1816			-0.1816
						[-0.39]			[-1.25]
Prisoners st.dev. squared lagged (t-1)						-0.0451			-0.0451
						[-1.16]			[-0.86]
Population density (persons per square mile)					0.0031		0.0032	0.0034	
					[2.11]**		[2.24]**	[1.99]**	
Whites per 1000 of the population					0.0011		0.0013	0.0015	
					[0.89]*		[1.01]	[0.63]	
World market prices of relevant export crops					-0.0023		-0.0027	-0.0105	
					[-0.91]		[-1.31]	[-0.88]	
Positive rainfall deviations							0.1611		
							[2.46]**		
Negative rainfall deviations							0.2181		
							[3.37]***		
Consecutive shocks								0.0387	
								[0.48]	
District FE		Y	Y	Y	Y	Y	Y	Y	Y
Time dummies		Y	Y	Y	Y	Y	Y	Y	Y
Observable controls * year			Y						
District-specific effects (unobservable * year)				Y	Y	Y	Y	Y	Y
Number of Observations	2216	1589	2138	2079	1588	2137	2206	2042	2242
Number of Districts	143	143	143	137	104	143	143	143	143
Number of Instruments	87	136	184	181	142	178	74	130	178
AR1 statistics (p-value)	0	0	0	0	0	0	0	0	0
AR2 statistics (p-value)	0.351	0.216	0.381	0.401	0.134	0.348	0.387	0.847	0.348
Hansen test (p-value)	0.317	0.199	0.406	0.299	0.397	0.238	0.319	0.207	0.238

Notes: System-GMM estimation for dynamic panel data-model. Sample period: 1920–1939. Corrected t-statistics are shown in brackets. Significance level at which the null hypothesis is rejected: ***, 1 percent; **, 5 percent; and *, 10 percent. Second (and latter) lags were used as instruments in the first-differenced equations, and their once-lagged first differences were used in the levels equation. Two-step results using robust standard errors corrected for finite samples using Windmeijer (2005) correction. We adjust standard errors for spatial and time dependency following Conley (1999).

2.8 Robustness of Main Results

We perform numerous robustness exercises which we report in the appendix. First, we seek to investigate whether our results remain robust even by using alternative indicators of both our dependent and independent variables. In Table A1, our results remain the same even if we use an alternative measure of rainfall, based on the Matsuura and Wilmott (2009) world rainfall database (0.5 x 0.5 grid), taking the most central grid-observation in each of our districts. In Table A2, we modify our dependent variable by distinguishing among various reasons for imprisonment; that is debt, safe custody and penal imprisonment. Moreover, we distinguish between high and low intensity of tension by using the duration of imprisonment; our cut-off point was 3 months.

Second, we seek to explore whether our results are driven by the selected econometric specification. In Table A3, we show that the results remain largely unchanged when OLS-fixed effects and Probit estimations were used. Holding all other control variables to their mean, we find that a one standard deviation increase from mean rainfall increases the probability of above-expected incarceration rates (that is, when the number of prisoners is above the 3-year moving average) by 21.4 percent. A two standard deviation increase from mean rainfall increases the probability of having more prisoners than the 3-year moving average by 53.1 percent. One and two standard deviation decreases from the mean rainfall are associated with 30.6 and 65.7 percent increases in the probability of having more prisoners than expected on the basis of the three-year-moving trend, respectively. These findings confirm this paper's underlying hypothesis that rainfall deviations from the long-term mean increase the probability of social tension and distress. Moreover, they confirm the asymmetrical influence of weather shocks on tension (H#1a). The probability remains low when the deviation is moderate (one deviation point), and increases gradually and significantly when the deviation becomes severe (two deviation points). It is reassuring that both these alternative estimations yielded similar results; i.e. that in cases of both drought and excessive rainfall the probability of conflict increases.

Third, we include dummies of more than ±2.5 and ±3 standard deviations of rainfall in order to control for the scenario that severe weather shocks drag the whole U-shaped correlation upwards (results not reported). Fourth, we entered several country and region dummies into the analysis to avoid any biases driven by country or region specific effects. One would expect that countries with relatively low per capita incomes (for instance Nyasaland) to be more vulnerable to the vagaries of climate as compared to countries with higher per capita incomes (such as Ghana; a country which derived most of its annual revenues from the cultivation and taxation of a notably lucrative cash crops, i.e. cocoa. Others have pointed out to a considerable East-to-West divergence of living

standards (Frankema & Waijenburg 2012), and we therefore included region dummies (East, West and South).

3. Does agricultural commercialization mitigate the impact of shocks?

3.1 The debate

The issue whether the introduction of cash crops was beneficial, or detrimental to vulnerable rural communities is the subject of a multifaceted, heated and long-standing debate among policy makers and social scientists (Maxwell & Fernando 1989; Myint 1958; Rodney 1972). We take up one aspect of the debate by exploring if districts with smallholder export crop cultivation experienced different levels of social upheaval (higher resilience or vulnerability) in the wake of annual weather anomalies, compared to areas relying primarily on subsistence agriculture.

British colonial Africa provides us with a highly suitable context to study the relationship between export crops and social resilience to annual weather shocks. In some areas, mostly on the African West Coast, smallholder production of agricultural commodities for international markets long preceded colonial rule, while in other regions, such as the fertile but landlocked Great Lakes Region of East Africa, African smallholders only began to produce sizeable amounts of agricultural commodities for export during the colonial era, after the area had been opened up due to the construction of roads and railways. The effects of export crop cultivation on livelihoods in British colonial Africa has been discussed previously (Austin 2014). Although the production of export crops in British Africa was certainly not free from abuses and coercion, it contrasts favourably with the extractive and coercive practices in French (Tadei 2013), Belgian (Frankema & Buelens 2013) and Portuguese Africa (Isaacman 1980), where export crop cultivation went hand in hand with price controls, extensive forced labour regimes and heavy direct and indirect taxes.

Our study of the colonial administrative record highlights that the impact of export crops on resilience in the wake of exogenous shocks is not only up for debate among scholars, but was regularly discussed by colonial officers as well. The fear that export crops had negative effects was certainly present. In some regions, for example, colonial authorities pursued the policy that the cultivation of cotton was only supported among food self-sufficient households and communities. In some instances, such as the West African cocoa belt, colonial authorities argued that their fears had borne out and that cash crop cultivation had already diminished food supply and created scarcity. However, in many occasions, such fears are likely to have resulted from an unwarranted lack of faith in indigenous agricultural practices, or to cover up for other motives to limit native cash crop cultivation. In fact, a number of factors seems to have mitigated possible negative effects

of export crop cultivation. To structure the wide range of mechanisms that have been proposed in the literature, we distinguish three levels on which the impact of cash crops on resilience may affect risk:

(1) **Agronomy**: Some contend that (non-edible) cash crop destabilize existing farming systems, draining scarce labour and land resources away from food production, as such increasing the chances of food shortages and malnutrition (Hughes & Hunter 1970, MacKenzie 1999; Anderman et al. 2014). These fears were already expressed in the colonial era[xxxv] and sometimes affected the degree to which the state supported the adoption of (inedible) export crops.[xxxvi] However, in many occasions, such fears were likely to have resulted from an unwarranted lack of faith in indigenous agricultural practices.[xxxvii] Others, indeed, point out that farmers carefully decided how and to what extent a cash crop would fit into their farming systems (Tosh 1978).[xxxviii] Adding a new cash crop to the existing crop-mix could in fact be an effective strategy to mitigate crop-specific risks, as newly introduced export crops such as cocoa or cotton often react differently to weather fluctuations than local food crops, so combining them can actually be a successful strategy to mitigate crop-specific weather risks (Maxwell & Fernando 1989). Indeed, the colonial reports discuss a variety of cases in which weather shocks adversely affected food crops but spared cash crops, or the other way around.[xxxix] Moreover, the adoption of export crops may have sped up the simultaneous diffusion of new drought-resistant crops (cassava) and crop varieties (drought resistant maize), as well as more advanced farming methods (ox-ploughing, use of pesticides). Colonial fears of food insecurity in cash crop areas (because food shortages could dis-incentivize farmers to cultivate cash crops) may in fact have led the state to focus its agricultural extension, education and research efforts in regions with cash crops.[xl]

(2) **Household income**: The adoption of export crops by a smallholder, unless coerced, should be seen as an attempt to raise income in reaction to new opportunities resulting from lower transport costs and access to new markets and technologies (Hill 1982; Hopkins 1973; Myint 1958; Szereszewski 1965; Von Braun & Kennedy 1986; Austin 2014). The (monetary) income from cash crop has been argued to have enabled households to store wealth and cushion the impact of shocks and smoothen consumption (cf. Dercon 2002; Morduch 1990). Moreover, other studies have pointed out that increased trade openness has the potential to stabilize food prices (Fafchamps 1992b; Burgess & Donaldson 2012). These arguments do not go uncontested. Some argue that production for volatile external markets introduces an additional dimension of income uncertainty and risk into already risk-prone environments (Sen 1981). Others question the degree to which the benefits from trade trickled down to the

majority of producers as large producers with access to credit may profit disproportionately (Maxwell & Fernando 1989), or elites may extract the benefits through taxation, marketing boards and other means (Bates 1981; Falola 2009; Rodney 1978; Watts 1983). However, it seems unlikely that, unless forcefully supervised and coerced, farmers would cultivate cash crops if they did not receive any benefits. Indeed, colonial states strongly favoured the import of 'incentive goods' that would stimulate cash crop cultivation. Historical case studies reveal that only if cash crops are sufficiently lucrative, did farmers decide to (partly) abandon food self-sufficiency (Berry, 1975; Tosh 1978; Bryceson 1988; Binswanger & McIntyre 1987; De Janvry et al. 1991; Omamo 1998).

(3) **Collective coping mechanisms**: A strand of scholarship has argued that the penetration of capitalism that went hand in hand with cash crop cultivation provoked a breakdown of traditional insurance mechanisms, consisting of a 'moral economy' of fair prices, mutual aid and exchange of food in times of hardship (Fafchamps, 1992a; Raynaut, 1977; Richards, 1990; Vaughan, 1987; Watts, 1983). Other argue that more food aid was distributed in communities with cash crops because they contributed to the state's tax base and revenues. A part of these revenues resulted in infrastructural investments which in turn, led to higher capacity of the state to broadcast power and to react to 'early warning' and quicker distribution of food (Bryceson 1980; 1981) [xli]

Disentangling the contribution of each of the mechanisms discussed above is beyond the scope of this paper. Our goal, instead, is to see if the *overall effect* of cash crops on the resilience of these communities in years of extreme weather shocks was positive or negative.

3.2 Using rainfall to leverage heterogeneity

Our approach in measuring the mitigating effect of cash crop cultivation on resilience, involves interacting the new cash crop intensity index with rainfall deviation. This approach ties in with an emerging literature. Miguel et al. (2004) have pioneered the use of rainfall as an instrumental variable. They use rainfall levels to proxy for economic growth to explain the probability of civil war outbreaks. Dell (2012) uses drought as an instrument to proxy for insurgency during the Mexican Revolution (1910-1918) to explain a number of present day development outcomes and make a case for historical path dependence. A number of recent contributions have moved beyond an instrumental variable approach and have started to interact weather variables with a range of indicators such as institutional quality or geographical conditions, expecting to find heterogeneous effects of weather on conflict outcomes (cf. Papaioannou 2015). In the paper cited above, Dell

(2012) tests the correlation between rainfall and insurgency on a number of above and below median sub-samples for a range of variables relevant to her analysis.

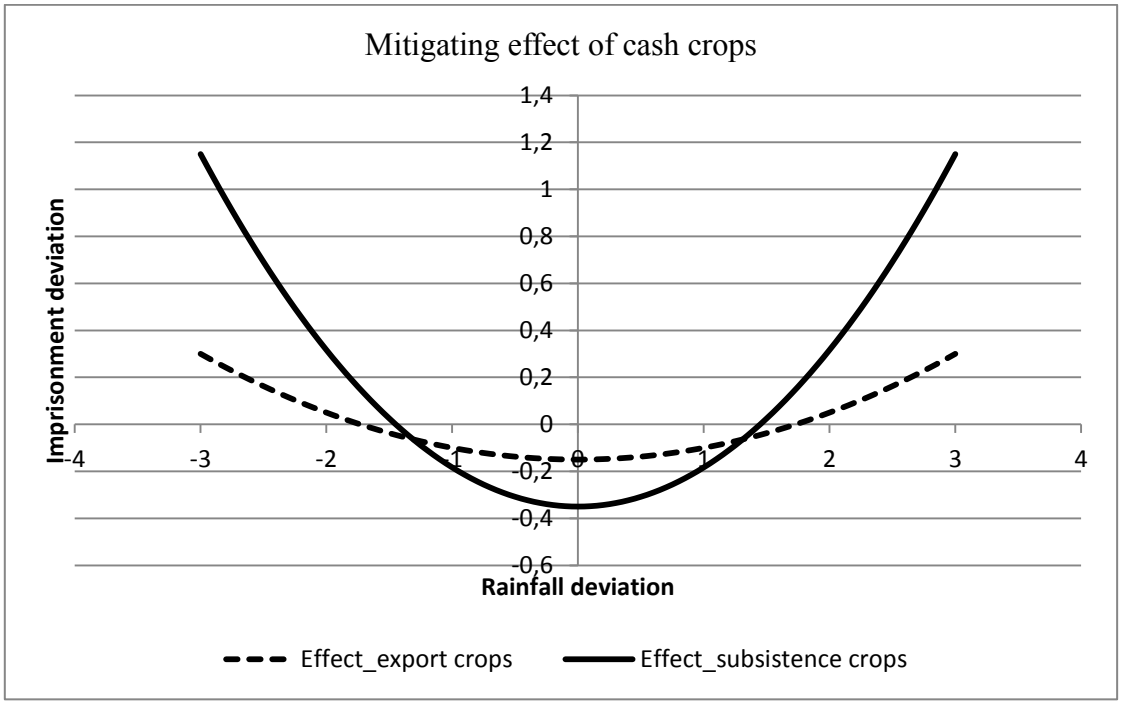
To explore the impact of socio-economic and socio-political variables on weather-induced conflict, Fjelde and von Uexkull (2012) interact rainfall with poverty and political marginalization. Christian and Fenske (2015) interact rainfall and temperature shocks with a number of compliers, including the presence of precolonial kingdoms and years of resistance to colonial rule and find that local state capacity reduces the likelihood of unrest resulting from exogenous (price and weather) shocks. Papaioannou (2015) interacts rainfall with the presence of cash crops on the provincial level (N=21), and finds evidence that weather-induced conflict in colonial Nigeria was less pronounced in regions where export crops (cocoa, palm oil or groundnuts) were produced. Our paper further elaborates on the latter finding, using our more sophisticated indicator of export crop cultivation and testing the heterogeneous effect on a much larger sample (N=151), with a range of additional robustness tests.

3.3 Hypothesis #2: Export crops and resilience to shocks

We propose the second testable hypothesis regarding the heterogeneous impact of weather shocks on districts with higher income derived from the cultivation of cash crops (figure 2). We propose the following hypothesis to be tested in the next section:

***Hypothesis #2*: The effect of rainfall deviations on social tension and distress is weaker in districts with higher income derived from the cultivation of export crops**

Figure 2. *Heterogeneous impact of weather shocks*



3.4 Data: an indicator for district-level cash crop cultivation

To the best of our knowledge, we are the first to construct an indicator of cash crop intensity during the colonial-era at the sub-national (district) level. We arrive at our indicator, following a number of steps. A simple example is given below. We have followed a similar procedure for all the districts in our dataset (see Appendix B)

A simple example:

(i) The total value of Nyasaland's cotton production in the years 1920-1939, following the Wageningen African Trade Database, fluctuated between a minimum of £35 thousand in 1932 and a maximum of £205 thousand in 1935.

(ii) The colonial Bluebooks of Nyasaland report annual estimates of district-level native cotton production. The *Lower Shire District*'s contribution, according to these estimates, fluctuated between 21 and 65 per cent of the country's total cotton production between 1920 and 1939.

(iii) By multiplying the annual value (i) with the Lower Shire's production share (ii), we find that the value of cotton produced in the Lower Shire district fluctuated between a minimum of £14 thousand and a maximum of £67 thousand.

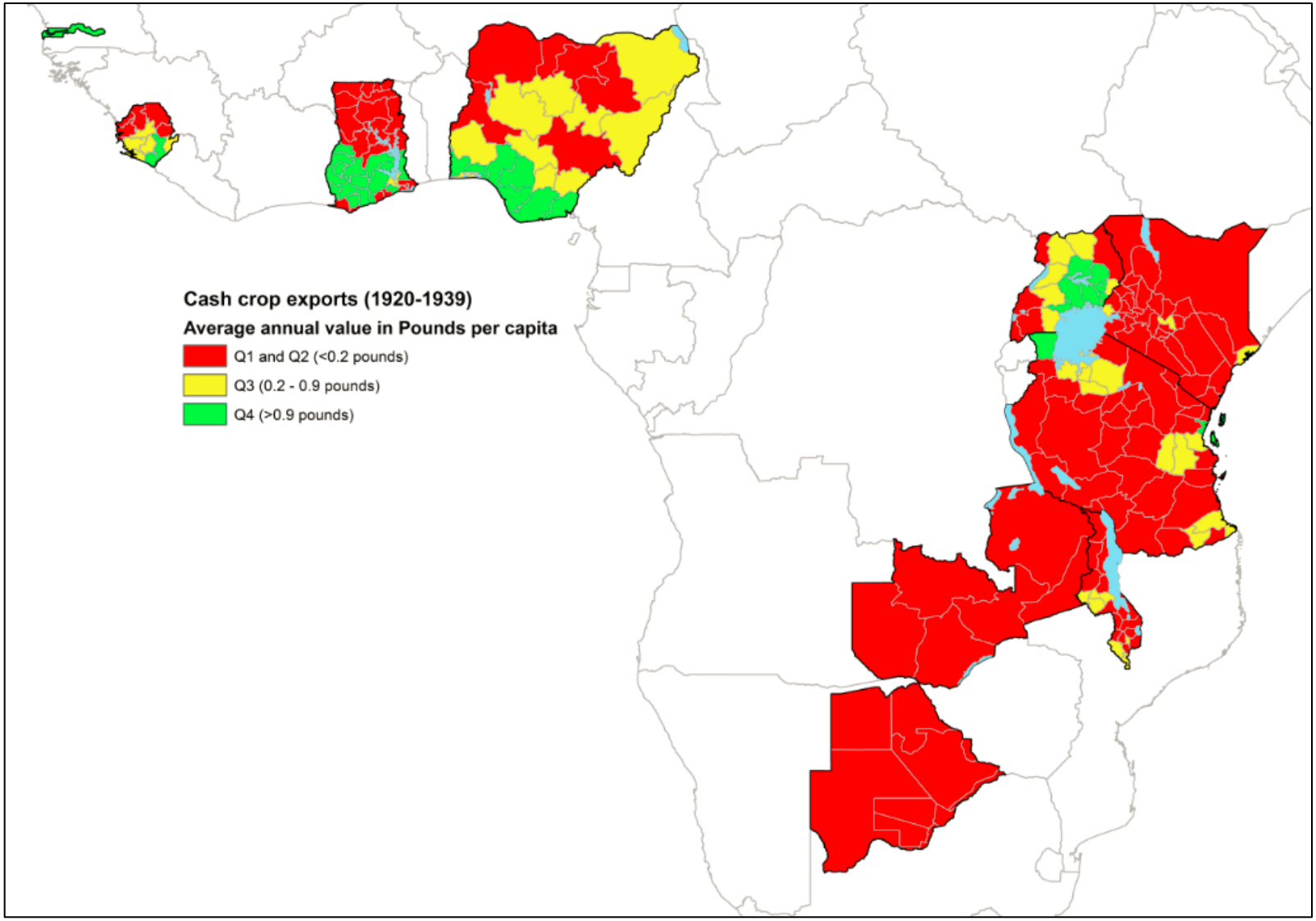
(iv) Next, we deflate these annual district-level values with district-level population numbers to obtain an estimate of *gross-export-crop-income per capita*, which in the case of the Lower Shire varies between £0.2 (during the depression years), and £0.8 per capita.

(v) Because both the district-level production estimates and population figures can only be considered rough proxies of reality, we discard annual fluctuations and take the average of the entire 20-year period as our indicator for export crop intensity. The average gross annual per capital export income for the Lower Shire district is £0.4.

We use this measure to split our sample in half as well as quartiles in the subsequent analysis. Despite the fact that our underlying data is rough, we argue that our indicator for cash crops is much more satisfactory than the use of a crude binary dummy, especially since export crop cultivation is our main heterogeneous variable.

Map 1 reports the cash crop intensity variable, dividing the dataset in quartiles and reporting the lowest two quartiles together (since districts in both quartiles exported negligible amounts of cash crops per capita). It shows that smallholder cash crop exports in interwar British colonial Africa were concentrated in the Gambia (groundnuts), coastal Gold Coast (cocoa), coastal Nigeria (cocoa and palm oil), northern Nigeria (cotton and groundnuts), the coasts of Lake Victoria (cotton and coffee), coastal Tanganyika and Zanzibar (cotton, copra and cloves) and southern Nyasaland (cotton and tobacco).

Map 1. *Cash crop intensity*



Source: Created by the authors in ArcGIS

3.5 Estimation Strategy

To test the mitigating effect of export crop cultivation in cases of extreme weather events, we estimate the following specification:

$$Y_{i,t} = \gamma Y_{t-1} + \beta_1 rainfall\_deviation_{i,t} + \beta_2 rainfall\_deviationSQ_{i,t} + \pi CashCropCultivation\_Interaction + \delta Z'_{i,t} + v_i + \mu_t + \gamma X_i t + \lambda X_i t + \varepsilon_{i,t} \quad (3)$$

$i = 1,...,151$ and $t = 1,...,20$

where *CashCropCultivation_Interaction* denotes the interaction of export crop income per capita with rainfall deviations and π is the coefficient of interest.

3.6 Heterogeneous Results

Table 3 reports the mitigating impact of export crop cultivation on social tension and distress. The dependent variable and the controls in columns 1–4 are the same as in Table 2. We conclude that the effects of extreme weather shocks are weaker in districts with export crop cultivation, as compared to ones without export crops. These results suggest that access to export crops mattered for the attenuation of shocks. On average, export crop cultivation attenuated the impact of weather shocks on imprisonment rates by 0.0793. Overall, districts with export crops were less severely affected, which is consistent with our hypothesis (*H#2)* that cash crops cultivation diversified production and acted as an insurance mechanism against the whims of nature.

Table 3. *The Mitigating effect of export crop cultivation*

Dependent variable Prisoners st.dev.	(1)	(2)	(3)	(4)
Prisoners st.dev. lagged (t-1)	0.5049	0.4411	0.4961	0.4407
	[6.45]***	[6.33]***	[6.57]***	[6.77]***
Rainfall st.dev.	-0.0078	-0.0817	0.0001	-0.0093
	[-0.33]	[-0.40]	[-0.02]	[-0.38]
Rainfall st.dev. squared	0.1691	0.1148	0.1082	0.1151
	[2.71]***	[3.03]***	[3.18]***	[3.74]***
Cash crop dummy * Rainfall st.dev. Squared	-0.0944	-0.0757	-0.0716	-0.0756
	[-2.68]***	[-2.06]**	[-1.82]*	[-2.05]**
Cash crop dummy	0.0459	0.0113	0.0101	-0.1365
	[0.79]	[1.51]	[0.39]	[-1.49]
District FE		Y	Y	Y
Time dummies		Y	Y	Y
Observable controls * year			Y	
District-specific effects (*unobservable* x year)				Y
Number of Observations	2216	2127	2131	2215
Number of Districts	143	142	137	143
Number of Instruments	89	169	170	169
AR1 statistics (p-value)	0	0	0	0
AR2 statistics (p-value)	0.245	0.421	0.486	0.482
Hansen test (p-value)	0.542	0.488	0.895	0.567

Notes: System-GMM estimation for dynamic panel data-model. Sample period: 1920–1939. Corrected t-statistics are shown in brackets. Significance level at which the null hypothesis is rejected: ***, 1 percent; **, 5 percent; and *, 10 percent. Second (and latter) lags were used as instruments in the first-differenced equations, and their once-lagged first differences were used in the levels equation. Two-step results using robust standard errors corrected for finite samples using Windmeijer (2005) correction. We adjust standard errors for spatial and time dependency following Conley (1999).

3.7 Robustness checks & alternative explanations

The literature and the qualitative evidence have already provided a range of plausible channels suggesting that the presence of cash crops had a direct effect on communities' resilience (see sections 3.1 and 3.2). However, we cannot entirely rule out the possibility of some alternative explanations feeding into our findings. This section attempts to address the most plausible alternative explanations upfront. We propose several alternative arguments and conduct multiple robustness checks to strengthen the consistency of our heterogeneous result.

The first concern is that cash crops were adopted mostly in *specific institutional conditions*, which might, by themselves, explain societal reactions to shocks. For example, strong precolonial institutions (i.e. the presence of a pre-colonial chiefdom), or higher colonial presence (i.e. a large expatriate community) may coincide with (i) the establishment of infrastructure (roads, railways, telegraphs, etc.), (ii) the introduction of improved agricultural

inputs and methods (improved seeds, fertilizers, implements), and (iii) better provisioning of food (efficient markets, granaries, food relief programs). Each of these factors has the potential to *directly* increase a smallholder community's resilience to adverse weather conditions. Each of them may also contribute *indirectly* to resilience, providing the right conditions for the adoption of export crops.

Moreover, strong precolonial and colonial institutions may reduce outbreaks of social tension and distress in years of harvest failures because the cost of engaging in unrest is higher in areas with greater state capacity, leading to higher levels of obedience (Papaioannou 2014; Christian & Fenske 2015). Moral economy theorists may even argue that the adoption of cash crops – hence penetration of capital – provokes individualization and breaks down a community's ability to challenge authority and rise up against colonial rule, suggesting that less pronounced imprisonment spikes in years of rainfall deviation signifies obedience or even lethargy rather than resilience.

To disentangle the effect of these alternative explanations from the cash crop to resilience explanation, we include three dummy variables: one indicator for colonial presence (based on average whites per 1000 of the population during 1920-1939), one for pre-colonial institutions (based on the absence/presence of consolidated chiefdoms and states), and one for the level of coercion (based on average annual imprisonments per 1000 of the population during 1920-1939). We interact these variables with our rainfall_deviation variable and include the new term in the regression. The estimated coefficients are presented in columns 1–3 of Table 4. Adding these interaction terms does not change our findings.

Secondly, one may hypothesize that export crops were adopted in areas with specific *geographical conditions*, which by themselves explain (higher or lower) levels of social tension and distress in years of harvest failures. For example, the adoption of cash crops might correlate strongly with the length of the rainy season(s) (since farmers in these areas harvested twice and could thus combine food crops and cash crops without compromising on food security). At the same time, the length of the rainy season also *directly* affects resilience to shocks (long or bimodal rains enabled farmers to replant food crops after a harvest failure).

In a similar vein, it can be argued that areas with more generous average annual rainfall are both more resilient by themselves, and more suitable for export crops as well. We would also expect that areas which had a higher degree of rainfall variability (i.e. high range of observations between min and max) to be more vulnerable (because continuous weather volatility made it more difficult for them to calibrate their farming systems and build buffers), while such areas can also be expected to be less suitable for export crop cultivation. We use average annual

rainfall (1920-1939), the coefficient of rainfall variation (CV) and length of the rainy season (average number of months with >60 mm of rainfall during 1920-1939) and interact them with rainfall_deviation to test for these alternative explanations. The results are reported in columns 4–6 of Table 4.

Thirdly, it is important to take stock of a range of *alternative income earning opportunities* which might explain differential reactions to shocks. In the interwar era, employment in the secondary and tertiary sector was limited, and urbanization rates low. Key alternative sources of income for smallholders consisted mainly of consuming or marketing livestock[xlii], or seeking agricultural employment (with African or expatriate ('settler') farmers) elsewhere (see section 2.2.b). Access to alternative income could alleviate tension and distress arising from harvest failure. If export crop areas also enjoyed higher levels of livestock ownership or settler agriculture, these could be alternative explanations of higher resilience. To test for these alternative explanations, we enter a livestock dummy (based on average livestock ownership per 1000 of the population during 1920-1939) and a settler agriculture dummy and interact them with rainfall_deviation. The results are presented in columns 7&8 of Table 4.

Finally, there are two methodological issues which may drive the mitigating impact of cash crop cultivation on social distress. Firstly, we want to know if our cash crop effect results from conditions that are specific to either the beginning or the end of our period of interest. One could argue that colonial officials, over time, invested more in districts with cash crops than ones without. The cultivation of cash crops might lead the colonial state to construct and expand a railway line or road network, which in turn could provide a collateral solution of food relief provision. We interact rainfall_deviation with a time trend and include this term in the regression. This procedure shows that the mitigating impact of cash crops was similar at the beginning and end of our period.

Secondly, we were concerned that our results were (partly) driven by the overlap of the rainy season in two years of some districts. We reasoned that in districts which rely on rainfall at the end of year *t*, harvest failure might only lead to distress (hence more prisoners) in year *t + 1*. Since our prisoner data is reported on a calendar year basis we cannot correct for this possibility. While the only possible effect of this data issue on our main effect was that it would *reduce* the explanatory power of rainfall in year *t* on social upheaval in year *t* (hence biasing our results downwards), the anticipated problem for the interaction effect was that places with overlapping rainy seasons were also places with export crops, which would imply that our interaction effect is driven by a data issue. We create a dummy for places with overlapping rainy seasons

(significant rainfall in December) and interact with rainfall_deviation. The results are presented in columns 9&10 of Table 4.

There were three additional issues for which we performed robustness checks by creating sub-samples (results are not reported). A *first issue* concerned the overrepresentation of livestock-dense districts in our below-median export crop sample. One could argue that the presence of livestock intensifies social tension and distress in years of weather shocks, for example because (i) cattle can be stolen with relative ease, and (ii) in years of drought cattle herders migrate in order to find water and pasture. To rule out the possibility that the higher spikes of social tension and distress in our below-median cash crop sample were driven not by the absence of cash crops, but by the presence of livestock, we rerun the analysis, excluding districts with above median presence of livestock. We find that the results remain robust. A *second*, analogous, *issue* concerned the possibility that higher spikes of social tension and distress in our below-median cash crop sample were driven not by the absence of cash crops, but by the presence of settlers (all settler districts end up in the below-median cash crop sample). The argument would be that land alienation and extractive institutions could potentially have a negative impact on resilience to rainfall shocks. We excluded the settler districts from the analysis and re-estimated our model. We find that the main as well as the cash crop interaction effect remain unchanged. A *third issue* would be that the mitigating effect of cash crops on resilience is driven by districts with cocoa, which are sometimes framed among economic historians of Africa as an exceptional case of successful cash crop adoption. To rule out the possibility that our cash crop interaction effect is driven by cocoa, we created a sub-sample excluding the cocoa districts from the analysis. To conclude, it is reassuring to find that the coefficient of our main heterogeneous effect remains statistically significant throughout these alternative specifications.

Table 4. Alternative explanations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	Institutions			Geography			Income		Specification Issues	
Prisoners std	Colonial Presence	Pre-colonial chiefdoms	Coercion Index	Length of rainy season	Rainfall Zones	Rainfall variability (CV)	Livestock	Settler Farming	Rainfall st.dev.*trend	Rainy season overspill
Prisoners st.dev. lagged (t-1)	0.4595	0.4314	0.4544	0.4439	0.4467	0.4322	0.4322	0.4551	0.4465	0.4541
	[7.25]***	[7.33]***	[7.88]***	[6.41]***	[7.30]***	[6.77]***	[6.11]***	[5.88]***	[5.75]***	[7.19]***
Rainfall st.dev.	-0.0136	-0.0159	-0.0115	-0.0966	-0.0065	-0.0101	-0.0101	-0.0077	0.0025	-0.0116
	[-0.57]	[-0.68]	[-0.48]	[-1.34]	[-0.28]	[-0.41]	[-0.41]	[-0.31]	[0.11]	[-0.51]
Rainfall st.dev. squared	0.1098	0.1171	0.1211	0.1172	0.1092	0.1164	0.1164	0.1093	0.2033	0.1392
	[4.35]***	[3.59]***	[4.73]***	[3.68]***	[2.88]***	[3.51]***	[4.58]***	[4.32]***	[4.40]***	[4.89]***
Cash crop dummy * Rainfall st.dev. Squared	-0.0742	-0.0805	-0.0756	0.0753	-0.0646	-0.0756	-0.0784	-0.0681	-0.0644	-0.0786
	[-2.10]**	[-2.37]**	[-2.44]**	[-2.03]**	[-1.99]**	[-2.05]**	[-2.10]**	[2.00]**	[-2.25]**	[2.01]**
Cash crop dummy	-0.0381	0.0113	0.0611	0.0101	0.0489	0.0071	0.0757	0.0381	0.0459	0.0359
	[-0.03]	[0.51]	[0.39]	[0.39]	[0.66]	[0.79]	[0.33]	[0.18]	[0.79]	[0.44]
Alternative explanations	-0.0002	0.0063	-0.0008	0.0151	0.0001	-0.0631	0.0061	-0.0156	-0.0084	-0.0505
	[-0.76]	[0.18]	[-1.00]	[1.34]	[0.28]	[-0.56]	[0.56]	[-0.65]	[-1.36]	[-1.44]
District FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observable controls x year	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
District-specific effects (*unobservable* x year)										
Number of Observations	2204	2151	2215	2194	2215	2215	2215	2215	2215	2199
Number of Districts	142	139	143	141	143	143	143	143	143	142
Number of Instruments	169	166	170	168	170	170	170	170	170	169
AR1 statistics (p-value)	0	0	0	0	0	0	0	0	0	0
AR2 statistics (p-value)	0.459	0.424	0.446	0.354	0.411	0.308	0.444	0.288	0.311	0.308
Hansen test (p-value)	0.369	0.488	0.408	0.793	0.688	0.567	0.621	0.536	0.483	0.745

Notes: System-GMM estimation for dynamic panel data-model. Sample period: 1920–1939. Corrected t-statistics are shown in brackets. Significance level at which the null hypothesis is rejected: ***, 1 percent; **, 5 percent; and *, 10 percent. Second (and latter) lags were used as instruments in the first-differenced equations, and their once-lagged first differences were used in the levels equation. Two-step results using robust standard errors corrected for finite samples using Windmeijer (2005) correction. We adjust standard errors for spatial and time dependency following Conley (1999).

4. Conclusion

This study has investigated two essential questions. First, to what extent did weather-induced scarcities cause higher levels of social upheaval? Second, to what extent did the introduction of cash crops mitigate the impact of these shocks? Building on various original source materials, the analysis has yielded two substantial findings. First, it presents consistent qualitative and quantitative evidence about the impact of weather shocks on levels of social tension and distress. While some previous papers in the climate-economy literature have modelled rainfall in a linear way, or have argued that high precipitation is associated with abundance, our analysis of colonial sources indicate that both drought (through crop failure and livestock starvation) and excessive rainfall (through failure, plant diseases and logistical problems) have increased scarcity and created conditions that generated social tension and distress. Our econometric analysis confirms this relationship, showing a strong and robust *U-shaped* relation between annual rainfall deviation and imprisonment rates.

Second, this study builds on the link between weather shocks and social outcomes to take up a long-standing debate on the impact of export crops on resilience to shocks in tropical Africa. Again, we employ both qualitative and quantitative methods. The literature and source materials provide a range of mechanisms through which cash crops had the potential to either improve or break down resilience on the levels of agronomy, household income and collective resources. Our econometric analysis, based on a new and fine-grained indicator of export crop cultivation, shows that the cultivation of cash crops increased farmers' resilience against erratic weather anomalies; regions with more cash crops displayed less pronounced spikes of social upheaval in years of weather shocks than regions with few to no cash crops.

We suggest a number of directions for future research. Firstly, future studies could attempt to disentangle the effects of agricultural commercialization on resilience, with regard to the levels of agronomy, household income and collective resources. It would be of particular interest to see if these effects are primarily channelled through private (household) income or through public investments on infrastructure and food aid programs. Secondly, it would be valuable to zoom in on the actual adoption of (different types of) export crops and identify conditions (either agronomical or institutional) that determine successful adoption. Thirdly, while this study finds a short term mitigating effect of export crops on resilience, it does not address long-term positive or negative effects that have been proposed in the literature; for instance, the underdevelopment of African living standards, the disruption of the 'moral economy' or the environmental impact of agricultural commercialization. A more complete understanding of the impact of export crops would benefit from studies that attempt to empirically study the *long-run effects* and *legacies* of export crops on

resilience. Finally, while cash crops were the main gateway to more open, monetized economies in large parts of Africa, it would be worthwhile to identify alternative 'roads to openness' (such as mining or industrialization) and analyse if they a have similar effects on resilience in the short and long-run.

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Appendix A. Robustness Tests

Table A1. *Main results with Grid rainfall deviations*

Dependent variable Prisoners std	(1)	(2)	(3)	(4)	(5)	(6)
Prisoners st.dev. lagged (t-1)	0.4701	0.5048	0.4711	0.4686	0.4821	0.4825
	[11.24]***	[9.74]***	[11.26]***	[11.23]***	[10.92]***	[12.49]***
Rainfall st.dev.	0.0144	-0.0743	0.0187	0.0091	-0.0458	-0.0467
	[0.21]	[-1.21]	[0.28]	[0.13]	[-1.15]	[-1.18]
Rainfall st.dev. squared	0.1062	0.1183	0.0974	0.1077	0.1055	0.1036
	[2.33]**	[3.31]***	[2.22]**	[2.35]**	[3.44]***	[3.37]***
Prisoners st.dev. lagged (t-1)						-0.1816
						[-0.39]
Prisoners st.dev. squared lagged (t-1)						-0.0451
						[-1.16]
Population density (persons per square mile)					0.0003	
					[1.96]**	
Whites per 1000 of the population					0.0036	
					[0.63]	
World market prices of relevant export crops					-0.0016	
					[-0.69]	
District FE		Y	Y	Y	Y	Y
Time dummies		Y	Y	Y	Y	Y
Observable controls * year			Y			
District-specific effects (unobservable * year)				Y	Y	Y
Number of Observations	2495	2490	2495	2495	1702	2479
Number of Districts	155	154	155	155	105	153
Number of Instruments	136	179	139	138	99	185
AR1 statistics (p-value)	0	0	0	0	0	0
AR2 statistics (p-value)	0.625	0.541	0.621	0.588	0.737	0.461
Hansen test (p-value)	0.188	0.552	0.181	0.218	0.156	0.195

Notes: System-GMM estimation for dynamic panel data-model. Sample period: 1920–1939. Corrected t-statistics are shown in brackets. Significance level at which the null hypothesis is rejected: ***, 1 percent; **, 5 percent; and *, 10 percent. Second (and latter) lags were used as instruments in the first-differenced equations, and their once-lagged first differences were used in the levels equation. Two-step results using robust standard errors corrected for finite samples using Windmeijer (2005) correction. We adjust standard errors for spatial and time dependency following Conley (1999).

Table A2. *Results with alternative dependent variables*

Dependent variable:	(1) Debt	(2) Safe custody	(3) Penal Imprisonment	(4) Convictions above 3 months	(5) Convictions below 3 months
Prisoners std. lagged (t-1)	0.2223	0.4539	0.3156	0.2911	0.3402
	[1.99]**	[10.03]***	[5.22]***	[6.41]***	[6.66]***
Rainfall_deviation_Stations	0.0334	0.0703	0.0001	-0.0452	-0.0051
	[0.84]	[1.15]	[0.00]	[-0.19]	[-0.15]
Rainfall_deviationSQ_Stations	0.0526	0.0751	0.1621	0.0445	0.0938
	[2.46]**	[1.75]*	[3.20]***	[1.90]*	[3.83]***
District FE	Y	Y	Y	Y	Y
Time dummies	Y	Y	Y	Y	Y
Observable controls x year					
District-specific effects (unobservable x year)	Y	Y	Y	Y	Y
Number of Observations	1640	2114	2123	2080	2047
Number of Districts	105	136	137	138	136
Number of Instruments	149	180	181	182	180
AR1 statistics (p-value)	0	0	0	0	0
AR2 statistics (p-value)	0.769	0.421	0.631	0.482	0.597
Hansen test (p-value)	0.701	0.488	0.151	0.567	0.285

Notes: System-GMM estimation for dynamic panel data-model. Sample period: 1920–1939. Corrected t-statistics are shown in brackets. Significance level at which the null hypothesis is rejected: ***, 1 percent; **, 5 percent; and *, 10 percent. Second (and latter) lags were used as instruments in the first-differenced equations, and their once-lagged first differences were used in the levels equation. Two-step results using robust standard errors corrected for finite samples using Windmeijer (2005) correction. We adjust standard errors for spatial and time dependency following Conley (1999).

Table A3. *Results with alternative econometric specifications*

Dependent variable	(1) OLS-FE Prisoners_deviation	(2) OLS-FE Prisoners_deviation	(3) Probit Binary Prisoners	(4) Probit Binary Prisoners
Rainfall_deviation_Stations	0.0111	0.0072		
	[0.48]	[0.032]		
Rainfall_deviationSQ_Stations	0.1223	0.1214		
	[3.44]***	[3.26]***		
Positive rainfall deviation			0.2148	
			[3.33]***	
Negative rainfall deviation				0.3065
				[4.26]***
Population density (persons per square mile)		0.0061		
		[2.75]***		
Whites per 1000 of the population		0.0236		
		[1.80]*		
World market prices of relevant export crops		0.0012		
		[0.82]		
District FE	Y	Y	Y	Y
Time dummies	Y	Y	Y	Y
Observable controls x year				
District-specific effects (unobservable x year)	Y	Y	Y	Y
Number of Observations	2334	1665	1019	1032
Number of Districts	143	104	143	143
R^2	0.46	0.38	0.49	0.53

Notes: Sample period: 1920–1939. Corrected t-statistics are shown in brackets. Significance level at which the null hypothesis is rejected: ***, 1 percent; **, 5 percent; and *, 10 percent. We adjust standard errors for spatial and time dependency following Conley (1999).

Table A-4. *Quartile effects of cash crops on imprisonment*

Dependent variable Prisoners deviation	
Prisoners deviation lagged (t-1)	0.4401 [6.45]***
Rainfall deviation	-0.0935 [-1.64]
Rainfall deviationSQ	0.1775 [2.71]***
Cash crops Q2	-0.0364 [-0.61]
Cash crops Q3	-0.0642 [-1.06]
Cash crops Q4	-0.1252 [-2.17]**
Geographical controls	YES
Controls	YES
Time dummies	YES
District-specific effects	YES
Number of Observations	2138
Number of Districts	143
Number of Instruments	142
AR1 statistics (p-value)	0
AR2 statistics (p-value)	0.245
Hansen test (p-value)	0.542

Notes: In Table A-4, we further investigated the heterogeneous effects by measuring the varied contribution of each quartile to the overall effect. As we expected, the top quartile of income has an attenuating response to weather shocks, which is highly statistically significant. The first quartile (Interaction Q1) is used as the reference category. Controls include all variables used in Table 2.

Appendix B. Cash crop intensity calculation

We proceed in the following steps:

(i) We obtain *annual, crop-specific, country-level cash crop export values*, compiled in the Wageningen African Trade Database, for the years 1920 to 1939;

(ii) we collect *annual, crop-specific, district-level, smallholder cash crop production estimates* for the years 1920 to 1939. We use a range of sources, including colonial maps, annual statistics and agricultural censuses. We inter-/extrapolate if production data is not available for all years;

(iii) we use (ii) to divide (i) over the individual districts, for each of the countries in our dataset, and add the value of all export crops grown in a district to arrive at an indicator of *annual, district-level cash crop export values per district*.

(iv) we divide (iii) over *annual, district-level population figures* to arrive at an indicator of *annual, district-level, smallholder cash crop export value per capita*. We inter-/extrapolate if population data is not available for all years;

(v) we take the average of (iv) for the years 1920-1939 to arrive our indicator of *export crop intensity (average annual value of export crops in pounds per capita)*.

Gold Coast

District borders are the administrative borders from 1930 reported in Gold Coast 'Administration Report 1930'. District-level, smallholder production shares for cocoa, cola nuts, copra and palm oil are estimated using maps in Cardinall (1932) and Kaplan et al. (1971). No panel data on cash crop production is used. The 1931 map-based production shares are used for the entire period (1920-1939). District-level, export crop production shares are obtained by dividing the district's production estimates by the country-sum of production estimates. Annual, district-level smallholder export crop production values are obtained by multiplying the 1931 production shares with annual country-level, crop-specific exports from the WTD. All crops are added up and the resulting total is divided by the district population. Annual population figures are obtained from Gold Coast Blue Books (1920-1939). For some districts, only data for 1930 is available. Missing years are extrapolated using a nearby district. Note that the maps only indicate the area in which cash crops were produced, and do not indicate the intensity of production or yields. Hence, the assigned shares are a rough approximation of reality.

Nigeria

District level data for Nigeria is not available. Instead, we use provinces. Borders are obtained from Papaioannou (2014). Province-level, smallholder production shares for cocoa, cotton, groundnuts and palm oil are estimated using maps cited in Papaioannou 'Climate shocks and conflict'. No panel data on cash crop production is used. The map-based production shares are used for the entire period (1920-1939). District-level, export crop production shares are obtained by dividing the district's production estimates by the country-sum of production estimates. Annual, district-level smallholder export crop production values are obtained by multiplying the map-based production shares with annual country-level, crop-specific exports from the WTD. All crops are added up and the resulting total is divided by the district population. Annual population figures are obtained from Nigeria Blue Books (1920-1939). Note that the maps only indicate the area in which cash crops were produced, and do not indicate the intensity of production or yields. Hence, the assigned shares are a rough approximation of reality.

Sierra Leone

In the absence of utilizable maps from 1920-1939, we use present day district borders. These borders coincide roughly with the colonial districts. District-level, smallholder production shares for ginger and palm oil are estimated using production estimates for 1938, reported on a map in Sierra Leone 'Administration Reports'. No panel data on cash crop production is used. The 1938 production shares are used for the entire period (1920-1939). District-level, export crop production shares are obtained by dividing the district's production estimates by the country-sum of production estimates. Annual, district-level smallholder export crop production values are obtained by multiplying the 1938 production shares with annual country-level, crop-specific exports from the WTD. All crops are added up and the resulting total is divided by the district population. Annual population figures are obtained from Sierra Leone Blue Books (1920-1939). Note that the districts in Sierra Leone shifted somewhat between the interwar period and today. The graphical representation on the map, hence, is not fully accurate.

Gambia

Gambia is treated as one district. Cash crop production (groundnuts) in that district can be equated to the total annual export figure in the WTD. Population figures from Gambia Blue Books (1920-1939). Note that considerable numbers of migrants ('strange farmers') came annually to the Gambia to produce groundnuts. Since these migrants are not counted in the population figures, the cash crop intensity may be biased slightly upwards.

Tanganyika

District borders are the administrative borders from 1933 reported in Berry (1972). District-level, smallholder production estimates for coffee, copra, cotton, groundnuts, sesame and tobacco are obtained from the Tanganyika Blue Books (1926, 1927, 1929, 1930, 1932, 1933, 1935, 1937, 1938 and 1939). District-level, export crop production shares are obtained by dividing the district's production estimates by the country-sum of production estimates. As the country export data does not distinguish between smallholder- and expatriate-produced export crops, crops (coffee) produced by expatriate farmers are included into this country sum. Production shares for missing years are interpolated. The shares for 1920-1925 are set equal to the average share of 1926 and 1927. Annual, district-level smallholder export crop production values are obtained by multiplying the annual production shares with annual country-level, crop-specific exports from the WTD. All crops are added up and the resulting total is divided by the district population. Annual population figures are obtained from Tanganyika Blue Books (1928, 1931, 1939). Missing years are inter-/extrapolated using the same procedure as for the production estimates. Note that some of the crops included (copra, groundnuts and sesame) were both consumed locally and exported. We are forced to assume that exports are equally divided over the producing districts, but this assumption has only a minor effect on the eventual cash crop intensity estimates.

Zanzibar

District borders coincide with Pemba Island and Zanzibar Island. District-level, smallholder production estimates for cloves and copra are obtained by estimating the relative contribution of the two Islands based on production figures in Zanzibar 'Administration Reports'. District-level, export crop production shares are obtained by dividing the district's production estimates by the country-sum of production estimates. As the country export data does not distinguish between smallholder- and expatriate-produced export crops, we roughly estimate expatriate-plantation clove production at 50% and copra production at 20% and include the crops produced by expatriate farmers into the country sum. Annual, district-level smallholder export crop production values are obtained by multiplying the annual production shares with annual country-level, crop-specific exports from the WTD. All crops are added up and the resulting total is divided by the district population. Annual population figures are obtained from Zanzibar Blue Books (1920-1939).

Kenya

District borders are from Kenya 'Administration Reports 1931'. District-level, smallholder production estimates for cotton, wattle, sesame, groundnuts and coconuts are obtained from Kenya

'Agricultural Census 1930'. No panel data on cash crop production is used. The 1930 production shares are used for the entire period (1920-1939). District-level, export crop production shares are obtained by dividing the district's production estimates by the country-sum of production estimates. As the WTD does not distinguish between smallholder- and expatriate-produced export crops, crops (maize and wattle) the total reported value of smallholder produced crops is taken as a share of total production, including production at expatriate farms. This share is applied to the entire period. Annual, district-level smallholder export crop production values are obtained by multiplying the 1930 production shares with annual country-level, crop-specific exports from the WTD. All crops are added up and the resulting total is divided by the district population. Annual population figures are obtained from Nyasaland Protectorate Blue Books (1927, 1929, 1934, 1938). Missing years are inter-/extrapolated using a procedure analogous to the production estimates under 'Tanganyika'. Note that the district-level production figures are based on sales rather than production. Note that some of the crops included (maize, sesame, groundnuts, coconuts) were both consumed locally and exported. We are forced to assume that exports are equally divided over the producing districts, but this assumption has only a minor effect on the eventual cash crop intensity estimates.

Uganda

District borders are from Uganda 'Administration Reports 1948', with some modifications based on Wrigley 'Crops and wealth'. District-level, smallholder production estimates for coffee and cotton are obtained from the Uganda Blue Books (1920, 1923, 1926, 1929, 1932, 1935 and 1938). District-level, export crop production shares are obtained by dividing the district's production estimates by the country-sum of production estimates. As the country export data does not distinguish between smallholder- and expatriate-produced export crops, crops (coffee) produced by expatriate farmers are included into this country sum. Production shares for missing years are set equal to the closest available year. Annual, district-level smallholder export crop production values are obtained by multiplying the annual production shares with annual country-level, crop-specific exports from the Uganda Bluebooks (the WTD does not break down export data for Kenya and Uganda). All crops are added up and the resulting total is divided by the district population. Annual population figures are obtained from Uganda Blue Books (1920, 1923, 1926, 1929, 1932, 1935 and 1938). Missing years are inter-/extrapolated using the same procedure as for the production estimates. Note that the district shares, as well as the smallholder versus expatriate shares are based on acreage rather than production, meaning that yield differences between provinces is not taken into account. This may slightly diminish the accuracy of the cash crop intensity estimates.

Nyasaland

District borders are from Nyasaland 'Administration Reports 1933'. District-level, smallholder production estimates for cotton and tobacco are obtained from the Nyasaland Blue Books (1923, 1925, 1927, 1929, 1931, 1933, 1935, 1937 and 1939). District-level, export crop production shares are obtained by dividing the district's production estimates by the country-sum of production estimates. As the country export data does not distinguish between smallholder- and expatriate-produced export crops, crops (both cotton and tobacco) produced by expatriate farmers are included into this country-sum. Production shares for missing years are inter-/extrapolated (analogous to procedure described under 'Tanganyika' above). Annual, district-level smallholder export crop production values are obtained by multiplying the annual production shares with annual country-level, crop-specific exports from the WTD. All crops are added up and the resulting total is divided by the district population. Annual population figures are obtained from Nyasaland Blue Books (1920-1938). Missing years are inter-/extrapolated using the same procedure as for the production estimates. Note that the district-level production figures are based on sales rather than production. The Blue Books explicitly note that this way of measuring diminishes the accuracy of production estimates, as 'many natives grow their tobacco and cotton in one district and sell in another'.

Bechuanaland

No cash crops were exported from Bechuanaland. All districts are set at 0.

Northern Rhodesia

No cash crops were exported from Northern Rhodesia. All districts are set at 0.

General notes

Population figures are obtained from the Blue Books. These official population figures are generally considered to be much too low (see Frankema & Jerven (2014). However, we are still very far from revising these official colonial population figures on the district level. Hence, we consistently use the colonial figures, taking stock of the possibility that our per capita estimates are too high all across the board and that some inaccuracy may enter the dataset as some districts may have been more accurately counted than others.

Country-level exports of each of the crops are obtained from Wageningen Trade Database (WTD). These figures are generally considered highly accurate and hence serve as the basis of our

estimates. However, we do not account for the possibility that a share of the export value did not accrue to others in the production chain.

[i] "During the year 1927 the rainfall [in Kenya] was on the whole under average and it was patchy, crops suffering from lack of rain at important times." Kenya *Agriculture 1927*.

[ii] A clear example comes from Baringo District (Kenya) in 1933: "The year 1933 has for Baringo district been one of the worst in living memory. A complete failure of the long rains caused enormous losses among stock, ruined the crops in the low-lying parts and made the harvest on Masop very late. It is safe to say 50 per cent of the cattle died" Kenya *Native Affairs 1933*, p. 17 In Mwanza Province (Tanganyika) 1929 "cattle and small stock suffered during the year and scarcity of grass and water necessitated much movement of stock which in turn favoured the spread of disease." Tanganyika *Native Affairs 1929*, p. 1

[iii] The agricultural report of Rufiji District (Tanganyika) in 1936 states that "a great flood, exceeding in height and duration the previous inundations of 1906, 1917 and 1930, destroyed the main crops of one-third of the population." Tanganyika *Native Affairs 1936*, p. 12

[iv] "The large Guinea corn (Basso) is the only crop which is seriously affected by insect pests in certain districts, and this crop fails year after year from the same cause. Farmers should be discouraged by their chiefs in planting this crop -- which is so uncertain-- when the red kinto seldom ever fails. In food value the red kinto is equal to the Basso, but is not quite as large in grain" Sierra Leone, *Agriculture*, 1930, p.17.

[v] In Nyanza Province, 1926, "the rainfall was much above the average with but a very slight break between the long and the short rains. Crops suffered as a consequence and yields have been low. Fever among the inhabitants restricted the amount of work done, particularly towards the end of the year. These factors have reduced the output of marketable crops, and in some areas a food shortage may result." Kenya *Agricultural report 1929,* p. 15

[vi] In 1927, the Gambian Agricultural Commissioner stated: "During the year under review, the climatic conditions were abnormal, the rainfall being much above the average, only a few inches below that for 1913, which was the highest recorded for twenty-nine years. At Freetown 77.03 inches were registered. Much of this rain fell after reaping operations had commenced and special efforts were made by the officers of this Department working in co-operation with the Travelling Commissioners and Chiefs to get the farmers to open up their groundnut heaps to prevent heating and fermentation. Where this advice was followed little damage resulted, but where it was disregarded fermentation was rapid and much damage was done to the nuts and to the quality of soil. The extent of this damage was widespread and felt throughout the country. The crop [groundnuts], however, suffered severely during the ripening and reaping period from the excessive rains which were then experienced". Only to conclude that "there was a great shortage of food early in the year". Agricultural report, 1927, p. 12.

[vii] "Motor traffic on all roads increased considerably both in weigh and number and during the wet season the roads suffered heavily. Owing to heavy floods the Oshogbo-Benin and Benin-Sapele roads were closed to through-traffic for long periods." Nigeria, Provincial report, 1928, p.37. On the Native Reserves in Meru, Embu and Kitui in Kenya in 1930, the Agricultural Report writes that "not only did the wet weather make it difficult to dry the crops sufficiently for export, but transport was disorganized and many cases great delay was experienced in getting the crop away from the farm" Kenya *Agriculture,* p. 5.

[viii] In 1936 Lake Province (Tanganyika) experienced its heaviest rainfall in the entire interwar period. The native affairs report states "The year under review has again been a prosperous one for most people in the Lake Province, in fact a little more so than any of the preceding years since British occupation." Tanganyika *Native Affairs*, p. 24

[ix] We learn that the heavy rainfall this year has caused a large rise in the rivers and the waterways of the Niger and Delta provinces and as a consequence, a large quantity of produce has been brought down form the upper country, so much so as to tax the carrying trade and place a great stress of work on the shipping.' *Lagos Weekly Record Newspaper* (27/Aug/1917)

[x] In 1926, rainfall in the Rift Valley area (Kenya) was far above the long term annual mean. The Native Administration report states that: "the rains were exceptionally good, and although [Elgeyo District suffered from the irregularity of the rains, most of the crops being flooded], the general effect was to revive the grazing upon which these pastoral people so greatly depend, as well as to enable areas which seldom reap a harvest to gather in fairly good crops." Kenya, *Native Affairs 1926*, pp. 21 & 48. On Kondoa-Irangi, which experienced an excessive rainfall shock in 1930, the agricultural report states that "the seasonal conditions in this normally very dry Province were on the whole unusually favourable for the crops grown, although the rainfall greatly exceeded the average and caused in certain areas considerable damage,

through flooding, to crops. The rains were so heavy as to prove a mixed blessing, so that the crops in low-lying valleys were destroyed and shortages were anticipated. Happily, however, there was little actual want." Tanganyika *Agriculture 1930*, p. 19

[xi] Ranging from Bonthe Sherbro (Sierra Leone), with an annual average annual rainfall of 145 inches, to the arid district of Ngamiland (Bechuanaland), with an average annual rainfall of only 17 inches.

[xii] After a few years of drought, Machakos (Kenya), a district with an average annual rainfall of only 40 inches, experienced an exceptionally wet year in 1930. The agricultural report notes that "despite the very heavy rain during the year, the condition of the Reserve has not improved; it has in fact degenerated further, particularly in regard to water supply. Owing to large areas being denuded of grass, the erosion caused by the heavy rains must have been enormous." Excessive rainfall also affected transportation. The District Commissioner of the highly arid Wajir area in the Northern Frontier District (Kenya) reported that "the rainfall was the heaviest remembered since the year Serenli was sacked [(from 1915 to 1918 the Somali Aulihan clan challenged British colonial authorities, attacking the British post in Serenli and killing the District Commissioner in February 1916)]. The black cotton soil areas became impassible to camels." Kenya *Native Affairs 1937*, p. 41

[xiii] The district officer in Northern Nigeria recounted (1927): "The rainfall, which was considerably below the average, caused a partial failure of the guinea corn and yam crops in certain districts of the province [Kabba]. It was stated in the last Annual General Report that the food crops in the Northern Provinces promised to be distinctly below average; and it was indicated that an actual famine was anticipated. This forecast proved to be accurate: there was a definite shortage which caused the price of grain to soar to three or four times the normal price". An episode of abnormally high rainfall in Saltpond and Winneba (Gold Coast) in 1925 resulted in crop damage, failure and 'resultant stress', 'shortage of the food supply' and high prices. The police reports 'an increase of grave crime during the year, the principal offence was burglary' Gold Coast Police, p. 6. During the same episode of heavy rainfall, "the friction between the Tantum and Legu culminated in an attack by Tantum on the town of Legu at the beginning of December. Legu was practically destroyed by fire and canoes were smashed. At least 40 were killed and some bodies were mutilated. Feeling was very acute". Gold Coast *Annual Report*, p. 35

[xiv] "With such favourable [weather] conditions coupled with the low price of foodstuffs, it was only to be expected that the crime figures should be satisfactory and never in the past 30 years has the total number of reports of serious crime been so small as in 1934.; it is too much to hope that such a peaceful state of affairs can become normal" Police report, Gambia, p. 41.

[xv] In 1921, the Agricultural officer (Sierra Leone) summarized: "Rice being the staple food of the country everything turns on the rice harvest [...] The abnormally heavy rainy season has had a disastrous effects on the rice crop. A large number of farms had to be abandoned altogether and many more could only be worked piecemeal. The usual loose talk about a coming famine made its customary appearance in April, but as this was part of the stock in trade of those who try to corner rice it failed of its purpose. A number of native in the rice-growing parts, noticing the profits made by retail sellers of rice during the season of scarcity, have seen the wisdom of not parting immediately with all their saleable surplus, but kept same and put it on the market at the most favourable time. This has and will continue to have a restraining influence on speculators, for these growers can always undersell the food profiteer."Sierra Leone *Agriculture 1921*

[xvi] Due to heavy rains in 1921, the rice harvest of Sierra Leone disappointed and speculators attempted to raise prices. The police commissioner reported a 'substantial increase in cases reported to the police, the number of persons arrested and the number of persons convicted. Sierra Leone Police 1921, p.6.

[xvii] In 1933, a year of severe drought and stock mortality in the Masai District (Kenya), the native affairs reports that "the depression naturally led to an increase in crime. Actual hunger caused many sheep thefts and the Matapato moran made three raids on the Kisongo in Tanganyika Territory in January, lifting forty-three head of cattle. Counter raids which might have proven serious were averted on two occasions. Eighty Kisongo moran were turned back by the Moshi police and five hundred Kisongo were with difficulty dissuaded by their District Officer from raiding into Kenya. They besought him for a license to kill twenty Matapato moran, promising faithfully not to exceed the schedule." Kenya *Native Affairs 1933*, p. 21. On the same district the next year, in 1934, the native affairs report writes that "from February to November there was a series of stock thefts and armed raids by Masai, chiefly in the Ndeiya area of the Kiambu Reserve. The probable cause of these was the drought conditions in Masai which resulted in heavy mortality among their stock." Kenya *Native Affairs 1934*, p. 5 The Tanganyika police report of 1933 points out that "stock theft shows a 60 per cent. increase in the number of cases brought to court, while the number of persons convicted has nearly

doubled. The largest increases have occurred in Iringa, Arusha and Tabora Districts and may possibly be attributed to the difficult times experienced by the natives owing to the failure of the rains." Tanganyika *Police*, p. 11 On Elgeyo-Marakwet (Kenya) in 1937 the District Commissioner writes: "with the exception of the first two months of the year, grazing has been good. [...] Several thefts of stock on the farms bordering on the Reserve were committed at the beginning of the year and a considerable amount of petty thieving took place." Kenya *Native Affairs 1937*, p, 27

[xviii] For example, during a famine in Bugufi district (Tanganyika) in 1929, 500 persons were estimated to have died. See Bryceson (1980: 301).

[xix] A famine in the Digo and Kilifi districts "drove large numbers of natives from the hinterland into the coastal area and the Arabs took full advantage of this influx to put a very large area of land under cotton." Kenya, *Native Affairs*, p. 24

[xx] On Kitui (Kenya): "The year was one of considerable advance in the social, educational and economic outlook of the Kitui Akamba and was a period of further recovery from the hardships of drought and famine experienced in the year 1934-35. A considerable movement of natives back to the native reserve after the famine migrations took place. Rainfall in Kitui was plentiful and exceeded all records since 1904." Kenya *Native Affairs*, p. 18 The agricultural report of Tanganyika describes 1929 Singida as suffering "a terrible year of drought." Tanganyika *Agriculture 1929*, p. 23. The native affairs report of the same year notes how the people of Singida were not able to market their cattle due to a lack of grazing or water on the way to the coastal markets. Instead the people "went off in thousands to look for work in the Northern Province" Tanganyika *Native Affairs*, p. 24 The district officer of Kitui (Kenya) describes the year 1937 as "a period of further recovery from the hardships of drought and famine experienced in the year 1934-35", and points at a return of large numbers of people from what he coins "famine migrations" Kenya *Native Affairs*, p. 18.

[xxi] A flood in Rufiji District (Tanganyika) in 1936 destroyed a large share of the food crops in the valley. However, the inhabitants "are closely related to the tribes inhabiting the hills on both sides of the valley. Thus the loss of their main food crops in the early part of the year did not lead to serious famine conditions as they borrowed or bought food from their kindred living in the hills who had reaped good harvests." Tanganyika *Native Affairs 1936*, p. 12. A similar practice was reported in 1930: "Rufiji has been exceptionally unfortunate, as for a considerable period 15,000 natives were homeless owing to the floods and many lost their houses, stock and crop. [...] It was fortunate that the adjoining Dar es Salaam District and the hill country of Rufiji District were not affected and the natives, on their own initiative, shifted to these areas and by working for their more prosperous neighbours earned their food and brought a supply back with them." Tanganyika *Native Affairs 1930*, p. 23.

[xxii] Turkana District (Kenya) experienced a good season in 1930. The native commissioner pointed out that the resulting "existence of plentiful water and grazing has probably led to less migration and possibly therefore less squabbles, crime and bloodshed than usual." Kenya *Native Affairs 1930*, p 22-23

[xxiii] On Turkana District (Kenya) in 1933, the native affairs report writes: "The year was one of exceptional difficulty from an administrative point of view. The Province experienced probably one of the worst years it has known. To drought, famine, poverty and excessive heat were added the constant anxiety of raids and massacres on the frontier. [...] Turkana--land always sparsely watered and but poorly covered with vegetation--has this year suffered from a phenomenal drought, the severest known to history. This unhappy fact is the outstanding feature of the year and it is not only giving rise to a serious agrarian problem but has been the cause of nearly all political events and social changes which have taken place during recent times.[...] The Turkana have been driven in unprecedented numbers to encroach on the grazing and water supplies of their more fortunate neighbours." *Native Affairs 1933*, p. 27

[xxiv] The pastoral district of Turkana (Kenya) experienced a serious drought in 1927. The native administration report notes that : "the losses in stock have been heavy and a considerable number of the inhabitants have been driven by lack of grazing to cross the boundary into Uganda. Happily there have been no untoward incidents consequent upon this migration and arrangements which it is hoped will be satisfactory, have been made under which the migrants pay temporary grazing fees until the advent of the rains permits of their returning to their own country." Kenya *Native Affairs 1927*, p. 12 On the Northern Frontier District (Kenya) in 1933, the native affairs report states: "Droughts usually mean an increase in bloodshed because of quarrels over grazing and water, and it is gratifying to report that there were only 21 deaths by violence as against 167 in 1932 and 117 in 1931." Kenya *Native Affairs*, p. 45

[xxv] For example, in Meru (Kenya), the colonial authorities issued an order requiring the burial of the deceased, violating certain local practices. The native affairs report states that "the order seems to have been generally obeyed, though there have of course been delinquents, a number of whom have been prosecuted. When the November rains appeared to be failing some thousands of women of Upper Abothuguch marched into the boma to protest against the order as in their opinion the failure of the rains was due to the fact of burial. They had suggested to the Chief that corpses already buried

should be dug up again. After a baraza they went quietly away. It rained heavily the following night." Kenya *Native Affairs*, p. 10

[xxvi] On the year 1929, the district officer of Meru District writes that: "the district, too busily occupied with its problems of locusts, food shortage and famine, had no time to devote to political problems." Kenya *Native Affairs, 1929,* p. 12-13. On Nyanza province, in 1933, the District Commissioner writes: "little has been heard of the Kavirondo Taxpayers' Welfare Association during the year. The probable reason is that money has been so short that they have had to consider means of earning a livelihood rather than framing any agitation." Kenya *Native Affairs 1933*, p. 5

[xxvii] For example, the District Agricultural Officers in Karonga (Nyasaland) opened his 1930 annual report by stating that no housing was yet available and that a headquarters had to be built from scratch. His first act upon arrival in Karonga was to 'make the necessary bricks'. The report proudly states how the officer, assisted by the District Commissioner, had managed by the end of the year to almost complete 'a double-storeyed residence (with office), eminent to the climatic conditions of the lake shore.' Nyasaland *Agriculture 1930*, p. 12

[xxviii] For instance, the Agricultural official (Gambia) of 1922 reported:"until farmers are definitely informed that no rice will be issued in future except in dire necessity, caused by uncontrollable natural causes, we may always expect an annual recurrence of this shortage. Land that is used for only four or five months of the year does not require resting for the whole of the following year, as is often the custom at present. This is but a further excuse for general laziness". *Agriculture report, p. 11* Moreover, in Sierra Leone the District Commissioner of Moyamba noted: "A moderate rice crop for 1923 was followed by the usual food shortage during the subsequent rains. Although the force of the "hungry" is usually exaggerated, it is beyond question that its occurrence is regular and that it is looked on as inevitable. Deaths from starvation are occasionally reported, and I am afraid that the sole reason for such an unfortunate state of affairs is to be found in the apathy of an ease loving people. To pay his tax and provide the minimum of grain food that will support himself and his dependents throughout the year is the only aim of the head of a family, who makes no allowances for crop failures and has generally speaking, no temptation to improve his position and mode of life. It is our business to shock the native out of this state of mind and this is most effectively done by the introduction of transport facilities. Rapidity of movement shakes the native out of his lethargy: his world begins to move more swiftly, he finds that some value is set on time and gradually ambition awakes with the desire for a higher standard of comfort. Until this incentive arrives the District Commissioner uses what persuasive powers he has to induce the native to increase his production". *Native affairs, p. 21*

[xxix] For example, the District Officer of Singida (Tanganyika) of 1929 states: "The chiefs cannot yet stand alone and, in some respects will always need advice, help and guidance from the district officers. [...] In these days of progress the chief must have in the district officer a trusted guide, philosopher and friend where external affairs are concerned." Even though his intentions might have been benevolent, such paternalism reveals unequal power relations. Since the friendly district officer had the power to advise his superiors to depose unwilling chiefs, these chiefs might have had very different incentives than the need for guidance and philosophy to 'befriend' the district officer. Tanganyika *Native Affairs 1929*, p. 28.

[xxx] For example, essentialistic prejudices seem to have clouded the South Kavirondo (Kenya) District Officer's understanding of quarrels between the Lumbwa and Kisii in 1933. His analysis did not reach beyond an attribution of the troubles to "idleness and nomadic instinct." Kenya *Native Affairs 1933*, p. 6. The District Commissioner of Kitui (Kenya) does not seem to penetrate any deeper in the motives of the people in his district: "the worst feature of the Akamba is their liability to commit crimes of violence in sudden passions." Kenya *Native Affairs 1933*, p. 13 Sierra Leone 1923: " Deaths from starvation are occasionally reported, and I am afraid that the sole reason for such an unfortunate state of affairs is to be found in the apathy of an ease loving people."

[xxxi] Killingray (1986: 414) writes: "District officials, often remote from the territorial capital, exercised their own discretion about local affairs. Invariably most officials, with an eye to promotion, were concerned that their activities as administrators should attract only favourable attention. Thus their actions were more likely to be directed towards avoiding, or smoothing over, local conflicts and keeping a 'clean book' with the Secretariat. If District Officers over-reacted to local crises they were likely to draw down on themselves not only gubernatorial wrath but also unfavourable notice from London." Nevertheless, the departmental reports are rife with references to unhappy events such as famines and unrest. A typical example: " Although we may not expect to show great progress in this year of drought, famine, and raids, yet, looking at the Turkana people as a whole, we are justified in expressing some confidence in the future." (Kenya *Native Affairs,* p. 19).

[xxxii] In Freetown (Lagos), for example, 82% of arrested persons between 1924-38 were apprehended for theft, 12% for crimes against the person, and 6% for a range of other crimes (mostly involving breaches or a range of colonial ordinances). Across 15 police divisions in Kenya 76% of reported crimes between 1926 and 1938 involved theft, while 12% involved crimes against the person and 13% other offences. Conviction for theft seems to have resulted in imprisonment in the majority of cases. We have evidence for Nigeria. Out of 69 instances of larceny in Upper river province, 59 were imprisoned (i.e. 85.5%). Similar case in McCarthy Island province, out of 43 larceny offences, 39 ended up in prison (90%), Kombo and Foni province exhibit the same pattern, 18 cases with 12 ending up in prison (67%). The total percentage of larceny leading to imprisonment in the whole country is around 80%. Nigeria *General view of Crime (CO 89/17), p. 5-7*.

[xxxiii] Some areas of Kenya experienced a prolonged drought in the early 1930s. In the coastal areas, consecutive harvest failures resulted in a severe famine: "after five successive bad or poor seasons, a state of food shortage existed in the hinterlands of Digo and Kilifi districts, locusts arrived at the end of January and, the drought continuing, produced the most severe famine within memory." Kenya *Native Affairs 1935*, p. 23

[xxxiv] The agricultural report of Rungwe District (Tanganyika) in 1933 states that "the total rainfall was much below normal, the general distribution however showed no very marked alteration. There has been no pronounced effect on agriculture generally despite the shortfall in total." Tanganyika *Agriculture 1933* "The Agricultural Report for Kenya in 1924 states that "the rainfall was generally below the average, but its distribution throughout the year was better calculated to prevent serious drought. [...] In no areas did the natives suffer from a serious food shortage, and in many cases there has been an increasing and substantial surplus available for sale." Kenya *Agriculture 1924*, p. 3 In Masai Province (Kenya) 1937, rainfall was far in excess of the long-term mean, but the native affairs report states that "a favourable distribution of rain resulted in good grazing for the Masai herds." Kenya *Native Affairs*, p. 160

[xxxv] The director of the 1930 agricultural report expressed considerable concerns regarding the cocoa farmers in southern Nigeria, who, according to him, were "...taking up cocoa and … considerably reducing their output of food crops." Nigeria *Agriculture*, p. 22. "There was a great shortage of food early in the year, resulting partially from the cocoa boom and partially owing to the drought. A single plantain fetched as much as 4 pence in Cape Coast. A similar state of affairs existed in other districts in the province." [...] "The chiefs were advised to devote more attention to foodstuffs and this advice was largely followed. The slump in cocoa will have done some good, if only it secures a large supply of native foodstuffs, and the prospects for 1921 argue that this will be the case." Gold Coast *Provincial Report 1920* p. 10

[xxxvi] In Tanga Province, for example, the native officer stated in 1930 that "the principle adopted has been that when a native wishes to grow cotton he must in the first instance ensure for himself and his dependents an adequate food crop." Tanganyika *Native Affairs 1930*, p. 81

[xxxvii] "Deaths from starvation are occasionally reported, and I am afraid that the sole reason for such an unfortunate state of affairs is to be found in the apathy of an ease loving people. To pay his tax and provide the minimum of grain food that will support himself and his dependents throughout the year is the only aim of the head of a family, who makes no allowances for crop failures and has generally speaking, no temptation to improve his position and mode of life. It is our business to shock the native out of this state of mind and this is most effectively done by the introduction of transport facilities. Rapidity of movement shakes the native out of his lethargy: his world begins to move more swiftly, he finds that some value is set on time and gradually ambition awakes with the desire for a higher standard of comfort. Until this incentive arrives the District Commissioner uses what persuasive powers he has to induce the native to increase his production" Sierra Leone *Agriculture 1923*, p. 45

[xxxviii] For example, we find many complaints by agricultural officers about the late planting of cotton, which adversely affected yields. Whereas late planting was regularly attributed to laziness, the agricultural officer of the Lake Province (Tanganyika) in 1933 gives a more plausible explanation, namely that smallholders prioritized food security over cash income: "the planting of food crops is the first consideration and poor planting rains very often cause unavoidable delay in the planting of cash crops such as cotton with the result that low yields are obtained." Tanganyika *Agriculture 1933*, p. 27

[xxxix] In 1930, large areas of Tanganyika experienced heavy rainfall. The agricultural report states that in Mwanza Province "the conditions favoured all crops except cotton, which suffered very considerable damage from insect attack, especially aphids and jassids, and from bud and boll shedding." In Tabora Province, "The heavy rains experienced in this comparatively dry Province at the beginning of the year resulted in unusually good crops with the exception of cotton." Tanganyika *Agriculture 1930*. A similar state of affairs existed in Central Kavirondo (Kenya) in

1937: “Unfortunately the year was an exceptionally wet one and the cotton crop suffered particularly in the October-November season, thereby causing many of the reopening bolls to become spoilt. [...] On the other hand the maize crop was an excellent one.” Kenya *Native Affairs*, p. 12. in some cases cotton failed while food crops succeeded (Mwanza 1930, Bukoba 1930, Tabora 1930). The situation was rather the opposite in Tanganyika in 1933, an exceptionally dry year. In the coastal areas, the drought “proved disastrous to food crops”, while the cotton crop “fared better” and “the failure of the food crops accentuated the value of cotton, [which was popular with local farmers], for those who had it to sell were able to subsist on their own resources.” Tanganyika *Agriculture 1933*, p. 31

[xl] In Mwanza Province (Tanganyika), where considerable amounts of cotton were cultivated, “Muhogo [=cassava] is extensively planted and is always a security against famine.” Tanganyika Native Affairs 1929, p. 1 In Tanganyika higher yielding seeds were distributed through so called ‘seed farms’ (Tanganyika *Native Affairs 1930*, p. 57) and the cultivation ‘famine reserve crops’ such as cassava was stimulated (Tanganyika *Agriculture*, p. 58). In Kenya, farmers were encouraged to cultivate buckwheat (Kenya *Native Affairs 1926*, p. 17), as well as cassava (Kenya *Agriculture 1930*, p. 40) as an insurance against famine.

[xli] On the Bugufi division of the Bukoba district (Tanganyika) in 1930, where few cash crops were cultivated, the native affairs report states that “as soon as the existence of the famine was known, food was produced, but owing to distance and the delay which had occurred in bringing the situation to a notice of the European officers, it was too late, as the deaths had already occurred and the harvest from the long rains was almost ready. The relief food was distributed to necessitous cases, many of whom were women whose husbands were away from home, and this tided over the few days until the millet crop was ripe. The conservation of this crop was secured by an Order under the Native Authority Ordinance prohibiting the manufacture of beer from millet.” Tanganyika *Native Affairs 1930*, p. 4-5 “With the successful development of cocoa-growing there has been a marked tendency to neglect the cultivation of foodstuffs and to depend on imported provisions. In an essentially agricultural country this is not satisfactory or what one might expect. In the same interior districts a shortage of foodstuffs is not actually felt, but in the industrial congested areas it has become very marked and the value of local grown products has consequently soared to unheard of prices in recent years. A special effort has therefore been institute to encourage development and help in the distribution of food crops of congested areas.” Gold Coast *Agriculture 1921*, p. 10 Among the *relief* measures were the distribution of (imported) food (Tanganyika *Native Affairs 1933*, p. 65) and the prohibition of food exports and beer brewing (Tanganyika *Native Affairs 1933*, p. 48). Famine relief was also given (Kenya *Native Affairs 1933*, p. 17). The Kenyan reports, however, also reveal some reluctance to provide unconditional food aid. During a famine in Baringo in 1933 recipients of relief were expected to ‘assume communal responsibility for a contribution of goats in proportion to the number of families in receipt of relief. The proceeds of the sale of goats had a negligible bearing on the finance of the relief, but the fact that they had to be produced afforded a salutary check on the number of dishonest applications for relief and saved many hundreds of pounds.” Kenya *Native Affairs 1933*, p. 17 During a famine in the hinterlands of the coastal districts of Digo and Kilifi in 1934, colonial authorities made relief conditional on so called “relief works”, which entailed working on “road improvements and camps under European foremen.” Kenya *Native Affairs 1934*, p. 23

[xlii] On the Central Province (Tanganyika) in 1933, the native affairs report notes that “the groundnut crop, upon which much depends, was poor owing to the distribution of the rains which ceased rather abruptly in March. The tribesmen have had to sell cattle and small stock to provide the wherewithal to pay tax and the livestock market returns show how excellent their response has been.” Tanganyika *Native Affairs*, p. 3