Regional Environmental Change (2019) 19:2683–2695
https://doi.org/10.1007/s10113-019-01563-y

ORIGINAL ARTICLE

The role of drought in agrarian crisis and social change: the famine of the 1890s in south-eastern Africa

Kathleen Pribyl[1,2] · David J. Nash[1,3] · Jørgen Klein[4] · Georgina H. Endfield[5]

Received: 28 June 2018 / Accepted: 17 September 2019 / Published online: 26 November 2019

Abstract

During the second half of the 1890s, south-eastern Africa was hit by a drought-driven ecological crisis. Using records previously unexploited for climate and climate impact research, and which cover the area from modern-day Zimbabwe and Botswana to eastern South Africa, this study explores the complexity of this crisis through an analysis of the spatial extent, duration and severity of the regional drought and its associated socio-economic and environmental repercussions. This interdisciplinary study stands at the nexus of environmental, economic and social history. The records used include (a) British administrative sources, (b) reports and letters by members of various Protestant missionary societies from diverse environments across the study area, together with (c) local newspapers. Analysis of these materials reveals that generally the period was marked by a sequence of considerably delayed rainy seasons, which in turn negatively impacted upon the rain-fed agriculture. Below-average levels of summer rainfall also adversely affected the development of young crops. The drought was more severe and continuous in the interior of the region than towards the Indian Ocean coast. The prolonged dry conditions were accompanied by, and likely exacerbated, locust outbreaks and the spread of cattle plague (Rinderpest). We demonstrate in this paper that drought, as the original driver of the crisis, triggered a cascade of responses from harvest failure to famine and ultimately led to profound socio-economic change.

Keywords Historical climatology · Agriculture · El Niño · Colonial history · Economic history · Epizootic · Nineteenth century

This article is part of the Topical Collection on *Societal Impacts of Historical Droughts*

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10113-019-01563-y) contains supplementary material, which is available to authorized users.

✉ Kathleen Pribyl
k.pribyl@uea.ac.uk

[1] School of Environment and Technology, University of Brighton, Brighton BN2 4GJ, UK

[2] Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK

[3] School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Private Bag 3, Wits, Johannesburg 2050, South Africa

[4] Faculty of Social and Educational Sciences, Norwegian University of Science and Technology (NTNU), NO-7491 Trondheim, Norway

[5] Faculty of Humanities and Social Sciences, University of Liverpool, Liverpool L69 3BX, UK

Introduction

The year 1896 was catastrophic for large parts of south-eastern Africa. A drought-driven agricultural crisis triggered massive harvest failures. Swarms of locusts compounded the problem, devouring the few maize and sorghum crops that the drought had spared. To add to this apocalyptic scenario, Rinderpest was sweeping southwards through the region and when it met with an already drought-weakened cattle population it destroyed this pillar of traditional African life and the mainstay of the colonial agrarian economy. This environmental crisis raised the pressure substantially on a region that was already under stress and subject to rapid socio-economic change. The environmental crisis affected a significantly larger population than previous subsistence crises; the African population of the former Colony of Natal is estimated to have increased by almost 30% from c. 1880 to the mid-1890s.[i] In general, population growth likely exceeded the rise in agricultural production (Wilson 1971). In Natal and at least some regions of the South African Republic (SAR; known as Transvaal) and Bechuanaland, the area of cultivated land

had expanded (Schapera 1970; Schapera and Comaroff 1991); however, access of the African people to the land was reduced in the colonial system (de Kiewiet 1965; Lambert 2003). As a result of the natural calamities in the mid-1890s, famine held the region in its grip. The situation was especially problematic in the interior and in semi-arid regions bordering the Kalahari, where the drought was more pronounced and persisted over several years.

Pre-industrial societies generally possess coping strategies to endure one failed harvest, but a sequence of years of dramatically reduced agricultural output will spell disaster (Roumasset 2003). Famine, however, is an ecologically and socially modulated process, and the political, social and economic situation has to be taken into consideration (Sen 1981). In late-nineteenth century southern Africa, pressure was growing for Africans to be integrated into the capitalist economy; hut tax and rent needed to be paid in cash which in turn often had to be gained by wage labour, often in the mining sector. Political power was almost exclusively in the hands of people of European descent (Thompson 2001).

In this study, hitherto largely unexplored data are used to achieve a comparative analysis of the severity and impacts of the mid-1890s drought across south-eastern Africa and to understand the role of drought in the developing agrarian crisis. Supplement 1 (S1) gives details on the wide variety of primary sources used and describes the mission network and the British administration in the region which supplied most of this information.[1] As a major event in a time marked by rapid political, economic and social change, the most disastrous famine year 1896 has attracted attention before, primarily in the narrow geographical setting of the colony of Natal and northern Transvaal (Ballard 1983; Dreier 2005; Lambert 1995; Ramdhani 1989), as has the cattle plague in southern Africa (Ballard 1986; Lambert 1995; Phoofolo 1993, 1999, 2003; Spinage 2003, 2012; van Onselen 1972). Unlike previous investigations, however, this study is regional in scale, focusing not only on the former British colonies of Natal and Zululand, and the SAR, but also on the British territories of Matabeleland (southern Rhodesia) and Bechuanaland, which was divided into the Crown Colony of British Bechuanaland (CCBL), formerly part of the Cape Colony, and Bechuanaland Protectorate (BLP) (Fig. 1).

Studies of this type can yield important insights into the differential vulnerability of historical societies to climate variability (cf. Pfister 2010). This paper provides a broader conceptualisation of historical droughts—not only the direct impacts of the failure of seasonal rains but also the implications of drought for the wider ecology of the region are considered. In mid-1890s south-eastern Africa, drought appears to have triggered crop failures and water shortages, but, as will be argued, also increased the prevalence of pests and heightened the vulnerability of the drought-stressed livestock to disease. Such wider assessments of drought-affected ecosystems are essential if historical analyses are to provide an accurate baseline against which the impacts of future droughts can be assessed (Niang et al. 2014).

Drought conditions over southern Africa during the mid- to late-1890s

Most of the study area is situated in the southern African summer rainfall zone and has a strongly seasonal precipitation regime with high interannual variability (Nash 2017). More than 66% of mean annual precipitation is concentrated into the austral summer months of October to March, with the dominant rain-generating weather systems, including ridging anticyclones, tropical-extratropical cloudbands, cut-off lows and mesoscale convective complexes (Tyson 1986). Much of the remainder of the year is dry due to the dominance of stable subtropical high-pressure systems over the interior of the subcontinent. Only in the coastal regions of former Zululand and Natal is rainfall perennial, albeit with a markedly wetter summer season. Precipitation decreases away from the coastal areas. Annual rainfall totals along the coast of former Zululand exceed 1300 mm, declining to 735 mm over the Lesotho lowlands and ~ 500–600 mm in former Bechuanaland (Schulze 2001; Hydén 2002; Nash 2017). Substantial fluctuations in summer rainfall totals are common (Knox 1911; van Heerden and Taljaard 1998). Rainfall totals are closely associated with sea surface temperature anomalies in the southwest Indian Ocean (e.g. Mason 1995; Reason and Mulenga 1999), with warmer sea surface temperatures generally correlating with wetter summers. Summer rainfall is also modulated as a result of El Niño–Southern Oscillation teleconnections, with droughts frequently occurring during the summer following an El Niño event (e.g. Lindesay et al. 1986; Nicholson and Entekhabi 1986).

Instrumental rainfall observations for much of South Africa began in the late nineteenth century (Nicholson et al. 2012); therefore climate conditions prior to c. 1900 are best assessed by rainfall indices constructed from weather references in documentary sources. Reconstructions using such sources show clearly that the drought conditions of the mid- and late-1890s affected large areas of the summer rainfall zone from Natal and Zululand (Nash et al. 2016), across Lesotho (Nash and Grab 2010), the Orange Free State (OFS) (Nicholson et al. 2012), the northern Cape Colony (Vogel 1989) to the Kalahari (Nash and Endfield 2008) and German South-West Africa (modern day Namibia) (Grab and Zumthurm 2018) and even extended to winter rainfall areas of Namaqualand (Kelso and Vogel 2007). Drought conditions also prevailed in Transvaal, where descriptions correspond to the instrumental

[1] All original source references are given in endnotes in S5.

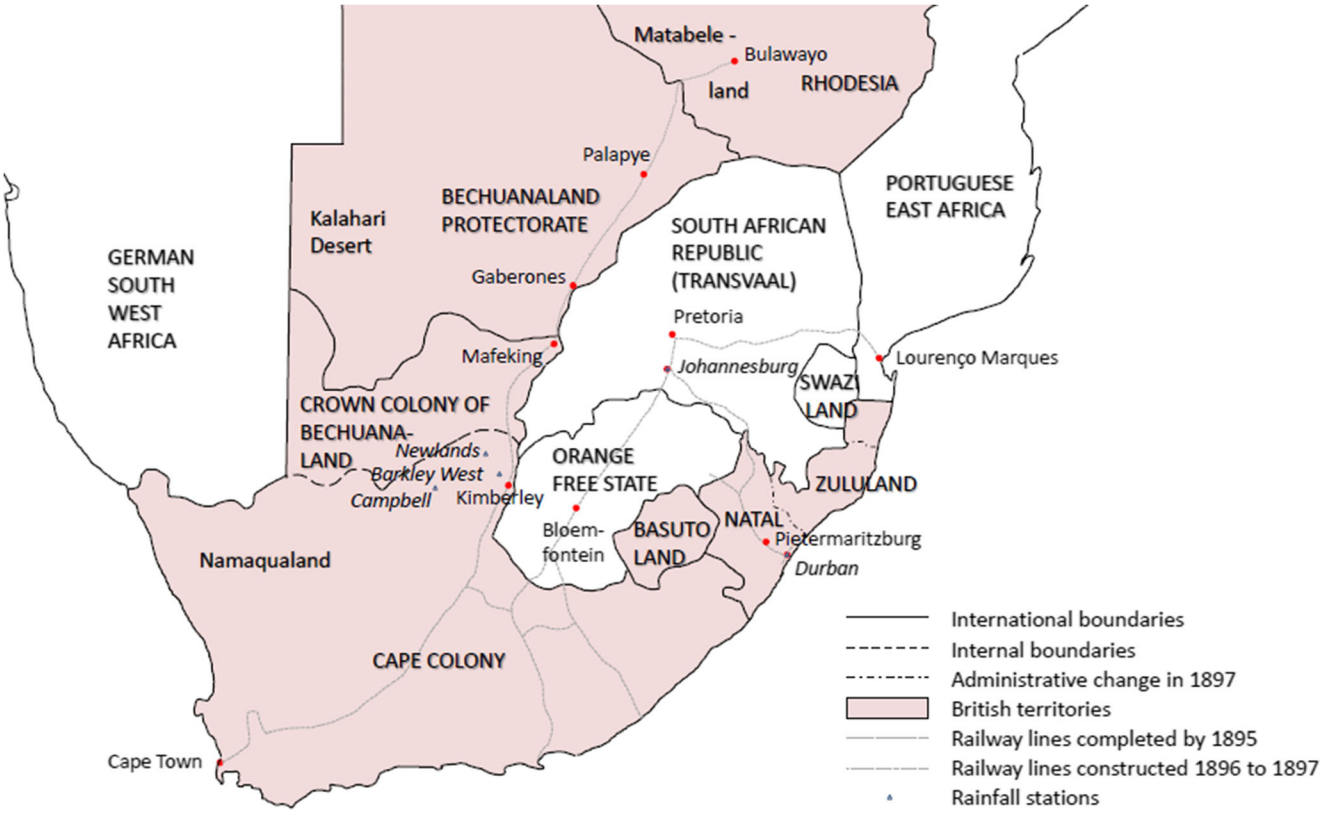

Fig. 1. Administrative boundaries and railway lines in southern Africa, 1895–98. Rainfall stations marked in italics with the locations indicated by triangles. Place names given as in use during the study period

observations from Joubert Park (Johannesburg), and in Rhodesia[2] (Selous 1896). In the last decades of the nineteenth century, meteorological stations were established across the region, but many early instrumental series are incomplete. Missing values are more frequent in these series during the drought years and may indicate a breakdown in administrative reporting. The complete series used in this paper are as follows: Durban (Natal), Joubert Park in Johannesburg (SAR), Campbell (Cape Colony) and Newlands (Cape Colony). Data for Barkly West (Cape Colony) are missing between August 1896 and May 1898 but available for the early and late parts of the crisis. These series were obtained from the Global Historical Climatology Network dataset (GHCN) version 3 (Lawrimore et al. 2011).

The drought of 1895–96 was the climax of a sequence of dry years stretching over the mid- to late-1890s. Even though the 1894–95 rainy season in Natal started relatively wet in September 1894, the following two months were very dry, so that midland and highland areas experienced drought-related problems; these do not appear to have occurred along the coast. In Natal, the rainy season from December onwards compensated for this shortage (Nash et al. 2016), while rainfall in Transvaal was normal. However, precipitation totals for 1894–95 in CCBL and BLP were below average in the semi-arid zones bordering the Kalahari Desert[ii] causing, in some regions, an early onset of drought-related dearth.[iii] This lack of rainfall is reflected in rainfall totals for Newlands, which dropped well below average in the early part of the rainy season and did not recover during the remainder of the summer. Barkly West shows a similar pattern in the months September to November, but rainfall was high in December 1894 and January 1895; in Campbell, the situation was normal. As Barkly West lies only c. 30 km from Newlands and c. 80 km from Campbell, this suggests spatially discontinuous rainfall, probably of a convective nature.

This generally dry but variable rainy season was followed by a long dry winter. The period from early winter to spring (May to October) 1895 was the driest in the Johannesburg station record (1893 to 1986); the drought from August to October was unique. It was also very dry in Durban. In early September, the Natal coast experienced unusually late frost and dry weather;[iv] in the Natal Midlands, winter conditions prevailed into the first week of October.[v]

[2] This paper focuses on the land south of the Zambezi River, on Matabeleland and to a lesser degree Mashonaland. However, the land north of the Zambezi also formed part of what was from 1895 onwards referred to as "Rhodesia". These territories were part of the British Empire, but the administration lay in the hands of the British South Africa Company. Matabeleland and Mashonaland formed "Southern Rhodesia" in 1898, which in the twentieth century became a British colony. In this paper, we refer to the area as Rhodesia, as this was the official name during most of the study period.

Instrumental data for Durban show a severe drop in precipitation during the 1895–96 rainy season, due primarily to a lack of rain in the early part of the season. Further inland in Natal and Zululand, the situation deteriorated considerably. After the dry winter, people were so eagerly awaiting the spring rains that the newspaper *Natal Witness* recorded almost every single rainfall event over the interior of the colony, starting with a short period of drizzly showers in the third week of September[vi] and continuing with rare thunderstorms during the second half of October.[vii] Nonetheless, the precipitation totals were frequently insufficient to allow planting.[viii] Complaints about north winds, which indicate high pressure over the southern African interior, were still common in September and November 1895 and occurred even in January 1896.[ix] Although the rainy season started around mid-November over most of Natal and Zululand, and December 1895 was wet, the rains failed again in January and February 1896.[x] Rainfall remained generally below average for the following years (Nash et al. 2016).

This basic pattern of a delayed onset of the rains in 1895 and a shortfall of precipitation in January and February 1896 was also observed over the inner regions of south-eastern Africa[xi] including Matabeleland (Selous 1896), although the dry conditions were even more pronounced and prolonged. The Limpopo, then still a perennial river albeit with weak flow, dried up unseasonably (Molosiwa 2013) and, by January 1896, Johannesburg could only be supplied with water by cart.[xii] The Johannesburg rainfall series shows the magnitude of the 1895–96 drought to be on par with 1932–33, 1935–36, 1962–63, 1965–66, 1968–69; only 1982–83 was considerably drier. The delayed onset of the rainy season contributed to the rainfall deficit from central Transvaal to the eastern edge of the Kalahari and beyond into German South-West Africa. During four subsequent years, until 1898, the spring and early summer months—September to November—were extremely dry, hindering the then largely rain-fed agricultural production. Even the severe drought around Johannesburg in the mid-1930s did not exceed three subsequent years of dry springs and early summers.

Rainfall totals for the summer of 1896–97 were average for Johannesburg, but wide areas of Transvaal and Bechuanaland experienced a delay in the onset of rains until mid-December 1896 or even early January 1897, a month that then was very wet.[xiii] Instrumental records at Johannesburg show the summers of 1897–98 and 1898–99 to be periods of below-average rainfall; reports from BLP, CCBL and Transvaal suggest extreme drought in spring 1897 and early summer 1897/98, when water levels dropped so low that streams or wells dried up, and normally reliable sources of drinking water dwindled.[xiv] These low water levels and the following bad harvest in western Transvaal and Bechuanaland in 1898 were again due to severely delayed rains.[xv] Further south at Campbell and Newlands, the spring and early summer months of 1897 were also very dry, but conditions ameliorated during the remainder of the rainy season. Drought conditions persisted in some areas (e.g. Johannesburg and southern BLP) until late 1898, contributing to yet another harvest failure in 1899[xvi]. However, the drought and famine cycle was broken in the Limpopo area and parts of CCBL and Transvaal.[xvii] This pattern is confirmed by rainfall observations at Campbell, Newlands and Barkly West, which show normal to good rains for the whole 1898–99 rainy season, including early summer.

The locust plague

The severe drought was not the only factor contributing to harvest failures. From Bechuanaland to Natal, grain crops that escaped the drought—in river valleys, due to localised thunderstorms or as a product of a third or more sowing—were devoured by countless Brown and Red locust swarms (Fig. 2). Locust plagues were a recurrent danger to southern African agriculture. The Brown locust outbreak that accompanied the drought of the mid- to late-1890s can be traced back to 1891, when small swarms of most likely Brown locusts were present at Mafeking (CCBL) close to the Transvaal border (Spinage 2012). Emmaus, a mission station in western Transvaal south of the Magaliesberg Range, was subject to severe but localised crop losses due to locusts in April 1891.[xviii] Subsequently, the locusts spread; in late 1892, they were reported in Heidelberg (SAR).[xix] The Cape Colony was affected in 1892–93 (Spinage 2012) and in that season locust swarms destroyed harvests at Emmaus and north of the Magaliesberg Range in Transvaal.[xx] The maximum distribution of the Brown locust can include most areas of non-coastal southern Africa (Spinage 2012), and, in late 1892 and early 1893, swarms even appeared in the northern districts of Natal.[xxi] In 1894, the more destructive Red locust appeared in western Transvaal,[xxii] which was unusual for the southern African interior. Red locusts tended to invade the eastern part of southern Africa, including the coastal lowlands; in 1894, they also reached the OFS (Spinage 2012). They were probably the main species affecting Zululand and caused major damage to the sugar plantations in the Natal coastal belt from 1894–95 onwards (Ballard 1983).[xxiii] It was not until the onset of severe drought in 1895–96, however, that locusts had a widespread detrimental effect upon grain crops.

Locust development, and the change from solitary grasshoppers to the gregarious swarm phase, is connected to ecological and climatological factors. Whereas the Brown locust tends to form swarms towards the end of bad droughts (Spinage 2012), the gregarious phase of the Red locust is more directly linked to dry conditions, which can contribute to the development of migratory swarms of Red locusts in the outbreak areas of southern Malawi and Zimbabwe. Some

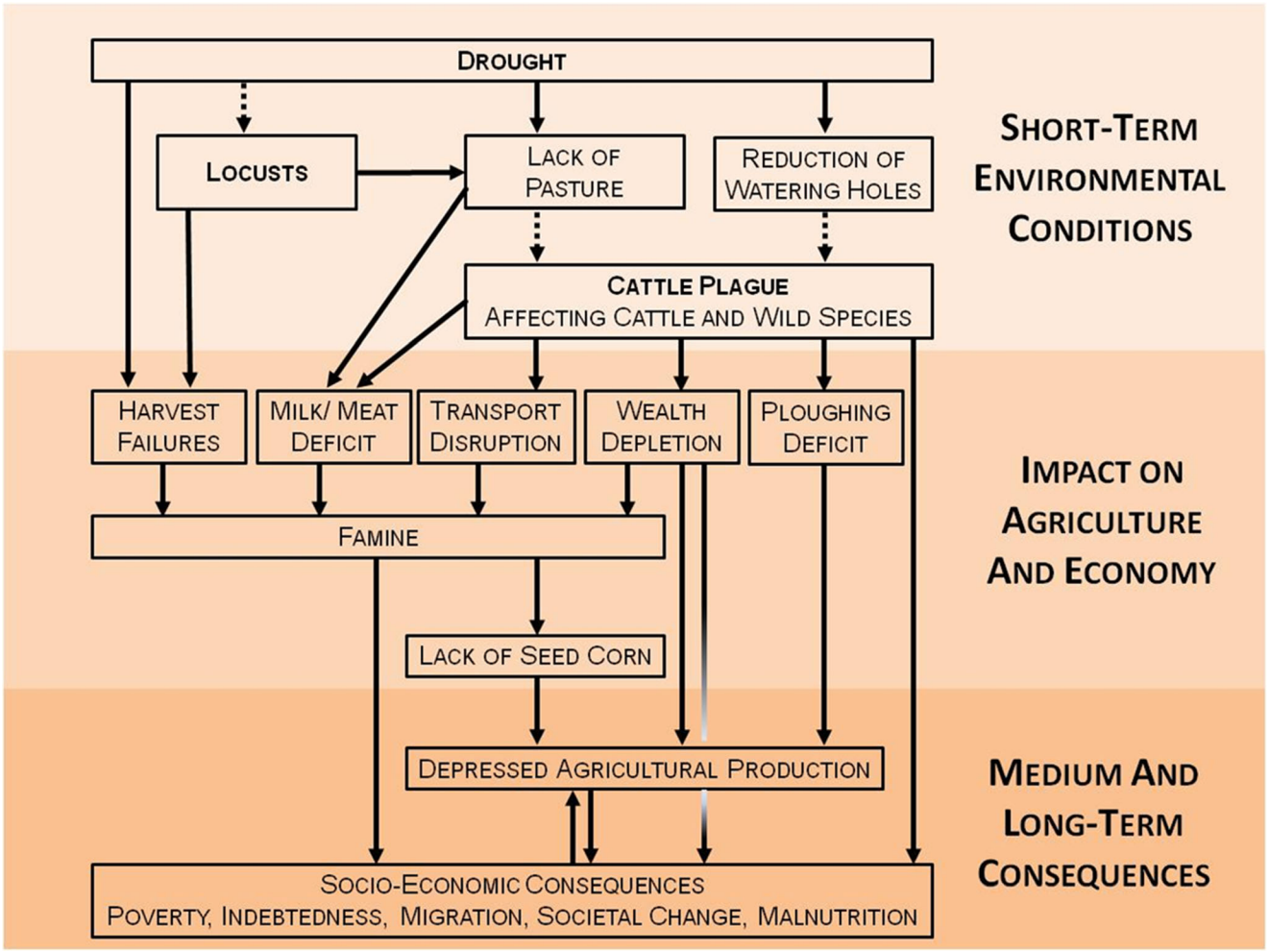

Fig. 2. Environmental aspects of the agrarian crisis and its consequences in the 1890s

contemporaries assumed the locust plague of 1895–96 originated about two years earlier in the area of "the lakes", presumably the Lake Malawi region (Spinage 2012). A lack of precipitation in the outbreak areas reduces the habitat of the Red locust; the higher locust density can then cause the locusts to enter the gregarious phase, in which they form swarms and migrate, often wreaking havoc to the grain and grass vegetation in their path (Steedman 1990). The coastal regions of Natal and Zululand attract Red locust swarms; in October and November 1895, the locusts arrived en masse in those colonies and in the eastern Transvaal[xxiv] and persisted throughout the following summer. Red locusts cannot normally breed successfully in these regions, where it is too moist (Spinage 2012; Steedman 1990). However, the 1895–96 drought allowed the Red locust to become enzootic in Natal and Zululand (Spinage 2012). Reports of locusts depositing eggs in the last quarter of 1895 are numerous.[xxv] Several localities did not suffer severely during the first visit of the locusts. However, although the Locust Extermination Bill of 1895 stipulated the digging up of locust eggs (Ballard 1983; Lambert 1995), sufficient numbers remained in the ground to ensure that the subsequently hatched insects would devour any remaining grain crops.[xxvi] The infestation of 1895–96 was, in some places, so severe that the insects stripped trees of their bark.[xxvii] By April 1896, large numbers of locusts succumbed to a fungus; it is likely that the insects' vulnerability to the pathogen was raised by the average precipitation levels that prevailed from March 1896 onwards in the coastal regions (Nash et al. 2016). As a result, the situation was much improved by 1896–97; locusts were present, but damage was localised and primarily occurred in Zululand.[xxviii] However, in the following season, the locust plague was more widespread and high numbers of insects caused problems, especially in late 1897 and early 1898,[xxix] a pattern that repeated itself in 1898–99 with more serious consequences.[xxx] Locust plagues would recur in Natal and Zululand during the first decade of the twentieth century (Ramdhani 1989; Spinage 2012).

The impact of the locust plague was more severe in Transvaal and Bechuanaland. These areas were infested with locusts throughout the drought years until at least 1899, with a devastating effect on grain crops in both 1895–96[xxxi] and 1897–98.[xxxii] The summer of 1896–97 did not offer much

relief either,[xxxiii] and southern BLP was still not free of the pest by 1898–99;[xxxiv] however, the situation in the eastern Limpopo region, in south-eastern Transvaal[xxxv] and in CCBL had by then improved.

Overall, it seems that locust infestations not only accompanied drought but also were enhanced by it, especially during the dry springs and early summers of the mid- to late-1890s. In Natal and Zululand, complaints about locusts were reduced once the summer rainfall, even if below average, had arrived. That heavy rains could destroy locust eggs was already known to local observers.[xxxvi]

The cattle plague

The outbreak of Rinderpest in southern Africa in 1896–98 would have had a devastating effect upon cattle numbers in any year. However, the outbreak occurred at the worst possible time, when, due to drought conditions, cattle were already weakened and more susceptible to disease. Furthermore, the measures taken to constrain the spread of the cattle plague and minimise the loss of livestock appear to have raised the vulnerability of local populations to both drought and locust impacts (Fig. 2).

Cattle plague had been advancing southwards through the African continent since 1889 until it stopped at the Zambezi River in 1893. In February 1896, the Zambezi was crossed and southern Rhodesia infected. The cattle plague spread rapidly along major transport routes, with draught oxen serving as the main vector. By late March, the disease had already reached the southern BLP (Spinage 2012); in March or April, it entered CCBL and Transvaal, where it raged until 1897; in September 1896, it reached the Cape Colony, and, in winter 1897, it finally crossed into Natal and Zululand (Phoofolo 1993; Spinage 2012; Unterhalter 1978). From this description, it is evident that expansion of the disease-affected area coincided with, or followed quickly after, the dry summers of 1895–96 and 1896–97. Southern Rhodesia and Bechuanaland experienced severe drought in spring 1895 and January–March 1896, during which time the plague crossed the Zambezi; Transvaal was similarly in drought in 1896–97 when Rinderpest ravaged the country.

Cattle populations in south-eastern Africa were in a vulnerable position at the outbreak of the Rinderpest panzootic, in part due to overstocking but also due to the establishment of colonial regulations concerning land access (Marquardt 2005). Drought-induced starvation of livestock is underreported in comparison to crop failure in contemporary accounts and studies of the 1896 famine. However, since malnourishment played a role in the following devastations of the cattle plague, it is imperative to outline its severity and prevalence. Reports of poor pastures and famished cattle come from all over the study region. In Bechuanaland, oral traditions describe debilitated cattle starving and dying of thirst, as well as very low milk yields due to the drought (Molosiwa 2013). Missionaries from western Transvaal and CCBL observed cattle dying of hunger in large numbers during the last quarter of 1896, just when or shortly before Rinderpest arrived in these areas.[xxxvii] In both regions, the situation was so bad that even the few cattle that survived the onset of the plague were threatened by a lack of pasture and death in the drought of late 1897.[xxxviii] Cattle in Zululand and northern Natal, especially in the mid- and upland districts, met with a similar fate in spring 1895 and winter 1896.[xxxix] The prolonged and widespread lack of pasture and fodder resulted in price rises of 44% for oathay and 20% for oats in 1896. That year, the import of forage and oats became economically viable, which had not happened previously.[xl] These imports of animal feed, probably primarily for the more valuable horses, were valued at £14,017. To put this into context, the fencing of Natal as a protection against Rinderpest would have cost £60,000. Even though the worst of the drought in Natal was concentrated in 1895–96, allowing livestock to recover, the winter and spring of 1897, when Rinderpest arrived, were again marked by low precipitation levels and consequently poor pastures.[xli] In some areas, such as Kuruman (CCBL) and south-eastern Transvaal, cattle were in such bad condition that substantial numbers succumbed to pleuro-pneumonia—including around half of the livestock on farms in the Vryheid district (SAR) (Macnab 1897).[xlii] This was not the first—or indeed last—time in southern Africa that drought had contributed to the loss of cattle due to starvation and ensuing disease; substantial livestock losses followed the drought episodes in the late 1870s (de Kiewiet 1941; Lambert 1989) and the 1930s (Beinart 2003).

Marquardt (2005) and Spinage (2012) consider drought to be a factor in the spread of Rinderpest through the reduction of watering points and feeding grounds, which would have raised the potential for infective contacts between livestock and with susceptible wild species. In eastern Africa, where the disease wrought havoc on the cattle stock between 1887 and 1892, its march was often also accompanied by dry conditions (Pankhurst and Johnson 1988; Nicholson et al. 2012; Serels 2018; Spinage 2003; Spinage 2012). In the mid- to late-1890s in southern Africa, fencing, quarantining and the killing of infected cattle herds were practised by the colonial authorities to counteract the spread of disease, but to little effect.

Weakened cattle were easy prey for the newly arrived Rinderpest, and mortality was extremely high. An almost total loss of cattle was observed in Rhodesia (Spinage 2012); in BLP, a conservative estimate ranges from 90 to 97%;[xliii] in CCBL, 97% of the cattle were destroyed (Marquardt 2005); and Boers and Africans in western Transvaal probably lost 95% or more of their cattle.[xliv] In an attempt to "stamp out the disease", herds under the British control outside native reserves were shot when some animals had become infected

until late 1896 (Gilfoyle 2003; Saker and Aldridge 1971). A similar policy and timeframe seems to have applied in Transvaal,[xlv] but, here, experimental inoculation was used much earlier (winter 1896) (Spinage 2003). Natal had the advantage of facing the disease about a year later than other areas. This not only gave cattle a chance of recuperation from the withered pastures, but, crucially, by then, effective inoculation methods had been developed (Gilfoyle 2003; Spinage 2003). As a result, the death rate of cattle owned by people of European descent was only c. 38%. However, some 75% of African cattle, often grazing communally in drier areas and less protected by preventive colonial measures, were killed in the panzootic (Fig. 3c).[xlvi] In the Cape Colony, inoculation was a successful tool to save herds, with only 40% of the cattle dying. In the middle of 1898, however, the inoculation campaign ground to a halt when the panzootic came to an unexplained "natural death" (Gilfoyle 2003). This coincided with the end of the extreme phase of the drought; so, it can be assumed that the combined effect of the inoculation campaign and improved water and grass supplies had diminished the pool of disease-prone cattle. This suggestion is supported by the lower mortality rates or even total absence of Rinderpest from Cape Colony districts within the winter- and perennial-rainfall areas, where the drought of the mid-1890s was less developed.

The consequences of such dramatic losses of cattle have received ample attention in South African historiography (Ballard 1986; Phoofolo 1993, 1999, 2003; van Onselen 1972). In broad terms, the Rinderpest vastly impoverished the African communities; about a decade after the Rinderpest, in 1905, Africans in Natal (where cattle mortality had been comparatively light) still only owned about half as much cattle as before the panzootic. With regard to the drought and famine conditions that were still continuing in Transvaal and Bechuanaland after the cattle plague, and which returned to Natal and Zululand within a few years, the Rinderpest heightened the vulnerability of the African population. In regions such as Bechuanaland, where cattle farming dominated the agricultural sector, the cattle plague itself was a major factor in the famine (Molosiwa 2013; van Onselen 1972).[xlvii] However, even areas with more diverse agricultural production were susceptible to the effects of the disease. The widespread death of cattle depleted supplies of draught oxen, shattering the transport system, and led to a severe shortage of plough oxen. The former contributed to steep rises in prices for foodstuffs, especially under famine conditions; foodstuff had to be carried by people or by horses and mules, which Africans in general did not own (Schapera and Comaroff 1991).[xlviii] The latter—combined with a lack of manure and consequent decreased soil fertility[xlix]—would lead to a lower level of agricultural productivity.[l] Cattle could no longer be sold for food in famine years, due to quarantining measures, fencing and the drop in livestock prices preceding the cattle plague.[li] In Transvaal, the quarantining of the sub-districts

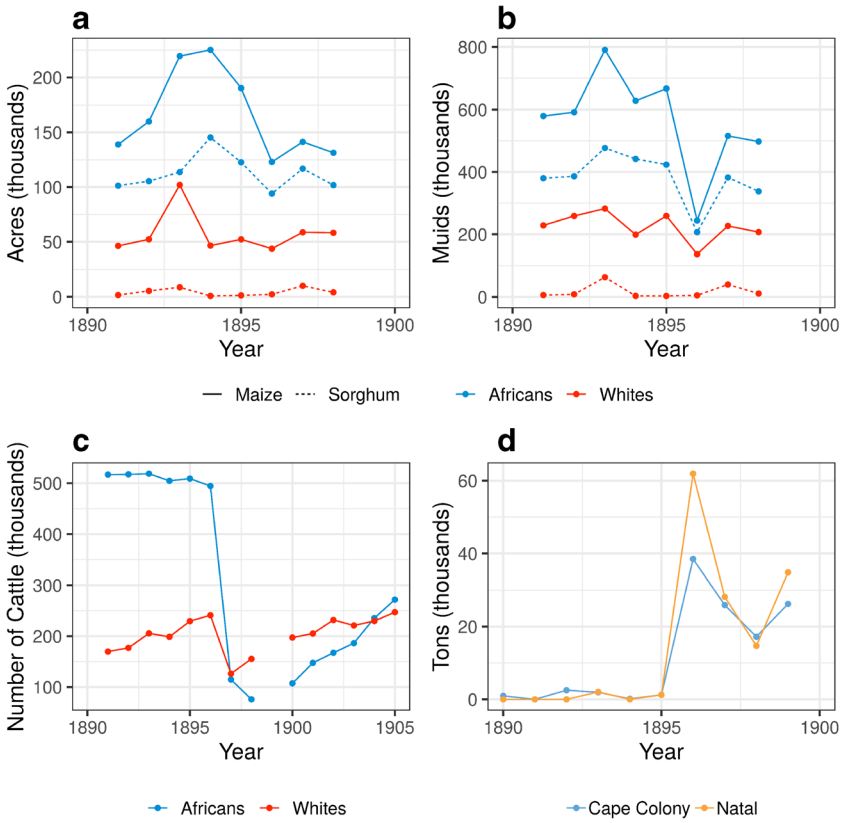

Fig. 3. Impact of the ecological crisis of the 1890s in southern Africa. a Natal, acres reaped with maize and sorghum 1891–1900. b Natal, harvest quantity of maize and sorghum 1891–99. c Natal, cattle 1891–1905. d Cape Colony and Natal, maize imports 1890–99. Data for panels (a)–(c) for Africans and Whites and referring to Natal in the borders of 1896, before Zululand in 1897 and Paulpietersburg, Vryheid and Utrecht came under the administration of the Colony of Natal

coincided with the climax of the drought and famine in 1896 and aggravated the situation by interrupting the trade network.[lii]

The closing of the border between SAR and BLP in 1896 severed the BLP from Transvaal grain supplies and contributed to a major spike in prices prior to the construction of the Mafeking-Palapye-Bulawayo railway in 1896–97 (Fig. 1).[liii] Africans in Bechuanaland survived this period of acute dearth by consuming the meat of doomed or diseased cattle,[liv] a measure that was later taken up in other regions.[lv] Once this short-lived glut was finished, the loss of cattle resulted in a collapse in the supply of meat and milk for Africans and European farmers alike;[lvi] as a consequence, African diets became generally low in protein and fat (Turner 1909a). The lack of (sour) milk particularly affected children, causing malnourishment and raising susceptibility to gastro-intestinal infections (Lambert 1995; van Onselen 1972).

Agriculture in crisis

The triad of drought, locusts and cattle plague ruined the agricultural and pastoral sectors in south-eastern Africa and constituted a massive shock to food supplies (Fig. 2). Agriculture was vulnerable to drought; irrigation was uncommon and, where it existed, was only small in scale. The bulk of agricultural production was in the hands of Africans; in many areas, farmers of European descent focused on pastoral farming. Due to a variety of factors, African agriculture was particularly at risk to drought-induced crop failure. Native reserves were frequently situated in arid areas (de Kiewiet 1965; Humby 1904). The crop range was limited and, even in Natal, peripheral locations were badly integrated into the colonial market. The agricultural system was based on the supply of surplus land that could be sown when necessary; however, by the early 1890s, population pressure and the developing social and legal framework in Natal hindered the access of Africans to the land. Maize and sorghum were the main food crops grown, although maize was not well adapted to the recurrent droughts of the region and more prominent in the areas of higher rainfall. Towards the north of the study area, sorghum was still preferred over the relative newcomer maize (Dreier 2005; Schapera and Comaroff 1991). Both crops were amongst the favoured foodstuffs of the granivorous locusts, but when the locust plague relented in Natal in 1896–97, sorghum proved more resilient to the pest.[lvii] In normal years, the varied geography and rainfall patterns in south-eastern Africa would permit the balancing out of local or regional harvest failures via trade. The severity of the drought cycle in the mid-1890s, especially 1895–96, however, and the ubiquity of locusts wrought havoc on this system. Transvaal and Bechuanaland experienced more problems, because the most significant drought-induced harvest failure of the period, 1896, coincided with the Rinderpest and its impact on the transport system and nutrition. The danger of a transport breakdown during a supply crisis was obvious; the resident magistrate of the starving Ixopo district of Natal expressed concern about grain transport a full year before the arrival of the cattle plague and urged the central government to stockpile supplies of grain in the stores (Ballard 1983).

Planting and sowing of the traditional African crops were dependent on the arrival of the spring rains. The first showers after the dry winter season triggered the onset of ploughing. In Natal, people would begin looking out for signs of spring by August, with the *Natal Witness* reporting every potential rain shower or storm; if the rains had not arrived by October the situation became precarious. In 1895, the rains reached south-eastern Africa in November, and late rainy seasons remained a recurrent problem until the end of the century. When sowing was delayed too long, harvest success was endangered by autumn frosts, especially in upland areas. Throughout Natal, Zululand and the south-eastern districts of Transvaal, frosts did not affect harvests in 1896,[lviii] but most crops had already withered during the drought from January to March or had been devoured by the locusts.[lix] Frost damage remained a risk in the following years, but it was rare.[lx] Whereas coastal colonies experienced a respite from drought and locusts in 1896–97, the situation further inland remained strained; the harvest was patchy in Transvaal and failed in BLP.[lxi] For BLP and CCBL, this was the third harvest failure in successive years, since crops had already failed there and in south-eastern Transvaal and parts of Zululand in 1895.[lxii] Harvest failures occurred in western Transvaal and Bechuanaland in 1898, though the harvest was sufficient towards the Indian Ocean coast.[lxiii] The problems continued for parts of BLP and Transvaal in 1899,[lxiv] but the build-up to the South African War (1899–1902) overshadowed all other developments.

Agricultural coping strategies were employed to reduce the impact of the environmental crisis. As long as there were draught oxen available, extra ploughs could be laid on to break up the hardened soil and accelerate ploughing and sowing when the late rains finally arrived.[lxv] Once the Rinderpest had killed the oxen, Africans had to resort to tilling the land with hoes, a much more time-intensive process; this contributed to a decrease in sown acreage. Some farmers and Africans on mission stations used mules for ploughing and the price of mules rose.[lxvi] In certain years, drought and locusts destroyed the seedlings and so made repeated sowing necessary; in northern Natal during 1895, maize was sown thrice by some farmers.[lxvii] Africans also employed repeat sowings, but this cost extra seed and delayed the harvest, thereby extending the period during which people depended on wild herbs, roots etc., which during famine constituted a larger share of the consumed calories.[lxviii] However, the necessary resources to endure times of crisis could not even be provided by all rural Whites (de Kiewiet 1941); in Transvaal, ruined farmers were unable to plant in 1896–97[lxix] and were in

need of financial aid from the government (Cripps 2012). Such assistance was unavailable for Africans. In the more affected regions, people had to resort to consuming seed corn; Britain attempted to avert the inevitable ensuing harvest failure through the donation of seed corn to the BLP.[lxx] Those Africans who could still plant favoured the more drought-resistant sorghum over maize. In many parts of Natal, the acreage of sorghum reaped by Africans increased relative to maize after 1895 (Fig. 3a, S2).[lxxi]

In regard to the locust plague, measures for raising resilience were also taken on a local level or by the colonies or states: they included a raised input of work as well as legal and scientific approaches. In Natal, where possible, Africans increased the acreages dedicated to sweet potatoes to escape the ravages of locusts (S3).

Nevertheless, the combined impact of drought and locusts proved a catastrophe for agricultural output; in the Natal midland districts south of Pietermaritzburg, the harvest failed almost entirely on land cultivated by Africans. The coast and the districts north of the capital fared somewhat better. The pastoral sector also suffered from drought, and whereas the cattle numbers in African ownership decreased, the cattle owned by farmers increased (Fig. 3a–c, S2).

With even the relatively wet Natal facing such a severe harvest failure, prices for maize and sorghum soared during 1896. Geographically, prices were determined not only by the magnitude of the harvest failure but also by the distance to the recently constructed railways (Fig. 1); these were the lifelines through which maize imported from the USA and Argentina was supplied.[lxxii] Remote areas suffered most and were also vulnerable to the profiteering of traders and speculators. Prior to the construction of the railway in BLP, the protectorate had to be supplied by mules. As a result, in the southern Protectorate, a 200 lb bag of flour fetched £3 10,[lxxiii] while, in the northern region, it reached an exorbitant £10 at the time of greatest dearth.[lxxiv] Once the railway opened, the price for imported bags of maize stood at £1 10 shillings.[lxxv] In Zululand, the average price was £1 7 shillings–£1 15 shillings.[lxxvi] The SAR government imported mules alongside maize to ensure the transport of grain into the hinterland.[lxxvii] Prices for the cheaper sorghum rose to £1–2 per sack on the Highveld by winter 1896.[lxxviii] Before the American maize arrived, the situation was tense in Johannesburg, prices oscillated between £1 5 shillings and £2 10 shillings (Cripps 2012). In general, urban centres along the railways were the best supplied places during the famine. In Natal, Durban and Pietermaritzburg saw the lowest prices of the colony, but even here the average price for a muid of maize doubled to 19 shillings 10 pence in 1896. Improvement in the agricultural sector, accompanied by falling prices, occurred in coastal colonies during 1896–97. Further inland, the situation did not relax due to lack of seed corn and discouraged cultivators reducing the sown acreage. By 1898, conditions in Natal had worsened again, resulting in a return to famine prices which were maintained over most of south-eastern Africa until at least the harvest of 1899.

Reduction of vulnerability to famine

The persistent environmental crisis of the mid- to late-1890s, culminating in the famine of 1896, occurred at a watershed moment. The precolonial strategies for managing dearth—extensive use of wild plant and animal resources, food sharing amongst communities, change in settlement patterns and occasionally the recourse to social conflict—were largely coming to an end, but colonial famine management was not yet fully developed. Once the administrations in the urban centres realised that the combined impacts of drought, locusts and cattle plague exceeded the potential of normal coping strategies, regional governments resorted to the international grain market. Imports of maize from the Americas were organised by the British dominions and SAR and were distributed via the railway network. Around New Year 1896, Transvaal opted for imports and the lowering of import tolls; Natal began to investigate the need for imports in late January.[lxxix] In the following year, c. 62,000 t of maize was imported at Durban and c. 38,500 t into the Cape Colony, a trade that had essentially not existed previously (Fig. 3d). The imported grain was to be sold at market price, but, with the speculation involved, many rural Africans were priced out of the market.

Government-level famine management focused on this provision of imported maize at market price. In the context of ongoing efforts to increase the reservoir of African wage labour in the farming and mining sectors, the subsistence crisis was considered an opportunity to separate African populations from traditional subsistence livelihoods and integrate them into the labour market (Ballard 1983; Unterhalter 1978).[lxxx] In Natal, the farming sector also aimed to reduce African agricultural competition (Lambert 1989, 2003). Even though resident magistrates, missionaries and chiefs had urged central governments to prepare for famine, [lxxxi] the administrations only rarely provided maize as relief or at cost price, conceded credit to Africans for the purchase of maize, or relinquished taxes or "squatters rent" (Ballard 1983; Lambert 1995; Ramdhani 1989). Thus, food relief in Natal and Zululand came late and was of limited extent; credit was rarely conceded and grain was mostly sold at market price (Ballard 1983; Lambert 1995; Ramdhani 1989).[lxxxii] In BLP, authorities embarked on relief on a larger scale and supplied grain at cost price, but the distribution of free food was largely avoided.[lxxxiii] After President Krüger inspected the famine-ridden districts of northern Transvaal in 1896, efforts were made to supply grain to starving Africans in northern and south-eastern regions (Cripps 2012; Wylie 2001).[lxxxiv]

Faced with severe shortages, coping strategies were developed by some of the mission stations in affected areas. The response of individual missions was much dependent on the financial situation and transport links of the station, the potential of the "home" mission society to accrue famine donations and the personality of individual missionaries. There is evidence that mission stations remitted the church tax and of missionaries using their purchasing power and the mission networks to provide grain for their communities and for passing refugees.[lxxxv] In northern Transvaal, the Berlin and Swiss Missions organised large-scale food provision and partly also medical treatment (Dreier 2005). Early in 1896, the London Missionary Society encouraged donations for BLP in Britain; this effort merged with the work of the London Relief Committee to supply primarily seed corn but also free food for mission stations.[lxxxvi] In British colonies, English-speaking missionaries used their influence to convince the government and public to increase food relief;[lxxxvii] in Transvaal, this duty fell to German and Swiss mission societies (Dreier 2005).

With speculative maize prices and a lack of food relief, Africans resorted to a mixture of old and new adaptive social mechanisms. Where market integration was still functional, and resources sufficient, Africans exchanged cash reserves and cattle for maize.[lxxxviii] The migration of whole tribes or villages to less vulnerable areas was no longer possible, but families or individuals, using traditional support networks, moved to friends or relatives; missionaries frequently reported people fleeing hunger. By 1896, selling labour for food or money was a well-established crisis management technique. Throughout southern Africa, primarily young men left their homes for the Transvaal mines or urban employment to raise cash for food and taxes, and to avoid further stress on dwindling local food supplies, thereby, however, weakening the community and family ties.[lxxxix] This sudden supply of labour, increased also by the defeat of the Gaza kingdom in modern-day Mozambique, however, enabled the Chamber of Mines to reduce African wages by 30% in late 1896 while increasing daily work hours (Marks 2011; Phoofolo 1993). To deflect growing tensions, the SAR government informed the workers that the responsibility for this decision lay with the "uitlanders" dominating the mining industry.[xc] Other Africans found work on farms or mission stations. Vulnerable members of African society had to stay behind without support; they compensated for harvest shortfalls by increasing hunting activities where possible, and by gathering wild roots, herbs and fruits, locusts and other insects. Energy was preserved by reducing activity.[xci] In parts of rural Transvaal and in Bechuanaland, 1896 represented the second year of harvest failure and was not the last.[xcii] The duration of the drought and the parallel occurrence of Rinderpest resulted in widespread mass migration—even the abandonment of villages—and in hunger and famine-related disease,[xciii] afflictions that did not occur to such an extent in the coastal colonies. Whereas in Natal and Zululand, the tradition of food sharing was still practised to some degree, in these semi-arid regions, such traditions appear to have collapsed, suggesting a breakdown of social cohesion (Dreier 2005; Molosiwa 2013).[xciv]

Demographic, social and political developments in the wake of the crisis

The pressures of the environmental and socio-economic stress and the adaptations to overcome the crisis had ramifications on a wide array of aspects of the life of Africans, including decreasing health, increased mortality, a change in religious attitudes and a contribution to political upheaval. Peoples' health suffered most in areas of prolonged severe food shortages, as in the so-affected Transvaal and Bechuanaland. Malnutrition was widespread, and starvation also occurred.[xcv] As noted previously, the loss of meat and dairy due to the Rinderpest removed a major source of fat and protein from the African and poor White's diet (Turner 1909a), with children suffering especially from a lack of vitamins and minerals (van Onselen 1972). The imported American maize was animal fodder, dried or roasted, and was nutritionally inferior to fresh local maize. The imported grain was generally disliked by Africans and in BLP was referred to as "Black Coals".[xcvi] In the prolonged drought, wild and cultivated vegetables were lost and sorghum harvests were severely affected. Since sorghum was also used for brewing, beer consumption in interior southern Africa dropped dramatically during these years.[xcvii] As beer, greens and milk were major sources of vitamin C for African populations (Turner 1909b), it is not coincidental that scurvy was widespread in BLP in 1896–97[xcviii] and that many Natal hospitals diagnosed the disease regularly after 1898, when the cattle plague had struck and the dry conditions were renewed.[xcix] It was troublesome in 1897 and 1898 (Hickley and Bronte Stewart 1952). Scurvy became a serious health problem in the mines, where workers tended to fall ill within a few weeks of arrival. Mining companies recognised that workers arrived in a pre-scorbutic state, but did not adapt their food provisions, which at this point consisted only of porridge made from dried import maize (Wylie 2001).

The post-1896 years saw a rise in famine disease due to the lack of food and of disease due to the consumption of unhealthy food, such as decomposing cattle carcasses; this was particularly widespread in Bechuanaland, where the Rinderpest coincided with the drought.[c] In Transvaal, dead cattle were partly burnt,[ci] but water sources contaminated during the drought or by dead cattle caused gastro-intestinal diseases and fever. Malnutrition and the associated social hardships and migration could increase vulnerability to infectious disease. Early in 1897, typhoid fever and malaria spread through low lying areas of Bechuanaland and Transvaal. Whereas typhoid fever was most

likely linked to the displacement of people and low living standards, the increase in malaria, which was endemic in the Lowveld (de Kiewiet 1941), can probably be attributed directly to the weather conditions. When the water flow in rivers ceased and left only scattered pools, these would provide the ideal breeding ground for mosquitoes—the vectors for malaria—in the warm summer months. Many Africans, as well as people of European descent, fell victim to these disease outbreaks.[cii] Mortality was high on some German Hermannsburg mission stations, and five missionaries (of a total of c. 10) as well as eight family members died during the first half of 1897.[ciii] Northern Transvaal did not escape (Malunga 2003). Smallpox, which had been prevalent in Johannesburg and Transvaal in 1893, took hold at least in south-eastern Transvaal in 1897 and west of Pretoria early in 1898, with villages being quarantined.[civ] In autumn 1898, malaria returned.[cv] In Berseba, Transvaal, the mortality rate for African people was 10%, while estimates for Kuruman (CCBL) reached 25%;[cvi] recurrent fever epidemics marked the following autumn and winter.[cvii] In accordance with the loss of life in Transvaal, a mortality rate of 20% is assumed for the badly hit areas of eastern Bechuanaland for the years of recurrent crisis between the mid-1890s and c. 1905.

With the catalysing effect of the famine and Rinderpest, African societies experienced profound social and religious change. Africans took refuge at the mission stations, sometimes as "bread-Christians", since missions were striving to feed their congregations and refugees.[cviii] However, the erosion of the basis of traditional African life brought with it the spread of millenarian fears and, in areas of prolonged or close contact with European settlers, this contributed to a real religious shift and a rise in conversions to Christianity, especially amongst the Tswana people.[cix] Rain-making rituals were in decline amongst the Tswana (Schapera 1970), as attested by the missionaries in Transvaal,[cx] although these rites used to be carried out annually in the arid regions of the west (Schapera 1937). In Natal, mission records are entirely mute upon this contentious issue, giving the impression that no rain-making took place. However, even though expanding, the subsistence crisis accelerated the profound change that African Christianity was undergoing. The "Ethiopian" Church, a movement for an independent African Christian community, widened its influence, new churches were founded, and the congregations of some mission societies sought increasing independence (Chidester 1992; Houle 2011; Klein et al. 2018). Revival movements swept through Protestant communities in Natal and Transvaal (Dreier 2005; Houle 2011).

In areas where colonial influence was limited, or where African–White relations were strained, Africans frequently associated the blights devastating the land with colonial expansion (van Onselen 1972). The recently colonised Matabele in Rhodesia, for example, blamed drought, locusts and cattle plague on the establishment of the rule of the British South Africa Company (Baden-Powell 1897; Selous 1896). The requisition of Matabele cattle by the company before and during the drought in late 1895[cxi] further enraged the tribe, and, by March 1896, rebellion spread. During this rebellion, the British strategically destroyed local grain stores after the failed harvest of 1896, when a bag of grain was already valued at c. £10 (Baden-Powell 1897; Selous 1896),[cxii] and when the railway to Rhodesia was still more than a year off completion. The Africans of the Langeberg region (CCBL), famished and without hope for the forthcoming harvest period,[cxiii] were confronted with hut-tax demands and the "stamping out" approach towards Rinderpest, and so rebelled in summer 1896–97 (Cleall 2012; Saker and Aldridge 1971). In 1898, the Venda, the last "independent" tribe on SAR territory, were vanquished (Braun 2013). Rumours of rebellion and uprising were prevalent in many regions, including Zululand, Natal and Basutoland. With cattle holding such a central place in traditional African life (Phoofolo 1993; Unterhalter 1978), these tensions were linked to the looming Rinderpest, but, in Natal and Basutoland, unrest preceded the cattle plague and coincided with the climax of the 1896 famine.

Ultimately, the environmental crisis of the mid-1890s left a more profound impact on the African population than the doomed rebellions. When the main shock of the 1896 famine had subsided, and the economic and social disruption it caused could be accommodated, the cattle plague, which equalled a massive wealth destruction, prevented any recovery. Agricultural data from Natal show that the acreage cultivated by Africans shrank.[cxiv] Further, swathes of land that had been grazed by African cattle were now empty and could easily be absorbed into White farms (Marks 2011). In 1905, in Natal, African cattle stood only at about 50% of the pre-plague level, while the cattle owned by white farmers slightly exceeded pre-plague numbers[3] (the recovery rates for both groups may also appear higher than they actually were due to the cattle raiding in the South African War).[cxv] Since cattle constituted wealth, their loss greatly reduced the potential for Africans to invest in agriculture, let alone purchase additional land where still legally possible. Unsurprisingly, the agricultural boost in Natal created by the South African War could not reverse the long term trend of farmers of European descent coming to dominate the agricultural and pastoral sector (Ballard 1986). When mining profits began to revive South African agriculture and help to start "scientific" farming, this growth totally bypassed the African population and only raised the speed with which "squatters" or tenants on unprofitable terms were removed from the land (Guest 1989; Lambert 1995). This development was greatly facilitated by the impact of the environmental crisis of the mid-1890s that impoverished African populations.[cxvi] The

[3] These numbers apply to Natal within the borders of 1896. In 1903, the districts Utrecht, Vryheid and Paulpietersburg were transferred to the Colony of Natal; cattle in these districts is excluded for the comparison.

result of the crisis was aptly summed up in the words of Africans near Kuruman (CCBL): "We are no longer a people, we are a remnant society".[cxvii] Africans lost economic standing and, increasingly, room for political manoeuvre. Impoverished Africans and landless White people swelled the ranks of the urban proletariat (de Kiewiet 1941; Marks 2011).

Conclusion

In the mid- to late-1890s, prolonged drought took hold of the summer rainfall regions of south-eastern Africa. During a series of extremely dry springs and early summers, locusts thrived and destroyed the young and late-sown crops. Pastures and watering holes were reduced by the drought, and this contributed to the spread and mortality of the cattle plague. In effect, rather than simply reducing crop yields and degrading water supplies, prolonged drought triggered changes to natural ecosystems and agricultural systems. The resulting environmental and agrarian crisis was particularly devastating in the interior of south-eastern Africa. As a natural phenomenon, the environmental crisis and famine impacted on all sectors of south-eastern African society, but the vulnerability of various social groups, and their resilience to and recovery from this crisis, were determined by pre-existing socio-economic and political structures. Groups and individuals of low socio-economic status, effectively barred from political influence, found it difficult to adapt successful short- or long-term coping strategies. In south-eastern Africa, in the 1890s, this put both African populations and poorer people of European descent at risk. Crisis management saved many lives, but the necessary coping strategies drew increasing numbers of Africans into the capitalist system (Marks 2011). The crisis accelerated existing trends and heralded the arrival of the twentieth century, where ultimately the South African society would be segregated culturally, socially and economically along racial lines.

Acknowledgements This research was funded by the Leverhulme Trust Research Project Grant number F/00 504/D. We extend our thanks to the ELM archive that holds the records of the Hermannsburg mission.

References

Baden-Powell RSS (1897) Matabele campaign 1896. Being a narrative of the campaign in supressing the native rising in Matabeleland and Mashonaland. Meuthen's Colonial Library, London

Ballard C (1983) 'A year of scarcity. ' The 1896 locust plague in Natal and Zululand. S Afr Hist J 15:34–52. https://doi.org/10.1080/02582478308671575

Ballard C (1986) The repercussions of Rinderpest. Cattle plague and peasant decline in colonial Natal. Int J Afr Hist Stud 19:421–450. https://doi.org/10.2307/218974

Beinart W (2003) Environmental origins of the Pondoland revolt. In: Dovers S, Edgecombe R, Guest B (eds) South Africa's environmental history. Cases and comparisons. Ohio University Press and David Philip Publishers, Athens (US) and Cape Town, pp 76–89

Braun LF (2013) The returns of the king. The case of Mphephu and western Venda, 1899–1904. J South Afr Stud 39:271–291. https://doi.org/10.1080/03057070.2013.796739

Chidester D (1992) Religions of South Africa. Routledge, London

Cleall E (2012) 'In defiance of the highest principles of justice, principles of righteousness.' The indenturing of the Bechuana rebels and the ideals of empire, 1897–1900. J Imp Commonw Hist 40:601. https://doi.org/10.1080/03086534.2012.724242

Cripps EA (2012) Provisioning Johannesburg, 1886–1906. Dissertation, University of South Africa

de Kiewiet CW (1941) A history of South Africa, social and economic. Oxford University Press, Oxford

de Kiewiet CW (1965) The imperial factor in South Africa. A study in politics and economics. Cass, London

Dreier M (2005) Years of terrible drought. Surviving the 1895–1897 supply-crisis in the Limpopo area. Limpopo histories. http://pages.unibas.ch/afrika/limpopo/papers/limpopo_pdf/limpopo_dreier.pdf. Accessed 9 July 2012

Etherington N (1989) Christianity and African society in nineteenth-century Natal. In: Duminy A, Guest B (eds) Natal and Zululand from earliest times to 1910. A new history. University of Natal Press Shuter & Shooter, Pietermaritzburg, pp 274–301

Gilfoyle D (2003) Veterinary research and the African Rinderpest epizootic. The Cape Colony, 1896–1898. J South Afr Stud 29:133–154. https://doi.org/10.1080/0305707032000060494

Grab SW, Zumthurm T (2018) The land and its climate knows no transition, no middle ground, everywhere too much or too little. A documentary-based climate chronology for central Namibia, 1845-1900. Int. J. Climatol. 38:e643–e659. https://doi.org/10.1002/joc.5397

Guest B (1989) The new economy. In: Duminy A, Guest B (eds) Natal and Zululand from earliest times to 1910. A new history. University of Natal Press Shuter & Shooter, Pietermaritzburg, pp 302–323

Hickley JM, Bronte Stewart B (1952) The history of scurvy. SAMJ/Suid-Afrikaanse Tydskrif vir Geneeskunde 26:293–297

Houle RJ (2011) Making African Christianity. Africans re-imagining their faith in colonial southern Africa. Lehigh University Press, Lanham and Plymouth

Humby AJ (1904) Irrigation of the Native reserves of the Colony of Natal. Minutes of the Proceedings of the Institution of Civil Engineers 157: 319–329. https://doi.org/10.1680/imotp.1904.16533

Hydén L (2002) The influence on summer rainfall in the Lesotho Lowlands from Indian Ocean SSTs. Nord Hydrol 33:305–318. https://doi.org/10.2166/nh.2002.0010

Kelso C, Vogel C (2007) The climate of Namaqualand in the nineteenth century. Clim Chang 83:357–380. https://doi.org/10.1007/s10584-007-9264-1

Klein J, Nash D, Pribyl K, Endfield GH, Hannaford M (2018) Climate, conflict and society. Changing responses to weather extremes in nineteenth-century Zululand. Environ Hist 24:377–401. https://doi.org/10.3197/096734018X1513794959193

Knox A (1911) The climate of the continent of Africa. Cambridge University Press, Cambridge

Lambert J (1989) From independence to rebellion. African society in crisis, c. 1880–1910. In: Duminy A, Guest B (eds) Natal and Zululand from earliest times to 1910. A new history. University of Natal Press Shuter & Shooter, Pietermaritzburg, pp 373–401

Lambert J (1995) Betrayed trust. Africans and the state in colonial Natal. University of Natal Press, Scottsville

Lambert J (2003) 'The *titihoya* does not cry here any more.' The crisis in the homestead economy in colonial Natal. In: Dovers S, Edgecombe R, Guest B (eds) South Africa's environmental history. Cases and

comparisons. Ohio University Press and David Philip Publishers, Athens (US) and Cape Town, pp 48–60

Lawrimore JH, Menne MJ, Gleason BE, Williams CN, Wuertz DB, Vose RS, Rennie J (2011) An overview of the Global Historical Climatology Network monthly mean temperature data set, version 3. J Geophys Res Atmos 116. https://doi.org/10.1029/2011JD016187

Lindesay JA, Harrison MSJ, Haffner MP (1986) The Southern Oscillation and South African rainfall. S Afr J Sci 82:196–197

Macnab F (1897) On veldt and farm. In: Bechuanaland, Cape Colony, the Transvaal and Natal. E. Arnold, London and New York

Malunga F (2003) Schism and secession. The founding of the Bapedi Lutheran Church, 1890–1898. Historia 48:48–65

Marks S (2011) Class, culture, and consciousness in South Africa, 1880–1899. In: Ross R, Mager AK, Nasson B (eds) The Cambridge History of South Africa, 2, 1885–1994. Cambridge University Press, Cambridge, pp 102–156

Marquardt G (2005) Water, wood and wild animal populations. Seeing the spread of Rinderpest through the physical environment in Bechuanaland, 1896. S Afr Hist J 53:73–98. https://doi.org/10.1080/02582470509464890

Mason SJ (1995) Sea-surface temperature—south-African rainfall associations, 1910–1989. Int J Climatol 15:119–135. https://doi.org/10.1002/joc.3370150202

Molosiwa PP (2013) 'The tragedy of the Ababirwas.' Cattle herding, power and the socio-environmental history of the ethnic identity of the Babirwa in Botswana, 1920 to the present. Dissertation, University of Minnesota

Nash DJ (2017) Changes in precipitation over southern Africa during recent centuries. In: Oxford Research Encyclopedia of Climate Science. https://doi.org/10.1093/acrefore/9780190228620.013.539

Nash DJ, Endfield GH (2008) 'Splendid rains have fallen.' Links between El Niño and rainfall variability in the Kalahari, 1840–1900. Clim Chang 86:257–290. https://doi.org/10.1007/s10584-007-9274-z

Nash DJ, Grab SW (2010) 'A sky of brass and burning winds.' Documentary evidence of rainfall variability in the Kingdom of Lesotho, Southern Africa, 1824–1900. Clim Chang 101:617–653. https://doi.org/10.1007/s10584-009-9707-y

Nash DJ, Pribyl K, Klein J, Neukom R, Endfield GH, Adamson GCD, Kniveton DR (2016) Seasonal rainfall variability in southeast Africa during the nineteenth century reconstructed from documentary sources. Clim Chang 134:605–619. https://doi.org/10.1007/s10584-015-1550-8

Niang I, Ruppel OC, Abdrabo MA, Essel A, Lennard C, Padgham J, Urquhart P (2014) Africa. In: Barros VR, Field CB, Dokken DJ, Mastrandrea MD, Mach KJ, Bilir TE, Chatterjee M, Ebi KL, Estrada YO, Genova RC, Girma B, Kissel ES, Levy AN, MacCracken S, Mastrandrea PR, White LL (eds) Climate Change 2014. Impacts, adaptation, and vulnerability. Part B: regional aspects. Contribution of working group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge and New York

Nicholson SE, Entekhabi D (1986) The quasi-periodic behavior of rainfall variability in Africa and its relationship to the Southern Oscillation. Arch. Met. Geoph. Biocl. A, Meteorology and Atmospheric Physics 34:311–348. https://doi.org/10.1007/BF02257765

Nicholson SE, Klotter D, Dezfuli AK (2012) Spatial reconstruction of semi-quantitative precipitation fields over Africa during the nineteenth century from documentary evidence and gauge data. Quat Res 78:13–23. https://doi.org/10.1016/j.yqres.2012.03.012

Pankhurst R, Johnson DH (1988) The great drought and famine of 1888–92 in northeast Africa. In: Johnson DH, Anderson DM (eds) The ecology of survival. Case studies from northeast African history. Lester Crook, London, pp 47–70

Pfister C (2010) The vulnerability of past societies to climatic variation. A new focus for historical climatology in the twenty-first century. Clim Chang 100:25–31. https://doi.org/10.1007/s10584-010-9829-2

Phoofolo P (1993) Epidemics and revolutions. The Rinderpest epidemic in late nineteenth-century southern Africa. Past Present 138:112–143. https://doi.org/10.1093/past/138.1.112

Phoofolo P (1999) In time of plague. The BaSotho and the Rinderpest, 1896–8. Dissertation, Rhodes University (SA)

Phoofolo P (2003) Face to face with famine. The BaSotho and the Rinderpest, 1897–1899. J South Afr Stud 29:503–527. https://doi.org/10.1080/03057070306204

Ramdhani N (1989) The effects of climate and disease on African farming in Natal, 1895–1905. S Afr J Econ Hist 4:79–91. https://doi.org/10.1080/20780389.1989.10417158

Ramsay J, Morton B, Mgadla T (1996) Building a nation. A history of Botswana from 1800 to 1910. Longman, Gaborone

Reason CJC, Mulenga H (1999) Relationships between South African rainfall and SST anomalies in the southwest Indian Ocean. Int J Climatol 19:1651–1673. https://doi.org/10.1002/(SICI)1097-0088(199912)19:15<1651::AID-JOC439>3.0.CO;2-U

Roumasset J (2003) Crop failures. Oxford University Press, Oxford

Saker H, Aldridge J (1971) The origins of the Langeberg Rebellion. J Afr Hist 12:299–317. https://doi.org/10.1017/s0021853700010690

Schapera I (1937) The Bantu-speaking tribes of South Africa. An ethnographical survey. G. Routledge & Sons, London

Schapera I (1970) Tribal innovators. Tswana chiefs and social change, 1795–1940. Monographs on social anthropology, 43. Athlone Press, London

Schapera I, Comaroff JL (1991) The Tswana. Wiley, London and New York

Schulze RE (2001) South African atlas of agrohydrology and climatology, Beta 1.002. University of KwaZulu-Natal, Pietermaritzburg

Selous FC (1896) Sunshine and storm in Rhodesia. Being a narrative of events in Matabeleland both before and during the recent native insurrection up to the date of the disbandment of the Bulawayo Field Force, 2nd edn. R. Ward, London

Sen A (1981) Poverty and famines. An essay on entitlement and deprivation. Clarendon Press, Oxford

Serels S (2018) The impoverishment of African Red Sea littoral, 1640–1945. Palgrave Macmillan, Springer, Cham

Spinage CA (2003) Cattle plague. A history. Kluwer Academic and Plenum Publishers, New York

Spinage CA (2012) African ecology. Benchmarks and historical perspectives. Springer, Heidelberg, Dordrecht, London and New York

Steedman A (ed) (1990) Locust handbook, 3rd edn. Chatham, Natural Resources Institute

Thompson LM (2001) A history of South Africa, 3rd edn. Yale University Press, New Haven and London

Turner GA (1909a) The diet of the South African natives in their kraals, part 1.2. Transv Med J 4:198–207

Turner GA (1909b) The diet of the South African natives in their kraals, part 2.1. Transv Med J 4:227–233

Tyson PD (1986) Climatic change and variability in southern Africa. Oxford University Press, Cape Town

Unterhalter E (1978) 'The natives appear contented and quiet. ' The Nqutu district of Zululand under British rule, 1883–1897. In: Collected seminar papers. Institute of Commonwealth Studies, London, pp 60–75

van Heerden J, Taljaard JJ (1998) Africa and surrounding waters. In: Karoly DJ, Vincent DG (eds) Meteorology of the southern hemisphere. Meteorological Monographs 27, no. 49, Boston, pp 141–174

van Onselen C (1972) Reactions to Rinderpest in Southern Africa, 1896–97. J Afr Hist 13:473–488. https://doi.org/10.1017/s0021853700011762