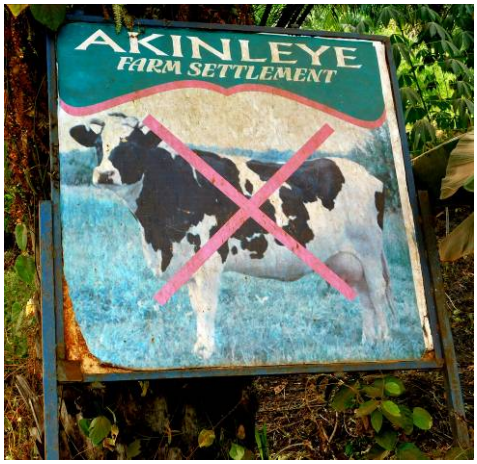
A TROPHIC CASCADE IN NIGERIAN VEGETATION

AND ITS IMPLICATIONS FOR HERDER-FARMER CONFLICT



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ABSTRACT

Recent decades in Nigeria have seen a dramatic escalation in herder/farmer conflict. This is typically attributed to political and religious differences, exacerbated by the conflict in the Northeast of the country. However, these are almost certainly secondary reframings; the underlying causes are a catastrophic change in vegetation patterns, caused by massive demographic expansion. Farmers open up more and more land, placing ever greater pressure on the open grazing of pastoralists. The result is overgrazing, which leads to replacement of digestible species by tougher grasses and woody species. This can be illustrated by the highly visible southward movement of particular tree species, such as the fan and dum palms. This in turn attracts pastoralists with livestock specialized in these species and consequently increased farm incursions. The paper argues that without an empirical scientific base to determine the causes of environmental change, no amount of reconciliation processes will make any difference to the incidence of conflict.

1. Introduction

The West African Sahel has been the focus of an accelerating pattern of conflict since the early 2000s (Higazi & Ali 2018). Various types of insurgent operation, conflicts between farmers, and most notably conflict between herders and farmers have all increased. Nowhere has this been more acute than in Nigeria, where the extremely dense human population has had the effect of magnifying the intensity of conflict. The causes of this have been much disputed, and many brows have been furrowed in development agencies without noticeable result. Conflict resolution agencies, both state and NGOs, have invested considerable effort in identifying the causes of the problems, bringing to bear enthusiasm, funding workshops and consultancies to resolve the issue. The outcome has been as close to zero as makes no difference, since the communal killings continue and possibly worsen.

At a popular level, social media now plays a major role in characterising conflict for a broad audience. Government officials with no time or inclination to read tend to appropriate the views they espouse without nuance. One of the key aspects of herder/farmer conflict which has begun to dominate the debate is the 'clash of civilisations' narrative, the idea that this represents a struggle between two ideologies, Islam and Christianity. Herders, conveniently all Muslim, have been suborned by shadowy forces to bring down the ethnic minorities of South-Central Nigeria, who are all Christian for the purposes of these polemics. No amount of evidence, for example that Muslims are just as frequently victims of these attacks, has made any significant impact on the views of the 'influencers'.

One of the reasons for these serial failures is that development agencies and their staff are almost always without any scientific training and therefore find it difficult to conceptualise the origins of conflict in other than political and socio-economic terms. Scientific illiteracy is now widespread, which may account for the widespread attribution of conflict to 'climate change', a hypothesis which has no empirical underpinnings.

The objective of this paper[1] is to present an argument to suggest that the origins of herder/farmer conflicts in Nigeria are primarily environmental, and arises from a perfect storm of unchecked demographic growth, catastrophically inept land management, combined with a laissez-faire attitude to environmental damage, for example from uncontrolled charcoal production. The conflicts are not, and never have been, primarily ideological in nature, although there is no doubt that the civil disorder they create has been exploited by both politicians and freelance insurgents, especially in Eastern Nigeria, to exacerbate the mayhem, thereby throwing blame on the pastoralists. It further suggests that there is no direct evidence for climate change which can be extricated from vegetation degradation; which is not to say it has not occurred, but it cannot be substantiated. The narrative is broadly as follows;

a) Since the 1980s, Nigeria has undergone unparalleled demographic growth without corresponding intensification of farming practices, so that farmers are compelled to exploit ever more marginal land. This applies particularly to riverine areas, where abundant grazing has been replaced by dry-season horticulture
b) Moreover, farmers are engaging in or allowing destructive practices, such as the sale of trees for timber, charcoal production and the deforestation of riverbanks, leading to soil erosion and reduced yields
c) Pastoralists who migrate seasonally along north-south routes are in turn placing the remaining open land under significantly greater grazing pressure.
d) The consequence is that the vegetation in the Sahel/semi-arid zone is undergoing significant replacement. Plant and animal species characteristic of the semi-arid zone are moving further south and colonising new ecological niches in the subhumid zone.
e) These new landscapes can apparently indicate reduced rainfall, but this is not a reliable inference. There are no directly gathered rainfall statistics for comparative purposes.

[1] This paper has not been funded by any development agency which allows me to express my views more trenchantly than would otherwise be the case. However, I would like to thank the individuals and organisations which have funded consultancies since the 1980s which have in one way or another contributed to the conclusions expressed here. Needless to say, none are in any way responsible for my views.

f) As a consequence, pastoralists with livestock varieties adapted to the vegetation of a specific ecozone are therefore moving southwards, not only because grazing is under pressure in their home areas, but also because new pastures have opened up, since the resident pastoralists in the subhumid region are in turn pushing still further south
g) The conjunction of a high density of farms and constant waves of 'new' pastoralists moving into each ecozone where they have no traditional relationships, inevitably results in conflict with farmers
h) While this is so, conflict will renew itself constantly, and no amount of reconciliation processes will have any impact on these waves of migration

The argument concerning the changes in ecology cannot yet be supported by dense scientific observation, since any network which could accomplis this has effectively disappeared in West Africa. §2. discusses what sources of evidence exist for these assertions, while §3. explores four plant species whose southward march can be broadly established. Evidence from fauna is more difficult to assess, since it depends entirely on non-specialist records. However, reports concerning the seasonality or changing visibility of birds, notably Palaearctic species, suggest that with more detail, these might also provide support for the hypothesis (§4.). §5. explores the changing patterns of pastoral migration which follow from vegetation change, and §6. how these are channelled into increased levels of conflict, and whether these can be disentangled from other sources of conflict, notably religious clashes.

§7. deals with the issue of climate change versus vegetation change. Since unsupported claims have been made about climate change, this is an important issue. If this is the major problem it requires a policy response different from improved land management. In turn, §8. discusses the way forward. Development agencies are willing to put considerable resources into resolving conflict issues, but if the underlying analysis is mistaken, then the policy response is also clearly in error and the expenditures likely to be wasted.

2. The sources of evidence

The present author first began fieldwork on herder/farmer conflict in 1984 (Blench 1986) and has been able to monitor the situation in various regions of the country up to the present (2019). Observational data was given a significant boost by the National Livestock Survey (RIM 1992) which provided a national snapshot of traditional pastoralism and village livestock production in 1990-1991. Notes on vegetation have been made whenever a survey of pastoral society was undertaken, as well as simply observing species. The maps in this paper are therefore a composite of personal records and retrospective interviews with herders. Inevitably they have limitations without a nationwide survey, but in terms of order of magnitude I believer they are broadly correct. The same is true of pastoral migration; this has been observed and mapped since the 1980s, although the records go back to the early colonial period (e.g. Jahnke 1982). This paper is part a record of observation, partly a plea for far more intensive scientific surveys, so some of the key technical parameters can be established with greater accuracy.

3. Plant species

3.1 Overview

Heavy grazing by ruminants places stress on the floristic environment, making it difficult for certain plant species to seed. They are typically replaced by other species which are more resistant to grazing, by being less palatable or digestible. In particular, the replacement of grasses by woody species, or by brackens on eroded slopes, has been documented in some detail for the grassy uplands of Adamawa (Boutrais 1974, 2000). The overall consequence is a degradation of soil structure, with a corresponding loss of capacity to support a high density of trees, or indeed species which require deep roots and waterholding capacity. As a consequence, trees characteristic of particular ecozones disappear or move southwards, leaving open a niche which can be invaded by more northern species.

These openings of niches and their invasion by plants, animals and eventually human beings is something like a trophic cascade. This can be defined as follows;

A *top-down cascade* is a trophic cascade where the top consumer/predator controls the primary

consumer population. In turn, the primary producer population thrives. The removal of the top predator can alter the food web dynamics. In this case, the primary consumers would overpopulate and exploit the primary producers. Eventually there would not be enough primary producers to sustain the consumer population. Top-down food web stability depends on competition and predation in the higher trophic levels. Invasive species can also alter this cascade by removing or becoming a top predator.

Interestingly, the first use of this concept discussed overgrazing, albeit in Wisconsin rather than West Africa. Aldo Leopold (1949) observed that the removal of top predators, in this case wolves, had had the effect of creating massive overgrazing by antelopes and mountain goats, with a series of consequences following in a cascade. This section discusses the evidence from trees species, which are rather more easily observed than animals.

3.2 Baobab, *Adansonia digitata*

The baobab is one of Africa's most iconic species, attracting a wealth of scholarly literature, as well as volumes of picturesque photos (Wickens & Lowe 2008; Petignat & Jasper 2015). Its central area of evolution appears to be Madagascar, where six species are found, with an outlier in Australia. The African mainland is host to a single species, *Adansonia digitata*. As a pachycaul, it is both long-lived and able to resist drought by storing water.

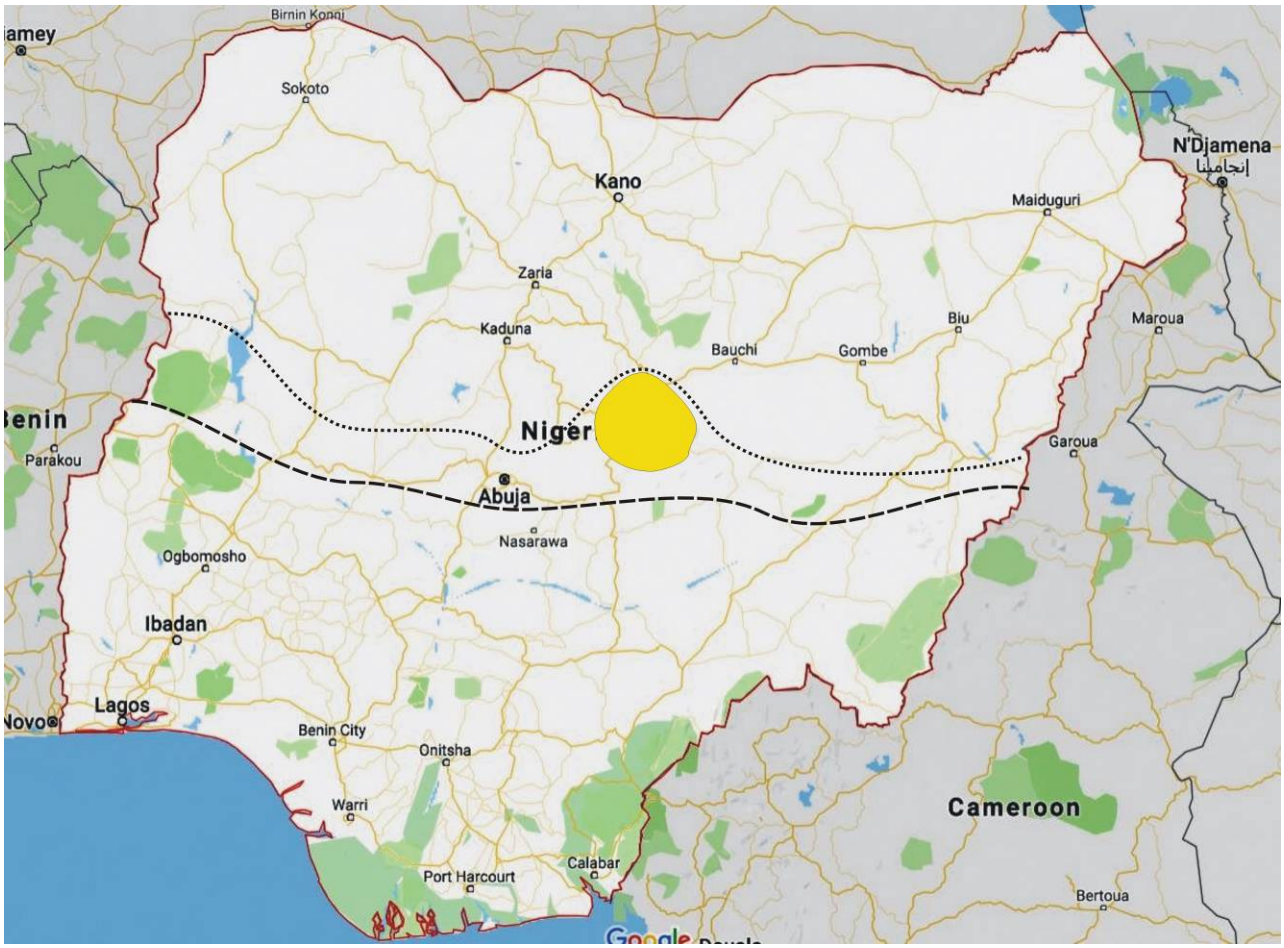
Its distribution in Africa is given on a map in Wickens & Lowe (2008: 273). This shows that although the baobab avoids equatorial rain forest and ultra-high humidity zones such as the Niger Delta, it can survive almost everywhere else. Some examples are found on the coast near Lagos and in Kinshasa. This is partly because its seeds remain viable over long periods encased in strong pod, which contains an edible fibrous substance. Pastoralists typically carried baobab pods as a snack, and therefore where they discarded the pods along stockroutes created corridors of baobabs. As an anthropic species, its natural distribution is quite hard to assess.

Photo 1. Baobabs west of Yankari Game Reserve

Source: Author photo

However, there is a phenomenon in Nigeria which is quite distinctive, the colonisation of eroded land by small 'forests' of young baobabs. These small forests seem to have appeared since the 1980s, and they are gradually moving further south. In the case of the baobab, records of single trees are therefore irrelevant, since it is only the appearance of small groves on eroded land which count as indicators of vegetation change. Map 1 shows the approximate extent of this phenomenon since the 1980s. The yellow patch is the Jos Plateau, where baobabs are very uncommon. The distribution has largely made its way around the Plateau.

Map 1. Southward movement of baobab 'forests' since the 1980s



There is certain irony to this, as there is a literature recording the baobab as 'disappearing' or 'under threat' (for example, Barnes 1982). This has variously been blamed on drought or marauding elephants, but all reports of this nature refer to Eastern and Southern Africa. In West Africa, the baobab has become a weedy species of waste land. Although baobabs have a certain number of uses, including edible leaves, edible pods and rope, in these numbers they are effectively destructive, as they take over the land without improving it and are hard to uproot.

3.3 Fan palm, *Borassus aethiopum*

The fan palm (also deleb palm and palmyra palm), *Borassus aethiopum*, is one of the most distinctive anthropic species of the African landscape (Arbonnier 2004: 173; Ouinsavi *et al*. 2011; Salako *et al*. 2018). Although classified as a 'solitary' palm, it appears to grow in clusters in Nigeria. It can be massive, one of the largest palms in the world, and occasionally lives to a great age. It is found across much of semi-arid arid Africa, and its close relative, the sugar-palm, *Borassus flabellifer*, is a key useful tree in much of tropical Asia. Its main use in Nigeria is the production of *muruci*, a sprout from the buried fruit, but the wood is used for construction and the leaves for mats.

In Nigeria, it has been spreading southwards rapidly in recent decades, colonising wasteland. It is therefore curious that, like the baobab, it is characterised in other countries in West Africa as under threat (e.g. Sambou *et al*. 1992, 2002; Salako 2015). Remarkably, it has reached rocky outcrops in Ondo State, not far north of the humid forest. Map 2 shows the approximate line of southward movement of the fan palm since the 1980s.

Photo 2. Grove of fan palms in Ondo State

Source: Author photo

Map 2. Southward movement of the fan palm since the 1980s

Fan palm fruits are traded and also carried between villages in order to create the edible sprouts. These are plausible mechanisms for the gradual diffusion of the palm further south.

3.4 Dum palm, *Hyphaene thebaica*

The dum or gingerbread palm, *Hyphaene thebaica*, was the key palm species valued by the Ancient Egyptians, seen on many tomb paintings. Growing in extremely arid areas, it provides shade, leaves for mats and is useful for construction. In Mali it is coppiced for this purpose. The dum palm is highly salient, as the trunk splits into two or occasionally more stems. The fruit is inedible, but the source for vegetable ivory, sometimes used for ornaments. The ethnobotanical literature appears to focus on its use in droughts and periods of food shortage (Fanshawe 1966; Humphry et al. 1993; Arbonnier 2004: 176). Map 3 indicates the striking movement over several decades of the dum palm in Nigeria from its natural Sahelian zone, to the northern edges of the subhumid zone. Similar studies in Benin Republic have reached broadly the same conclusion, although the climatic regime is quite different, hence the patterns do not match (Idohou et al. 2016). It is unlikely that it is being transported by humans, as its uses are limited in high rainfall regions.

Photo 3. Dum palm, *Hyphaene thebaica*

Source: Author photo

Map 3. Southward movement of the dum palm in Nigeria since the 1980s

3.5 Desert rose, *Adenium obesumT*

The last plant in this survey is the least well documented. The desert rose, *Adenium obesum*, is also known as the 'false baobab' due to its succulent stem. In season, it has brilliant red flowers. It is characteristic of the Sahel and the northern semi-arid zone, so its presence in these high rainfall areas is striking. Textbooks say that it is usually found as single specimens highly dispersed (Arbonnier 2004: 161). However, this is apparently no longer the case in parts of the Nigerian Middle Belt. Photo 4 shows a small 'forest' in the degraded stony soils near Tal, some 100 km southeast of Jos, photographed in February 2019.

Photo 4. 'Forest' of the desert rose, *Adenium obesum*

Source: Author photo

Data on *Adenium obesum* is so far too weak to plot its advance on a map, but the few records are indicative of its movement. The literature on its ecology is not abundant, but Turton (1977) mentions it as an invasive species which took over following drought in southwest Ethiopia.

Photo 5. Blue-cheeked bea-eater, *Merops persicus*

Source: CC

4. Possible faunal evidence

Evidence from faunal patterns is harder to use because there is no systematic collection of data from sightings of birds or insects such as is common in the British Isles. The main indicators mentioned by informants are birds which come at unusual times of year. West-Central Africa is a key node in the Palaearctic migration system, first described by Moreau (1952). Nigerian sites, such as the Hadeijia-Nguru wetlands on the Komadugu Yobe, were formerly well-known for their abundance of overwintering bird life, but in recent times, they have become a biotic desert (Hollis et al. 1993; Ringim et al. 2018). Various studies have noted the long-term population declines in Afro-Palaearctic migrant bird species and identified as the principal causes as environmental degradation and consequent food shortages (Sanderson *et al*. 2006; Vickery *et al*. 2014). Tøttrup et al. (2008) observe that avian migrants can quickly adjust their migration routes to respond to environmental conditions and the anecdotal evidence suggests this is occurring in Nigeria.

Two salient species well-known to local communities are the European roller, *Coracias garrulus*, and the blue-cheeked bea-eater, *Merops persicus* (Photo 5). Both are seasonal Palaearctic migrants, overwintering in

West Africa before heading further south. Recent studies of the European roller have suggested both an overall decline in populations and a shift in migration patterns (Rodríguez-Ruiz *et al*. 2014; Emmenegger et al. 2014). The likely cause of this is the scarcity of food resources in West African locations. The data is less sure for the bee-eater, but local discussions suggested it has disappeared in some places and its appearance is less sure in others. Another species for which this is noted is the northern red bishop, *Euplectes franciscanus*, whose annual appearance at the beginnings of the rains is celebrated in children's' songs. Several informants have noted the absence of this bird in recent years.

The avifaunal evidence is so far only suggestive. We would need far more systematic interviewing and monitoring to be certain about changes the pattern of in seasonal migrations. What is not in dispute, however, is the overall pattern of catastrophic collapse in overall bird numbers due to environmental degradation. Birds, and their principal source of food, insects, are highly sensitive indicators of the health of regional ecologies.

5. Human migratory patterns

Pastoralist migrations are highly sensitive to the abundance and quality of pasture as well as the accessibility of water. Moreover, different livestock breeds are adapted to the vegetation of specific ecozones and Nigeria has typically had a system of ecological layering of livestock breeds (Blench 1999). The semi-arid regions are characterised by red breeds of cattle (Azawak), and the large Uda sheep breed, with its half-black, half-white coat, both specialised in grasses rather than browse. The herders are often highly nomadic, being on the move for much of the year and still often without an agro-pastoral component. Such breeds were typically confined to the Sahel because of disease; they were susceptible to the pathogens in more humid areas.

However, the southern migrations of herds of Uda'en pastoralists have become very noticeable in the region east of Bauchi across to the Benue river. Interviews with resident pastoralists in Gombe State in January 2019 suggested that the first tentative migrations of these herders (many of whom originate in the Niger Republic) appeared around the year 2000, with more coming every year. The herders arrive in December, so that they can eat the crop residues from the harvest of guinea-corn and millet. They then move south to the valley of the Benue River, some even crossing to southern Taraba State on the periphery or even with the Gashak-Gumti faunal reserve. At the end of the dry season in April, they move northwards, arriving in their home area when the rains have created the first flush of grass. Photo 6 shows multiple herds of red cattle and Uda sheep on migration in the area of Futuk, Gombe State in January 2019.

Photo 6. Herds of migratory red cattle southwest of Gombe

Source: Author photo

As a consequence of the national livestock survey in 1990-1991 (RIM 1992), it is possible to establish the broad limits of southern expansion of red cattle breeds (locally known as Azawak). Blench (1999) published a series of maps showing the distribution of different livestock breeds as established in 1991, and these can be compared with the situation recorded in 2019. Map 4 shows a comparison of the two and underlines the

marked southern movement of red breeds[2].

Map 4. Changing southern limits of red cattle breeds in Nigeria since 1991

Another confirmation of changed environmental conditions are the presence of both camels and donkeys brought along as transport animals (Photo 7).

Photo 7. Camels used by pastoralists for baggage in the Futuk area

Source: Author photo

6. The relevance for conflict genesis

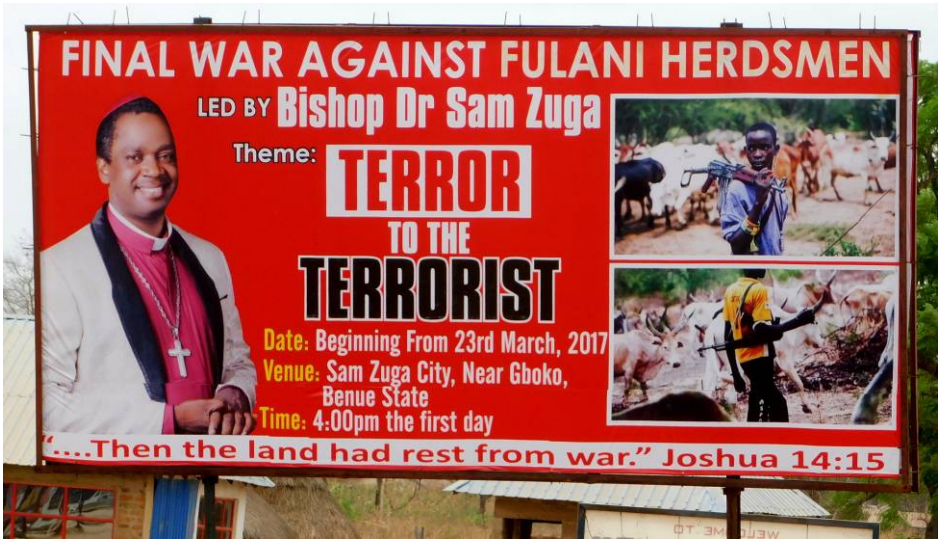
The implications of these changes are evident in retrospect. The demographic expansion in all regions, but especially in the semi-arid zone, squeezes pastoralists onto ever decreasing patches of open grazing. This causes conflict directly as it is more and more difficult to navigate between the cultivated areas and the likelihood of livestock entering the fields is ever higher. At the same time, farmers are taking over land that pastoralists considered 'theirs', although they may have had no legal title to it, which causes resentment. Combined with the free availability of more sophisticated weapons, due partly due to instability in the Sahel region, and additional pressure from herds fleeing the Boko Haram area, inevitably leads to incursions in farmed areas and thereby conflict.

[2] It must be underlined that the lines on the map for 2019 are somewhat approximate and based on personal observation plus reports from others. Particular thanks to Adam Higazi.

Meanwhile the pressure on grazing leads to the degradation of vegetation, with indigestible species replacing the existing vegetation. Pastoralists inevitably move southwards to find the vegetation their herds are adapted to consume, putting renewed pressure on farmer/herder relations in new areas. A lack of established relationships with local farmers, as well as the psychological insecurities related to war, kidnapping and rustling, makes the incoming herders more likely to use their weapons to defend their herds. Moreover, the lack of respect between these herders and the farmers, and the increasing use of young men without their families as herders, makes for a greater willingness to invade farms and restricted areas such as game reserves, especially as the cattle are increasingly hungry. Hence the greater numbers of clashes and the relatively high mortality[3].

This instability is seized on by irresponsible politicians and social media commentators to frame the clashes in religious terms, a narrative which suits those who like simple, science-free analyses, which also justify the irresponsible exercise of political power. There is probably something deeper at play, the distaste of the settled for the nomadic, anxieties which have played out in history, with the Roman fear of the wandering German tribes, or the perpetual raids of the nomads of the periphery on the 'civilised' cities of ancient China. Certainly some of the rhetoric in Nigeria is framed in highly apocalyptic terms. Photo 8 shows a not-atypical representative of this kind of thinking[4]. That this type of hate speech is sanctioned by the Christian church is a troubling indicator of how embedded apocalyptic rhetoric now is.

Photo 8. Anti-pastoralist propaganda in the Gboko area



Source: Author Photo

The conclusion is that the genesis of herder/farmer conflict is nothing to do with political or religious oppositions; these are secondary framing of the narrative. The core element is the consequences of demographic expansion and the consequent pressure on the ecology, which has led to unexpected migratory patterns which increase significantly the chances of crop incursions and thus conflicts. Unless these issues are addressed, no amount of reconciliation exercises will have the slightest impact. Agreements may be made in meetings, but conflicts will break out again in the following months, because the root causes have not been addressed.

7. Disentangling climate change from landscape mismanagement

Evidence from flora, fauna and related pastoral migration all point to rapid environmental change, with species characteristic of the semi-arid zone replacing those of the subhumid zone (e.g. Wezel & Haigis 2000). However, the causes of this are unclear. They are often attributed to climate change, although without any evidence. The monitoring of rainfall, both aggregate and distribution, has stopped in Nigeria, and indeed in most of West Africa, in the early 2000s[5]. In earlier decades, this type of data was considered to be essential to all types of agricultural planning and massive syntheses, such as Kowal & Knabe's (1972) *An*

[3] It is very noticeable that fatalities in the southwest, where both pastoralists and farmers are likely to be armed only with cutlasses is far lower than the southeast, where both sides have modern weapons.
[4] Incidentally, the photos used in this poster are internet memes, taken outside Nigeria.
[5] Based on a survey of papers cited on Google Scholar.

agroclimatological atlas of the Northern states of Nigeria were characteristic of the period. Surveys of Northern Nigerian rainfall data were regularly published (e.g. Hess *et al*. 1995).

A possible reason for this absence of direct data is the increased reliance on satellite imagery. The multi-coloured maps they produce no doubt give their interpreters a sense of omniscience, and of course analysis can be conducted from computer screens, not requiring fieldwork in problematic environments. However, imagery is virtually useless without ground-truthing, which is now almost never undertaken, because 'scientific' publication is acceptable without it being required. It cannot be emphasised too strongly that for understanding the environmental changes which affect pastoralist subsistence, it is nearly useless. The replacement of digestible pasture species with those which are virtually inedible does not show up as a change. Even trying to assess the expansion of farming in the semi-arid zone, where fields are not boundary marked and the overall biomass of crops and weeds may resemble the bush outside is not easy. Attempts to determine the changes in woodland cover in the Sahel are now some decades out of date (Ringrose & Matheson 1992).

Put another way, there is no incontrovertible evidence for climate change in north-central Nigeria over the last two decades. There are anecdotal observations of the rains coming early, or late, or being heavy or faltering, but this is not science. Rainfall variability, both decadal and inter-annual is a fact of life in the semi-arid zone. Even if rainfall has changed, it may anyway be interconnected with the massive changes in the vegetation, for which the evidence is clear. Climate change though has one massive advantage for policymakers, as it provides an excellent alibi for the mismanagement of landscape resources by human beings. If the changes can be attributed to some external agency, preferably caused by fossil fuel emissions in developed economies, this allows for requests to donors to mitigate the effects and puts no pressure on government to change or even enforce its policies. We cannot know clearly about climate change, and evidence should be sought for with much greater energy. We can know about landscape mismanagement and introduce policies to remedy the worst excesses.

8. The way forward

If the argument of this paper is correct, north-central Nigeria has been subject to a trophic cascade, caused by demographic expansion. Over the last four decades this has changed the ecozonal vegetation very rapidly, bringing characteristic semi-arid plant and animal species further south. This in turn has allowed pastoralists who typically herd livestock breeds adapted to the Sahel to bring their herds well into the subhumid zone, just as those with herds adapted to subhumid vegetation push even further south to the edge of, and in some cases into the humid forest. The widespread availability of modern veterinary medicines has increased the viability of these herding strategies.

The consequence has been a major increase in violent clashes between herders and farmers, as the land available for open grazing decreases and is replaced by farms. Accidental incursions are made more likely, but the shortage of nutrition for cattle also makes intentional grazing on farms more attractive. The policy response to this has been weak, to put it politely. A lack of basic scientific knowledge has allowed political scientists to seize the agenda and thus allowed the intervention of inexperienced and broadly useless NGOs. International donors have commissioned extensive duplicated and cross-cutting reports and a wide variety of position papers have appeared from those whose only knowledge of the situation is drawn from reading online newspapers.

Empirically it is unfortunately evident that these activities have had almost no impact on the ground, as the violent episodes continue unabated. If the diagnosis of this paper is correct, this is because they do not address the root causes, and furthermore cannot address them due irremediable ignorance of the technical and scientific issues that underlie the conflicts.

A quite different approach can be recommended, based on the following steps;

a) A serious attempt is made to recover rainfall data for north-central Nigeria to establish the extent or absence of climate change
b) Key environmental indicators of both flora and fauna be mapped and retrospective interviews used to

establish the degree of change over the last three decades

c) Sample surveys can indicate the extent of the expansion of cultivation over the last three decades

d) Time series analysis of satellite imagery should be correlated with the ground information to establish the extent to which the three can be correlated.

e) A survey of stockroutes and grazing reserves can establish the extent to which these exist and are functional in different states

f) Based on this evidence, government can develop a policy derived from empirical data. In particular, it can use existing data to predict the situation in coming decades, especially if demographic growth is unchecked

g) One element of this policy will evidently be improved land management which should involve;

- Reduction in degradation of woody species, especially through timber cutting, firewood and charcoal production
- Publication awareness campaigns of the role of trees in reducing soil erosion
- Restoration of gallery forest along key waterways
- Promotion of sustainable farming strategies, in particular composting
- Promotion of livestock/ crop integration, through exchange of crop residues for manure
- Promotion of live fencing to reduce livestock incursions
- Promotion of techniques to reduce invasions of reserved areas
- Restoration of reserved livestock facilities
- Promote awareness of the role of biodiversity in maintaining soil fertility and structure and the role of bees in crop pollination

Active policy transformation in this area will be far more effective than multiplying studies of farmer/herd conflict which recommend enhanced reconciliation procedures[6].

Finally it should be underlined that the situation is far more serious than in neighbouring countries, simply because the far greater density of human population. Demographic pressure has simply caused these cascades of environmental change to happen much faster. But as populations expand in other African countries, the same sequence of events is likely to occur, unless remedial action is taken. Indeed, the breakdown of relations between herders and ranches in East Africa, particularly Kenya, in recent years is probably a parallel process at work.

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[6] It is beyond the scope of this paper to explore the innovative methodologies imported into Nigeria which are said to have worked in other regions of the world, but empirically, their impact has been zero

[7] https://unowas.unmissions.org/sites/default/files/rapport_pastoralisme_eng-2.pdf

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