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EDITORIAL INTRODUCTION:

Public understanding, conflict and power in the population and sustainability nexus

David Samways

As I write this editorial, COP28 has just concluded. Hosted by the UAE and presided over by the CEO of the Abu Dhabi National Oil Company, this COP has rightly been regarded with greater scepticism by environmentalists than many previous to it, yet, astonishingly, it is the first to officially recognise the burning of fossil fuels as the (proximate) cause of the climate crisis. Amongst other items in the final communique was the pledge of an extra $400 million to assist vulnerable countries with the effects of climate change. Whilst bringing the total in the 'loss and damage' fund to $700 million, this represents only a tiny fraction of the estimated $400 billion needed (Richards et al. 2023) and somewhat shamefully amounts to only ten per cent of the cost of building the COP28 venue in Dubai.

While the level of consumption, especially of the most affluent, is cited as the most significant factor in the generation of the environmental crisis (Steffen et al. 2015), population growth is universally acknowledged in the scientific literature as a significant indirect driver of present and future trends[1] (Brondízio et al., 2019; Almond et al. 2022; IPCC, 2022). Importantly, the majority of future population growth will take place in the least affluent countries, many of which have the lowest carbon footprints but are also the most vulnerable to the effects of climate change. Lowering the rate of population growth in these emerging

1 Somewhat understandably, reducing population growth has not been considered as a policy instrument at the COP meetings since, although addressing population growth will lower emissions in the longer-term (Bongaarts and O'Neill, 2018), population momentum means that the change in population size will take too long to address the imminent crisis (Bradshaw and Brook, 2014).

economies will have multiple benefits for human welfare and for the environment (including longer-term carbon emissions) (see *JP&S* **7** (2)). Decreasing fertility rates are closely correlated with economic and social development, including the education and empowerment of girls and women (Bongaarts and Hodgson, 2022) and a number of models have shown that lower than projected global population sizes accompanied by reduced environmental impacts and greater sustainability are possible (Raihi et al. 2017; Vollset et al. 2020; Callegari and Stoknes, 2023). Tackling global inequality via the transfer of wealth and technology to less developed countries is acknowledged as central to achieving the most favourable welfare and environmental outcomes (Callegari and Stoknes, 2023).

The COP loss and damage fund is potentially an important contributor to the overall welfare of the least developed countries most vulnerable to climate change, yet clearly much more needs to be done. According to Callegari and Stoknes (2023), if their 'Giant Leap' scenario were to be followed, institutions of collective long-term economic decision making could eliminate poverty and substantially reduce the risks from Earth system shocks. Moreover, following this scenario would mean population peaking at 8.5 billion in 2040 and falling to 6 billion by 2100 with average global temperatures kept under 2°C above preindustrial levels. Yet, while they conclude that increasing taxation of the wealthiest ten per cent of the global population by between four and eight per cent will raise sufficient funds to execute the Giant Leap, it is important to recognise that the richest ten per cent of the population consists of all those earning above €37,500 PPP (Chancel et al., 2022). With the appearance of what has been dubbed the 'green backlash' or 'greenlash' (Marsh et al. 2023), it is more important than ever to communicate to the public the extent and risks of the environmental crisis but also the global connectedness and complexity of the crisis and its possible consequences. To a greater or lesser extent, the diverse articles collected in this issue of the *JP&S* all speak to these issues.

Although no consensus exists about their relative significance, the multiple determinants of falling fertility in developing countries are well known to demographers. However, if fertility transitions are to continue and accelerate the public understanding of the determinants, argue Götmark and Wetzler in their article published in this issue of the *JP&S*, may be critical. This is the case for citizens in both developing and developed countries. Notwithstanding

the question of what policy instruments are the most effective, in democratic countries public understanding and support for population and development policies can influence government's propensity to fund them. Similarly, personal reproductive choices may be influenced by public understanding of the causes of fertility decline. Yet little is known about public perceptions of the causes of fertility decline and Götmark and Wetzler's article sets out to investigate what educated people in a developed country (Sweden) and a developing country (Nigeria) understand about the causes of falling fertility in developing countries.

The results of their research showed that the vast majority (72 per cent) of Swedish respondents believed that economic and social development including improved education and reductions in infant mortality were responsible for declining fertility in developing countries. While Swedish responses were largely as expected, the responses of the Nigerian participants were somewhat perplexing since they believed almost the opposite to be true: that declining birth rates were the result of poverty, bad socioeconomic conditions and poor health. Götmark and Wetzler suggest that these results reflect the well-publicised Swedish international aid programme and the expressed preference for large families in Nigeria. Interestingly, family planning (FP) and contraceptive use were not cited as particularly significant factors by either Swedes or Nigerians (FP 1.9% and 5.9% respectively; contraception 10.3% and 3.7% respectively). Given the importance of international aid in the fertility transition, Götmark and Wetzler recommend more research is required to further explore the disparity in beliefs about fertility decline between citizens in developed and developing countries.

Chukwudi Njoku, Joel Efiong and Stefano Moncada's contribution to this issue examines the well documented conflicts between pastoralists and settled farmers in the Mid-Benue Trough in central Nigeria, illustrating the complexity of the interactions of demographic factors, environmental change, socio-economic conditions and cultural factors. Many scholars have attempted to identify the primary causal factors involved in the conflict which has caused destruction of property and led to the deaths of thousands of people and the displacement of many thousands more. Yet Njoku et al. observe that no conclusive evidence exists to show the relative significance of environmental, socio-economic, political, cultural, ethnic and religious factors on the lethality of the conflicts.

Using data from secondary sources, their multinomial regression analysis included covariates of climate change, economic development, population density, political violence, terrorism and ethnicity. From this nexus of factors, ethnic diversity and polarisation was found to have had the greatest effect on the lethality of conflicts. They note that the effects of climate change and low levels of economic development correlate well with incidents of lethal pastoralist-farmer conflict. However, where others have claimed high population density as a cause they find the opposite, with low population density forming part of the context for a greater number of lethal conflicts. They suggest that this supports the hypothesis that rural population growth is exceeding the capacity of the available land to support pastoralists, leading to increased conflict as pastoralists move into less densely populated areas and compete with established farmers for land. Importantly, while Njoku et al. find ethnic polarisation to be the most significant factor in the lethality of pastoralist-farmer conflict, they are clear that climate change, demographic, economic and political factors should not be disregarded. Indeed, they note that ethnic diversity itself is not a cause of conflict but 'can emerge as a major fault line for violent conflicts when it gets linked to other social, economic and ecological processes in a problematic way'.

Our third article by João Aldeia considers Michel Foucault's work on biopolitics in the context of mass species extinction. The structure and operation of power was a theme visible throughout Foucault's work. He contended that, from the seventeenth century, the nature of power shifted from disciplinary power to 'biopower' directed towards humans as living beings. Biopower, Foucault argued, was concerned with the administration life and operated at both an individual level (what he called the 'anatamo-politics of the human body') and social institutional level (Gutting, 2005). The latter is biopolitical, since social institutions operationalise biopower at the population level with areas of concern such as the birth rate, life expectancy, migration, public health, housing and so on. Foucault's notion of biopolitics encompasses attempts of state institutions to control population size both through pro-natalist and anti-natalist policies which aim to strategically manipulate reproductive choices (Coole, 2018). In addition, the control of national borders and the movement of people is also within the purview of biopolitics.

Aldeia argues that rather than being concerned with life, modern biopolitics is intrinsically 'thanatopolitical' – in his words: 'it is a politics of life based on a politics

of death'. For Foucault, disciplinary power is based upon the use or threat of death, but biopolitics is concerned with the promotion of life with death subordinated to a secondary role in the exercise of power. Observing that Foucault's ontology is Cartesian and anthropocentric, Aldeia argues that his concept of biopolitics treats the non-human environment as simply a *milieu* and fails to fully recognise humankind's entanglement with and dependency upon other species. Moreover, Foucault's Cartesianism passively accepts the notion of the human mastery of nature. Aldeia therefore contends that biopolitical state practices concerned with promoting ways of life for particular populations (mainly those of the affluent Global North) have necessarily led to mass deaths of non-human (both wild and domesticated) species – hence modern biopolitics is actually thanatopolitical. The recognition of the thanatopolitical nature of modern biopolitics is the first step towards creating a truly multi-species biopolitics that nurtures all of life. However Aldeia notes:

> for life as a whole to be nurtured in the long term, healthy multispecies entanglements are essential, and these are not compatible with the unchecked growth of any single species – no more than they are compatible with mass consumption, unchecked industrial production or the current scale of global movement of humans, non-human species and things. Hence, an emancipatory biopolitics cannot be premised on unrestrained pronatalism or unlimited economic growth since this sooner or later disrupts local multispecies homeostasis.

Aldeia's sentiments are echoed in our final 'Perspective' article from Lynn Lamoreux and Dorothy Bennett who observe that, despite the warnings about the its scale and extent, public opinion has failed to grasp urgency of the ecological crisis. They argue that this is due to five factors: an outdated, misleading view of evolution; a belief that technology will solve the problem; ignorance about human population size as a major cause; an underestimation of the consequences of environmental change and a belief in our ability to adapt; and the role of social media in fostering the expectation of simple answers to complex problems.

Lamoreux and Bennett outline modern evolutionary theory and, through the concepts of the biosystem and corposystem, systemically interrogate the unsustainability of present human relationships with the environment. They define

the biosystem as countless interacting and overlapping ecosystems evolved over billions of years which together, via their emergent properties, function to sustain life. The corposystem refers to the global market-orientated social and economic system which has become the dominant human social system. While the biosystem's function is to sustain life, Lemoreux and Bennet argue that the corposystem functions to produce growth and profit through competition and domination. Perpetual growth is intrinsic to the corposystem and the idea that growth is necessary has become normalised over time. However, the growth of corposystem is now in conflict with the ability of the biosystem to evolve, adapt and continue to function sustainably. Lemoreux and Bennet show how the aforementioned five beliefs are mistaken. In particular, they argue that technical fixes will not avert catastrophe since the underlying cause of the environmental crisis is human overpopulation. While acknowledging that tackling per capita consumption in the rich world is crucial, they argue that if the size of the human population is not humanely addressed then environmental change will impose enormous suffering and involuntary population reductions.

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PEER REVIEWED ARTICLE

Public opinions about causes of declining fertility in developing countries: differences among citizens in Sweden and Nigeria

Frank Götmark[1] and Nordhild Wetzler[2]

Abstract

Research indicates multiple causes of declining total fertility rate (TFR) in developing countries, including reduced child mortality, improved education and economy, family planning programmes and female empowerment. However, public opinions about the causes have rarely been studied. Using surveys in 2022 in Sweden and Nigeria, we compare answers of educated citizens to the question of why fertility (birth rate) has fallen in developing countries (also in Nigeria). In Sweden, 72 per cent of respondents suggested improved living conditions, including economy and education, lower infant mortality and generally progressive development. In contrast, in Nigeria 66 per cent of the respondents suggested that poverty, bad socioeconomic conditions and poor health cause declining birth rates. Birth rates were thus assumed to be falling mainly because the conditions in Nigeria are generally getting worse, not better. A contributing reason for the difference of opinions between the countries may be social norms for large families in Nigeria. Few Swedish respondents suggested family planning (1.9% of answers) but this answer was more common in Nigeria (5.9%). In Sweden, women answered contraceptive use (17%) more often than did men (4.5%), while in Nigeria the contraception answer hardly

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differed between men (6.1%) and women (5.7%). Only minor differences in opinion existed between the southern and northern (Muslim-dominated) states in Nigeria, among educated respondents that participated in this survey. We recommend more, and extended surveys.

Keywords: demography, human population, survey, questionnaire, norms, values

Introduction

The human population is projected to increase from the current eight billion to 10.4 billion by 2100 (UN, 2022). The large population and its strong growth impair human conditions, biological diversity, climate, food and freshwater resources (e.g. Crist et al., 2017). Population growth depends on fertility rates, which need to be reduced for long-term food security, conservation of ecosystems, biodiversity and other purposes (Ripple et al., 2017; Bongaarts and O'Neill, 2018; Cafaro et al. 2022).

The total fertility rate (TFR) is the average number of children women would bear if surviving to the end of reproductive life, with the same probability of childbearing in each age interval as now prevails. In the demographic transition, decline in mortality precedes fertility decrease, and, as long as fertility remains high and population momentum is important, the population grows (e.g. Poston and Bouvier, 2017). In most western countries, TFR started to decline from about 1870 (Roser, 2022), following changes related to industrialisation and improved health. In developing countries, TFR began to fall from about 1965, with marked variation among countries (UN, 2022; Roser, 2022). TFR depends on many factors, such as child mortality, economy, education, family planning programmes, female empowerment and schooling, social norms and religiosity (Colleran et al., 2014; Bongaarts, 2016; KC and Lutz, 2017; de Silva and Tenreyro, 2017; Lee, 2020; Götmark and Andersson 2020; Skirbekk, 2022; Bongaarts and Hodgson, 2022; Turner and Götmark 2022).

This research gives a broad picture of factors causing, or potentially causing fertility decline in developing countries. While increased education of girls and women is often emphasised as the main factor behind falling fertility (e.g. KC and Lutz, 2017; Skirbekk, 2022), other factors, such as family planning programmes, have also been important, perhaps even more than schooling per se (e.g., de Silva

and Tenreyro, 2017; Psaki et al., 2019; review in Bongaarts and Hodgson, 2022). Despite decades of research, no consensus exists on the relative importance of factors determining TFR in developing countries.

Our aim here is to investigate the opinion of the public regarding the factors reducing fertility in developing countries. For policymakers, politicians and agencies involved in implementing population policy and in deciding forms of international aid, knowledge of the opinion of the public is important, in developed as well as developing countries. Support from informed citizens is needed in democratic societies. For example, beliefs that family planning programmes or access to contraception are major causes of fertility decline might influence a government's propensity to fund such programmes in developing countries, while beliefs that education or improved living standards are the most important factors might lead to a different emphasis in foreign aid. Moreover, citizens are having or planning to have children, and may be influenced by perceived causes of fertility decline. As far as we know, no survey has investigated and compared opinions of the public in developing and developed countries about the causes of fertility decline in developing countries.

In many nations, and internationally, population growth and birth rates are discussed in popular articles, radio, television and websites. Media have long circulated research results regarding population and fertility, influencing opinions. From the mid-1970s the slogan 'development is the best contraceptive' became influential (originally from India's Karen Singh, at the UN's International conference on population and development in Bucharest, 1974). For Sweden in northern Europe, we expected that 'economic development' would be a common view held by the public to explain declining birth rates in developing countries. For instance, in response to African population growth and migration to Europe in 2016, Angela Merkel emphasised aid for 'real economic development' to Africa (France24, 2016). Due to high TFR and population momentum, the populations of many African countries are increasing rapidly, but policymakers and politicians do not often argue for family planning programmes, even though they are known to be effective (Bongaarts and Hodgson, 2022).

Recently, a survey investigated the views of citizens in Sweden (developed country), and their answers to the question, 'Which factor do you think is most

important for falling birth rates in developing countries?' The results are available in a university thesis (Wetzler, 2022). Here we use relevant parts of the results for comparison with results of a survey in Nigeria later the same year. In that survey, the term 'developing countries' was exchanged with 'Nigeria' (used as an example of a developing country).

Material and methods

The survey in Sweden

The opinions of Swedish citizens were quantified through an online web survey by the company Novus (see https://novus.se/en/). Its web panel consists of 50,000 participants, selected to be representative of Swedish citizens aged 18–80 years. The entire survey was in Swedish, as were the answers from participants (but translated for the thesis). The pre-selected sample of 1,741 respondents comprised approximately fifty per cent male and fifty per cent females, from all age classes (18–80) and regions in the country.

Each respondent was given the following information, and a question as follows:

> The population of the world is increasing and will continue to increase, according to the UN, for the next 75 years. Birth rates and family sizes in developing countries have decreased on average since the late 50s. But in many countries, e.g. large parts of Africa, birth rates are still high and are only falling slowly.
>
> Question: *Which factor do you think is most important for falling birth rates in developing countries?* State your own opinion. If you are unsure, answer as well as you can. Name only one factor, the one you think is most important. Ignore forced population measures, which a few countries have used (mostly China). Reply only to the question above. Please read it several times. Do not seek aid in answering.

The answer to the question above was given in free text format, i.e. each person wrote an answer (in limited space). To facilitate analysis of answers, we requested only a single suggestion for why birth rates are declining. Hence, there was no presentation of alternative answers where respondent could mark one out of several, as that might lead her/him to an answer sounding most correct (e.g.,

'family planning') even when she/he was unaware of such answer. Free format answers also have disadvantages, e.g., subjective categorisation of answers, but representation of true or 'free opinion' was prioritised.

The survey was sent out on 13 April 2022 to 1,741 persons in the web panel, and 1,010 answers came back (response rate 58 per cent). For each (anonymous) participant we had information about gender, age, education level and approximate location. The age groups were sorted into Young Adults (18–38), Adults (39–59) and Seniors (60–80). We used two education levels: 'upper secondary school or lower' (467 respondents), and 'university or corresponding' (543). Thus, many respondents had university or corresponding education level and on average the opinions came from more educated people in Sweden.

Categorisation of answers in Sweden

One author (N.W.) read and categorised all answers, after presenting a plan to F.G. (discussed and decided together). All answers were interpreted individually and sorted into categories. To preserve the nuance of answers, some categories had to be further divided into subcategories in the classification, also described below.

Increased education – subcategories *Education in general* and *Education for women.*

Reduced child mortality – mortality below age 5, approximately.

Increased living standard – subcategories *Better economy* and *Better socioeconomic factors.*

These were separated, due to many respondents answering specifically that increase in countries' GDP or personal wealth was the reason for reduced fertility rates. The broader socioeconomic factors also include mention of healthcare, safety, employment and social security.

Family planning – family planning in general, family planning programme, and similar initiatives.

Progressivism – subcategories *Female rights, Individualism, Secularisation, Democracy* and *Cultural Shifts*. Individualism refers to the notion of people focusing more on themselves rather than community, and delaying or foregoing children in favour of personal fulfilment through work and own choices. Cultural shift refers to societies' move away from traditional norms of large family and expectations of women to bear and rear them (it could also mean other things that did not fit in any other category).

Contraceptives – access to these, and knowledge of how to use them.

Sterilisation – past or current measures in countries with voluntary or forced sterilisations

Reduced sexual activity – for instance, wars keeping men from home, or people having reduced sexual activity.

High mortality – the subcategories *War, Starvation,* and *Disease.* People in developing countries die for various reasons, and fertility rates drop.

Uncertain future prospect – an uncertain future, caused by, for instance, climate change.

Bad living standards – subcategories *Corruption/Oppression* and *Bad socio-economic factors.*

Don't know – no answer, apparently judged themselves to be uninformed.

Misunderstood the question – respondents who did not understand the question or gave an unrelated answer.

When there were multiple answers (suggestions), only the first answer was used in the analysis. If the answer described a theme, we placed it in a corresponding category after interpretation. There was no discrimination as to quality of answer, as we wished to compile all suggestions, regardless of how plausible they appeared to be.

The survey in Nigeria

We followed as much as possible the same procedure as in the Swedish survey, with exceptions necessary due to differences between countries, as explained below. Nigeria has a much larger population (about 218 million) than Sweden (10.5 million). Our budget allowed an increase from 1,000 to 1,500 answers for the survey, conducted by the company Kantar (see https://www.kantar.com/). Their Nigerian web panel is non-representative and consists of recruited English-speaking citizens. English is the official language in Nigeria, and according to the Oxford English Dictionary, 53 per cent of the population speaks English, or a form of English. The respondents, about equal numbers of males and females, were at least eighteen years old, and well-educated (see below). The northern Nigerian states are dominated by Islam, the southern ones by Christianity. Kantar sought to obtain one half of respondents from northern states, and one half from southern, which was almost achieved: 707 respondents from the northern states Sokoto, Kebbi, Niger, Zamfara, Katsina, Kano, Kaduna, Jagawa, Bauchi, Gombe, Yobe, Borno, Adamawa, Kwara, FCT-Abuja, Nasarawa and Tarab; and 793 respondents from southern remaining states.

The survey was sent out on 12 July and ended on 20 July 2022. It consisted of a brief background, a question and instruction as follows:

> The average number of children per woman is decreasing in the world, though slowly. In Nigeria, the average number of children per woman was 6.7 in 1985, and it had decreased to 5.4 in 2020.
>
> Question: *For Nigeria, which factor do you think is most important for decline in birth rates (decrease in number of children per woman)?* Please write the factor that you personally believe is most important for fewer children per woman. Please write only one factor. Do not seek help from others to obtain more information.

As in the Swedish survey, free format answering was used (with limited writing space).

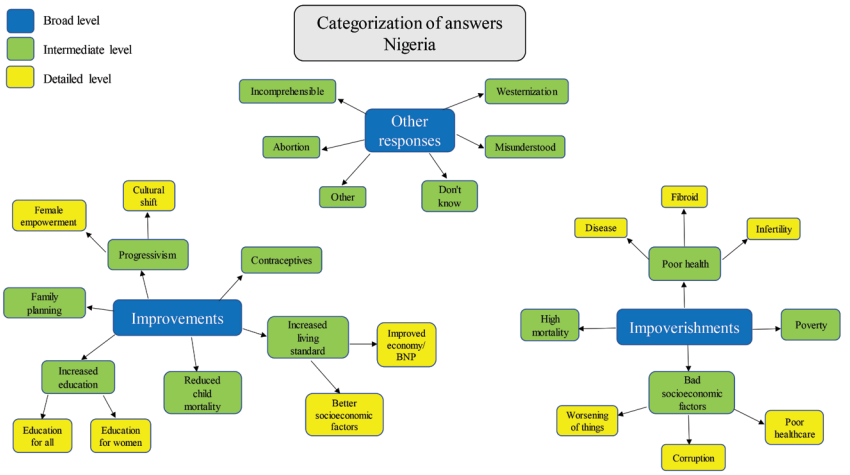
The response rate was twenty per cent (survey sent to 7,509 persons; web panel was successively increased until 1,500 had responded). Among the 1,500

respondents, 750 were women and 750 men. Only four respondents had no, or only primary, education; eighty had secondary school only; 181 high school or college as highest level; and a majority had university degree or higher (1,225 respondents; ten preferred to not state education). Overall, by Nigerian standards the respondents therefore were highly educated. This was true also for Sweden, though in Nigeria such highly educated respondents represent a much smaller proportion of the population.

Categorisation of answers in Nigeria

To make the two countries comparable in the final analysis, we sought to use similar response categories as in Sweden. This was largely possible, but the sample from Nigeria was larger, with a higher diversity of answers compared to Sweden. In addition, new patterns in the responses emerged, and we had to create new categories which however still allowed for broad comparisons between the countries. Figure 1 shows how we formed three major broad categories from categories and subcategories, as explained below.

Figure 1. Categories of answers to survey question, 'For Nigeria, which factor do you think is most important for decline in birth rates (decrease in number of children per woman)?'



Improvements – the interpretations of respondents' answers suggested improved conditions were responsible for declining birth rates. Under this heading were six categories also used in Sweden, and for three of these, answers had first been grouped into the subcategories shown in Figure 1.

Impoverishments – respondents' answers suggested that impaired conditions were responsible for declining birth rates. Under this heading were four categories, partly or mainly corresponding to two categories in the Swedish survey (High mortality, Bad living standards). The new category Poverty was an addition (Figure 1).

Other responses – responses that did not fit in other categories or were too few to warrant their own category; answers that were difficult to understand, often short and not explained; and answers from respondents who stated they had no answer. Abortion and 'westernisation' could be seen as neither negative nor positive, and so were regarded as unclear and added here (see Figure 1).

Statistical analyses

We use graphical analysis, showing the proportions of respondents giving answers in particular categories. Comparisons of categories (e.g., men/women, Sweden/Nigeria) with a clear difference in proportions would be statistically significant, due large samples. We did not test comparisons (by chi-square test, for instance) due to non-random selection of respondents in the surveys (statistical inference requires random sampling), non-independence (repeated test using the same respondents) and 'significance by chance' (one test in twenty would on average automatically be statistically significant with $P<0.05$). Instead, we give n-value and percentages in the graphs, making it possible to use our data for a test of a certain comparison for anyone interested in doing so (keeping in mind the problems above).

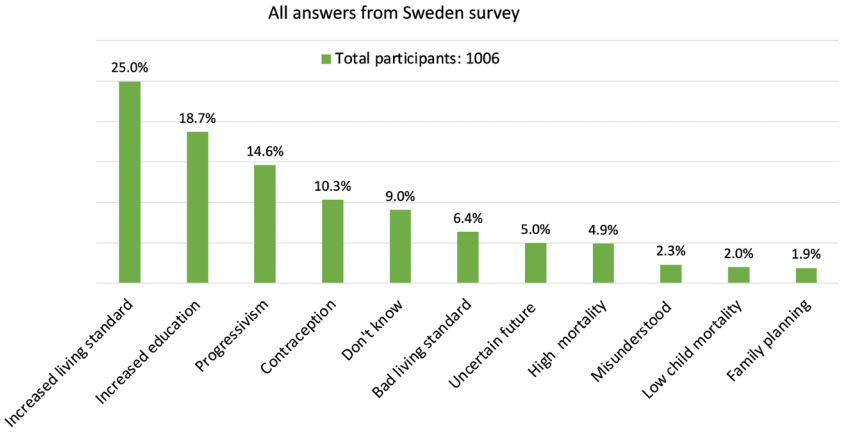
We present results for Sweden first, then Nigeria, and finally direct comparison of countries.

Results

Sweden

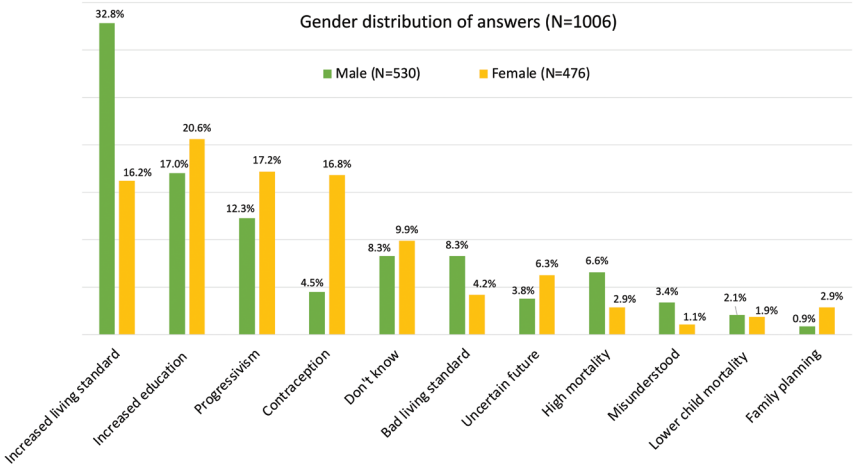
Figure 2 shows categories of answers to the question, 'Which factor do you think is most important for falling birth rates in developing countries?' Six categories of answers, comprising 72 per cent of the respondents, suggest improved conditions as the reason: better living standards, increased education, progressivism, contraception, low child mortality and family planning. Four categories, comprising sixteen per cent of respondents, suggested worse conditions for people: bad living standards, uncertain future, high mortality. Eleven per cent of respondents were categorised under don't know or misunderstood (Figure 2).

Figure 2. Categories of answers to survey question 'Which factor do you think is most important for falling birth rates in developing countries?' by Swedish respondents.



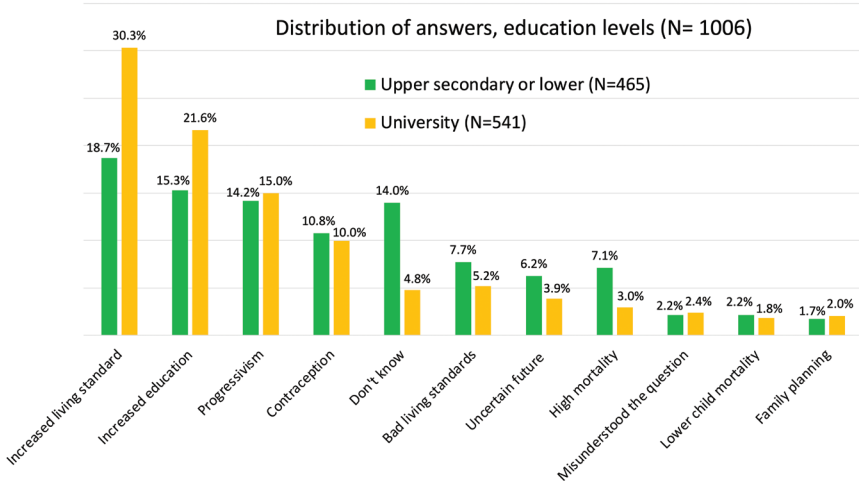
Male and female respondents differed more clearly in six categories of answers (Figure 3): men emphasised increased living standards, bad living standards and high mortality, while women emphasised contraception, uncertain future and family planning more than men did. The strongest difference existed for the answer contraception (Figure 3). Men and women differed least in the categories don't know and reduced child mortality (Figure 3).

Figure 3. Categories of answers to survey question 'Which factor do you think is most important for falling birth rates in developing countries?' by Swedish respondents.



Well educated respondents (university and higher) differed from those with only secondary and lower education in some categories of answers (Figure 4). The well-educated emphasised increased living standards and increased education, whereas respondents with lower education were 'less positive', emphasising high mortality, don't know and some minor categories (Figure 4).

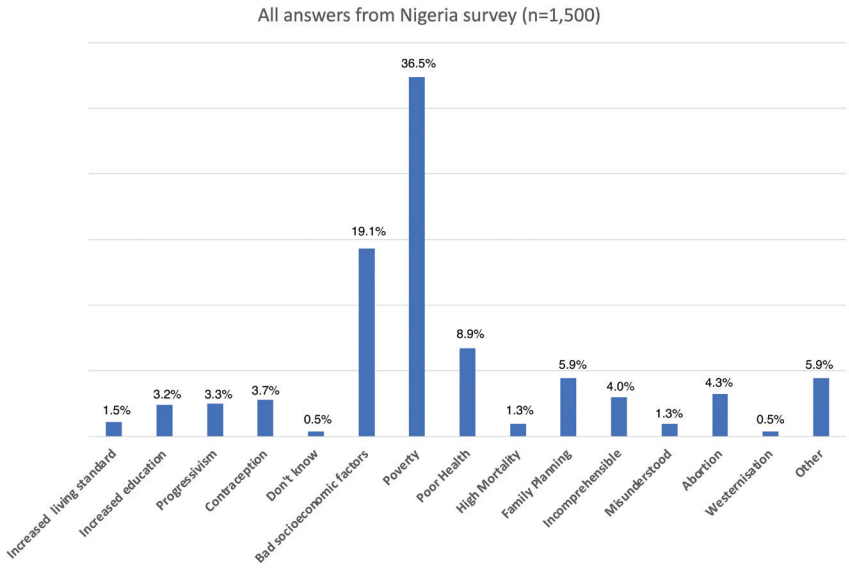
Figure 4. Categories of answers to survey question, 'Which factor do you think is most important for falling birth rates in developing countries?' by Swedish respondents.



Nigeria

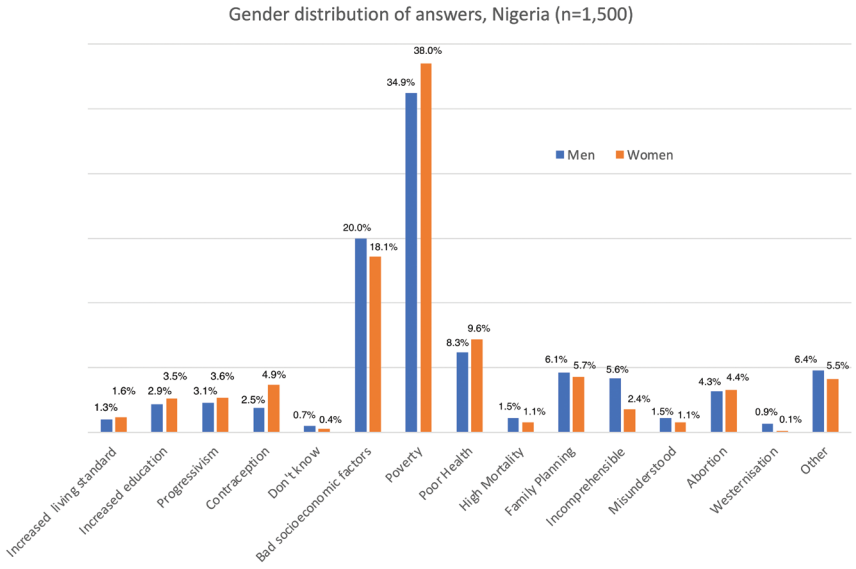
Figure 5 shows categories of answers to the question, 'For Nigeria, which factor do you think is most important for decline in birth rates (decrease in number of children per woman)?' The first five categories given on the x-axis in Figure 5 are the same as for the Swedish survey. Few respondents in Nigeria, compared to Sweden, emphasised improved living conditions as the reason for declining birth rates. Instead, bad conditions, poverty and poor health were the three most frequent categories of answers (Figure 5). A majority (66 per cent) suggested these conditions as the reason for fewer children per woman (including high mortality). Family planning was a more frequent answer in Nigeria (5.9 per cent) than in Sweden (1.9 per cent). Abortion (4.3 per cent) was also suggested but could not be classified as either 'bad' or 'good'.

Figure 5. Categories of answers to survey question, 'For Nigeria, which factor do you think is most important for decline in birth rates (decrease in number of children per woman)?' by Nigerian respondents.



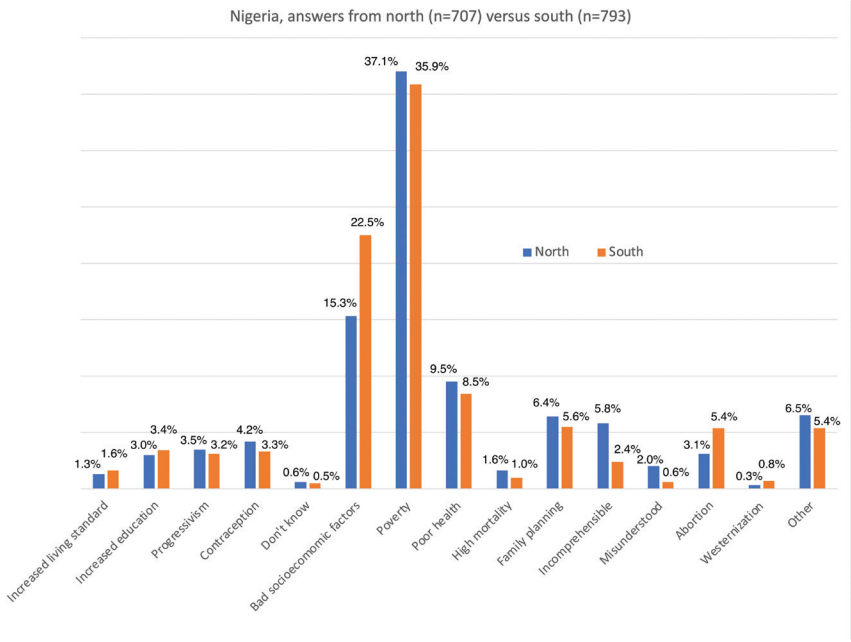
In contrast to Sweden, men and women in Nigeria tended to answer similarly (Figure 6). Slightly more women than men answered poverty and poor health, and slightly more men answered bad socioeconomic factors. As in Sweden, women were more likely than men to suggest contraceptives, though men suggested family planning approximately as frequently as did women. Men gave incomprehensible answers more often than did women (Figure 6).

Figure 6. Categories of answers by women and men to survey question, 'For Nigeria, which factor do you think is most important for decline in birth rates (decrease in number of children per woman)?' from Nigerian respondents.



Among the answers from states in northern compared to southern Nigeria, bad socioeconomic conditions and abortion were factors emphasised more in the south, while in the north we found slightly more misunderstandings and incomprehensible answers (Figure 7).

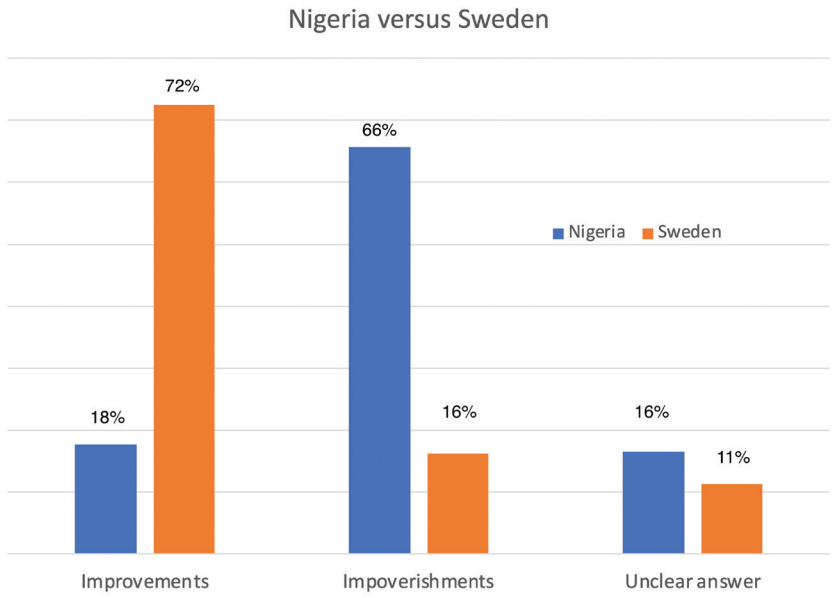
Figure 7. Categories of answers from North and South Nigeria to survey question, 'For Nigeria, which factor do you think is most important for decline in birth rates (decrease in number of children per woman)?'



Broad comparison, Sweden – Nigeria

Here we sorted the answers into three broad groups, improvements, impoverishments and unclear answers with respect to the survey question (Figure 8). The question in the Swedish survey related to developing countries in general, while the one in Nigeria related to citizens in their own country. Swedish respondents most likely would have regarded Nigeria as developing country. In Sweden, the respondents generally thought that improved conditions lead to declining fertility, whereas in Nigeria the respondents generally thought that impoverished conditions reduce fertility (Figure 8).

Figure 8. Categories of answers from respondents in Sweden and Nigeria to survey question 'Which factor do you think is most important for decline in birth rates (in developing countries / in Nigeria)?' Categorisation follows classification of answers in Figure 1.



Discussion

We were surprised at the difference between the respondents in Sweden and Nigeria in perceived reason behind fertility decline in developing countries. The scientific literature on the determinants of fertility decline in developing countries emphasises progress (more education, family planning programmes, female empowerment, economic improvements). Our results from Sweden, where improved conditions generally were assumed to explain declining fertility, was therefore rather expected (but see below). However, educated respondents in Southern and Northern Nigeria, men as well as women, had the opinion that impaired conditions explain fertility decline in Nigeria. It is unclear whether a survey mainly or only including respondents with low education would give the same result, but one could argue that educated respondents in Nigeria should have relatively good knowledge of the situation in the country with respect to the survey question.

One interpretation of our results, if the respondents are correct, is that improved conditions in Nigeria might lead to increasing fertility or a stable high fertility level. This would have important implications for international aid. Sweden has one of the highest aid budgets per capita in the world, aiming to transfer the equivalent of one percent of its GDP annually to developing countries (including support to the UN and its agencies, aid during catastrophic conditions and more). Essentially all adult Swedes are probably aware of this goal, as it is often mentioned and discussed – it costs 5.2 billion US dollars annually at present (in 2023, 15 million US dollars was allocated to Nigeria). The answers given by Swedish respondents are probably largely based on information from education and reports in the media. Nigeria, on the other hand, is a developing country where GDP has grown strongly, mainly due to oil revenues, and with strong population growth (1970, 56 million; and 2021, 211 million, compared to Sweden 1970, 8 million; and 2021, 10.4 million). Yet Nigeria can be considered a poor country on a per capita basis (Ogunbiyi, 2023), with forty per cent of the population living below the national poverty line (World Bank 2022, corresponding figure for Sweden is sixteen per cent). The respondents in Nigeria, mainly from universities, were probably also influenced by education and media. They represented a smaller minority, compared to Swedish respondents.

The results of the survey in Nigeria might have been different if other respondents had been used. But the results are nevertheless interesting as well-educated people influence societies in many ways. Moreover, our results are consistent with a recent study of Demographic and Health Survey (DHS) in Nigeria (Odusina et al., 2020), where the mean ideal number of children in 2018 for men and women was 7.2 and 6.1, respectively. This is higher than the present TFR for Nigeria (5.4 in 2020), and the DHS data apparently reflects an average strong desire for large families in both sexes, though it may depend more on social and religious norms than on individuals' wishes (see Odusina et al., 2020; Dasgupta and Dasgupta, 2017; Turner and Götmark; 2022).

Perhaps the respondents in Nigeria were unaware of the fertility decline in Nigeria from 1985–2020. Yet we informed respondents about this decline before posing the survey question. They might also be unaware of the literature dealing with declining birth rates, if not discussed in schools and at universities. Their response could relate mainly to 'what has become worse in Nigeria for childbearing', rather than other factors influencing birth rates, studied in Nigeria and elsewhere.

A strong impression from the answers is that many people cannot afford more children at present.

In the Swedish survey, few respondents suggested Family Planning (FP), despite the strong role of FP and FP programmes in reducing high fertility in developing countries (reviewed by Bongaarts and Hodgson, 2022). One reason is the change in policy, from FP programmes to SRHR (Sexual and Reproductive Health and Rights) in the mid 1990s, after the UN's International conference on population and development in Cairo 1994 (see Bongaarts and Hodgson, 2022). It is interesting that three times as many respondents in Nigeria (5.9 per cent) compared to Sweden (1.9 per cent) answered Family Planning. According to the Nigerian Implementation Assessment Report (2015) regarding population policy, the Nigerian government in 2011 committed to provide contraceptive commodities at no cost to states. In 2014 it approved the national Family Planning Blueprint and the Task-Shifting and Task-Sharing Policy for Essential Health Care Services. FP is discussed in the media in the country (e.g. Alagboso, 2022), apparently more than in Sweden, but the contraceptive prevalence rate remains low, at about 22 per cent of couples (Odusina et al., 2020).

Many respondents in Sweden suggested that economic development favours fertility decline in developing countries, apparently because they see declining fertility rates in the West as linked to increasing economic growth and/or its consequences. However, many demographers instead point to reverse causation; a decline in fertility favours the economy (e.g. O'Sullivan, 2013; Bongaarts and Hodgson, 2022; Götmark and Andersson, 2022). A 'demographic dividend', of inreased working age proportion in the population and smaller dependent young age classes, may favour the economy. Yet, politicians and media (e.g. France24, 2016) often emphasise economic development in demographic contexts, as did respondents in Sweden. To test empirically whether TFR declines with increased GDP and consumption rate, we recently analysed longitudinal changes in many developing countries 1970–2014. The results show that changes in economic growth or household consumption were not associated with TFR declines, which, however, closely followed modern contraceptive prevalence rates (Götmark and Andersson, 2022). Modern contraception is an essential part of FP programmes, and these can lower fertility rates and contribute to UN's Sustainable Development Goals (see, for instance, Starbird et al., 2016).

Conclusions

The public is an important part in population policies. We find opposing views in the educated public in two countries about reasons for fertility decline in developing countries. In Sweden in 2022, respondents suggested the reason is mainly improved conditions for people, which agrees with research results, but the role of family planning programmes was almost unknown. In Nigeria in 2022, respondents suggested that fertility decline is due to worse socioeconomic conditions, not better conditions. In view of the role of Sweden as a committed donor country, the low public agreement between donor and receiver as regards answers to the survey question is challenging. We suggest more detailed surveys in both developed and developing countries, to inform politicians and policymakers about views and reasoning with regard to fertility decline.

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PEER REVIEWED ARTICLE

Socio-ecological drivers of the pastoralist-farmer conflict in Nigeria's Mid-Benue Trough: introducing the ethnicity dimension

Chukwudi Njoku,[1] Joel Efiong[2] and Stefano Moncada[3]

Abstract

It is not clear how different social, demographic, economic and ecological factors influence the prevalence and lethality of pastoralist-farmer conflicts in Nigeria's Mid-Benue Trough. This study introduces the ethnicity dimension alongside factors such as climate change, economic development, population density, political violence and terrorism. Data originates from secondary sources, and multinomial regression is used to model significant effects. The results suggest that ethnicity has a greater impact on the lethality of conflicts than other factors (0.038, $x^2 = 16.339$). Further results show that lethal pastoralist-farmer conflict incidents occur in areas directly affected by climate change (87.4 per cent), with low levels of economic development (77.3 per cent) and low population density (58.9 per cent). The study highlights the effect of the multi-ethnic nature of the area as a main driver of lethal conflicts. Solutions for actions are therefore discussed for consideration by relevant authorities in efforts to integrate the ethnic diversity of the area into policy.

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Keywords: Conflict, conflict lethality, pastoralist, farmer, ethnicity, Mid-Benue Trough

1. Background to the study

Conflicts between pastoralists and sedentary Indigenous farmers continue to be a major obstacle to social cohesion and development in different parts of the world, especially in countries of the Global South, which lack the symbiotic combination of crop and livestock enterprises as practiced in the Global North (Smith 1969).

The violent conflicts between pastoralists and farmers in the West Africa have escalated in recent years, claiming thousands of lives at known flashpoints – described as zones of insecurity – especially in parts of Nigeria and Mali (UNOWAS 2018). Similar to terrorism, these conflicts engender bottlenecks in the socioeconomic development of Nigeria (Njoku et al. 2018). Notwithstanding the widespread conflicts, in many areas of West Africa, pastoralists and farmers have a history of harmonious and symbiotic relationships characterised by exchange of goods and services (International Crises Group 2017).

Nigeria is at the centre of the conflict between pastoralists and farmers, which occur in varying degrees. The current scale of violence is unprecedented (Aov et al. 2017), with large parts of Nigeria, especially the Mid-Benue Trough in central Nigeria, experiencing an escalation of the conflict, which has leaft hundreds of citizens dead, property destroyed and thousands of people displaced (SBM Intelligence 2018). For example, in 2020, 363 communities in Taraba state were recorded to have experienced incidents of pastoralist-farmer conflicts leading to the displacement of more than 70,000 people in the state (Oruonye, Ahmed and Fatima 2020). Also, there was an estimated death toll of over 2,000 persons arising from the conflict in Kaduna and Benue states in 2016 alone (International Crises Group 2017). Overall, the conflict has led to the death of at least 4,000 people since 2016 (Adebayo 2023), the displacement of thousands of people, and it has cost Nigeria approximately 14 billion US dollars due to lost potential revenues annually (Baba and Abeysinghe 2017; International Crises Group 2017).

The interaction between the two groups has led to conflicts that often originate in broader issues, such as religion, ethnicity and politics. The conflicts have been described as 'localised green wars', taking place in a milieu of demographic change, environmental degradation, resource scarcity and political instability

(Shettima and Tar 2008: 179). However, it has not yet been empirically tested how much influence such factors have on the prevalence and lethality of the conflicts. For instance, notwithstanding the attempt to link climate change and conflict by scholars (Abugu and Onuba 2015; Akinyemi and Olaniyan 2017), there is still uncertainty about the actual weight of climate events on the lethality of the conflict (Amusan, Ola and Akinyemi 2017). Moreover, the attempts by scholars to investigate the potential link between climate change and violent conflict in recent years have not yielded a consensus (Odunuga and Badru 2015; Sester, Theisen and Schilling 2016; Akinyemi and Olaniyan 2017).

Similarly, it is not certain how socioeconomic factors like population density, economic development, terrorism, political violence and ethnicity influence the prevalence and lethality of conflicts. While some authors have identified a nexus between the five factors (Tavares 2004; Blomberg and Rosendor 2009), the debate about the level of their relative impact is ongoing (Python et al. 2019). For example, Le Houerou stated that conflicts involving pastoralists are driven by several factors and that 'the effect of climate on pastoralism cannot be validly considered in isolation but should be examined within a socio-economic framework' (1985: 4). In this vein, the new violent and widespread conflicts between pastoralists and farmers have been linked to an increase in both human and livestock population (Nwalimu and Matimbwa 2019; Nwakanma and Boroh 2019).

While ethnicity has been identified as a powerful motive for violence (Hansen, Nemeth and Mauslein 2018), its effects on the pastoralist-farmer conflicts in the multiethnic Mid-Benue Trough is yet to be empirically examined. Kratli and Toulmin (2020) attempted to link the conflicts in the sub-Saharan region to ethnic differences and stereotyping, especially between the Fulani pastoralists – the biggest ethnic group among the pastoralists – and sedentary farming groups who are of other ethnicities, such as the Tiv, Idoma, Jukun andHausa. According to Krätli and Toulmin (2020), ethnicity becomes a potential source of conflict when the pastoralists do not establish social connections with local communities. This is exemplified in the Ruga of the pre-colonial era, which aided conflict resolution between Fulani pastoralists and farming groups (Ellwood 1995). The Ruga is an elected official who regulates grazing activities within his group, selecting grazing areas and migratory routes, and takes responsibility for conflict resolution within Fulani groups and between his kinsmen and farming groups (Ellwood 1995).

Ethnicity may also lead to conflict when pastoral groups exhibit 'heroic' traditions that celebrate warfare and raiding. Furthermore, it has been hypothesised that the violence between pastoralists and farmers is usually high in areas of prevailing insecurity resulting from terrorism or ethnic and political violence (UNOWAS 2018; Kratli and Toulmin 2020; Tade 2020).

Similarly, it has been noted that climate change and landscape transformation affect agricultural activities in Nigeria. The Intergovernmental Panel on Climate Change (IPPC) forecasts that these effects are likely to further strain the delicate relationship between pastoralists and farmers (Cabot 2017). Moreover, the uncontrolled loss of vegetal cover and continued aridity of northern Nigeria (Olagunju 2015) exacerbates changes in Land Surface Temperature (LST; Timbal and Arblaster 2006). This leads to a decline in land and water resources (Muhammed, Ismaila and Bibi 2015) and ultimately resource scarcity (Sester, Theisen and Schilling 2016). In this vein, Benjaminsen, Maganga and Abdallah (2009) linked the conflict between pastoralists and farmers to increased tension between the groups due to scarcity of renewable resources and population growth.

The uncertainty about the influence of socioeconomic, ecological and especially ethnic polarisation on the pastoralist-farmer conflicts in Nigeria presents a research gap. This study thus examines the effects of ecological (climate change) and socioeconomic (economic development, population density, terrorism, political violence and ethnicity) factors on the prevalence and lethality of the pastoralist-farmer conflict in Nigeria's Mid-Benue Trough, a hotspot of the conflict.

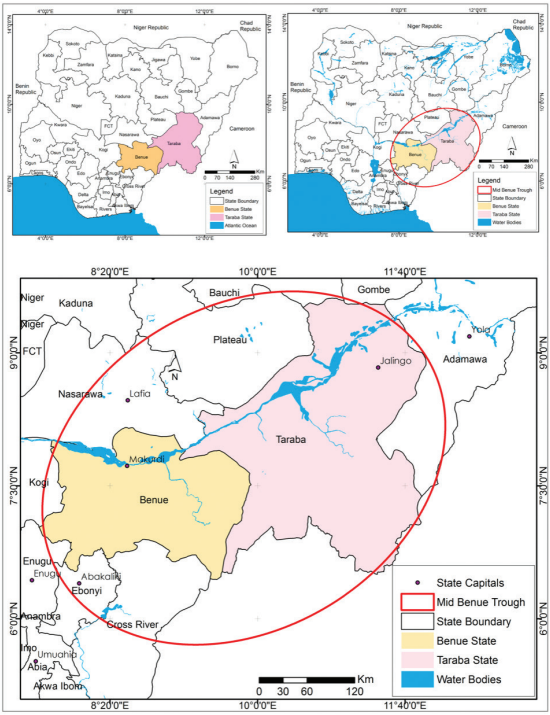
1.2 Description of study area

The study area is the Mid-Benue Trough of Nigeria, specifically, Benue and Taraba states (Figure 1). The Mid-Benue Trough is part of the Benue Trough of Nigeria, which is geologically partitioned into Lower, Middle, and Upper-Benue Trough. Benue and Taraba states are in the northcentral geopolitical zone of Nigeria. Both states are located in the Mid-Benue Trough, stretching west and east of the Benue River, from the SSouthwest, around Otukpo in Benue state, to the Northeast, around Jalingo, the capital city of Taraba state. The Mid-Benue Trough stretches latitudinally from 8°10′ to 11°40′ and longitudinally from 7°00′ to 9°30′.

The area is known to possess fertile soil and lush vegetation for farming and grazing (Isola 2018) and has been host to protracted violent conflicts. From 2001 to 2018, the conflicts are recorded to have led to about 60,000 fatalities, with more than 300,000 persons estimated to have been displaced. An estimated 176,000 were displaced in Benue and about 19,000 in Taraba alone (Babatunde 2021).

Both states are home to more than eighty ethnic groups, making the area one of the most ethnically diverse in Nigeria (Oronye 2012). According to Awopetu, Awopetu and Awopetu (2013), most of the people in the area are farmers and herders (especially on the Mambila Plateau and along the Benue and Taraba valleys), while the inhabitants of the riverine areas engage in fishing as their primary occupation.

Figure 1. Benue and Taraba states in the Mid-Benue Trough



SOURCE: AUTHORS, 2021

2. Data and methods

Types of data used for the study include continuous data of LST, population density and nighttime-lights (NTL) data. Also, discrete data of incidents and attributes (lethality) of the pastoralist–farmer conflict, incidents of political violence and terrorism were collected, as well as nominal data of ethnicity. These datasets originate from secondary sources. Table 1 shows the types and sources of data and Table 2 shows the attributes of the remotely sensed LST, population density and NTL data.

2.1 Data selection

2.1.1 Pastoralist-farmer conflict data

The pastoralist-farmer conflict data was sourced from Armed Conflict Location and Events Data (ACLED 2019). ACLED is a conflict dataset that collects reported information on internal conflicts within unstable states (Raleigh et al. 2010). The ACLED data was suitable for this study as it provided information on the lethality of the conflicts. Lethality in this study implies conflict events with at least one death. The lethality of pastoralist-farmer conflicts formed the dependent variable of the study, and only conflict incidents with at least one death were considered for the analysis. This is similar to the study of Aliyev and Souleimanov (2018), where lethality was also the dependent variable that presented the total number of deaths during conflicts.

To prepare the conflict data for analyses, the ACLED data was filtered, arranged and reduced to reports of conflicts perpetuated by or between the pastoralists and farmers in Nigeria. The edited data comprises of the following information: date, type of conflict, actor (pastoralists and/or farmers), location of events (including coordinates), number of injuries, fatalities and a brief summary of the circumstances surrounding the event.

2.1.2 Covariates

There is no consensus on which of the covariates adopted in this study is more influential in the prevalence and lethality of the pastoralist-farmer conflict in Nigeria and elsewhere. The conflict between both groups have been hypothesised to be influenced by several factors, such as climate change, environmental degradation, population explosion, religion, ethnicity, political instability. Some of these possible causal factors were adopted as covariates for this study, based on the premise of

their nexus with the existing conflict reports and literature. The covariates considered in this study include climate change, economic development, population density, political violence, terrorism and ethnicity.

The role of climate change in the prevalence and escalation of the pastoralist-farmer conflict has been identified in a number of studies (Aliyu 2015; Sester, Theisen and Schilling 2016; Akinyemi and Olaniyan 2017). Climate change was proxied by LST, which ecologists posit as useful for assessing how humans interact with and within landscapes (Meacham et al. 2016).

Other studies have highlighted the effects of socio-economic factors on the prevalence, escalation and lethality of pastoralist-farmer conflicts (e.g., Hima et al. 2019; Tavares 2004). The role of economic development in particular was highlighted in a similar study on non-state terrorism by Python et al. (2019). NTL was used as a proxy for economic development in their study as it turned out to be suitable for modelling human economic activities worldwide. NTL has been used in the same vein by several other authors (e.g., Ebener et al. 2005; Elvidge et al. 2007; Henderson, Storeygard and Weil 2009).

In the present study, NTL is used as a proxy to measure economic development. While the limitations of using NTL to measure economic development has been identified, such as the tendency to underestimate economic activities that emit less or no additional NTL (Keola, Andersson and Hall 2015), in Nigeria and elsewhere, energy is closely linked to economic development. Research shows that a higher Gross Domestic Product (GDP) correlates with greater electricity use and access (Jack 2022), and light intensity (Levin and Zhang 2017). According to Pérez-Sindín, Chen and Prishchepov (2021), the level of illumination of towns and cities is therefore important to examine patterns of socioeconomic change, especially in middle- and low-income countries like Nigeria.

Rapid population growth, informed by the demographic theory of conflict, has also been identified as a factor that explicates violent and far-reaching nature of farmer-herder conflicts (Nwakanma and Boroh 2019; Nwalimu and Matimbwa 2019). In this vein, Hauge and Ellingsen hypothesised that 'countries with high population density are more likely to experience domestic armed conflict than countries with low population density' (1998: 305). Oyama (2014) also attributed conflicts to population explosion. These assertions and inferences are in-line with

Malthusian and Neo-Malthusian conceptions of population growth and increasing land and water scarcity as primary drivers of resource conflicts (Conroy 2014).

Hauge and Ellingsen's (1998) hypothesis also linked political indicators to the prevalence and nature of conflicts. They posited that countries with stable democracies are less likely to experience violent conflicts, thus highlighting the possible role of political violence in the prevalence of pastoralist-farmer conflicts. In Nigeria, according to ACLED (2023), the electoral process coincides with a surge in violent events carried out by and against some supporters of political parties every election year. This political violence usually escalates along ethnic, sectarian and religious lines, resulting in several fatalities (Alabi 2023). Political violence in this study thus implies actions that suppress opponents, deter rival candidates from running, change voting outcomes and influence the overall electoral process. It also involves inciting hate speech and actions that stoke up intercommunal tensions along already fragile ethnic and religious lines (Oyewole 2022).

Also, the linkages between terrorism and the pastoralist-farmer conflict have been identified. Terrorism in Nigeria is characterised by organised violent attacks on targets such as government forces, institutions, individuals and groups, with the aim of undermining a lawfully constituted authority and breeding fear among the populace to advance their sociopolitical objectives (Osewa 2019). Terrorist groups in some parts of Nigeria, such as Boko Haram or their splinter group, the Islamic State West Africa Province (ISWAP), have exploited the pastoralist-farmer conflict to advance some of their activities such as recruitment, propaganda and violent attacks, which are easier to execute in an already chaotic civil state (Brottem 2021).

Ethnically polarised areas have also been shown to lead to more lethal conflicts (Python et al. 2019). Nigeria is an ethnically and socially diverse country. The Mid-Benue Trough reflects this with different groups of people who profess a shared common identity based on origin, traditions, cultural uniqueness and language (Solomon and Leith 2001). In Nigeria, the influential role of ethnicity in the conflict was attested to by Shettima and Tar (2008) but challenged by Shittu, Galtima and Dan (2016), who noted that factors such as climate change and environmental degradation are more influential. Other authors (Montalvo and Reynal-Querol 2000; Alesina et al. 2003) have used different sources to construct datasets of ethnic groups for a large sample of countries with good results. In line with this, this study adopted the ethnic-diversity data presented in a map by Went (2014).

Table 1. Types and sources of data

S/N	Data	Category	Type	Source	Period
1	Incidents and attributes (lethality) of pastoralists/farmers conflict	Secondary	Discrete	ACLED	1997 to 2019
2	Incidents of political violence	Secondary	Discrete	ACLED	1997 to 2019
3	Incidents of terrorism	Secondary	Discrete	ACLED	1997 to 2019
4	Satellite imageries	Secondary	Continuous	MODIS	2020
5	Population density	Secondary	Continuous	UNOCHA	2018
6	NTL	Secondary	Continuous	NASA	2016
7	Ethnicity	Secondary	Nominal	Went (2014)	

SOURCE: AUTHORS, 2023

Table 2: Attributes of satellite data

S/N	Dataset	Period	Time	Month	Resolution/ Sensor	Derivable	Source
1.	MODIS Land Surface Temperature and Emissivity	2020	Start: 00:00:00 End: 23:59:59	January	1000m/ MODIS Terra	LST (Day)	USGS NASA EarthData (https://lpdaac.usgs.gov/products/mod11a1v006/)
3.	DigitalGlobe high resolution population density raster	2018			30m	Population density	Facebook Connectivity Lab and Center for International Earth Science Information Network (https://data.humdata.org/dataset/highresolutionpopulationdensitymaps-nga)
4.	NTL	2016			National Oceanic and Atmospheric Administration (NOAA)	NTL	NASA (https://earthobservatory.nasa.gov/features/NightLights)

SOURCE: AUTHORS, 2023

2.2 Data-analysis techniques

To determine the linkages between the prevalence of lethal pastoralist-farmer conflicts and the covariates, the point data of the conflicts (see Appendix 1) were overlaid on each of the independent variables (LST, NTL, population density, political violence, terrorism and ethnicity) in the ArcGIS Geographic Information Systems (GIS) software application. The covariates were firstly analysed as maps and categorised into different classes (see Appendix 2 to 6). As shown in Table 3, the information obtained from the LST indices analysis was classified into five categories using the manual classification method and temperature-classification scheme adapted from Kapoi and Alabi (2013). Population density was classified into two categories; areas with low (<9) and high population densities (10–22) per 30 square metres grid. Terrorism and political violence were classified into two categories respectively, differentiating places where such events did and did not occur in the past. NTL was divided into five categories based on radiance level, while ethnicity was broken down into nine categories based on the number of major ethnic groups identified in the area. The *extract multi-values to point* tool in ArcGIS was used to extract the lethal incidents that occurred within each category of the independent variable.

To draw inference from this study, the multinomial regression analysis was used to test the hypothesis that socio-ecological factors (climate change, economic development, population density, political violence, terrorism and ethnicity) do not significantly influence the lethality of pastoralist-farmer conflicts in the Mid-Benue Trough. The regression model is expressed as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \varepsilon \quad \textit{(equation 1)}$$

Where:
y = dependent variable (lethality of pastoralist-farmer conflicts)
β = coefficients
$x_1 - x_6$ = independent variables (LST, NTL, population density, political violence, terrorism, ethnicity)
ε = error term

The data were coded as dummy, nominal and ordinal variables into the SPSS database as shown in Table 3.

Table 3: Variable classification and coding

S/n	Variable (units)	Type	Dummy value	Variable classes
1	Conflict lethality	Nominal	1	Occurrence of lethality
2	Population density (persons per 30m2 grid)	Ordinal	1	Less than 9
			2	10 to 22
3	NTL (Radiance)	Ordinal	1	Less than 8
			2	8 to 51
			3	51 to 116
			4	116 to 176
			5	176 to 224
4	Terrorism	Nominal	1	Occurrence of terrorism
			2	No occurrence of terrorism
5	Political violence	Nominal	1	Occurrence of political violence
			2	No occurrence of political violence
6	Ethnicity	Nominal	1	Idoma
			2	Tiv
			3	Jukunoid
			4	Ful
			5	Jibu
			6	Somyev
			7	Mumuye
			8	Hausa
			9	Igbo
7	LST (°C)	Ordinal	1	Very low (<25°C)
			2	Low (26°C – 29°C)
			3	High (30°C – 33°C)
			4	Very high (34°C – 37°C)
			5	Extremely high (>38°C)

SOURCE: AUTHORS, 2023

3 Results and discussions

3.1 Overlay of pastoralist-farmer conflict lethality and socio-ecological drivers

An overlay of the conflict data on each of the independent variables revealed the number of conflicts that occurred within each variable class. As shown in Table 4, there were 203 lethal conflict incidents between pastoralists and farmers (65.7 per cent) in the high-LST class areas (30–33 degrees Celsius). This implies that there was more conflict prevalence in the high-LST class. In addition, the very high-(34—37 degrees Celsius) and extremely high-LST (>38 degrees Celsius) areas recorded 39 (12.6 per cent) and 28 (9.1 per cent) lethal incidents respectively.

The hostilities between the two groups have led to several fatalities in the high-LST areas, likely due to unfavourable climatic conditions, which places further strain on the delicate relationship between pastoralists and farmers (Cabot 2017). Drawing on the eco-violence theory, Odoh and Chigozie (2012) argued that, although the immediate cause of the pastoralist-farmer conflict in Nigeria is the scarcity of natural resources, climate change is likely to be its ultimate cause.

Supporting the notion of a nexus between climate change and conflict, Akinyemi (2016) contends that 'climate change has aggravated livelihood constrictions and migratory adaptation thereby heightening agro-cultural, economic and social contestations which account for increasing incidence of resource competition and violent conflicts in Nigeria' (2016: ix). This is similar to the case of the Agogo area in Ghana where Issifu, Darko and Paalo (2022) showed that frequent clashes and conflicts between the herders and farmers are primarily caused by the competition for water and grassland use, especially during the dry seasons, where an increased number of pastoralists and farmers hustle for reduced fertile lands and water resources.

Table 4 shows the result of the analysis of the number of lethal conflicts that occurred within each population density class. Notably, there were more lethal pastoralist-farmer conflicts (58.9 per cent) in low population-density areas (0 to 9 persons per 30 square metres) and fewer lethal conflicts in locations with higher population density (10 to 22 persons per 30 square metres). As argued by Shettima and Tar (2013), this implies that violent events are more likely to occur in areas with low population density, such as suburbs, villages, farmland and rangeland. The prevalence of high incidents of conflict lethality in less densely populated

areas also suggests that population growth in the rural areas is exceeding the capacity of the available land to support increased pastoral and farming activities (Nwakanma and Boroh 2019).

Blench (2005) noted that the more land under cultivation in areas with low population density the more likely is a conflict between pastoralists and farmers to occur. To contextualise this, in the pre-colonial era, the population of Nigeria was as low as 10 million, whereas in the late nineteenth century the population had grown to 140 million (Shettima and Tar 2013). In line with this, Brottem (2021) noted that 'the rural population in the Sudano-Sahelian zone of West and Central Africa has grown by more than 40 per cent over the past 20 years and cropland has doubled in area reaching nearly 25 per cent of the total land surface' (2021: 2). This trend is said to accelerate alongside population growth, leading to increased land scarcity, especially for pastoralists, and consequently, conflicts between competing land users.

NTL was used as a proxy to measure the level of economic development in the Mid-Benue Trough. The result of the analysis in Table 4 shows that there were 242 lethal conflicts in areas with the lowest NTL-radiance class (0 to 8 watt per steradian per square metre). This represented 77.3 per cent of the total number of conflicts. The prevalence of a high number of conflicts in low-NTL areas suggests that pastoralist-farmer conflicts may be driven by under-development. Beyene (2014) claimed that socioeconomic factors are both causes and remedies for conflict. Beyene noted that socioeconomic deprivation is a significant ingredient in the process of conflict initiation. The scenario of high lethal-conflict incidents in areas of low economic development can also be explained by Hauge and Ellingsen's hypotheses that 'economic development has a higher explanatory power in the initiation and escalation of conflicts than environmental scarcity' (1998: 305).

Table 4 shows the number of lethal conflicts that occurred within communities that have also experienced terrorism. It indicates that only 42 pastoralist-farmer conflict events (13.6 per cent) occurred in locations with history of terrorism between the year 1997 and 2019. A total of 267 lethal conflicts (86.4 per cent) thus took place in locations without history of terrorism. The prevalence of pastoralist-farmer conflicts and terrorism in the same communities could imply a nexus

between the two violent events. Fulton and Nickels inferred that the conflicts between pastoralists and farmers can be worsened by the prevalence of terrorism in an area as the terrorists 'actively aggravate hostilities and manipulate ethnic and religious differences attached to different lifestyles of both groups' (2017: 2). Johnson and Okunola (2017) also linked the conflicts to terrorism, describing pastoralism as a new phase of terrorism in Nigeria. This linkage according to Fulton and Nickels is because 'general pastoralist grievances and conflicts could facilitate terrorism's push into new areas' (Ibid.). The United Nations (2021) also suggests that terrorist groups have exploited the growing tensions between herders and farmers to recruit new members. For example, in Mali, marginalised populations of herders are increasingly becoming a target of recruiters of terrorist groups; many pastoralists have actively joined terrorist groups because of anti-government and pro-pastoral causes (Benjaminsen and Ba 2021).

Political violence was shown to be prevalent in the Mid-Benue Trough. The result in Table 4 shows that, from 1997 to 2019, 151 lethal pastoralist-farmer conflicts (48.9 per cent) occurred in communities with history of political violence. Although Shettima and Tar (2013) noted that the conflicts are 'less political', the findings from this study suggest that political differences and the violence that ensues from this may be a driving factor of the conflicts. This corroborates the finding of Tade (2020) in Nassarawa state, where the tussle for election victory in 2019 was linked to the initiation and escalation of farmer-herder conflicts.

Further analysis in Table 4 revealed that Benue and Taraba states in the Mid-Benue Trough are multiethnic, thus people of different ethnic groups are neighbours or coexist in the same communities, even when there is a more dominant ethnic group. Lethal pastoralist-farmer conflicts occurred within the domains of the nine ethnic groups identified, although they were more lethal in some than others. Notably, there were more lethal conflicts (55.3 per cent) in the domain of the Tiv ethnic group. A total of 14.6 per cent of the conflicts also occurred within the Jukunoid areas and 8.7 per cent on the land of the Idoma ethnic group. According to Awopetu, Awopetu and Awopetu (2013), the majority of the people that make up these ethnic groups (Tiv, Jukunoid and Idoma) engage in farming and fishing as their primary occupation. On the other hand, only 9.1 per cent of the lethal conflicts occurred in the areas occupied by the Fulani ethnic group, who are predominantly pastoralists.

Table 4. Frequency of pastoralist-farmer conflict lethality within covariate classes

Variable	Class	Frequency	Percentage
LST (°C)	less than 25	1	0.3
	26 to 29	38	12.3
	30 to 33	203	65.7
	34 to 37	39	12.6
	greater than 38	28	9.1
	Total	309	100
Population density (persons per $30m^2$ grid)	less than 9	182	58.9
	10 to 22	127	41.1
	Total	309	100
NTL (Radiance)	less than 8	242	78.3
	51 to 116	33	10.7
	116 to 176	32	10.4
	176 to 224	2	0.6
	Total	309	100
Terrorism	occurrence of terrorism	42	13.6
	no occurrence of terrorism	267	86.4
	Total	309	100
Political violence	occurrence of political violence	151	48.9
	no occurrence of political violence	158	51.1
	Total	309	100
Ethnicity	Idoma	27	8.7
	Tiv	171	55.3
	Jukunoid	45	14.6
	Ful	28	9.1
	Jibu	18	5.8
	Somyev	3	1
	Mumuye	11	3.6
	Hausa	1	0.3
	Igbo	5	1.6
	Total	309	100

SOURCE: AUTHORS, 2023

3.2 Effects of socio-ecological drivers on pastoralist-farmer conflict lethality

The multinomial regression analysis was adopted to test the hypothesis that socio-ecological factors (climate change, economic development, population density, political violence, terrorism and ethnicity) do not significantly influence the lethality of pastoralist-farmer conflicts in the Mid-Benue Trough. The first regression output, the goodness of fit (Table 5), tests the statistical significance of the variables added to the model compared to the intercept, or constant, alone, as seen in the 'Sig.' column, $p = 0.000$. This implies that the full model statistically significantly predicts the dependent variable better than the intercept-only model.

Table 5: Model-fitting information

Model	Model Fitting Criteria -2 Log Likelihood	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept Only	123.289			
Final	72.330	50.959	18	.000

SOURCE: AUTHORS, 2023

Table 6 shows the goodness of fit, which provides two measures for assessing how well the model fits the data. The table indicates that the Pearson chi-square is not statistically significant ($p = 0.594$), meaning that the model fits the data well. The second statistic is the deviance, which, in the same way, indicates that the model fits the data well as the test shows no significance ($p = 0.570$).

Table 6: Goodness of fit

	Chi-Square	df	Sig.
Pearson	37.260	40	.594
Deviance	37.794	40	.570

SOURCE: AUTHORS, 2023

The likelihood-ratio tests displayed in Table 7 show which of the covariates are statistically significant. The result shows that population density was not statistically significant because $p = 0.086$. Also, NTL, political violence and LST were not statistically significant ($p = 0.146$, 0.503, 0.962, respectively). On the other hand,

terrorism and ethnicity were shown to be statistically significant (p = 0.009, 0.038). Specifically, ethnicity had the highest chi-square value (X^2 = 16.339), which provides strong evidence supporting the hypothesis that ethnicity most significantly influences the lethality of pastoralist-farmer conflicts in the Mid-Benue Trough.

Table 7: Likelihood-ratio tests

Effect	Model Fitting Criteria -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept	72.330(a)	.000	0	.
Population density	75.272	2.941	1	.086
NTL	77.713	5.382	3	.146
Terrorism	79.221	6.890	1	.009
Political violence	72.778	.448	1	.503
Ethnicity	88.670	16.339	8	.038
LST	72.936	.606	4	.962

SOURCE: AUTHORS, 2023

The conflict between pastoralists and farmers has been linked to demographic, socioeconomic and ecological shifts in the Sudano-Sahel Region. However, there is not sufficient evidence to suggest that the scarcity of resources or climate pressures are the primary causes of these conflicts. According to Brottem & McDonnell (2020), the pressure these factors assert are significant, but it is likely that they unfold in the background of cultural issues that are at the heart of conflicts involving both groups. The inference drawn from the hypothesis is that the multiethnic nature of the Mid-Benue Trough significantly and disproportionately influences the lethality of conflicts between pastoralists and farmers, while other factors (climate change, terrorism, economic development, political violence and population density)turned out to have less significant effects.

Although the connection between ethnicity and violent conflict is not straightforward and has been a subject of debate (Ylönen 2017), the nexus cannot be overemphasised where conflicts occur in ethnically polarised areas. Easterly (2000), for example, suggests that ethnic fractionalisation is an important driver of recurrent bloodshed on the African continent.

To buttress the role of ethnicity in the lethality of the conflicts, Hansen, Nemeth and Mauslein (2018) highlighted that ethnicity is a powerful motivation for violence as different parties usually organise along ethnic lines during a conflict. This process is termed ethnic mobilisation, where a group organises along ethnic lines to pursue a socioeconomic or political end (Nagel and Olzak 1982). When ethnicity motivates mobilisation in conflicts over natural resources, the conflict usually features overtones of ethnic claims to resources, such as the pastoralist and farming groups organising and collectively fighting to lay claim to specific lands (Wegenast and Basedau 2013).

This is likely the case in the Mid-Benue Trough, where Benue and Taraba are amongst the most ethnically diverse states in Nigeria. On the one hand, Benue State is inhabited by several ethnic groups, such as the Tiv, Idoma, Igede, Etulo, Abakpa, Jukun, Hausa, Akweya and Nyifon (Awopetu, Awopetu and Awopetu 2013). Taraba State, on the other hand, is the most diverse state in Nigeria; it is home to about 80 ethnic groups speaking around 70 languages (Oronye 2012). Among its major ethnic groups are the Jukun, Mambila, Fulani, Jango, Kuteb and the Mumuye.

Ylönen (2017) explained how ethnicity can drive conflict, noting that when physical violence occurs among individuals, it could extend to interethnic groups as the concerned persons often seek safety with the group they share specific binding identity attributes. Tade (2020) exemplified ethnicity as a trigger in Nassarawa State, where the Tiv ethnic group is a minority tussling for land resources with resident and migrating Fulani pastoralists, some of whom were displaced in Benue State, where the Tiv is a majority, due to the instituted anti-grazing law.

According to Richards (2013), rather than climate change, land expropriation and enclosure are possible drivers of the pastoralist-farmer conflict. This links the conflict to land ownership based on geographical boundaries along ethnic lines. Geographical boundaries in Nigeria are in most cases also ethnic borders. Pastoralism and crop cultivation are distinct agricultural production systems associated with specific groups. While 90 per cent of pastoralists are Fulani (ICG 2017), the farming groups are usually sedentary and have more legally recognised tenure rights over land, leading to issues around property and access rights (Shettima and Tar 2013).

This can be explained by Ostrom's (2008) common-pool resources (CPR) theory, which outlines the conditions necessary for cooperation in managing resources considered common, such as land, whosecontrol is at the centre of the pastoralist-farmer conflict. Conflicts over the utilisation of CPR are not simply material but also depend on the perceptions and affiliations of the competitors (Adams, Brockington, Dyson and Vira 2003). Thus Ostrom (2008) suggested eight principles necessary for managing CPR, such as the need to define clear group and resource boundaries, establish conflict-resolution mechanisms, self-monitoring and self-sanctions to deter rule-breaking, group member's participation in rule making and so on.

In a similar vein, Hardin (1968), in his tragedy of the commons theory, argued that indigenous land-tenure systems are often designed or structured along ethnic lines and have greatly influenced the initiation of conflicts in Africa. There is no well-defined land-tenure system in the region, causing confusion in land administration and intensifying the fight for scarce resources (Akov 2017).

In summary, this study has shown that it is necessary to include ethnicity as a regressor in empirical analysis of the drivers of the pastoralist-farmer conflict since ethnic polarisation is a significant driver of the conflict. In the same vein, Montalva and Reynal-Querol (2005) noted that ethnic diversity generates problems in the design of structural policies related to socioeconomic development. The structural problems that ensue foster corruption, such as favouritism and nepotism, and low efficiency in governments that undermine and marginalise ethnic minorities.

Chigudu (2019), however, noted that ethnic diversity is only a cause of conflict due to external factors like economic and political competition, marginalisation and inequality, which have negative impacts on ethnic diversity. This is the case because, as (Singh 2002) writes, ethnicity in itself is not a cause of violent conflict. However, it can emerge as a major fault line for violent conflicts when it gets linked to other social, economic and ecological processes in a problematic way.

4. Conclusion and recommendations

This study argues that the ethnic polarisation in the Mid-Benue Trough is the most important predictor of the conflict between pastoralists and farmers. It specifically emphasises the effects of ethnicity on the lethality of the conflicts and suggests

that climate change, population growth, economic development, terrorism and political violence cannot be considered alone or as the main factors. The results presented in this paper indicate that ethnic issues are more central to the process of development in the Mid-Benue Trough, thus special attention should be paid to the area due to its multiethnic nature. It becomes necessary to implement appropriate institutional settings and policies that reduce feelings of grievance, which seem to be high in ethnically polarised regions. Highlighting the role of ethnicity does not, however, imply that the effects of climatic, demographic, political and economic linkages should be discarded, especially due to some limitations in the data available for some of the variables used in this research.

The study finds the following arguments that could be used to further guide policy and structural changes:

i. Institutions should be set up to mitigate the adverse effects of ethnic rivalry, taking as examples the structures in other places or eras that tended to prevent the negative social and economic consequences of ethnic fractionalisation. For instance, considering its level of success, the Ruga system that was implemented in the pre-colonial era could be reintroduced. The Ruga is a social structure that helped preserve the harmony between farmers and pastoralists through an elected official who regulated grazing activities within his group and spearheaded conflict resolution between both groups.

ii. Community-based peace-building committees should be set up. These committees and their activities should be driven by neutral parties such as the State or non-governmental organisations and should be inter-ethnic, to facilitate dialogue and implement conflict-mitigation interventions.

iii. The government should ensure the protection of every group, especially the rights of ethnic minorities. This will require the engagement of trusted, independent, external actors. The physical and legal protection of the individual groups could be a collective effort of security agencies and the judiciary, who would make sure that law and order prevails and that necessary sanctions and punishments are imposed on violators.

iv. The government, through its agencies that administer lands, agriculture and borders, could increase their efforts to ensure sustainable land development, defining clear boundaries and introducing innovations in agriculture that would reduce the dependence on large expanse of land for optimal productivity.

Conflict of interest

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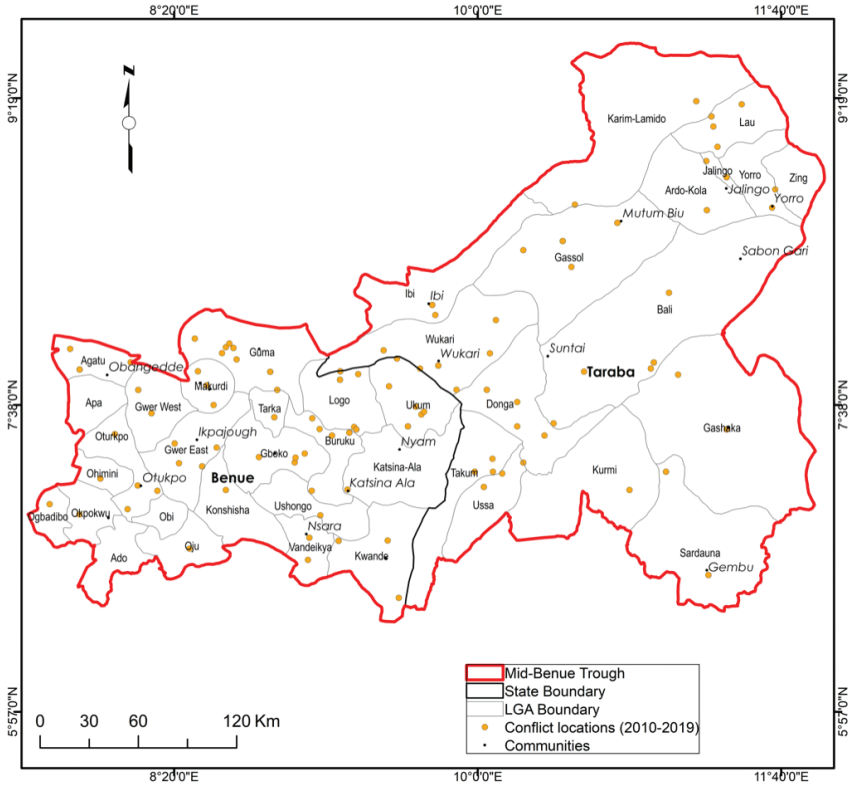
Appendices

Appendix 1: Map of pastoralist-farmer conflict incidents (1997–2019)

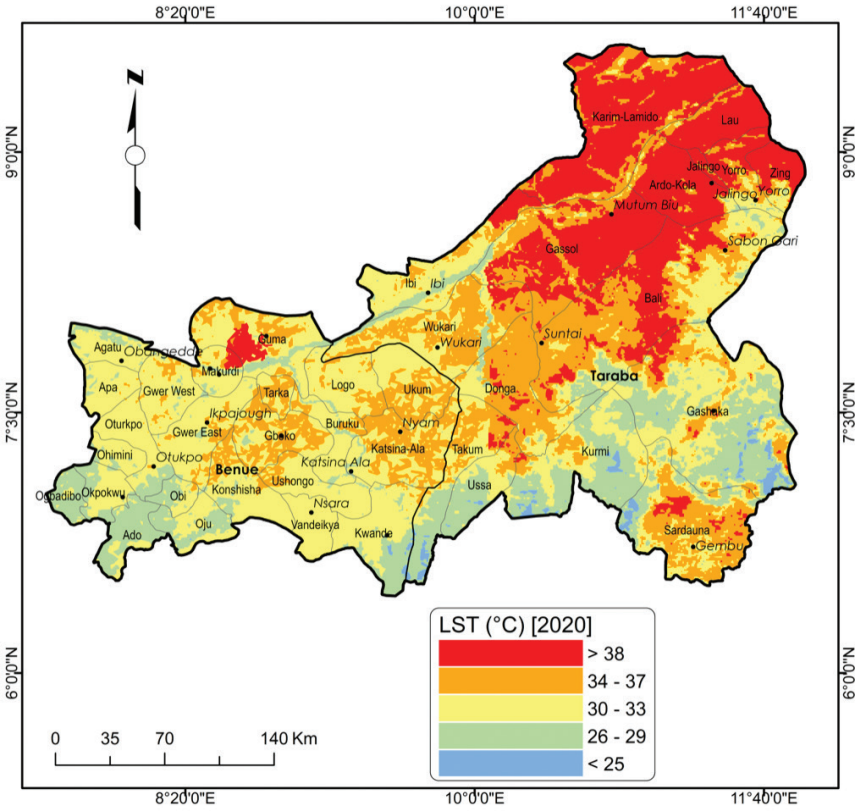


SOURCE: AUTHORS, 2023,

Appendix 2: Map of major ethnic groups in the Mid-Benue Trough

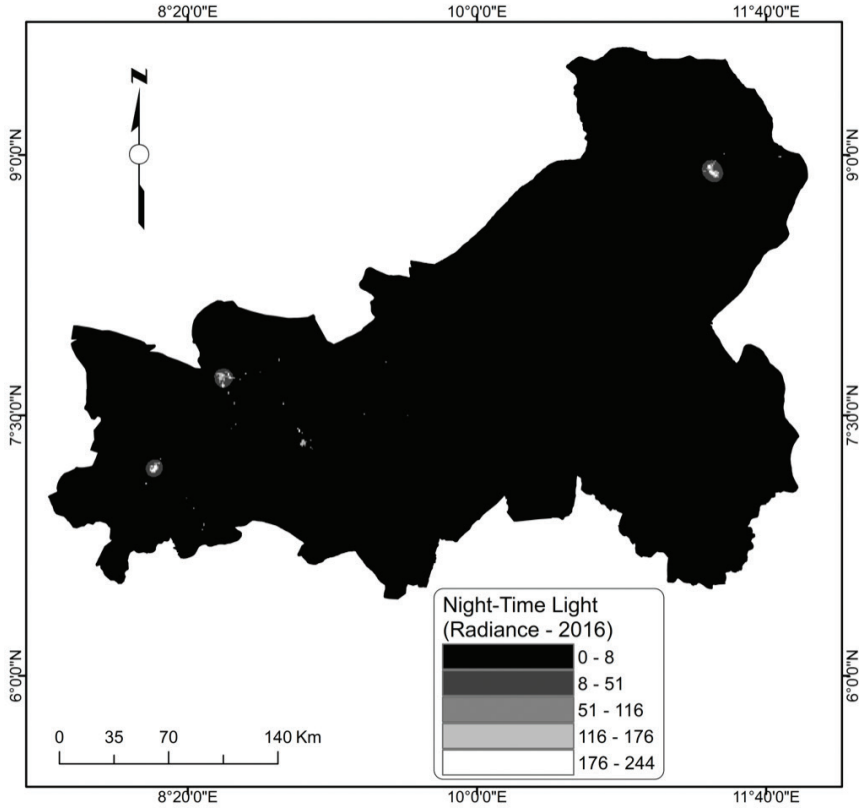
SOURCE: AUTHORS, 2023; WENT 2014

Appendix 3: Map of LST in the Mid-Benue Trough (2020)



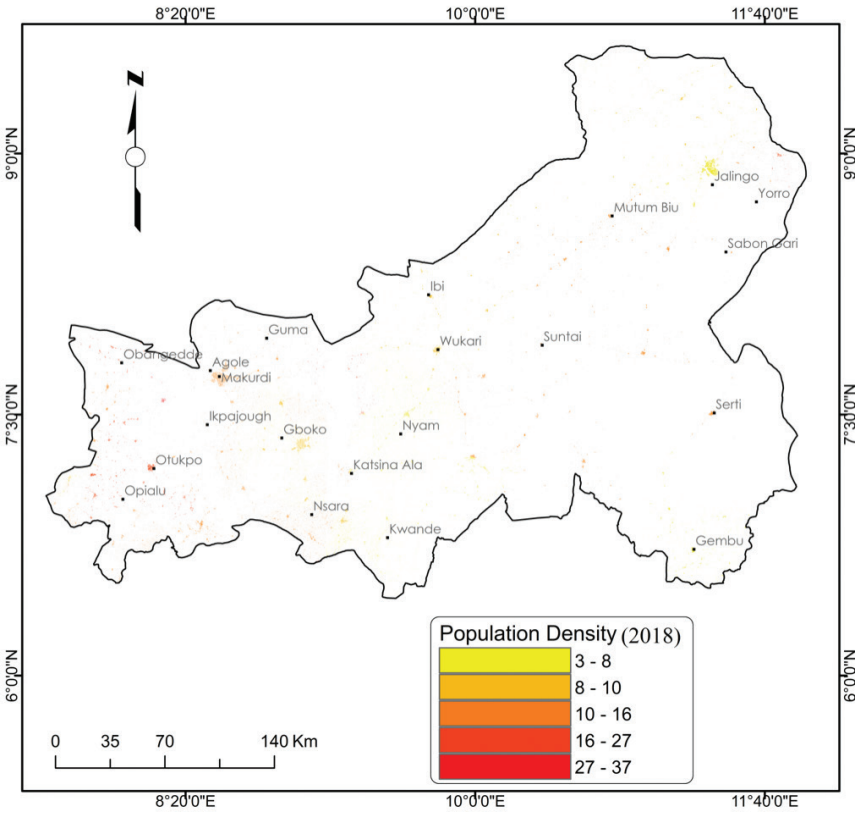
SOURCE: AUTHORS, 2023

Appendix 4: Map of NTL in the Mid-Benue Trough (2016)



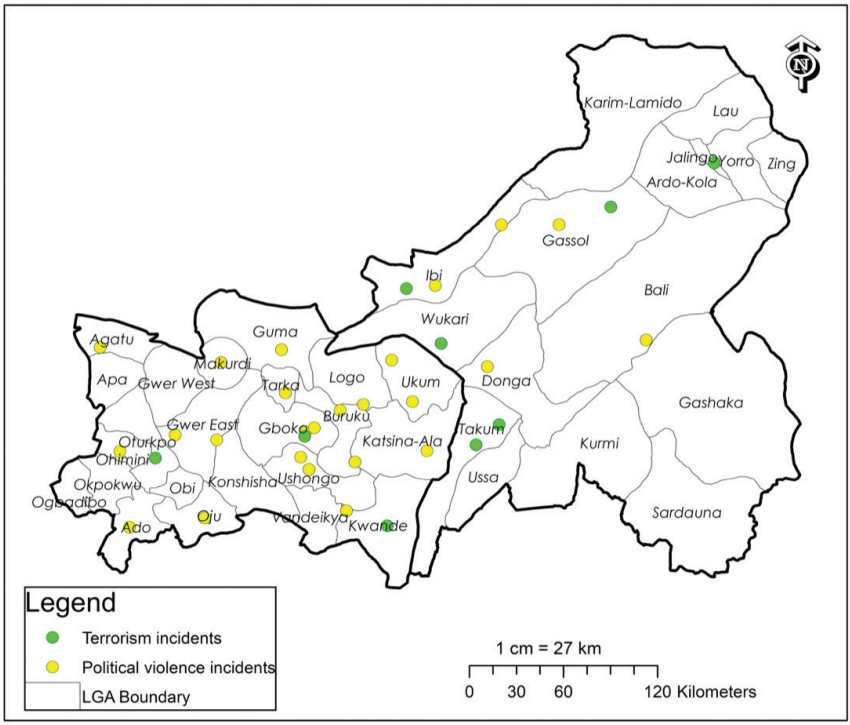
SOURCE: AUTHORS, 2023

Appendix 5: Map of population density in the Mid-Benue Trough (2018)



SOURCE: AUTHORS, 2023

Appendix 6: Map of political-violence and terrorism incidents in the Mid-Benue Trough (1997–2019)



SOURCE: AUTHORS, 2023

10.3197/JPS.63799953906868

PEER-REVIEWED ARTICLE

Contemporary extinctions and multispecies thanatopolitics

João Aldeia[1]

Abstract

Contrary to what Foucault argued, modern biopolitics is inherently thanatopolitical, i.e., it is a politics of life premised on a politics of death. This becomes clear when non-human elements are given greater relevance than Foucault afforded them. Since the reproduction of life results from interdependencies between species and abiotic elements, multispecies relations are at the core of 'a power to foster *life or* disallow *it to the point of death'. In modernity, biopolitical interventions in what Foucault defines as the* milieu *are intended to foster the lives of (certain) human populations, while they are also premised on killing non-human species. This occurs whether these species are needed to make humans live (e.g., as food) or whether they oppose the goal of fostering the lives of human populations (e.g., as pests or weeds). The ongoing proliferation and acceleration of the extinction of non-human species is one of the extreme manifestations of this thanatopolitical drive of biopolitics, showing that biopolitics promotes death to the point of eliminating entities and relationships on which the reproduction of life depends, which makes it increasingly difficult to keep intervening with the goal to 'make live'.*

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Keywords
biopolitics; extinctions; modernity; multispecies interdependencies; thanatopolitics.

Introduction
Contrary to what Michel Foucault (1978, 2003) argued, modern biopolitics is inherently thanatopolitical, i.e., it is a politics of life based on a politics of death. Death is not the limit after which the 'power to "make" live or "let" die' (Foucault 2003: 241) ends (Foucault 1978: 138; 2003: 247–248). Rather, in (capitalist,[2] colonial, Cartesian) modernity, biopolitical acts intended to 'make live' in specific ways are premised on amplifying death (Aldeia 2016, 2022; Dutkiewicz 2015; Esposito 2008, 2010, 2011). Foucault's conceptualisation of biopolitics fails to recognise this fact because it is Cartesian: it reduces non-human species to part of what he defines as the *milieu* (environment) instead of understanding biopolitics as a series of power exercises over multispecies entanglements. Since Foucault's interest lies in how human populations are shaped by biopolitical practices, he does not consider the thanatopolitical effects of these practices on non-human species.

Foucault's work is Cartesian in a peculiar manner. Foucault's subject could not be less in line with the idealist subject that constitutes itself exclusively out of its own internal capabilities and only afterwards moves into the world. For Foucault, the subject is unavoidably the dynamic result of a series of discursive and material subjective processes, which turn a certain being into a subject of a specific kind (Foucault 1975, 1978, 2004, 2009, 2014). Hence, this subject's ontology is inherently variable according to the historical and geographical setting in which its life unfolds. Foucault's work is Cartesian despite this insofar as there is a clear anthropocentric privilege in it, which takes Descartes's (2006: 51) logic of human mastery over and possession of nature for granted.

2 Since the sixteenth century, the world's dominant political ecological system is modernity – and modernity has been ontologically tied to capitalism from the start (Dussel 1995; Mignolo 1995, 2000; Moore 2009, 2010, 2015; Patel and Moore 2017). I do not deny that there are experiences of modernity that reject capitalism, such as communism. However, despite their different economic rationalities, the kinds of practices employed to govern human populations have been mostly the same in communist and capitalist modern societies (e.g., extensive bureaucratic administration, police or military violence, the scientific identification of normality and deviance) (Foucault 2003: 261; 2004: 91–94; Scott 1998). It is in this sense that Foucault argues that 'there is no autonomous socialist governmentality' (Foucault 2004: 92), i.e., the governmental rationalities employed in communist societies have mostly been taken, although not unchanged, from capitalist societies.

As several authors have made clear – with more success than Foucault (2009) – the biopolitical government of human life[3] entails the government of non-human life (Cavanagh 2018; Darier 1999; Dutkiewicz 2015; Fletcher 2017; Luisetti 2019; Lynch 2019; Malette 2009; Parenti 2016; Pugliese 2020; Wolfe 2013; Youatt 2008). However, the ways in which multispecies life is governed in modernity amplify death by making the promotion of certain ways of human and non-human life lead to large-scale death of non-humans (and not only of these). This thanatopolitical drive of modern biopolitics is clear in the contemporary and ongoing acceleration of the extinction of non-human species.

Biopolitics has never purely been the 'power to "make" live or "let" die' (Foucault 2003: 241; see also Foucault, 1978: 138), but rather is from the onset inextricable from the sovereign 'right to *take* life or *let* live' (Foucault 1978: 136, 138; 2003: 241). Given that life inevitably is the result of deep interdependencies between species, the extinction of non-human species also diminishes the condition of possibility for human life, even if this occurs heterogeneously for different social classes, regions and time periods. For privileged human populations in Western countries, such a reduction of vital possibilities is still kept at bay precisely by pushing death towards other spaces, temporalities and humans, thus further intensifying biopolitics' thanatopolitical drive. Waste produced by the mass consumption of the middle classes and elites in the Global North is dumped in marine and terrestrial ecosystems across the planet, the immediate ecological costs of large-scale industrial production are avoided by outsourcing factory work to other countries (mostly to China), and non-renewable energy sources required to maintain such lifestyles are used at the expense of future generations (of both humans and non-humans).

3 I understand the concept of 'government' in the Foucauldian sense of 'governmentality' (Foucault 2004, 2009, 2014). As Foucault puts it, 'government' should be understood here 'not in the narrow and current sense of the supreme instance of executive and administrative decisions in State systems, but in the broad sense, and old sense moreover, of mechanisms and procedures intended to conduct men, to direct their conduct, to conduct their conduct' (Foucault 2014: 12). Governmental practices are power exercises intended to shape both individuals and populations so that they act (and exist) in certain ways. These governmental acts unfold within a specific governmentality, i.e., a type of governmental rationality or, as Foucault (2014: 7) sometimes calls it, an 'art of government'. In this Foucauldian sense, governmental practices are carried out by myriad actors and not only by the executive branch of constituted political power of a nation-state.

Although Foucault's conceptualisation of biopolitics fails to acknowledge how modern governmental practices magnify death across species while they 'make live' in some way, his discussion of biopolitics is crucial to our understanding of the complex interplays between the shaping of modern human populations and the political-ecological problems of our times. In Foucault's work on regulatory controls over populations (Foucault 1978, 1980, 2003, 2004, 2009), populations are collective entities with statistical regularities whose (historically and geographically variable) behaviours and characteristics are the object of specific governmental acts intended to shape them. Each human population has a different relationship with non-human species and abiotic elements. This is because two populations never inhabit the same *milieu* and because two populations are never governed in exactly the same way, which leads to the specific features and dynamics of each human population. Such analytical sensibility helps those concerned with the relationship between population and ecological sustainability to keep in mind that the way of life of human populations is not homogeneous.

My main interest in this essay is to discuss how Foucault's work on biopolitics turns out to be limited when multispecies interactions are considered. I hope to do this in a way that provides some tentative clues for the general understanding of the complex interplays between the modern government of human populations and political-ecological unsustainability. I will delve into my analysis of Foucault's work by assuming that while the total number of human beings living on Earth contributes to political-ecological unsustainability (Haraway 2015; Mathews 2019; Samways 2022), the latter is chiefly influenced by the particular ways of life of specific human populations. While the ways of life of (mostly Western) middle classes and elites unalterably damage biotic and abiotic elements that make life possible, the ways of life of most of the world's poor humans do not have such damaging effects (Monbiot 2012; Satterthwaite 2009). Thus, the crucial aspect in the relationship between human populations and political-ecological unsustainability is the thanatopolitical manner in which the former have been governed since the onset of modernity around 500 years ago, which destroys the dynamic ecological balances between life and death.

I will start by examining the role of non-humans in Foucault's framing of biopolitics. In a series of lectures given at the Collège de France in 1977–1978, titled 'Security, Territory, Population', Foucault (2009) discusses how the biopolitical regulation

of human populations entails regulating (hence transforming) the elements that compose the *milieu*, the environment that enable the lives of these populations. In these lectures, non-human species are treated in exactly the same way as abiotic elements and human-made infrastructures, i.e., as variables that influence the life of human populations. This take on non-human species is insufficient to fully consider the act of disallowing them 'to the point of death' (Foucault 1978: 138) in biopolitical analysis. Thereafter, I will briefly outline contemporary extinction trends as they are framed in academic disciplines such as ecology, biology and palaeontology. These indicate that the extinction of non-human species has accelerated and proliferated for the last 500 years, which coincides with the beginning of modernity. I will end this essay by discussing how modern biopolitics is inevitably thanatopolitical when considered in its full, multispecies reach.

The role of non-humans in Foucault's biopolitics

Foucault's framing of the birth of modern biopolitics is well known. According to him, in Europe, until the seventeenth century, power worked primarily through the sovereign 'right to *take* life or *let* live' (Foucault 1978: 136, 138; 2003: 241). Sovereignty is a form of power derived from the ancient Roman *patria potestas* (power of the father), which granted the *pater familias* (head of the family) an absolute right over the life and death of all members of the *domus* (household), both family members and slaves (Foucault 1978: 135). Sovereignty is inherently asymmetrical insofar as it can only be expressed through the act of killing: this power is only at work in the moment that the person who exercises sovereignty kills or chooses not to kill (Foucault 1978: 136; 2003: 240–241). Sovereignty is 'essentially, a right of seizure: of things, time, bodies, and ultimately life itself' (Foucault 1978: 136) that can only function discontinuously through publicly dramatised moments of punishment or of arbitrary indulgence (Foucault 1975).

From the seventeenth century onwards, the ways in which power works have changed profoundly. Sovereignty did not end, but it became tied – and subordinated – to biopower, a form of power that seeks to promote and govern life, pushing death to a secondary role. As Foucault states: 'Death becomes, insofar as it is the end of life, the term, the limit, or the end of power too. Death is outside the power relationship' (2003: 248). The centrality accorded to governing life transforms death into the point after which biopower cannot continue to

function, thus changing power from the sovereign 'right to take life or to let live' to a 'power to "make" live and "let" die' (Foucault 2003: 241) – or, in the rather more exact phrasing found in the first volume of *The History of Sexuality*, 'a power to *foster* life or *disallow* it to the point of death' (Foucault 1978: 138).[4]

This power that has life at its centre operates in two interconnected ways: it totalises through regulatory control over populations (Foucault 1978, 1980, 2003, 2004, 2009), and it individualises through corporeal (and mental) disciplines[5] (Foucault 1975, 1999) – a duality that, according to Foucault (2006), is encapsulated in the Latin maxim *omnes and singulatim* (all and one). Whereas disciplines are 'an *anatomo-politics of the human body*', 'regulatory controls' are 'a bio-politics of the population' (Foucault 1978: 139).

The goal of biopolitics is to promote certain kinds of life, something to which the emergence of modern techno-science – from medicine to demography, all the way to urban planning and many other fields – is crucial. The scientific identification of a population's normal state (i.e., healthy, non-pathological) allows to intervene in phenomena that influence that population's life to bring it closer to this normality (Foucault 1978, 2003, 2009). Unlike the discontinuous appropriation of life and death that characterises sovereignty, biopolitics requires a continuous government of the phenomena that influence a population's life. This continuity of governmental intervention is shared by biopolitics and disciplines, although the latter involve a much more detailed and ubiquitous kind of control over individual bodies and minds (Foucault 1975, 1999). Biopolitics, on the other hand, allows behaviours at the population level to vary from the statistical norm in order to reach an adequate average or median living state (Foucault 1978, 1980, 2003, 2009). If disciplinary practices attempt to minutely control every bodily action and thought of individuals, biopolitics is concerned with guaranteeing that a population as a whole can live in specific ways despite individual outliers. For instance, the epidemiological government of a population accepts that, while some individuals inevitably die from disease at any given time, these individual

4 The second phrasing is more exact because it highlights that the push towards death that is inherent to power exercises is active and not passive.

5 For Foucault (1975), disciplines are power techniques intended to produce docile individual bodies and minds, from (religious or psychotherapeutic) confession of the self to solitary confinement over mandatory repetitive work, among other techniques.

deaths are not *per se* problematic if they are kept in sufficiently low numbers to enable the entire population to live amid disease. Likewise, when governing the hygienic behaviours of a population to lower the mortality rate, it is unavoidable that some individual conducts deviate from the scientifically defined ideal, but this is acceptable as long as collective behaviour changes enough to increase of general life expectancy.

While Foucault's account of biopolitics is anthropocentric, it does not ignore the roles played by non-human elements in power exercises aiming to '"make" live or "let" die' (2003: 241). He considers them as part of the *milieu* from which human populations take their vital conditions of possibility (Foucault 2009: 20–23, 29–30, 77–78). Foucault defines the *milieu* as 'a set of natural givens – rivers, marshes, hills – and a set of artificial givens – an agglomeration of individuals, houses, etcetera. The milieu is a certain number of combined, overall effects bearing on all who live in it' (Foucault 2009: 21).

When governmental exercises take the promotion and preservation of life of human populations as their essential objective, the *milieu* becomes the empirical field of biopolitical action. In Foucault's conceptual framework, normalising a population entails regulating the *milieu* in which its members live. In Foucault's words, 'the milieu appears as a field of intervention in which … one tries to affect, precisely, a population' (Foucault 2009: 21). It is by directly influencing the *milieu* that a governmental exercise indirectly achieves changes in the way that population experiences life (e.g., one intervenes to reduce the mortality rate by building public sanitation systems in cities so that residents are not exposed to unsanitary conditions).

By understanding human populations as subject-objects that are inextricably linked to their *milieu*, Foucault emphasises that human life is inherently dependent on non-human elements and that governing the former involves acting over the latter. In this sense, a population is 'a multiplicity of individuals who are and fundamentally and essentially only exist biologically bound to the materiality within which they live' (Foucault 2009: 21).

Non-human elements, thus, are of utmost importance for governmental exercises, which is clear in the modern connection of sovereignty and biopolitics.

The privilege of biopolitics over the 'right to *take* life or *let* live' (Foucault 1978: 136, 138; 2003: 241) does not eliminate sovereignty but fundamentally changes its goals and the means of achieving them. Subordinated to biopolitics, sovereignty becomes concerned with influencing non-human elements. Putting the right to kill in a very secondary position – at least, according to Foucault – , now,

> the sovereign deals with a nature, or rather with the perpetual conjunction, the perpetual intrication of a geographical, climatic, and physical milieu with the human species insofar as it has a body and a soul, a physical and a moral existence; and the sovereign will be someone who will have to exercise power at that point of connection where nature, in the sense of physical elements, interferes with nature in the sense of the nature of the human species, at that point of articulation where the milieu becomes the determining factor of nature (Foucault 2009: 23).

Since the reproduction of life results from multispecies interactions (Rose 2005, 2008, 2011, 2012; van Dooren 2014),[6] interrelations between humanity, non-human species and abiotic elements are at the very core of biopolitics. However, non-humans are entirely deprived of agency in Foucault's work. The *milieu* is a population's environment and non-human elements of this environment are biopolitically relevant only to the extent in which they are variables that influence the normal or abnormal state of a population, either as resources to be used in governmental acts or as obstacles to be governmentally dealt with. This Cartesian understanding of the *milieu* as the environment of a human population – that 'Great Outside' from which humanity, more or less freely, appropriates its vital resources (Aldeia and Alves 2019) – allows room for non-humans only insofar as they exist for human objectives. Thus, non-human species are part of the 'natural givens', and Foucault's account of biopolitics deals with them in the exact same way as it does with abiotic elements.

6 I will return to this point in the section entitled, 'The Thanatopolitics of Extinctions in Modernity'. Deborah Bird Rose (2005, 2008, 2011, 2012) and Thom van Dooren (2014) argue that life is the result of myriad intergenerational and coeval interactions between different species.

Foucault's discussion of the biopolitical production of nature and of the co-production of nature and humanity is largely underdeveloped. Several authors have alluded to this in their (heterogeneous) efforts to better take non-human elements into account in biopolitics, hence showing that the *milieu* as an object of biopolitical intervention is much more than a set of 'natural' and 'artificial givens' (Cavanagh 2018; Darier 1999; Dutkiewicz 2015; Flecher 2017; Luisetti 2019; Lynch 2019; Malette 2009; Parenti 2016; Pugliese 2020; Wolfe 2013; Youatt 2008). More so than Foucault's inclusion of non-humans in biopolitical analysis as parts of the *milieu* shows, the environments that humans inhabit are actively created by governmental interventions – from building infrastructures to farming and forest plantation over deforestation and scientific knowledge production (Altvater 2016; Parenti 2016; Scott 1998; Tsing 2017).

My interest here is not to further develop these arguments but rather to discuss how, by considering non-human species simply as parts of the *milieu*, Foucault's understanding of biopolitics does not sufficiently take into account the inherent dependence of governmental exercises intended to 'make live' on the promotion of death. As I argue in the following, taking multispecies relations into account makes the thanatopolitical drive of modern biopolitics clear, which is observable in today's large-scale extinction of non-human species.

Extinction trends in the past five centuries

Since the beginning of modernity around 500 years ago (Dussel 1995; Mignolo 1995, 2000; Moore 2009, 2010, 2015; Patel and Moore 2017), the extinction of species has accelerated and proliferated, reaching an uncommon magnitude compared to the natural background, i.e., the standard extinction rate in geological time. Depending on the source, current extinction rates are estimated to be somewhere between 100 times (Ceballos et al. 2015, 2020) and 1000 times (De Vos et al. 2015) above the natural background. Data presented by Ceballos et al. (2015) shows a massive increase in extinction in the past five centuries, which has accelerated significantly in the past two centuries and again in the last decades.

In late 2022, 45,187 species were 'threatened with extinction', according to the Red List of Threatened Species compiled by the International Union for Conservation of Nature (IUCN), the most widely accepted institution registering the extinction

of species. Additionally, 940 (known) species have become extinct since 1500 AD, not counting the 86 species that are 'extinct in the wild' (IUCN 2022).[7]

The true number of endangered species might be much higher since the Red List is based on incomplete data (Pimm and Raven 2019: 98–99). As of late 2022, a little over 150,000 species have been assessed by the IUCN, which, while significant, is less than 10 per cent of the species known, which, in turn, is likely to only be a fraction of all species on the planet. Furthermore, the criteria used to establish the Red List are ill-suited for taking into account the long-term effects of climate change on species and ecosystems (Cameron 2012: 54; Hannah 2012: 6).[8] Other sources, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, estimate significantly higher numbers of threatened species (IPBES 2019).

These numbers have led to the idea that we are living through the 'sixth mass extinction' event in the history of Earth (Kolbert 2014; Leakey and Lewin 1996; Sepkoski 2020: 263–283; Wilson 1992).[9] However, framing the issue in these terms conceals methodological difficulties in quantifying and comparing current and past and extinction rates: among them, the fossil record holds little information on species, frequently leading palaeontologists and biologists to work at different taxonomical levels (families or genera in the case of palaeontologists, species in the case of biologists) that are not automatically commensurable (Barnosky et al. 2011; Sepkoski 2020: 269–271).

7 For a discussion of the process of creating the Red List and its uses (and, more general, of threatened-species lists) as biopolitical technologies of calculation deployed to govern human and non-human life, see Braverman (2017). Braverman's examination of the application of computational mathematics in the creation of threatened-species lists in order to govern unknown phenomena – i.e., the risk of future extinction – is particularly interesting. Analysing extinction estimates and the technologies used to measure and classify species in threatened-species lists is, however, outside the scope of this essay. Notwithstanding the peculiarities and problems of scientifically measuring extinction, I accept the general point that the extinction of species has accelerated and proliferated in the past centuries.

8 See Mace et al. (2008) on the criteria used for the Red List.

9 The five largest (known) mass-extinction events (there have been others of smaller scale) occurred near the end of the Ordovician (c. 450 million years ago), Devonian (c. 375 million years ago), Permian (c. 252 million years ago), Triassic (c. 202 million years ago) and Cretaceous (c. 66 million years ago) geological periods (Raup and Sepkoski 1982).

Despite the difficulties in quantifying and establishing comparisons across geological time, scientific estimations of contemporary extinction rates indicate a significant increase during the last 500 years. It can be stated with reasonable certainty that, within this period and with respect to the species that are known, extinction rates have significantly accelerated. These estimates point to a geo-historical correlation between the emergence of modernity and accelerated extinction rates.

The thanatopolitics of extinctions in modernity

Either due to the inability to biologically adapt (Darwin 2008) or due to catastrophic climatic and ecological events (Cuvier 2009; Raup and Sepkoski 1982), extinction is a characteristic of planetary geological time.[10] However, the present acceleration and proliferation of extinctions are peculiar: they are the product of the magnification of death across species that results from modern forms of making life (McBrien 2016; Rose 2005, 2008, 2011; Tsing 2017, 2019; van Dooren 2014). The ecological phenomena that feed contemporary extinctions – such as rising emissions and concentration of greenhouse gases, desertification, deforestation, rising sea levels, increased toxicity and radioactivity, the proliferation of industrial waste, the extraction and depletion of energy sources, etc. – are the thanatopolitical consequence of biopolitical exercises intended to 'make live' in specific ways in modernity.

Modern biopolitics is not thanatopolitical because it amplifies the extinction of non-human species. Rather, extinction unfolds within modernity because, when considered at the full length of multispecies interdependencies, biopolitics has unavoidable thanatopolitical effects (Aldeia 2022; Dutkiewicz 2015; Lynch 2019; Pugliese 2020). Although extinction shows the thanatopolitical drive of biopolitics, the latter is thanatopolitical in itself, and before extinctions occur. Alongside extinction, other biopolitical practices that involve non-human species are clearly thanatopolitical, from the massive death machine of industrial stock breeding, which is not only predicated on large-scale slaughter but also greatly contributes

10 Darwin's argument that the extinction of species was part of biological evolution was presented against Cuvier's understanding of extinction as the result of catastrophic climatic and ecological events. In the last decades, without denying Darwin's theory of evolution, the statistical verification of the geological occurrence of mass-extinction events in the fossil record (Raup and Sepkoski 1982) has steered scientific discourses towards the idea that ecological and climatic catastrophes can lead to the massive extinction of species independently of their adaptive capabilities (Sepkoski 2020).

to the creation of zoonotic pathogens (Keck 2019; Wallace et al. 2016, 2020), to daily pest-management practices aimed at killing individuals and populations of species whose presence in farms and orchards hinders human mastery over crop commodities (Aldeia 2022; Dutkiewicz 2015; O'Gorman and van Dooren 2017; Perfecto, Jiménez-Soto and Vandermeer 2019; Philipps 2013; Scott 1998: 262–306).

In modernity, regulating the life of human populations is premised on promoting urbanisation, industrial production, mass consumption and accelerated movement by car, ship and airplane. Biopolitical interventions to normalise human populations so that their biological lives are protected require creating the epistemic and material context in which human beings can act (Foucault 2004, 2009). To govern the lives of human populations, this context must be techno-scientifically mastered, which entails transforming the non-human elements with which humans interact – from species and ecosystems to the atmosphere. Mastery requires that these non-human elements become either resources to be appropriated or obstacles to be eliminated.[11] In other words, for modernity to exist, the non-human elements of the world need to be transformed into 'the environment', i.e., the *milieu* in which humans exist and that exists solely for their purposes (Aldeia and Alves 2019). This is the essence of Cartesianism: using modern technology and science, humans (white, European, male, property owner) would become 'the masters and possessors of nature' (Descartes 2006: 51).

Creating the right environment for the lives of modern human populations requires myriad biopolitical interventions. Forests need to be cleared out so that wood can be used to build infrastructures or as an energy source for industrial production and household activities, as well as to make space for crops that would feed growing populations of humans, cattle or poultry (that will end up feeding humans). Ecosystems need to be altered to allow for monoculture and pharmaceutically supported agriculture that produces food in abundance at relatively cheap prices.[12] Land and sea need to be drilled and mined to extract raw materials for both energy sources (e.g., coal or oil) and money (e.g., silver or gold). Mountains need to be excavated and the course of rivers altered to build cities and roads to connect urban settlements.

11 On the modern relationship between mastery and ecological problems, see Plumwood (1993).

12 Jason Moore argues that cheap food is one the foundations of what he calls the 'capitalist world-ecology'. In modernity, the remaking of ecosystems is inextricable from the needs for cheap food to feed cheap labour (Moore 2015, 2016; Patel and Moore 2017).

The creation of new forms of nature occurs both intentionally and unintentionally. Some forms of nature are purposefully produced, such as new kinds of simplified plantation ecologies characterised by a relatively small number of species that are welcome and whose vital activities can be mobilised to foster the rapid and large-scale growth of commodity crops (Aldeia 2022; Haraway 2015; Haraway, Tsing and Mitman 2019; Moore 2009, 2010, 2015; Perfecto, Jiménez-Soto and Vandermeer 2019; Scott 1998: 262-306; Tsing 2017). Other forms of nature are the unintentional result of promoting modern ways of human and non-human life, such as an atmosphere with a growing concentration of greenhouse gases due to the emissions of burnt fossil fuels (Malm 2016).

Intended or not, new forms of multispecies entanglement that result from biopolitical interventions to 'make live' lead to the extinction of species through the extermination of pests and weeds, consumption of edible species or radical alteration of the ecological features of the sites where species reside. Modern biopolitics cannot operate without bringing death to non-human species (Aldeia 2022; Dutkiewicz 2015; McBrien 2016; Pugliese 2020; Rose 2005, 2008, 2011; Tsing 2017, 2019; van Dooren 2014).

This biopolitical spread of death cannot be understood without expanding Foucault's work. Foucault's conceptualisation of the roles of non-humans in biopolitics is limited by its Cartesian subordination of non-human entities – and, especially, of non-human species – to humans. This is one of the main reasons why Foucault's discussion of biopolitics wrongly assumes that death is primarily the limit after which this power 'to make live' cannot be exercised (Foucault 178: 138; 2003: 247–248). In other words, by ascribing importance to non-human species merely as factors that influence human populations, Foucault fails to see that at the core of biopolitics is not only the avoidance of death but also, paradoxically, the amplification of death. Among other things, the role of non-human species in Foucauldian biopolitics makes it impossible to fully take into account how contemporary extinctions show that modern biopolitics is inherently thanatopolitical.

Current extinctions are the result of the thanatopolitical ways in which human life is fostered in modernity. Biopolitical interventions amplify death in the form of destroyed ecosystems, depleted sources of nourishment or an unbreathable atmosphere, which makes extinction proliferate. Each new extinction further amplifies death because its consequences harm all the other species that depend

on the activities carried out by the dead one, humanity included (Rose 2005, 2008, 2011). As Deborah Bird Rose (2012) reminds us, life and death are inextricably linked both across intra-species generations and across inter-species interactions (see also van Dooren 2014). Through these sequential and synchronous bonds, 'multispecies knots' (Rose 2012) manage 'to bend death back into life' (Rose 2005: 124): dead organisms turn into nourishment for other species, whose activities allow other species to flourish, which in turn will allow the next generation of the dead organisms' species to thrive.

The extinction of a species interrupts these – agonistic or harmonious – situated inter-species relations of mutual support on which life depends. Extinction is a phenomenon of what Rose (2005) calls 'double death', an amplification of death that not only entails the death of individual bodies or populations (the first death) but also breaks the sequential and synchronous bonds between species and generations, between life and death, making the act of turning death back into life significantly more difficult (see also Rose 2008, 2011; van Dooren 2014). The result of double death is the spread of the damages of extinction to the remaining species whose life experiences depended on the support provided by the deceased one.

For Foucault, the central aims of sovereignty and biopolitics are fundamentally at odds. Whereas sovereignty is premised on death, biopolitics is focused on promoting (certain kinds of) life. According to Foucault, since biopolitics cannot be exercised once death occurs, biopolitics must operate through state racism to become predicated on death (Foucault 2003: 254–263). Emerging in the nineteenth century and gaining strength in the twentieth century (e.g., Nazism, Soviet Communism), state racism enabled power exercises to differentiate between categories within the population under its control, which were ordered hierarchically on the basis of a biological discourse on 'race'. With modern state racism, the biopolitical exercises through which the life of a human population is protected and fostered become directly dependent on the sovereign act of killing other populations: Foucault writes that 'if the power of normalization wished to exercise the old sovereign right to kill, it must become racist' (2003: 256). In other words, state racism enables the sovereign 'right to *take* life or *let* live' to express itself within the matrix of life-affirming biopolitics.[13]

13 See Mbembe (2019) for a more recent discussion of how racism and colonialism turn biopolitics into thanatopolitics – or, in his terminology, 'necropolitics'.

This Foucauldian conceptualisation of what is, essentially, the thanatopolitical impulse of biopolitics is insufficient. Instead of being something that might eventually show itself under certain specific historical circumstances, thanatopolitics is at the very core of modern biopolitics. The thanatopolitical dimension of biopolitics has been argued before, and it is clear in the exposure of bare life to sovereign acts (Agamben 1998, 2005) or in strategies employed to immunise communities (Esposito 2008, 2010, 2011).[14] These are undoubtedly important arguments to understand how biopolitics' promotion of life is predicated on death. But if one goes beyond the anthropocentric premise common to the work of Agamben and Esposito, it becomes clear that there are many other instances where biopolitics unfolds in ways that are inherently predicated on the amplification of death. Rather than being its limit, death is *condition sine qua non* of the exercise of biopolitics: to make humans live in certain ways in modernity, death needs to be pushed away from the human populations whose lives are at stake – but this can only occur by pushing it towards other human and non-human populations.

Going beyond Foucault's analysis, contemporary extinctions show that thanatopolitics is constitutive of biopolitics. If life is understood as the result of multispecies interactions and is not restricted to humans in biopolitical analysis, it can be observed that, since the beginning of modernity, attempts to 'make live' have been fundamentally dependent on killing non-human populations.

Conclusion: multispecies thanatopolitics

Foucault's conceptualisation of biopolitics is invaluable for the analysis of modernity. However, it is also limiting due to the scholar's treatment of non-human species as part of the *milieu*, which makes it impossible to fully grasp the connection of biopolitics and thanatopolitics. As I have argued, the acceleration and proliferation of extinction in modernity points to a foundational dependence of biopolitical acts intended to 'make live' on the amplification of death.

14 It is outside of the scope of this essay to discuss the works of Agamben and Esposito, which are tangential to my argument. Although they are crucial to understand thanatopolics, my point is that the centrality of death in the biopolitical objective of fostering life is clear if non-human species are considered as an integral part of biopolitics – because they are integral to the reproduction of life. I have discussed a possible extension of Esposito's arguments to multispecies relations in Aldeia (2022). A proposal to expand Agamben's ideas to political ecology (lato sensu) can be found in Smith (2011).

To understand this, the analysis of biopolitics must start with the empirically verifiable assumption that governing human populations is inextricable from governing non-human species and ecosystems. Non-human species are not merely part of the *milieu*. Rather, they are sets of living individuals who are permanently entangled in multispecies interdependencies. Life's conditions of possibility are always the result of these interdependencies, which makes an anthropocentric understanding of biopolitics inadequate. In other words, biopolitics always is a multispecies phenomenon.

A multispecies framing indicates that modern biopolitics is also always thanatopolitics. The point I have made is not that biopolitics is thanatopolitical because it amplifies extinction. Rather, it amplifies extinction because it is thanatopolitical. Governmental practices intended to 'make live' in modern ways are inherently premised on a duality between life and death in which (certain kinds of) human life can only be fostered at the expense of making death proliferate among non-human species – and also among other human populations besides the ones whose lives are being fostered, but this was outside the scope of this essay. Hence, understanding biopolitics as a type of power that has its limit in death is misleading. More so than sovereignty, which separates life and death insofar as it can only operate through the latter, modern biopolitics merges life and death in its life-fostering practices, although this interrelation is uneven insofar as life and death are distributed in different ways to different populations – and even to different species. By continuously intervening in multispecies entanglements to foster the lives of human populations, modern biopolitics keeps amplifying death in ways that ultimately oppose the promotion of life. To put it in Foucault's terminology, as governmental practices keep intervening in the *milieu* to regulate the lives of human populations, they impoverish it by eliminating living beings and relationships on which the reproduction of life depends. As time goes by, the potentialities found in the *milieu* are reduced – which inevitably makes it harder to sustain modern ways of life (or any kind of life).

Given the unavoidable amplification of death in modernity, thanatopolitics can only (possibly) end by imagining different – and undetermined – forms of multispecies relations that break away from this political-ecological system. This would most likely not end biopolitics, but it could create conditions of possibility to stop 'double death', i.e., the magnification of death that makes death start to

threaten the lives of different species instead of providing nourishment for them (Rose 2005, 2008, 2011). To borrow Roberto Esposito's (2008: 11) formulation, doing so might make it possible to change multispecies biopolitics from a 'politics over life', which is inextricable from thanatopolitics, to a 'politics of life' that aims to foster it without *a priori* deciding that only the life of a preferred phenotype, social class, place of birth or species matters. Assuming that anyone knows *a priori* whose lives should be nurtured is fraught with peril. One needs to look no further than the historically shifting interpretation of exactly who is 'human' to be aware of these dangers.

While I do not presume to provide any sort of normative answer to what such a multispecies biopolitics should be like, I do think that it is important to highlight that the 'politics of life' needed to break away from modern thanatopolitics must nurture life as a whole, which is not compatible with nurturing all potential (future) lives across different species. The point of such an emancipatory biopolitics is providing the conditions of possibility for all humans and non-humans to experience a good life – as it might be defined in specific multispecies entanglements. This means nurturing the lives of all human beings who are currently alive and, as far as possible, the lives of non-humans – essentially, it means nurturing the lives that are harmed by multispecies thanatopolitics. But for life as a whole to be nurtured in the long term, healthy multispecies entanglements are essential, and these are not compatible with the unchecked growth of any single species – no more than they are compatible with mass consumption, unchecked industrial production or the current scale of global movement of humans, non-human species and things. Hence, an emancipatory biopolitics cannot be premised on unrestrained pronatalism or unlimited economic growth since this sooner or later disrupts local multispecies homeostasis.

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PERSPECTIVE

Scientists' warning on the problem with overpopulation and living systems

M. Lynn Lamoreux[1] and Dorothy C. Bennett[2]

Abstract

A biological system can be defined as a collection of interacting elements, organised together with a common function(s). This framework can provide valuable insights into the problematic interactions between humanity and the rest of life on earth. Life is composed of a nested hierarchy of systems, united into a vastly complex, global system of ecosystems, the biosystem. The function of the biosystem and its components is the sustainable reproduction and evolution of life. Humans have many of their own systems, including a global, commercially oriented system of corporations and social structures, which we term the corposystem. A major aim of the corposystem is endless growth for profit, which depends on endless human population growth: not sustainable on a finite planet. These two global systems are clearly in direct conflict. To preserve the biosystem, including humanity, we must align the corposystem ethic with the reality of the biosystem's needs.

Keywords: biosystem, corposystem, evolution, information, overpopulation

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Introduction

Our 'blue-green marble' – our living earth, blue waters and green plants that support the lives of animals, including us – is turning brown. Areas of brown earth, as seen from space, spread across the continents: places where lush vegetation can no longer flourish. The substance of life, the biomass, is draining out of life and into the cities (West, 2018), which cannot recycle it into living matter. Planet Earth is being depleted of life, with mass species extinctions (Kolbert, 2014), as well as climate change and degradation of soil and other ecosystems. David Suzuki, David Attenborough, William Ripple and many more biologists, with astronauts, agriculturists, medics, foresters and more, have seen that planetary life is crashing, and they have warned us (Ripple et al., 2022).

The concern is valid, the danger clear and present. But much of public opinion has minimised these warnings because: (1) we have an outdated, misleading view of evolution; (2) we believe that we can use technologies to save us as we have done with great success since *Homo sapiens* invented agriculture or used fire; (3) many people do not realise or believe that the current global crises are largely caused by human overpopulation (Bajaj and Stade 2023; Rees, 2023); (4) we believe the consequences will not be all that bad and we can adapt to any environmental changes; and (5) many people reliant on social media have learned to expect simple answers to our complex problems (Bajaj and Stade, 2023; Crist et al., 2022; Salmony, 2023; Wolf et al., 2021; Rees, 2023).

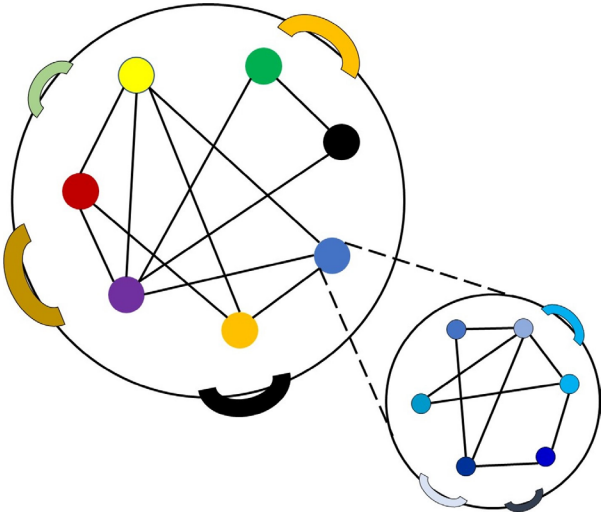
This article aims to summarise a more current view of evolution, of life relative to its environments, and of human relationships with them (Lamoreux, 2021), which may help to understand why the above five views are mistaken and how we may more appropriately address our current planetary crises. We propose that urgent and radical changes are needed in human behaviour and in our dominant social system, to move away from the unsustainable goals of profit and endless growth, and align ourselves with the overall needs of life on earth.

Biosystem and corposystem

Here we introduce key concepts: the biosystem (and how a living system can be sustainable), and the corposystem. A biological **system** can be defined as a collection of elements that interact together with a common, evolved function (Meadows, 2008) in support of life (Figure 1), although the idea of

function needs qualification at the ecosystem level and above (more below). The components of a system can themselves be systems, and so on, as happens widely in biology (Figure 1).

Figure 1. System and subsystems



The outer circles represent systems, which could be living systems. The coloured circles represent components of each system, with one expanded to show that the components are subsystems – e.g. species within an ecosystem, organ systems within an animal or organelles within a cell. The solid lines represent interactions / communication between the components (such as between flowering plant and pollinator). The arcs on the outside represent emergent properties (such as shape and colour, see text later). The interactions between components will involve emergent properties.

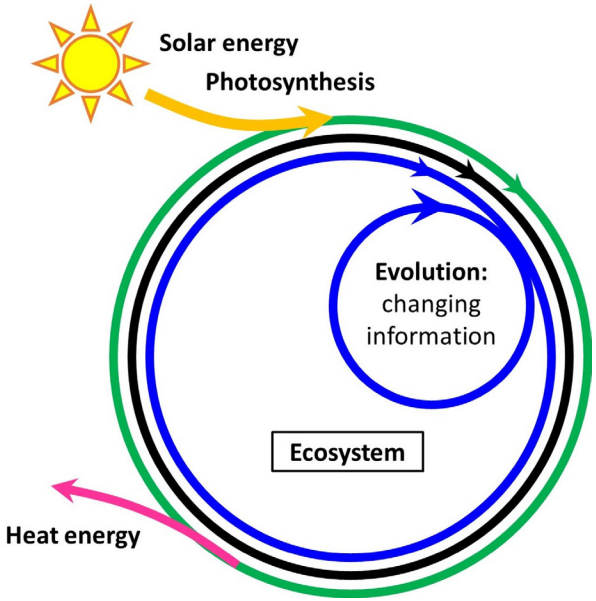
Living cells are systems composed of organelles and molecules. Organs and organ systems are composed of cells and tissues. Likewise, individual living organisms are composed of organs, species are composed of individuals and ecosystems of species. The solid lines represent the highly evolved and balanced interactions/communications among the components, whether components of a living cell or of an entire ecosystem. These living systems are also **complex adaptive systems.** Complex means that their subsystems are disparate (not all the

same), and adaptive means they can respond to their environments (Meadows, 2008). An ecosystem that is not in evolutionary steady state, for example where an invasive species has been introduced, may also become a 'complex maladaptive system', where its subsystems are in conflict (Wilson et al., 2023). Such systems will generally be unstable. The entire planetary biosphere is composed of countless interacting and overlapping ecosystems that have evolved naturally over billions of years, from simple toward complex (although not monotonically but occasionally via catastrophes and mass extinctions), to work efficiently and sustainably together; so we call it here the **biosystem**. Ecosystems and the global biosystem can be said to have a function, since natural selection operates on them and continues to select the current version. In this sense, their function is the sustenance of life. The biosystem plays an active role in the biogeochemical (combined biological, geological, and chemical) cycles of Earth (Turner, 2018).

At each level of organisation, we find **emergent** properties – properties of an entity that are not found in its component parts (Figure 1). The emergent properties of a living system are responsible for that system's particular functions, including communication with specific other systems. Examples of emergent properties at the planetary level are the global distribution of species and their migrations, and the atmospheric levels of oxygen and carbon dioxide. At a less complex level, an emergent property of an enzyme in a cell might be a specific form of catalysis.

A defining characteristic of the biosystem is its ability to sustain itself using recycling processes, while responding to changing environments using evolution (Figure 2).

Figure 2. Requirements of a sustainable living system



Yellow/incoming arrow: Energy from the sun is captured, through photosynthesis. *Green/outermost cycle*: Organic chemical energy cycles through life (food chains). *Black/next cycle in*: Organic matter recycles, carrying biological information and energy within biological structures. *Blue/two innermost cycles*: Genetic (and other biological) information, determining the processes fuelled by the energy, recycles over long timescales, modulated by evolution. *Pink/arrow leaving*: Energy released as heat, after doing work maintaining life.

Figure 2 represents minimal requirements of a sustainable living system (an ecosystem or the biosystem). Importantly, all these functions are carried out by the organic molecules of living cells, each function exquisitely tailored to the requirements of ecosystem members.

1. To capture energy from the sun (yellow/incoming arrow in Figure 2), convert it to organic chemical energy, and convey this appropriately to every living process that requires energy (green/outer cycle);

2. To recycle and propagate the information that directs life processes, including genetic information, with modifications over time in response to its environmental system (evolution) (blue/inner two cycles), and

3. To recycle the materials of which it is composed (black/intermediate cycle). Living systems recycle, making no pollution.

Because the energy input is from the sun, a sustainable living system must include organisms that can capture light energy and convert it to the organic energy of life systems: plants and some micro-organisms. For sustainability, ecosystems and the biosystem maintain and require an intricate balance among their component systems and subsystems. Importantly, animals such as humans are not sustainable on their own, but require a complete ecosystem providing food and recycling waste.

Homo sapiens is a global species, participating in many ecosystems. We have diverse interactions with other life, which are vital to our survival. The biosystem generates the many food chains that feed us, using solar energy, and is crucial in recycling much of our vast output of waste.

We humans also organise ourselves into various types of interacting human systems, though still within the biosystem – such as families, villages, colleges, orchestras, nations, social systems, corporations and so on. One global, market-oriented social and economic system, however, has come to dominate the behaviour and beliefs of many populations on the planet. This we term the **corposystem** (Lamoreux, 2021). For many humans it has replaced the biosystem as their primary experienced environment. We defined a system as having a function(s), so can the corposystem be said to have a function? Arguably, as an emergent social system, it has evolved and been selected for relative success, like living organisms and ecosystems. In this case its 'function' may be seen as what has made it survive (so far) and develop as it has: growth for profit, through competition and domination. Thus, perpetual growth is intrinsic to the corposystem and many of its subsystems and it has become, over time, better and better at promoting growth as well as normalising the idea that growth is necessary. This produces the dilemma *Homo sapiens* faces today. **The growth of the corposystem is now in conflict with the balance of the biosystem**. The goal of endless growth is causing massive changes

and loss of balanced interactions among the systems of life, beyond the capacity of the biosystem to adapt or evolve.

What is evolution?

Evolution of a living system, as currently defined, is a change over time in its genome (meaning all the heritable information in a particular system: biosystem, ecosystem, species, individual or cell). Evolution is not primarily, as many imagine, 'survival of the fittest', if fittest means strongest or most dominant (Feldman, 2022). Unfortunately, this 'red in tooth and claw' image of evolution is misleading (Ripple and Bescha, 2012; Ratajczak et al., 2022; Bishopp et al., 2010), and has contributed to a widespread and influential view of ourselves, humans, which 'portrays our basic nature as selfish, with competition as our fundamental drive' (Jinpa, 2015). The concept has probably played a significant part in establishing the corposystem attitude that self-centred competition is natural and good.

Science, however, does not see evolution as survival of the strongest individual specimens. When current physics and systems thinking (Felder, 2022; Goldsmith, 1981; Lloyd, 2008; Margulis, 1998; Page, 2009; Schumacher, 2015; Strogatz, 2008) are factored in, evolution of living systems can be described much more accurately as a collaborative balancing act (Lamoreux, 2021). As Dawkins (1982) has noted, we can speak equally correctly of natural selection acting on genes, on individuals or on interacting groups; but it is crucial to note that the first two never happen without the third. This kind of interactive evolution is called **coevolution** (Medina et al., 2022). As Bateson (1972) also pointed out, the principal unit of natural selection is a **relationship** between an individual system and the environment within which it evolved, represented as lines in Figure 1, such as flowering plants and their pollinators which coevolve to fit each other, in addition to more complex networks. Darwin's finches evolved different beaks and behaviours on different islands in relation to their different environments. By fitness, Darwin meant suitability, not strength or dominance. Like a developing embryo, and in the absence of major disruptive processes, the biosystem can propagate and evolve for very long periods, sustainably and resiliently, because of the precision of the cross-talk among the component systems and their components, honed by long evolution. As we will argue, this resilience is under major threat from humans.

It is commonly imagined that evolution always leads to improvements, or that evolution is primarily about numbers of offspring, but that is not so. True, if there are insufficient 'replicators' then a system (species or other inherited system) will not survive (Dawkins, 1982). However, a system that overpopulates or is otherwise destructive to its environmental system is also unlikely to survive, and the environmental system also may not. Or systems may become incompatible with their environments. Compatibility with the local environmental system is the measure of evolutionary survival.

When a living system becomes extinct, all of its genetic information is lost, including communication links that bind its components together, such as species into interacting sets or ecosystems, and ecosystems into the global biosystem. This information loss is also evolution and, unlike adaptation, it is permanent. The current mass extinction threatens dangerous reductions in genetic diversity in many ecosystems and loss of essential elements of the biosystem as a whole: essential in the longer term to preserve many forms of life including humans from our planetary impacts.

Evolution in terms of systems and information

We characterised life above as a system of systems of systems (etc). We introduced emergent properties (Figure 1) – those properties of any entity that are not properties of its component parts. For example, zebras are striped, but their component organs, even hairs, are not striped. It is interesting to notice that the shared emergent properties of a given type of living system (species, organ, etc) include its **phenotypes**: the name in genetics for genetically encoded physical traits. Communication between and within systems involves these phenotypes/emergent properties. For example, colour patterns can be used within an ecosystem for male-female recognition, or camouflage against predators, or attraction of a pollinator. Within our own bodies, chemical and electrochemical phenotypes are used by the organs to sustain their proper interactive balance. Communication can be defined as receiving and/or sending any kind of information. Colours, touch, chemical changes, sounds, the genetic code: these are all relevant information (Ben-Naim, 2022: Schumacher, 2015; Meadows, 2008).

Since life began, evolution has generated progressive increases in complexity, information content and levels of organisation of living systems, as well as increasing

diversity. Indeed, this concept can be traced back through the physical evolution of the universe, where, since the Big Bang, there were progressive increases in local complexity and information content of structures, through subatomic particles, then atoms, molecules, gas, stars, solar systems and galaxies (Lamoreux, 2021 and recently analysed by Wong et al., 2023). With life, there is additionally the process of natural selection of genetically transmitted traits. Here evolution has often involved recombination of simpler systems (Margulis, 1998). Cells evolved with organelles, some of which came from primitive bacterium-like cells. Simple multicellular organisms arose by combining cells. Then there were evolving interactions between species (e.g. prey-predator), self-sustaining multi-species ecosystems and eventually our overall planetary biosystem, which continues to evolve.

In this way, evolution has generated a progressive increase in genetic information content and biological complexity. The genes encode interactive behaviour as well as structure and metabolism. We cannot directly measure all the information in an organism in bits or bytes (except the genetic code, but that is only part of it). Information is also constantly flowing between living system components at each level; for example between organs in a body (neural impulses, hormones etc) and among interacting species in an ecosystem.

For sustainability, ecosystems and the biosystem maintain and require an intricate balance among each other and their component systems and subsystems. Species must be able to interact well within their ecosystems, or they will not survive, because evolution (coevolution) selects systems of which the interacting components function best together (such as a flower-pollinator pair). Lloyd (2008) proposed that the complexity of the biosystem is so great that it would take a quantum computer as long to describe it as life itself takes to live it.

Indeed, the biosystem and its components are vastly more complex and precise than we can understand in detail, an important point that has contributed to our species' falling out of balance with the biosystem. Anyone expecting simple answers to this crisis will be disappointed.

Evolution, adaptation and climate change

Adaptation by living systems is their genetically programmed ability to sense and respond to their environments. In winter, deer migrate down mountains and trees

shed leaves, then both return in the spring. Each species communicates with its environment in crucial ways, as discussed above. Many people believe that we and the biosystem can adapt in this way to climate change. They may therefore not be very concerned about environmental issues because, if it could so adapt, then our biosystem could one day return to its former fruitful cornucopia of 'environmental services' within which humans evolved. However, the recent human-associated changes, including rapid climate change and many kinds of overgrazing (abetted by corporate agriculture), are too dangerous to be ignored, because a large part of the change is evolution rather than adaptation.

We have increasingly been changing or destroying environments to which living systems are adapted, and either replacing them with our technologies and monocultures or reorganising them using foreign species. Species are out-competed through human hijacking of their food sources and habitats, to supply our billions of humans with food, habitation and transport. Other species are thus becoming extinct at a high rate (Kolbert, 2014). Such changes break the inborn links, the intricate web of naturally evolved communication among species and organisms, the result of billions of years of evolution. This leads not to adaptation but to the irreversible changes of evolution, including disruption of the balance and communications among the species that is required for the sustainability of the entire biosystem. With species loss, heritable information is lost forever.

Technology, biosystem and balance

The only proposed reaction among far too many corposystem leaders (company boards, national politicians) to our biological crisis is to ignore overpopulation, grow more, and attempt to rebalance the resulting biological imbalance using human technologies. This is inadvisable for two reasons at least: it further unbalances the biosystem, and human technologies cannot be specifically designed to efficiently address the needs of biological interactions. Life is more efficient than our technologies can be (West, 2018).

Homo sapiens has not until recently considered making major efforts to retain the ecological balance of our environment; instead, many of us are proud of the global changes that we have made in the fabric of life. Historically, humans have responded to ecosystem feedback loops and limiting factors by using technologies to eliminate them. An example is our invention of farming, producing more food

and supporting many more people (Hopfenberg and Pimentel, 2001). Another is our medical technologies that counteract infection and disease. Probably the biggest boost in our populations came with the industrial revolution, based on ancient sources of organic chemical energy, fossil fuels, which are now generating massive pollution and global heating and need to be discontinued as soon as possible.

As a result, our population has exploded. To imagine that this would not affect our relationships with the biosystem is so unrealistic that it qualifies as denial (Turner, 2018). We need to acknowledge that humanity is experiencing a classical out-of-control overpopulation event, as global population is already well beyond what is considered a sustainable level and still growing even so (Tucker, 2019; Rees, 2023). Such overpopulation events result in population crashes when a species reaches an inescapable limiting factor, such as a completely exhausted food or water supply. The population typically then crashes to well below the previous sustainable level, after which it may or may not survive.

Up to now we have used technologies, as in the Green Revolution, to extend or eliminate limiting factors. However, because of the complex interdependence of the biosystem and living systems in general, we can no longer continue this practice. The efficiency of our technologies cannot match the overall efficiency of living systems, perfected over billions of years (West, 2018). The solution to our overpopulation must not be to try further to change the biosystem, which supports our life, nor to increase energy generation, whatever the sources, as that would risk resulting in yet more people (Hopfenberg and Pimental, 2001). Further increasing efficiency of human food production is also no longer a solution; this would cause even more competition with other life forms, accelerating species extinction and irreversible loss of genetic information. If we want to sustain *Homo sapiens* within the biosystem, we must now use our brains and technologies, particularly birth control technologies, to restore or replace the checks and balances that we have overwritten with previous technologies. Otherwise, nature will 'control' us, and the suffering will be enormous.

The corposystem problem

The goal of the corposystem is not to save human life, but to make as much profit as possible, through growth, as mandated by typical corporate charters. Economic growth (say of a nation) means more total production and more

total consumption over time, which requires population growth. With a stable population, economic growth would require the average individual to continue consuming and producing more each year forever, which is of course impossible. Accordingly, the corposystem needs, and often actively promotes, human population growth, requiring ever more resource provision from the biosystem. On the contrary, for sustainability (Figure 2), the biosystem requires balance among its component systems, rather than nearly all its global resources going to a single species, humans. Moreover, with a stable or falling population, total consumption and production can stabilise or fall with no loss of living standards.

We will need radically altered economic goals if we are to rescue life on earth, including humanity. Unfortunately for its own survival, the corposystem works hard to oppose this concept of overpopulation, even to the point of demonising the word. It supports only those so-called 'solutions' that allow its continued growth, and actively denies that overpopulation threatens the balance of the biosystem. It is a growth machine, and will not voluntarily stop.

The corposystem, through extreme human expansion, has already markedly unbalanced the biosystem, with major changes and mass extinctions. After four or five billion years of success, the biosystem seems unlikely to collapse altogether. The corposystem, however, requires endless growth, which is impossible, and thus it is highly vulnerable to collapse. Various activist organisations aim to make the corposystem less harmful, which is admirable, but it is crucial that they also work to support the biosystem.

Addressing symptoms of overpopulation

Before this century we were using 'spare' biosystem resources that, like body fat, could be regenerated, as long as we did not exceed carrying capacity. But as of 2000 (data from the World Wildlife Fund), humans have been consuming more resources than can be regenerated by the biosystem. As a starving animal metabolises its own body, we are now consuming the muscle and organs of the biosystem.

To ecologists and many others, human overpopulation is clearly the underlying cause of our many resulting crises, including climate change, famine, territorial wars, pollution and so on. Yet many of those in power, and even some activists

and scientists, still deny the role of overpopulation, and focus on treating only these symptoms, if anything. The symptoms will of course continue to worsen unless we also acknowledge and eliminate their common underlying cause.

We should not relax and imagine that nature will take care of the problem. Nature will of course; it already is. The next limiting factors are here and expanding: famine, war, pollution, plague and social and economic disintegration. We are of course advocating only the humane approach to overpopulation, active reduction of birth-rates. This can be politically very challenging and can reduce population only over long time-scales, so that active reduction of consumption per capita especially in rich, highly-consuming nations is also crucial to support the biosystem (Steffen et al., 2015; Samways, 2022). Both types of action are urgent, including reduction of food waste where possible and dietary changes away from land-, water- and carbon-intensive items.

Some faith communities are being told that all is well because God will save us. But if God is the Creator, would this not be asking Him to save us from His own laws that govern the Creation? This seems inconsistent. As Lyla June Johnston (2022) says, 'When you break a system that the creator has made, you break a system that was designed to support your life.' This understanding is indeed basic to our major wisdom traditions and religions (Antal, 2018; Jinpa, 2015; Johnston, 2022; Loy, 2010, 2019; His Holiness Pope Francis, 2015; Rasmussen, 1998; Salmony, 2023). Basic science is of course much younger than the wisdom traditions, but has been forced to recognise the same limitations (Bishopp et al., 2010; Goldsmith, 1981; Ripple and Beschta, 2012; Ripple, 2022; Ratajczak et al., 2022). We humans are not the centre of the universe, or of life. There are more powerful realities that we must consider as we try to save our responsible place within the biosystem. Ignoring the reality will not change that reality, nor will it solve our problems.

The more people there are, beyond sustainable numbers, the more suffering results. While it is rewarding to help suffering people, it is heinous to increase their numbers knowingly. The danger from treating only the symptoms of our overpopulation is that, in future, the suffering people will be everyone.

We can no longer fix our problems with technologies, for reasons explained above, especially when in reality they are used to deplete the biosystem further to make

money for the corposystem and/or to support ever more humans. This will intensify the problems, by further disturbing the exquisite balance that the biosystem requires for its own wellbeing (Lamoreux, 2021). Instead, the long-term cure for *Homo sapiens* is to change our corposystem-based behaviours and attitudes (Johnston, 2022, for example), towards managing our birth-rates and consumption worldwide, as recommended by Tucker (2022) and Earth4All (Callegari and Stoknes, 2023) among others. Only thus can we return our species to a size and to behaviours that are compatible with the welfare of the planetary biosystem.

According to Tucker (2022),

> There is a large community of thoughtful practitioners who have spent decades building data-driven foundations for their programmes' effectiveness who would simply argue, 'Give us the budget to do it, and we will achieve the goal – ethically.'

In conclusion, if we want our children to survive, we must demand that our governments, media and the United Nations explain, promote and fund the urgent need to reduce our populations.

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