HOW FACTORY FARMING EMISSIONS ARE WORSENING CLIMATE DISASTERS IN THE GLOBAL SOUTH

WORLD ANIMAL PROTECTION

Table of contents

How factory farming emissions are worsening climate disasters in the Global South

World Animal Protection is registered with the Charity Commission as a charity and with Companies House as a company limited by guarantee. World Animal Protection is governed by its Articles of Association.

Charity registration number 1081849

Company registration number 4029540

Registered office 222 Gray's Inn Road, London WC1X 8HB

The front cover illustration and others in this report are from the short World Animal Protection film *"A cleaner, fairer, cruelty-free way to feed the world"* which will premiere at COP28 in Dubai – see here www.worldanimalprotection.org for more details.

Image: Kajiado County in Kenya is an area which has been adversely affected by climate change. A three year drought in the area has caused the death of animals and affected livelihoods. As a result, pastoralists here are being forced to buy hay and food. Streams that used to supply water for irrigation have completely dried up. **Credit:** World Animal Protection / Crimson Communications

1. Executive summary

2023 has been a year of climate extremes with temperature records tumbling across the world[1]. Human activities are driving these temperature records and the intensity and frequency of climate-induced weather disasters (droughts, heatwaves, wildfires, storms, and flooding) that result. Our climate crisis is deepening, and global inequality and hunger continues to grow.

Factory farming continues to expand around the world in response to urbanisation, a growing population and growing demand for meat - but this growth comes with significant cost: to our climate, environment, health and to billions of animals caught up in cruel factory farms. Factory farming releases vast quantities of Greenhouse Gas Emissions (GHGEs) across the supply chain – it is very energy intensive, relies on significant quantities of fossil fuel-based fertilisers and drives deforestation, compromising a vital carbon sink. The spread of factory farming to the Global South also threatens traditional pastoral, agroecological and smallholder livestock systems that support the livelihoods of about 1.7 billion poor people.

Whilst attribution science is still in its infancy, this report explores how GHGEs from factory farming in the Global North contributes to the frequency and intensity of droughts, heatwaves, wildfires, storms and flooding in Africa, Asia, and South America. Our analysis finds that in 2021, GHGEs from factory farms contributed an estimated 11% of global GHGs. We also found that factory farmed emissions from 34 Global North countries contributed to an estimated 4.3% of global GHGs. The most disproportionate impacts of climate induced weather disasters are felt by the poorest and most vulnerable communities in the Global South, particularly Africa and Asia, who contribute the smallest share of global GHG emissions.

This report outlines the economic costs of 13 climate induced weather disasters over a five-year period (2018 – 2022) where weather attribution data is available. For example, three of the most costly weather related disasters in 2022, attributed to climate change are; the Pakistan floods with economic costs of at least $15 billion with the cost attribution of factory farming emissions from the Global North estimated at least $0.64 billion; the prolonged drought experienced by Kenya, which has resulted in economic losses of at least $1.5 billion, with the cost attribution of factory farmed emissions from the Global North, estimated to be responsible for at least $0.06 billion worth of these costs; and the India and Pakistan heatwave with economic losses of at least $157 billion, with the cost attribution of factory farming emissions from the Global North estimated at $6.71 billion.

Unless governments change direction, the continued support for the expansion of factory farming will inevitably contribute to the rise in global GHGEs and therefore the increase in severity and frequency of climate induced weather disasters impacting the Global South.

By 2050, the economic costs of loss and damage associated with weather disasters globally could exceed $1tn every year, as the impacts of climate change intensify.

Given that factory farming contributes 11% of total GHG emissions, the industry associated with them would be liable for over $100 billion of these estimated costs.

Food and agriculture are set to take more prominence at the 2023 United Nations Climate Change Conference or Conference of the Parties (COP28) Summit, to be held in Dubai. Leaders at COP28 must deliver a strong commitment that raises climate ambition and recognises that factory farming emissions must be reduced whilst supporting the countries most impacted by climate change to adapt, including reducing their vulnerability to future climate induced weather events.

This report highlights 6 key recommendations for governments and policy makers. Specifically, governments and policy makers should impose a moratorium on factory farming for the next 10 years and remove and redirect policy and subsidy support away from factory farming towards humane and sustainable livestock production. This includes countries in the Global South where factory farming is not yet widespread. Richer countries have a moral and ethical responsibility to support countries in the Global South to promote humane and sustainable agroecological and pastoral livestock production: ultimately, they are the best solutions for long term food security, climate change mitigation and adaptation, and livelihoods.

2. Glossary

For this research, we have defined several of the most common terms used within the report:

Adaptive capacities
Refers to the ability of a system, country, or community to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with consequences. Enhancement of adaptive capacity represents a practical means of coping with changes and uncertainties in climate, including variability and extremes. A reduction of disparities, levels of climate mitigation investment, and disaster preparedness all impact on the adaptive capacity of a country.

Climate induced weather disaster
Defined as an event that is rare at a particular place and time of year, and as a pattern of extreme weather, whose frequency or intensity has increased because of climate change and has resulted in a significant number of deaths and/or disrupted the lives of a significant number of people[2].

Climate change
A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is, in addition to natural climate variability, observed over comparable time periods.

Exposure
Describes the lives, livelihoods, natural and economic assets that are geographically and temporally exposed to the effects of climatic events of a given intensity. The nature and extent of exposure will depend on the hazard, as well as the characteristics of the relevant area.

Factory farming
Intensive farming practices that do not acknowledge the sentience and welfare of animals, and where negative animal welfare, environmental and labour impacts are significant yet not factored into the costs of production. The business model is characterised by concentrated and highly corporatized management, a focus on production efficiency and process control, reliance on monocultures, high production volumes, and a strong focus on cost minimisation. These systems are associated with damaging human and planetary health.

Global North
Richer countries are almost all located in the Northern Hemisphere, apart from Australia and New Zealand. For the purposes of our analysis, we have defined Global North countries as North Amehrica (United States and Canada), Europe (including the UK), Russia, Japan, Australia, and New Zealand. Inequality exists between richer and poorer communities within these countries.

Global South
Poorer countries are mostly located in tropical regions and in the Southern Hemisphere. For the purposes of our analysis, we have focused on countries within Africa, Asia (including China) and South America.

Hazard
Refers to the potential occurrence of a natural or human-induced physical event or trend. It may lead to the loss of lives, livelihoods, and financial losses. Climate-related hazards include extreme weather events including heat waves, droughts, wildfires, floods, and storms.

Loss and damage
Loss and damage are the negative impacts of climate change that occur despite, or in the absence of, climate mitigation and adaptation. It can be economic (costs of damage or longer-term economic impacts to the economy) or non-economic (numbers of people killed/injured or displaced) in nature.

Susceptibility
The potential to weaken populations through climate induced disasters. Susceptibility is often related to levels of socio-economic development, social disparities, and deprivation.

Vulnerability
Refers to the multifaceted ways people, communities and their livelihoods are sensitive to, and can be adversely impacted by, climate-related hazards. Vulnerability to hazards is driven by a range of socio-economic and political factors.

3. Introduction

There is increasing recognition that the climate related impacts of producing more than 80 billion land animals for food annually increases the frequency and impact of climate related weather events around the world. Those countries in the Global South (particularly in Africa, Asia, and South America) are often those that are most vulnerable to the impact of the extreme weather events and pick up the costs of the loss and damages that result.

The purpose of this report and associated research is to attribute a proportion of the increased frequency and intensity of those climate related weather disasters that impact the Global South to emissions produced by factory farming systems. The main goal and significance of this work is less in the exact numbers, but more in the ability to link the impacts of factory farming emissions to the economic impacts of disasters, particularly within the Global South.

Based on attribution science and estimates of the economic impacts of loss and damage caused by the most damaging climate induced weather disasters over 5 years (2018 – 2022), we attribute the proportion of loss and damage to factory farming globally and from the Global North specifically.

Given that the human and economic costs of climate related disasters in the Global South are consistently under-reported, the attribution impacts presented here are likely to be significant underestimates. In addition, this research does not consider how climate change may affect the drivers of conflict or the potential future impacts and cost of climate related pests, diseases, and epidemics.

In summary, this research aims to:

- Establish what proportion of global GHGEs come from factory farming in the Global North.
- Propose an approach to attribute a proportion of costs or impacts of climate induced weather disasters to factory farming.
- Identify a set of case studies which look at climate induced weather disasters in the Global South and detail their health and economic impacts, attributing a portion of these impacts to Global North factory farming, where the evidence exists.
- Outline key recommendations and next steps that can be presented at the COP28 summit in Dubai for governments, policy makers and civil society organisations.

4. Factory farming, climate induced weather disasters, and the science of attribution

4.1 Factory Farming Emissions in the Global North

The burning of fossil fuels is linked to rising concentrations of greenhouse gases (GHGs), contributing to the fact that global temperatures are currently 1.2°C above pre-industrial levels[3]. Each of the last three decades have been warmer at the Earth's surface than any preceding decade since 1850. Most of this warming has occurred in the past 25 years, with 18 of the 19 warmest years on record occurring since 2000[4].

The sixth assessment report by IPCC[5] calls for decarbonization in all sectors, including food systems, in mitigating climate change. GHGs from animal agriculture are estimated at 11.2% to 19.6%[6], predominantly coming from factory farm production systems, many of which are situated in developed nations within the Global North. Over 80 billion farmed land animals are produced annually with an estimated 70% of these animals raised and slaughtered within cruel factory farm systems[7]. Factory farm systems are highly reliant on commodity feed including soy and maize. Overall, GHGs from factory farm animal feed production and processing represent 45% of total agricultural emissions[8].

Using previous calculations from World Animal Protection to determine the proportion of global animal production reared on factory farms[9], combined with data from a variety of other sources[10 11 12 13], we have calculated the carbon emissions (expressed in carbon dioxide equivalents) of factory farm emissions both in the Global North and Global South. We focus on chicken (broilers or chickens raised for meat), cattle (only beef) and pigs which are those species predominantly reared on factory farms (sheep, goats etc are reared using predominantly extensive, outdoor systems). For our analysis we use the Brandt Line[14] definition of Global North and Global South countries (although we include China in our Global South calculations). Table 1 summarises these emissions as shown on the next page.

Table 1: Carbon Emissions of Factory Farming (2021). The proportion of chicken, cattle(beef) and pigs reared within factory farms was 74%, 42% and 67% respectively. A variety of data and reference sources were used[15 16 17 18 19 20 21 22].

Country/ Region	Factory Farm Animals			kg-CO2 e					
Global North	Cattle heads	Pig heads	Chiken heads	Cattle	Pork	Poultry	Total	Per capita emissions (Tons)	
US	24,052,000	126,481,152	9,325,584,000	666,721,440,000	141,152,956,632	184,646,563,200	992,520,968,832	14.86	
EU-27	15,398,071	186,412,327	5,364,415,120	426,834,528,120	208,036,156,932	106,215,419,376	741,086,104,428	6.28	
Russia	5,089,087	34,284,557	2,106,059,160	141,069,498,570	38,261,566,081	41,699,971,368	221,031,036,019	12.10	
Canada	2,323,299	22,960,226	770,131,000	64,401,837,192	25,623,612,171	15,248,593,800	105,274,043,163	14.30	
Australia	2,780,946	3,787,755	535,329,280	77,087,823,120	4,227,134,580	10,599,519,744	91,914,477,444	5.15	
UK	1,737,450	8,420,460	1,007,920,000	48,162,114,000	9,397,233,360	19,956,816,000	77,516,163,360	15.09	
New Zealand	1,972,575	437,176	93,822,770	54,679,788,979	487,888,104	1,857,690,846	57,025,367,929	6.59	
Japan	446,114	11,617,442	667,898,390	12,366,266,220	12,965,065,685	13,224,388,122	38,555,720,027	8.57	
Global North Total	**53,799,542**	**394,401,095**	**19,871,159,720**	**1,491,323,296,201**	**440,151,622,545**	**393,448,962,456**	**2,324,923,881,202**	**10.37**	**37.31%**
Global South Total	**94,163,591**	**551,846,929**	**34,343,487,890**	**2,610,214,746,955**	**615,861,172,976**	**680,001,060,222**	**3,906,076,980,153**	**3.68**	**62.69%**
World	**147,963,133**	**946,248,025**	**54,214,647,610**	**4,101,538,043,156**	**1,056,012,795,521**	**1,073,450,022,678**	**6,231,000,861,355**	**4.61**	**100.00%**

4.2 Factory farming replaces family farming in the Global South to meet the forecast rise in global meat consumption

Globally, meat consumption from poultry, pork, beef, and sheep meat is projected to grow 16%, 17%, 8%, and 16%, respectively, by 2031[23]. Poultry meat is projected to constitute 47% of the protein consumed from meat sources, followed by pig, sheep, and bovine. Overall meat consumption is projected to grow by 30% in Africa (from a low base), 18% in the Asia and Pacific region, and 12% in the South American region[24]. As the factory farming model spreads from the Global North to the Global South to meet the forecast increased demand in meat consumption, so will the associated GHG impacts and the impacts on traditional livestock livelihoods in the Global South.

Traditional pastoral and smallholder livestock systems contribute to the livelihoods of about 1.7 billion poor people, and 70% of those employed in the sector are women[25]. These systems give people in low- and middle-income counties access to livestock derived foods which provide an important source of nutrients, family income, transport, fuel, and fertilizer inputs (manure) for crop production on mixed farms[26]. As a result, the sector plays a major part in reducing poverty, improving resilience as well as combating food insecurity and malnutrition. These wider socio-economic benefits, alongside the need to keep global warming to below 1.5 degree Celsius, are under threat from the spread of industrial factory farming.

Image: Small holder farmer Beatrice Kituku tends to her livestock on her small Kenyan farm. Farmers like Beatrice are suffering drought and subsequent crops fails and loss of livestock. This impacts their local community's food security and undermines stability. **Credit:** World Animal Protection.

4.3 Climate induced weather disasters have a disproportionate impact on the Global South

People all over the world are facing the reality of climate change – in many parts of the world this is manifesting in an increased frequency and severity of extreme weather events. From 1970-2019, the number of extreme weather events has increased by a factor of five according to data from the World Meteorological Organization[27]. Between 2000 and 2019, about 475,000 people died worldwide and losses of $ 2.56 trillion were incurred as a direct result of more than 11,000 extreme weather events[28].

In addition to becoming more frequent, extreme weather events have become more severe and unpredictable with respect to timing and location.

Those people hardest hit by climate induced weather disasters often live within communities that contribute the least to global emissions, particularly in the Global South. They tend to have fewer assets, less insurance and generally poorer access to comprehensive public services. According to Oxfam, people in poorer countries are at least four times more likely to be displaced by extreme weather than people in rich countries[29]. The loss of human lives is the most tragic example of *'loss and damage'*, a term used to describe how people, particularly the poor and most vulnerable in the Global South, are already experiencing the impacts of human-caused climate change, which is predominantly driven by the emissions of the Global North. Vulnerability (see section 2 for definitions) is often what turns an extreme weather event into a disaster. During the 2022 UN General Assembly, UN chief António Guterres described loss and damage as a *'fundamental question of climate justice, international solidarity and trust'*,– adding that *'polluters must pay'* because *'vulnerable countries need meaningful action'*[30].

In the World Risk Index 2022, Africa and Asia have a lower risk index compared to North and South America but crucially Africa, Asia and South America have the highest vulnerability, susceptibility, lack of coping and lack of adaptive capacities. These factors strongly determine the magnitude of loss and damage.

Ultimately it explains that whilst North America is exposed to a greater number of extreme climatic events, its death toll is often significantly lower than those extreme climatic events occurring within Africa or Asia, for example.

Table 2: **Adapted from the World Risk Index 2022[31]. The figures in orange highlight that whilst North America is exposed to a greater number of extreme weather events, it is Africa that is more vulnerable and susceptible to such events.**

	WRI	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
Africa	4.33	0.70	**31.26**	**30.18**	**14.80**	**60.43**
South America	13.00	8.96	22.41	19.06	12.19	47.25
Asia	5.93	1.60	21.99	15.87	12.98	43.77
Europe	2.14	0.49	8.87	6.92	5.69	29.30
North America	**20.86**	**32.74**	13.49	10.99	6.94	32.45
World	4.11	1.05	20.39	15.86	11.77	44.35

Based on data from the international disaster database (EMDAT), we analysed the observed health and economic impact of climate related disasters over a five-year period (2018 – 2022), from Asia, Africa, and South America, as shown in table 3 below. A total of 35,500 deaths were recorded over the three regions, impacting over half a billion people, and causing damages totalling over US$317 billion. Given the difficulties of attributing health and economic impacts within Global South contexts (poor monitoring, little or no insurance and research gaps relating to the long-term economic impacts of weather-related disasters), these figures are likely to be significant underestimates. For many weather disasters economic data in relation to loss and damage simply does not exist. In all cases the attributable influence of climate change on extreme weather events is increasing as global emissions and temperatures continue to rise.

Table 3: **Direct physical health and economic impacts of different types of disaster between 2018 and 2022. Data and the attributable influence of climate change on each hazard is derived from the EMDAT database[32]. These values are likely to be substantial underestimates of the true magnitude of damages which are likely to be many times higher.**

	Deaths	Total people affected	Total cost of damages ($billion)	Attributable influence of climate change on hazard severity/likelihood (confidence level)
Asia				
Floods	18,489	153,535,402	146.0	Increase (medium)
Storms	4,859	105,553,607	121.0	Rainfall increase (high)
Droughts	77	71,975,561	12.2	Increase (medium)
Wildfire	87	710,657	0.3	Increase (medium)
Heatwave	876	449,332	0.0	Increase (high)
Total	**24,388**	**332,224,559**	**280**	
Africa				
Droughts	2,465	174,172,677	2.20	Increase (medium)
Floods	5537	25,731,378	9.49	Increase (medium)
Storms	1,941	8,160,840	2.60	Rainfall increase (high)
Heatwave	8	195,000	0.00	Increase (high)
Wildfire	184	80,018		Increase (medium)
Total	**10,135**	**208,339,913**	**14**	
South America				
Wildfire	23	10,305,824	0.77	Increase (medium)
Floods	1,554	5,716,533	2.50	Increase (medium)
Storms	393	567,572	4.80	Rainfall increase (high)
Droughts	8	519,147	15.10	Increase (medium)
Heatwave	0	0	0	Increase (high)
Total	**1,978**	**17,109,076**	**23**	

Africa is an example of a continent that contributes the least to climate change (3.9% of global GHGs in 2021)[33] and yet is the most vulnerable to its impacts. African countries that contribute so little will have to spend up to five times more on adapting to the climate crisis ($53 billion will be required annually by 2030)[34]. In Somalia, there were 43,000 deaths[35] in 2022 because of the drought in the Horn of Africa, which *'would not have happened at all'* without human-induced climate change[36]. In addition, the drought is pushing 20 million people into food insecurity across the horn of Africa – and yet the region only accounts for a tiny proportion (0.59%) of global GHGs[37]. Meanwhile, G20 countries, the majority of which are in the Global North, produce around 81% of global greenhouse emissions[38].

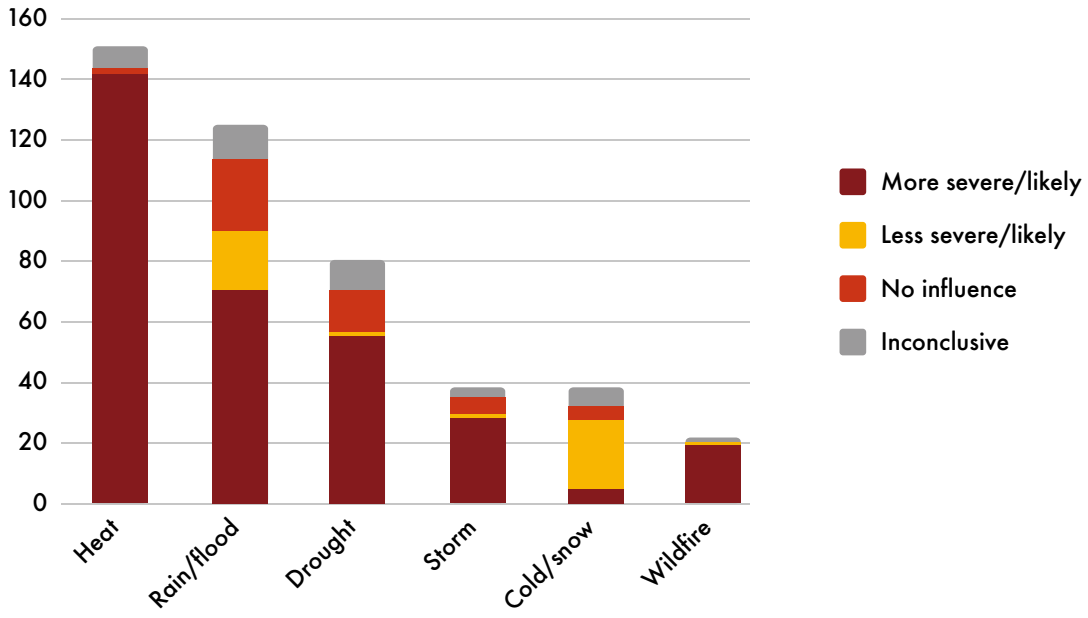
4.4 The science of climate attribution

Over the past decade, a compelling body of evidence has linked a range of extreme weather events to human-induced climate change. The IPCC[39] concludes that it is an *'established fact'* that human-induced emissions are causing temperature increases, which in turn are leading to more climate induced extreme weather events and disasters. They highlight that this is leading to more heat waves, the intensification of heavy rainfall, including that associated with tropical cyclones, and the worsening of droughts in some regions.

The use of information from climate change attribution studies to quantify damages associated with climate induced weather events, such as heatwaves, droughts, wildfires, and storms, was first proposed 20 years ago[40]. Today, this area of research, now known as 'event attribution', provides a means for climate scientists to examine how the severity and frequency of weather events are changing as greenhouse gas concentrations rise. Methodological developments have increased robustness and confidence in event attribution[41], and it is now possible to say with a high degree of confidence that the likelihood of occurrence of extreme weather events has increased due to anthropogenic climate change.

Attribution studies have the power to link the seemingly abstract concept of climate change with lived experiences of those most impacted by these climate driven disasters[42]. Analysis by Carbon Brief found that 71% of 504 of the most extreme weather events over the last 20 years were made more likely or more severe by human-induced climate change[43].

Figure 1: Chart shows the number of studies for each type of extreme event that fall within each category of human influence[44].

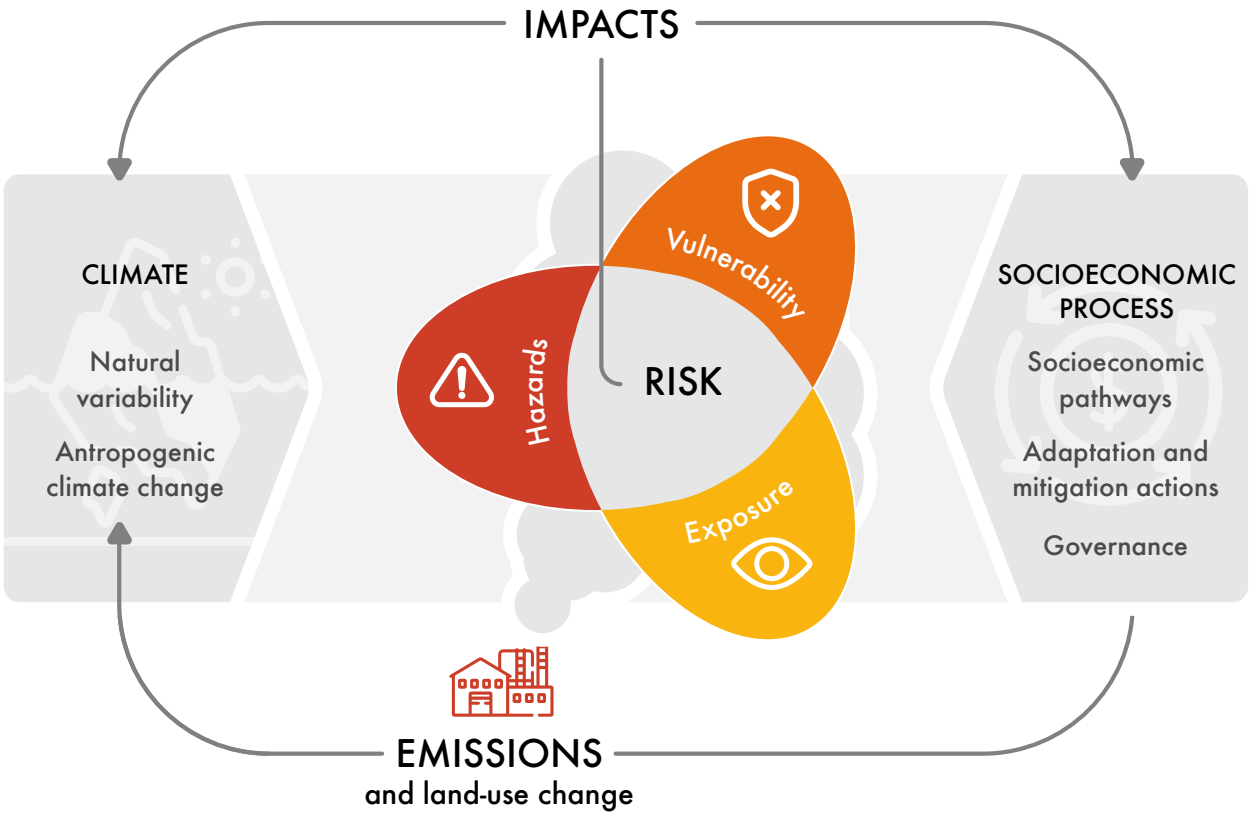


Caveats of Climate Attribution

Attributing extreme weather events to anthropogenic climate change is an imperfect science and difficult because of natural climate variability. It's also important to recognise that a wide range of socio-economic and political factors can have a significant bearing on the loss and damage caused by specific climate induced weather disasters. The damages and impacts caused are inherently a function of the vulnerabilities on the ground, with Global South countries being particularly vulnerable[45]. A climate induced weather event may cause little or no damage in a well-prepared community.

However, a vulnerable community may incur loss and damages that scale, or even multiply, with the force of the disaster. Inequality has an enormous bearing on the impacts of any climate induced disaster. The role of poverty, poor housing and other infrastructure and a myriad other social and economic conditions can have a significant impact on the magnitude of loss and damages incurred. Increasing GHGEs augment the risk of impacts from climate related disasters. Disaster risk is widely recognized as the consequence of the interaction between a hazard and the characteristics that make people and places vulnerable and exposed.

Figure 2: **Climate risks result from the interaction between hazards resulting from changes in the physical climate, the exposure of people or property to those hazards and the vulnerability of those exposed elements. Changes in the climate system (left-hand side), including anthropogenic climate change, and in a range of socio-economic factors (right-hand side), influence hazards, exposure, and vulnerability (For definitions see section 2)[46].**



5. Attributing factory farmed emissions to climate induced weather disasters in the Global South

5.1 An overview of the categories of climate induced weather disasters:

Our analysis has categorised 5 main climate induced weather disaster events that cause the highest number of deaths and damage in the Global South. These are:

1) Heatwaves:

Climate change amplifies the temperature of most heat extremes[47]. Attribution research has found that the most extreme heatwaves have become substantially more likely, or even only possible at all due to climate change. A heatwave that would once have had a chance of 1 in 10 to occur in any given year in the pre-industrial climate will now occur 2.8 (1.8–3.2) times more frequently and be 1.2 °C hotter[48]. Heatwaves are amongst the deadliest climate induced hazards with thousands of people dying from heat-related causes each year and many more suffering other severe health and livelihood consequences. It is estimated that if global temperature reaches 2°C above pre-industrial levels, the number of people in regions across the world affected by extreme heat stress could increase nearly 15-fold[49]. Heatwaves brought on by human-induced climate change have cost the global economy about $16 trillion since the 1990s, according to one study[50].

2) Droughts:

Climate change has contributed to increases in droughts in many regions due to evapotranspiration increases[51]. Warmer temperatures can increase evaporation of water from the ground. As soils become drier, the air above may heat even more, resulting in even more water evaporating, which can further worsen drought. Regions that are not adapted for longer dry spells may therefore experience more prolonged drought. Climate change has increased the likelihood of droughts occurring by at least 20 times across much of Europe and by 100 times across Africa[52]. In 2022 at least 258 million people, predominantly located in the Global South, faced hunger, a figure that has been rising in recent years, which is in part due to increases in drought in regions such as the Horn of Africa (see section 5.3)[53]. It is estimated that 34% of crop and livestock production loss in low- and middle-income countries is traced to drought, costing the sector $37 billion/annum overall. From an economic perspective, drought impacts agriculture the most, sustaining 82% of all drought impact, compared to 18% in all other sectors[54].

Image: Small holder farmers are on the front line of climate change. Farmers like John and Belice Kimanthi from Kenya are suffering drought and subsequent crops fails and loss of livestock. This impacts their local community's food security and undermines stability.

Life on the frontline of climate change: When the drought comes, you lose everything.

Belice Kimanthi, 61, remembers with nostalgia how her neighbourhood thrived in plenty until mid-1980s when life began to take a new twist.

Today the sleepy rural village of Kyamwalye in Kee ward of Makueni County, south-eastern Kenya, is a pale shadow of its former self. Indigenous trees have disappeared leaving behind large swathes of cracked, dry earth that radiate sweltering heat as the sun above burns acrimoniously.

"We used to have bumper harvests but the yields have dwindled. We didn't harvest anything for the last two seasons and what we got this time is barely enough to sustain us for long," says Belice as she wipes huge beads of sweat from her face.

Belice's family used to harvest about 30 bags of 90kg of maize on a good season. Other crops like beans, green peas and cassava also did pretty well. But that was more than10 years ago when the rainfall was frequent and the patterns predictable.

Her husband, John Kimanthi, says the rains began to dwindle while rivers and streams slowly dried up from the late 1980s affecting crop and livestock production. The family used to have between 10 and 20 cows and 30 goats, but the herd has been reduced to a mere three heifers.

"Livestock farming is no longer a viable economic activity. You can't keep enough cattle because of scarcity of grass and water. We have to buy feeds and water for the animals and the costs are very high....When the drought comes you lose everything," says Kimanthi.

"If we don't change policies and habits then we are doomed. Everyone has a responsibility to take action to save the planet. Developed countries must also compensate the rural poor in developing countries by funding projects aimed at mitigating adverse effects of climate change," he stresses.

3) Wildfires:

Wildfire risk increases because of a combination of high temperature, low humidity, drought, and high wind speed. A recent review concluded that wildfires are becoming more severe and widespread because of human-induced change[55]. The risk of wildfire has substantially increased in many regions, particularly in South America and Asia with total deaths attributable to landscape fire smoke estimated to be 33,000 annually[56]. Globally wildfires cost $50 billion annually[57]. Many regions 'are very likely' to experience a significant increase in burning by the end of the century[58] with the UN suggesting a 50% increase of extreme fire events by the end of the century[59].

4) Floods:

Over the last 20 years, heavy rainfall has become more frequent and intense across most parts of the world. Globally, in a given location, what would once have been a one-in-10-year rainfall event currently occurs 1.3 (1.2–1.4) times every 10 years and is 6.7% wetter. Human induced climate change is likely the main driver of the observed intensification of heavy precipitation over many regions[60]. Over the last 20 years flooding has resulted in over 111,000 deaths and affected 1.66 billion people[61]. In 2021 global flood losses were estimated at $82 billion[62]. The country most affected by flooding in the past two decades is China, with 900 million people affected[63].

5) Storms:

Trends indicate no significant change in the frequency of storms globally, but a greater fraction of those that do occur are the most intense – associated with higher wind speeds and heavier rainfall[64]. Storms killed nearly 200,000 people between 2000 and 2019 making them the deadliest type of weather-related disaster in the past 20 years with Asia being the region most impacted. The number of the most extreme storms is predicted to double by 2050[65].

5.2 Attributing factory farmed emissions to climate induced weather disasters in the Global South

Using the five categories of climate induced weather disasters highlighted above, we analysed those events which caused the most significant human health and economic impacts over a ten-year period (2013 – 2022), where attribution data is available, to estimate the proportion of loss and damages that could be attributed to factory farm emissions. Despite record breaking weather events in 2023 (record temperatures/ extreme heat), the economic costs and specific attribution data are currently unknown and so 2023 data is not included in this analysis. Before 2013 the science of climate attribution was very much in its infancy and hence, we have not included climate induced disasters before this period.

In estimating the risk of climate events attributable to anthropogenic climate change we use the 'Fraction Attributable Risk (FAR)[66] metric, which is defined as:

$$FAR = 1 - P0/P1$$

where P0 is the probability of an event occurring in the absence of human influence on climate, and P1 is the corresponding probability in a world in which human influence is included. FAR is thus the fraction of the risk that is attributable to anthropogenic climate change. The estimates of FAR in this analysis are, for the most part, indicative estimates based on the current state of knowledge aimed at providing an approximate order of magnitude of the costs of current climate change – as such it is acknowledged that, as a metric, FAR has some limitations. The data as a result is therefore qualitative rather than quantitative in extent.

Much of the attribution data sourced for this analysis comes from World Weather Attribution[67] or a database of over 400 attribution studies published by Carbon Brief[68]. These studies use weather observations and climate models to understand how climate change influences the intensity and likelihood of extreme weather events. They also assess the role of vulnerability and exposure in the extent of the impacts.

Image: By 2050, the economic costs associated with climate driven disasters globally could exceed US$1 trillion annually as the impacts of climate change intensify. This research finds factory farms could be liable for over US$100 billion of that cost. See page 24 for more details.

Much of the data on deaths and the economic costs of these events originate from EMDAT[69] and a variety of other sources[70 71]. Given the difficulties of attributing health and economic impacts within Global South contexts (due to poor monitoring, little or no insurance and research gaps relating to the long-term economic impacts of weather-related disasters), these figures are likely to be significant underestimates. In many Global South contexts, only a small fraction of losses is insured, making these costs even more difficult to estimate.

To apportion the costs of climate induced weather disasters to factory farmed emissions we calculated the GHGEs from factory farming (Table 1) as a proportion of the estimated 54.59 gigatonnes GHGEs produced in 2021[72].

As shown in Table 4 below, we estimate that global factory farm emissions contribute 11% of global GHGEs and Global North countries contribute 4.26% of global GHGEs.

Table 4: Apportioning factory farming GHGEs as a percentage of total global GHGEs emitted in 2021.

Apportioning global factory farming GHGEs as a percentage of total global GHGEs emitted in 2021	
Total Global GHGEs (~kg CO2e in 2021)	54,593,196,000,000
Total GHGEs from factory farming globally (~kg CO2e in 2021)	6,231,000,861,355
Percentage global factory farming emissions as proportion of global GHG emissions	11.41
Apportioning Global North factory farming GHGEs as a percentage of total global GHGEs emitted in 2021	
Total Global GHGEs (~kg CO2e in 2021)	54,593,196,000,000
Total GHGEs from Global North factory farming (~kg CO2e in 2021)	2,324,923,881,202
Percentage Global North factory farming emissions as proportion of global emissions	4.26

On the next page, table 5 highlights those climate related disasters causing the greatest number of deaths and economic impacts for which data is available.

Table 5: **Attributing economic costs of climate related disasters in the Global South to factory farming in the Global North.**

Year	Date	Continent	Location	Type	Increased likelihood/ severity because of climate change	Climate Change FAR (Fraction of Attributable Risk - estimated)	Number of Deaths	Total Cost ($billion)	Cost ($billion) attributable to climate change	Cost attribution from factory farming emissions across the world ($ billion)	Cost attribution from factory farming in the Global North ($ billion)
2022	April/May	Asia	India/Pakistan	Heat	100X	0.99	90	159	157.41*	17.96	6.71
2022	8 - 15 April	Africa	South Africa	Floods		0.5	459	3	1.5	0.17	0.06
2022	14 June – September	Asia	Pakistan	Floods	50% more intense rains	0.5	1739	30	15	1.71	0.64
2022	June – September	Asia	China	Floods	2x	0.5	239	12.3	6.15	0.70	0.26
2022	All year	Asia	China	Drought	5-20X	0.8		8.4	6.72	0.77	0.29
2022	November/ December	South America	Argentina, Paraguay Uruguay	Heat	60X	0.9	Unknown	4.8	4.32	0.49	0.18
2022	January – March	Africa	Madagascar, Mozambique, Malawi	Floods/ Storms	2x	0.5	366	0.3	0.15	0.02	0.01
2022	June – October	Africa	West Africa	Floods	80x	0.95	800	9.12	8.664	0.99	0.37
2018-2022	October 2020 – present	Africa	Horn of Africa (Ethiopia, Kenya etc)	Drought	100X	0.99	43,000 in Somalia in 2022 alone	1.5	1.485**	0.17	0.06
2021	17 – 31st July	Asia	China (Henan)	Floods	Amount of rain increased by at least 7.5%	0.1	398	17.6	1.76	0.20	0.07
2019	June – August	South America	Brazil, Bolivia, Peru (Amazon forest fires)	Wildfires	5x	0.8	0	957 (over 30 years)	765	87.29***	32.59***
2016	June – July	Asia	China (Yangtze–Huai)	Floods	10x	0.9	200	22	19.8	2.26	0.84
2013	November – December	Asia	Philippines (Storm Haiyan)	Storm	20% worse	0.2	6300	2.2	0.44	0.05	0.02

* No cost attribution data is available for 2022 heatwave but the heatwave in India in 2021 (which was less intense and with lower temperatures) was estimated to have cost $159 billion. We have used these figures as a very conservative estimate at this stage.

** In Kenya alone, the economic cost of livestock loss is estimated at more than $1.5 billion. The real economic costs of the ongoing drought in E Africa are likely to be much higher but there is a lack of data. Over 34 percent of crop and livestock production loss in LMICs is traced to drought, costing the sector $37 billion overall.

***Conservative estimate of the Amazon Forest fire costs over a 30-year period. Data for individual weather disasters obtained from a variety of sources[73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96]

5.3 The impact of factory farming on five weather disasters in the Global South

Based on our analysis (See Table 5), this section explores the costs and damages caused by impact of factory farming in the Global North, using five examples of weather induced disasters that have had a significant impact on Africa, Asia, and South America:

India and Pakistan heatwave 2022

In March and April 2022 India and Pakistan experienced extremely high temperatures recording the hottest temperatures since records began 122 years ago[97]. The heatwave was combined with a drought, with rainfall being only a quarter to a third of normal. It occurred during a La Niña event, in which heat records are generally less likely. The prolonged heat caused widespread human suffering, and at least 90 people died. A Meteorological Office scientific attribution study estimated the chances of exceeding the record-breaking temperature was made 100 times more likely because of climate change[98]. ***Based on our analysis and estimates, the economic costs of this event attributable to climate change were at least $157 billion with the cost attribution of factory farming emissions from the Global North estimated at $6.71 billion.***

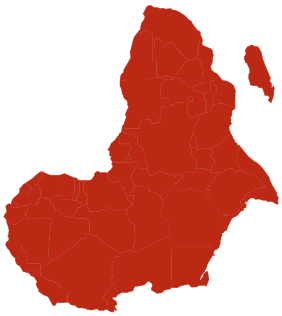
Between 2001 and 2020, India lost around 259 billion hours of labour per year due to the impacts of extreme heat, according to one study[99], translating to a loss of about $624 billion to India's economy. The increased heat is expected to cost India 2.8%, and 8.7% of its Gross Domestic Product (GDP) and depressed living standards by 2050 and 2100, respectively[100].

Pakistan floods 2022

After weeks of non-stop rain (June – September 2022) severe flooding devastated much of Pakistan, affecting over 33 million people, destroying 1.7 million homes, and killing 1,739 people[101]. Pakistan received 243% more rainfall than usual during this period, and it stands as the wettest August on record since records began in 1961. 750,000 livestock were killed and around 18,000 square kilometres of cropland were ruined, including roughly 45% of the cotton crop - one of the nation's key exports[102]. Climate attribution modelling highlighted that climate change could have increased the rainfall intensity by up to 50%[103]. ***Based on our analysis and estimates, the economic costs of this event attributable to climate change, were at least $15 billion with the cost attribution of factory farming emissions from the Global North estimated at least $0.64 billion.***

Pakistan, although responsible for only 0.9% of global GHGEs[104], is extremely vulnerable to climate change and its location means it can experience heatwaves, drought, and intense rains, often within the same year. The World Bank estimates that the combined risks of extreme climate-related events, environmental degradation, and air pollution are projected to reduce Pakistan's GDP by at least 18 to 20% by 2050[105].

Horn of Africa Drought 2020 – Today



Since October 2020 large parts of Eastern Africa have been experiencing prolonged periods of drought which is still ongoing in many parts of the region. This has had devastating consequences. In 2022, 942,000 children aged between six months and five years suffered from acute malnutrition in Kenya alone[106]. Across Kenya, Ethiopia, and Somalia, 3.3 million people have had to leave their homes[107]. Climate change attribution models have found that droughts like the one recorded in the Horn of Africa over the last three years have been made at least 100 times more likely by climate change[108] . East Africa is responsible for just 1.4% of global greenhouse gas emissions. ***Because of the lack of data on the economic impacts of drought across East Africa, we have used the estimated $1.5 billion economic costs of livestock loss in Kenya as the basis of our attribution[109] - with the cost attribution of factory farming emissions from the Global North estimated at least $0.06 billion.*** This is likely a significant underestimate of the real economic costs of the drought across the Horn of Africa.

By 2050, the length of dry and wet spells is projected to increase and decrease respectively across the Horn of Africa which could force up to 9% of the population – as many as 49 million people – to move in the decades ahead[110]. The Africa Development Bank estimates Africa's finance needs for loss and damage in the period 2022-2030 to be between $289.2 and $440.5 billion[111].

'The drought we are experiencing in East Africa has been unprecedented. The Maasai community are being significantly impacted and are losing significant numbers of livestock due to drought - the Maasai community love their animals more than they love themselves and these losses devastate livelihoods. We are feeling the impact of global climate change caused by countries far away. Global climate change is hitting Africa in ways that are creating new records in terms of disasters". (Dr Judy Kimaru, Director, Action for Protection of Animals Africa, interviewed 15th June 2023)

Amazon forest fires 2019

There was a surge in deforestation-related wildfires occurring in the Amazon rainforest and Amazon biome within Brazil, Bolivia, and Peru during the 2019 Amazonian tropical dry season. More than 80,000 wildfires occurred across all Brazil, a 77% year-to-year increase. It is estimated that over 906 thousand hectares were lost[112]. It is estimated that the dieback from the Amazon rainforest due to the fires could cost Brazil $957 billion to $3.5 trillion over a 30-year period[113]. Attribution models suggest the frequency of wildfires increased fivefold because of climate change[114]. ***Based on our analysis and estimates, the economic costs of this event attributable to climate change, over a 30-year period, are at least $765 billion with the cost attribution of factory farming emissions from the Global North estimated at least $32.6 billion.***

Amazon wildfires are predicted to double by 2050[115].

Henan Floods, China 2021

In July 2021 record rainfall resulted in severe flooding in China's Henan Province resulting in 398 deaths. The floods caused the evacuation of 815,000 people and affected 14.5 million people around the province[116]. Direct economic losses reached about $17.6 billion. Researchers from Peking University found that climate change increased the amount of rain that fell during the 2021 Henan floods by 7.5%[117]. The researchers also found that existing emissions may have caused enough warming and wetting to double the likelihood of disastrous hourly precipitation of 100 millimetres or more. ***Based on our analysis and estimates, the economic costs of this event attributable to climate change are at least $1.76 billion with the cost attribution of factory farming emissions from the Global North estimated at least $ 0.07 billion.***

Without urgent action to reduce emissions, heatwaves in China will last 1,563% longer and heat-related excess deaths will increase by 92%. Over 25 million people in China will face river flooding by 2050 and river flooding will cost China $442 billion by 2100 according to some estimates[118].

5.4 Mitigation, adaptation and loss and damage

Who bears responsibility for loss and damage is a question right at the heart of debates surrounding the links between climate change and climate induced weather disasters. With millions suffering from the impact of ongoing droughts in the Horn of Africa or the significant loss and damages caused by, for example, the floods in Pakistan during 2022, the most polluting industries must share a portion of the blame and costs associated. As such, factory farming, as a significant contributor of GHG emissions, also needs to share this responsibility. We have estimated some of the costs attributed to factory farming for the loss and damage caused by factory farming emissions, which, given the lack of economic and attribution data in relation to climate induced disasters, are likely to be significant underestimates of the real costs. These costs and impacts place a significant burden on the economies of the Global South who are having to pick up the tab. Loss and damage are already occurring on a large scale and will only worsen as global heating increases.

Factory farming emits approximately 11% of global GHG emissions and these need to be considered in climate mitigation and adaptation strategies if we are to limit global temperatures below 1.5 degrees Celsius. Accounting for loss and damage contributions from the factory farming sector is closely connected to adaptation and mitigation. The climate-induced weather events highlighted in this report will continue to cause significant economic and human health costs unless urgent action is taken to mitigate GHG emissions and support Global South countries adapt to the impacts of climate change. Not enough is being done on both fronts. ***Leaders at COP28 must deliver a strong commitment that raises climate ambition and recognises that factory farming emissions must be reduced whilst supporting the countries most impacted by climate change to adapt,*** including reducing their vulnerability to future climate induced weather events. Governments need to put a stop to the most polluting industries – whether that is the fossil fuel industry or cruel factory farming operations, which bear a responsibility for the growing intensity and frequency of climate induced weather disasters impacting on the poorest and most vulnerable communities. COP28 offers an opportunity for solutions that achieve many of the Sustainable Development Goals for climate, nutrition, nature, health, and livelihoods whilst supporting the transition towards agroecological and pastoral livestock systems.

Image: Small holder farmers are on the front line of climate change. Kenyan farmer James Kituku Kikuvi is among those suffering drought and subsequent crops fails and loss of livestock. This impacts their local community's food security and undermines stability.

Global North needs to shift its farming practices

In the Kenyan village of Mutulani, tucked some 50Km away from Wote, the county's headquarters, 63-year-old James Kituku Kikuvi paces up and down his compound pondering over where he will get the next bale of grass to feed his cattle.

James was a proud farmer boasting eight cows and 40 goats but when drought reached the peak last year, his source of livelihood was wiped away, leaving only one cow, a calf and a donkey.

The retired teacher says he realized that the climate had changed when the birds that used to wake him up early morning disappeared. He had over 40 avocado and many other fruit trees that provided natural habitats for the birds, but they all dried up.

Termites invaded the land to feed on dry grass and vegetation while bees flew away from the hives as rains failed and the trees slowly withered.

A downcast James says it has now reached a point where they have to buy water for domestic use and irrigation. A 20-litre jerrican of water costs $0.4 and his family uses 5 jerricans at a total cost of $2 a day for domestic alone. In a country where many people live on less than a dollar per day, water is turning out to be a luxury.

Without rain they cannot grow anything and will have to depend humanitarian aid. "If the situation continues like this, our children will drop out of school to look for food elsewhere, the rate of crime will spiral and our social fabric will disintegrate," says James.

He wants farmers in the Global North and other parts of the world to shift from factory farming to more sustainable land and resource management practices.

The profits of some of the world's biggest meat processors and packers who are based in the Global North, come at the expense of lives and livelihoods in the Global South. In the US for example, just four large conglomerates (Tyson, JBS, Marfrig, and Seaboard) control approximately 55-85% of the market for pork, beef, and chicken - their gross profits have collectively increased by more than 120% since before the COVID-19 pandemic, and their net income has surged by 500%[119]. There is a moral and ethical responsibility, based on historic emissions alone, for the world's biggest meat processors and packers, to be held to account for damage and loss inflicted on Global South countries. Financing for loss and damage cannot and should not be minimised or averted and a 'polluter pays' principle should be the cornerstone of the Loss and Damage Fund which was committed to at COP27[120].

5.5 Future loss and damage associated with factory farms

By 2050, the economic costs of loss and damage associated with climate driven disasters globally could exceed $1tn every year[121], as the impacts of climate change intensify. Given factory farming contributes 11% of total GHG emissions, the industry associated with them would be liable for over $100 billion of these estimated costs. Another study argues compensation of $192 trillion for countries of the Global South for the appropriation of their atmospheric fair shares by 2050. The Food & Land Use Coalition estimates the hidden environmental, health and economic costs of the food system at almost $12 trillion a year and these are expected to rise to $16 trillion a year by 2050.

Image: A cleaner, fairer, cruelty-free way to feed the world. **Credit:** World Animal Protection

6. Recommendations

1

Put a stop to supporting factory farming systems and the continued industrialisation of livestock systems which make a significant contribution to GHGEs and global heating.

2

Support a global moratorium on any new factory farms. In the Global South and in Africa in particular, there is a need to stop factory farms from displacing agroecological and pastoral livestock systems that support communities and millions of livelihoods.

3

Establish national plans to support a just transition away from industrialised livestock production towards agroecological systems that produce sustainable plant-based foods and fewer farmed animals in high welfare environments.

4

Establish the Loss and Damage Fund committed to at COP27, and provide it with sufficient money. The 'polluter pays' principle should be the cornerstone of this Loss and Damage Fund, with the biggest polluters, including the world's biggest factory farming companies, held responsible for the loss and damage associated with climate induced weather disasters in the Global South. Financing arrangements for the global Loss and Damage Fund must not come in the form of loans, which add to the debt burden of countries.

5

End government subsidies that support factory farming. Re-orient these subsidies to support plant-based protein production and agroecological/pastoral livestock systems that deliver better human, animal, and planetary health outcomes.

6

Ensure food systems and agriculture are central to climate action efforts at COP28 and ensure priority is given to dealing with factory farmed emissions within countries' Nationally Determined Contributions (climate action plans).

7. Conclusion

As the UN Secretary General has recently said 'The era of climate boiling has arrived. Climate change is here. It is terrifying. And it is just the beginning'. He has warned that the consequences are as clear as they are tragic: 'children swept away by monsoon rains, families running from the flames (and) workers collapsing in scorching heat'[122]. Overall, the window of opportunity for climate mitigation and action is rapidly narrowing, with the current decade a crucial window of opportunity to limit the worst of the damages and direct harms of overshooting a 1.5°C temperature rise. The need to reduce GHGEs, including those from factory farming, particularly in the Global North, is clear. Without action today, those in the Global South, which are the most vulnerable and susceptible to climate induced weather disasters, will continue to bear the brunt of the economic and human costs that result.

8. Acknowledgments

This report briefing was prepared for World Animal Protection by Mark Driscoll, Founder and Director at Tasting the Future. Contributions and valuable insights were also provided by:

Jacqueline Mills,
Head of Food Systems Campaigns,
World Animal Protection

Ephraim Batungbacal,
Research Manager,
World Animal Protection

Monica List,
Head of Research and Animal Welfare,
World Animal Protection

Angel Flores,
International External Affairs Manager,
World Animal Protection

9. Further information

For further information with regards to this report please contact:

Jacqueline Mills,
Head of Food Systems Campaigns,
World Animal Protection
jacquelinemills@worldanimalprotection.org

Mark Driscoll,
Founder and Director,
Tasting the Future
mark@tastingthefuture.com

10. References

1. https://www.weforum.org/agenda/2023/07/climate-2023-hottest-year-on-record/ (accessed 24th July 2023)
2. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter11.pdf (accessed 24th July 2023)
3. https://public.wmo.int/en/media/press-release/eight-warmest-years-record-witness-upsurge-climate-change-impacts#:~:text=The%20global%20mean%20temperature%20in,%2D1900%20pre%2Dindustrial%20average (accessed 24th July 2023)
4. https://earthobservatory.nasa.gov/images/event/85098/annual-global-temperature-records#:~:text=The%20past%20five%20years%20have%20been%20the%20warmest%20years%20in,years%20have%20occurred%20since%202000. (accessed 24th July 2024)
5. IPCC (Intergovernmental Panel on Climate Change 2021: The Physical Science Basis https://www.ipcc.ch/report/ar6/wg1/ (accessed 24th July 2023)
6. https://thebreakthrough.org/issues/food-agriculture-environment/livestock-dont-contribute-14-5-of-global-greenhouse-gas-emissions#:~:text=(2021)%20using%20these%20lower%20values,from%20grazing%20land%20are%20included (accessed 17th August 2023)
7. https://tastingthefuture.com/wp-content/uploads/2022/03/Health-Impacts-of-Industrial-Livestock-Systems-FINAL-REPORT-1.pdf (accessed 24th July 2023)
8. https://www.fao.org/news/story/en/item/197623/icode (accessed 2nd August 2023)
9. https://www.worldanimalprotection.us/sites/default/files/media/global-public-health-technical-report_0.pdf (accessed 27th July 2023)
10. https://www.fao.org/faostat/en/#data (accessed 27th July 2023)
11. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6447276/ (accessed 27th July 2023)
12. https://ourworldindata.org/grapher/food-emissions-supply-chain (accessed 27th July 2023)
13. https://website-production-s3bucket-1nevfd7531z8u.s3.eu-west-1.amazonaws.com/public/website/download/b9c3ead2-9d5c-452e-b0bf-1ba6613fa76d/Blonk%202022%20LCA%20HW%20broiler%20&%20pork%20FINAL.pdf (accessed 27th July 2023)
14. https://www.rgs.org/CMSPages/GetFile.aspx?nodeguid=9c1ce781-9117-4741-af0a-a6a8b75f32b4&lang=en-GB (accessed 27th July 2023)
15. https://www.fao.org/faostat/en/#data (accessed 1st July 2023)
16. https://www.worldanimalprotection.us/sites/default/files/media/global-public-health-technical-report_0.pdf (accessed 1st July 2023)
17. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6447276/ (accessed 1st July 2023)
18. https://ourworldindata.org/grapher/food-emissions-supply-chain (accessed 1st July 2023)
19. https://website-production-s3bucket-1nevfd7531z8u.s3.eu-west-1.amazonaws.com/public/website/download/b9c3ead2-9d5c-452e-b0bf-1ba6613fa76d/Blonk%202022%20LCA%20HW%20broiler%20&%20pork%20FINAL.pdf (accessed 1st July 2023)
20. https://ourworldindata.org/grapher/food-emissions-supply-chain (accessed 1st July 2023)
21. https://ourworldindata.org/grapher/food-emissions-supply-chain (accessed 1st July 2023)
22. https://ourworldindata.org/grapher/co-emissions-per-capita?tab=table (accessed 1st July 2023)
23. https://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2022-2031_f1b0b29c-en;jsessionid=9fvghWv4CPxGqoTNLnAWnTPPtZn2mYAX0ajs9cHb.ip-10-240-5-79 (accessed 2nd August 2023)
24. OECD/FAO. 2021. OECD-FAO Agricultural Outlook (Edition 2021). OECD Agriculture Statistics (database), https://doi.org/10.1787/4bde2d83-en (accessed 2nd August 2023)
25. FAO. 2021. Decent Rural Employment: Livestock http://www.fao.org/rural-employment/agricultural-sub-sectors/livestock/en/ (accessed 2nd August 2023)
26. FAO. 2012. Livestock sector development for poverty reduction: an economic and policy perspective – Livestock's many virtues http://www.fao.org/3/i2744e/i2744e00.pdf (accessed 4th August 2023)
27. https://public.wmo.int/en/media/press-release/weather-related-disasters-increase-over-past-50-years-causing-more-damage-fewer (accessed 25th July 2023)
28. https://www.germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_2.pdf (accessed 24th July 2023)
29. https://www.oxfam.org/en/5-natural-disasters-beg-climate-action (accessed 26th July 2023)
30. https://www.un.org/sg/en/content/sg/statement/2022-09-20/secretary-generals-address-the-general-assembly-trilingual-delivered-follows-scroll-further-down-for-all-english-and-all-french (accessed 24th July 2023)
31. https://reliefweb.int/report/world/worldriskreport-2022-focus-digitalization (accessed 25th July 2023)
32. https://public.emdat.be/data
33. https://www.statista.com/statistics/1287508/africa-share-in-global-co2-emissions/#:~:text=Africa%20accounted%20for%203.9%20percent,share%20among%20all%20world%27s%20regions (accessed 26th July 2023)
34. https://gca.org/news/new-report-reveals-africa-is-facing-a-crisis-in-funding-for-climate-adaptation/#:~:text=In%202019%20and%202020%20an,estimated%20African%20countries%20will%20need. (accessed 27th July 2023)
35. www.bbc.co.uk/news/world-africa-65015084 (accessed 28th July 2023)
36. www.carbonbrief.org/deadly-drought-in-horn-of-africa-would-not-have-happened-without-climate-change/ (accessed 27th July 2023)
37. https://www.unocha.org/climate-threats-and-opportunities-horn-africa#:~:text=Despite%20contributing%20the%20least%20to,bearing%20the%20brunt%20of%20it (accessed 26th July 2023)
38. https://www.destatis.de/EN/Themes/Countries-Regions/International-Statistics/Data-Topic/Environment-Energy/Environment/G20_CO2.html#:~:text=Global%20CO2%20emissions%20reached,United%20States%20and%20the%20EU%20 (accessed 28th July 2023)
39. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter11.pdf#page=55&zoom=100,0,0 (accessed 27th July 2023)
40. https://www.nature.com/articles/421891a (accessed 24th July 2023)
41. National Academies, 2016. Attribution of Extreme Weather Events in the Context of Climate Change. https://nap.nationalacademies.org/read/21852/chapter/1 (accessed 25th July 2023)
42. https://www.sciencedirect.com/science/article/pii/S2212094718301853 (accessed 25th July 2023)
43. https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world/ (accessed 24th July 2023)
44. https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world/ (accessed 25th July 2023)
45. https://wires.onlinelibrary.wiley.com/doi/full/10.1002/wcc.750 (accessed 24th July 2024)
46. IPCC (2014), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, University of Cambridge, Cambridge, United Kingdom, and New York.
47. https://iopscience.iop.org/article/10.1088/2752-5295/ac6e7d#erclac6e7dbib217 (accessed 27th July 2023)
48. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FrontMatter.pdf (accessed 27th July 2023)

49. https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2021/2c-rise-to-put-one-in-eight-of-global-population-at-heat-stress-risk (accessed 27th July 2023)
50. https://home.dartmouth.edu/news/2022/10/heat-waves-have-cost-world-economy-trillions-dollars (accessed 27th July 2023)
51. IPCC Ibid
52. https://www.scientificamerican.com/article/absolutely-no-doubt-that-climate-intensified-current-drought/ (accessed 27th July 2023)
53. https://www.fightfoodcrises.net/ (accessed 27th July 2023)
54. https://www.fao.org/3/cb3673en/cb3673en.pdf (accessed 27th July 2023)
55. https://sciencebrief.org/briefs/wildfires (accessed 27th July 2023)
56. https://www.newscientist.com/article/2289547-wildfire-pollution-linked-to-at-least-33000-deaths-worldwide/ (accessed 27th July 2023)
57. https://economictimes.indiatimes.com/news/international/world-news/globally-wildfires-cost-50-bln-every-year-ai-can-help-fight-them-wef/articleshow/97035706.cms (accessed 17th July 2023)
58. IPCC Ibid
59. https://www.unep.org/resources/report/spreading-wildfire-rising-threat-extraordinary-landscape-fires (accessed 27th July 2023)
60. IPCC ibid
61. EMDAT ibid
62. https://www.swissre.com/press-release/Extreme-flood-events-once-again-drive-high-losses-in-2021-yet-75-of-flood-risks-remain-uninsured-Swiss-Re-Institute-reveals/3269ad99-b743-4398-82e3-534a87783910 (accessed 27th July 2023)
63. https://www.preventionweb.net/files/74124_humancostofdisasters20002019reportu.pdf (accessed 27th July 2023)
64. ibid
65. https://www.science.org/doi/10.1126/sciadv.abm8438? (accessed 27th July 2023)
66. https://archive.ipcc.ch/publications_and_data/ar4/wg1/en/ch9s9-4-3-3.html (accessed 31st July 2023)
67. https://www.worldweatherattribution.org/ (accessed 31st July 2023)
68. https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world/ (accessed 31st July 2023)
69. ibid
70. https://www.christianaid.org.uk/sites/default/files/2022-12/counting-the-cost-2022.pdf (accessed 31st July 2023)
71. https://reliefweb.int/report/world/counting-cost-2021-year-climate-breakdown-december-2021 (accessed 31st July 2023)
72. https://ourworldindata.org/grapher/total-ghg-emissions (accessed 31st July 2023)
73. https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world/ (accessed 28th August 2023)
74. https://www.christianaid.org.uk/sites/default/files/2022-12/counting-the-cost-2022.pdf (accessed 28th August 2023)
75. https://disasterphilanthropy.org/disasters/horn-of-africa-hunger-crisis/?gclid=Cj0KCQjwwvilBhCFARIsADvYi7JeapLpslanNphemHOhyETL8zPJHBOs5c0VU9Lf9xV-KntVWHYWca0aAv0kEALw_wcB
76. https://www.worldweatherattribution.org/high-temperatures-exacerbated-by-climate-change-made-2022-northern-hemisphere-droughts-more-likely/ (accessed 28th August 2023)
77. https://www.worldweatherattribution.org/ (accessed 28th August 2023)
78. https://www.thenationalnews.com/world/asia/2022/10/21/indias-heatwave-in-2021-cost-country-159-billion/ (accessed 28th August 2023)
79. https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/climate-science/attribution/indian_heatwave_2022.pdf (accessed 28th August 2023)
80. https://reliefweb.int/report/world/counting-cost-2021-year-climate-breakdown-december-2021 (accessed 28th August 2023)
81. https://www.carbonbrief.org/deadly-drought-in-horn-of-africa-would-not-have-happened-without-climate-change/ (accessed 28th August 2023)
82. https://www.worldweatherattribution.org/human-induced-climate-change-increased-drought-severity-in-southern-horn-of-africa (accessed 28th August 2023)
83. https://public.wmo.int/en/media/press-release/economic-losses-from-extreme-weather-rocket-asia (accessed 28th August 2023)
84. https://www.worldweatherattribution.org/wp-content/uploads/WWA-Argentina-Scientific-report.pdf (accessed 28th August 2023)
85. https://www.worldweatherattribution.org/wp-content/uploads/WWA-KZN-floods-scientific-report.pdf (accessed 28th August 2023)
86. https://www.worldweatherattribution.org/wp-content/uploads/WWA-MMM-TS-scientific-report.pdf (accessed 28th August 2023
87. https://www.worldweatherattribution.org/wp-content/uploads/WestAfrica_Foodcrisis_Scientific-report.pdf (accessed 28th August 2023)
88. https://punchng.com/2022-flood-caused-n4-2tn-economic-loss-says-fg/#:~:text=The%202022%20floods%20in%20various,Federal%20Government%20announced%20on%20Friday (accessed 28th August 2023)
89. https://en.wikipedia.org/wiki/2021_Henan_floods (accessed 28th August 2023)
90. https://www.caixinglobal.com/2021-08-03/henan-floods-to-cost-insurers-billions-101750646.html (accessed 28th August 2023)
91. https://www.researchgate.net/publication/362821900_Climate_change_attribution_of_the_2021_Henan_extreme_precipitation_Impacts_of_convective_organization (accessed 28th August 2023)
92. https://chinadialogue.net/en/climate/how-climate-change-exacerbated-the-2021-henan-floods/ (accessed 28th August 2023)
93. https://www.pnas.org/doi/pdf/10.1073/pnas.1721770115 (accessed 28th August 2023)
94. http://www.ametsoc.net/eee/2016/ch20.pdf (accessed 28th August 2023)
95. https://en.wikipedia.org/wiki/Typhoon_Haiyan (accessed 28th August 2023)
96. https://iopscience.iop.org/article/10.1088/1748-9326/10/6/064011/meta (accessed 28th August 2023)
97. https://journals.plos.org/climate/article?id=10.1371/journal.pclm.0000156 (accessed 31st July 2023)
98. https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/climate-science/attribution/indian_heatwave_2022.pdf ; https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/climate-science/attribution/indian_heatwave_2022.pdf (accessed 31st July 2023)
99. https://iopscience.iop.org/article/10.1088/1748-9326/ac3dae (accessed 31st July 2023)
100. https://www.mckinsey.com/capabilities/sustainability/our-insights/will-india-get-too-hot-to-work (accessed 31st July 2023)
101. https://iopscience.iop.org/article/10.1088/2752-5295/acbfd5#erclacbfd5bib61 (accessed 31st July 2023)
102. ibid
103. https://www.worldweatherattribution.org/climate-change-likely-increased-extreme-monsoon-rainfall-flooding-highly-vulnerable-communities-in-pakistan/ (accessed 2nd August 2023)
104. https://unfccc.int/sites/default/files/NDC/2022-06/Pakistan%20Updated%20NDC%202021.pdf (accessed 31st July 2023)
105. https://openknowledge.worldbank.org/entities/publication/614ddc2b-ca31-53c9-b59c-6bf12a56d336 (accessed 31st July 2023)
106. https://www.who.int/emergencies/funding/outbreak-and-crisis-response-appeal/2023/2023-appeals/appeal-horn-of-africa#:~:text=The%20worsening%20food%20security%20situation,and%20in%20need%20of%20treatment (accessed 31st July 2023)
107. https://www.unhcr.org/news/horn-africa-drought-enters-sixth-failed-rainy-season-unhcr-calls-urgent-assistance (accessed 31st July 2023)
108. https://www.carbonbrief.org/deadly-drought-in-horn-of-africa-would-not-have-happened-without-climate-change/ (accessed 31st July 2023)
109. Horn of Africa Drought: Regional Humanitarian Overview & Call to Action (Revised 28 November 2022) - Ethiopia | ReliefWeb (accessed 28th August 2023)

110. https://www.preventionweb.net/news/climate-change-will-force-113m-people-relocate-within-africa-2050-new-report#:~:text=Up%20to%202.5%20million%20people,move%20in%20the%20decades%20ahead (accessed 31st July 2023)
111. https://www.afdb.org/en/knowledge/publications/african-economic-outlook (accessed 1st August 2023)
112. https://www.cbsnews.com/news/amazon-wildfires-brazil-spurns-20-million-aid-offer-from-g-7-nations-today-2019-08-27 (accessed 4th August 2023)
113. https://www.businessinsider.in/science/environment/news/amazon-wildfires-will-cost-brazil-trillions-of-dollars-damage-from-australias-bushfires-maybe-5-times-greater/articleshow/73120609.cms (accessed 1st August 2023)
114. ibid
115. https://www.newscientist.com/article/2229559-area-of-amazon-affected-by-wildfires-predicted-to-grow-by-2050/ (1st August 2023)
116. https://en.wikipedia.org/wiki/2021_Henan_floods (2nd August 2023)
117. https://www.researchgate.net/publication/362821900_Climate_change_attribution_of_the_2021_Henan_extreme_precipitation_Impacts_of_convective_organization (accessed 2nd August 2023)
118. https://www.g20climaterisks.org/china/ (accessed 2nd August 2023)
119. https://www.whitehouse.gov/briefing-room/blog/2021/12/10/recent-data-show-dominant-meat-processing-companies-are-taking-advantage-of-market-power-to-raise-prices-and-grow-profit-margins/ (accessed 31st July 2023)
120. https://www.unep.org/news-and-stories/story/what-you-need-know-about-cop27-loss-and-damage-fund (accessed 10th August 2023)
121. https://link.springer.com/chapter/10.1007/978-3-319-72026-5_14 (accessed 24th July 2023)
122. https://news.un.org/en/story/2023/07/1139162 (accessed 29th August 2023)

About World Animal Protection:

World Animal Protection is an international animal welfare organization. Our mission is to create a better world for animals. From the frontlines of disaster zones to the boardrooms of large corporations, we are fighting to create better lives for all animals. World Animal Protection is registered with the Charity Commission as a charity and with Companies House as a company limited by guarantee. World Animal Protection is governed by its Articles of Association. Charity registration number 1081849. Company registration number 4029540. Registered office 222 Gray's Inn Road, London WC1X

World Animal Protection

5th Floor

222 Grays Inn Road

London WC1X 8HB

UK

+44 (0)20 7239 0500

info@worldanimalprotection.org

W: worldanimalprotection.org

/WorldAnimalProtectionInt

/world_animal_protection

/MoveTheWorld

/animalprotection

11.23

World Animal Protection is the operating name of World Society for the Protection of Animals. Company Limited by Guarantee in England and Wales, Registration No. 4029540. Registered Charity 1081849