WFP World Food Programme

SAVING LIVES CHANGING LIVES

Impact of Global Warming on Food Security

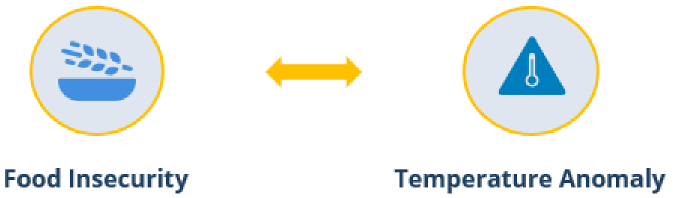
How does a 1°C increase in temperature affect levels of food insecurity?

BACKGROUND

Thinking of the drivers of food insecurity, one can easily imagine the impact of extreme weather events – droughts, natural disasters, and more – on a family's ability to meet its food security needs. However, **the gradual and incremental impact of global warming on food security might be less perceptible.**

METHODOLOGY

Global warming is represented by an increase in the global average temperature, which in turn influences and alters the climate and which then in turn can influence each of the drivers of food insecurity. Modelling the interactions between complex patterns of climate, each of these drivers, and food insecurity would be extremely complex. Instead, the analysis looks at the link between local temperature change and local food insecurity directly.



Local Food Insecurity

The model uses IPC assessment data describing the prevalence of food insecurity – the proportion of that country's population that is classified as IPC Phase 3 or greater – at the date the assessment. The dataset includes 393 assessments over 45 countries between 2017 and 2025.

Local Temperature Change

The model uses local temperature anomaly for the year leading up to that assessment (the difference between the annual average temperature for the year leading up to that assessment, and the 1992-2016 average temperature).

- No temperature anomaly: Average temperature in the year leading up to the IPC assessment is equal to the 1992-2016 average

KEY RESULTS

70M more people could fall in IPC Phase 3+
In the 45 countries studied

A scenario where the 45 countries would have a 0 °C anomaly simultaneously would see about 252M people in food insecurity. This estimate jumps to 322M in a +1°C anomaly scenario.

An estimated 4.8 percentage point increase in acutely food insecure population

The share of food insecure population jumps from 17.3% to 22.1% when moving from a 0 °C to a +1°C anomaly scenario in the 45 countries studied.

276M more people could fall in IPC Phase 3+
In the 84 countries with WFP presence

Assuming the same 4.8 percentage point increase in the share of food insecure, 276M more people could become food insecure in countries with WFP presence.

- Positive temperature anomaly: Average temperature in the year leading up to the IPC assessment is higher than the 1992-2016 average
- Negative temperature anomaly: Average temperature in the year leading up to the IPC assessment is lower than the 1992-2016 average

Figure 1. Temperature anomaly (illustrative)

The relationship between temperature anomaly and the prevalence of food insecurity can be found on the next page.

The relationship between temperature and the proportion of a country's population that is food insecure is not a simple one: **not all instances of food insecurity result from an increase in temperature, whilst not all increases in temperature cause an increase in food insecurity.**

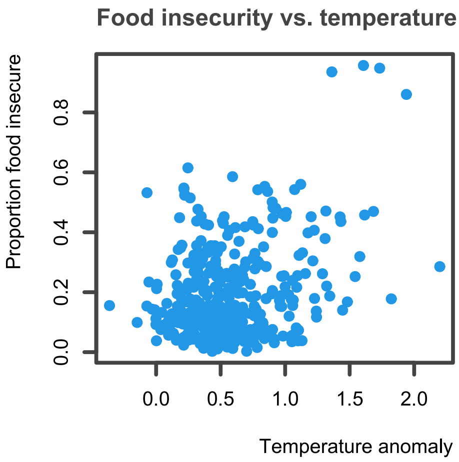


Figure 2. Prevalence of food insecurity plotted against temperature anomaly. Each point represents an IPC assessment.

A regression approach is used to characterise the overall association between temperature and food insecurity that exists across the range of countries included in the analysis. To isolate this effect, the analysis controls for other variables generally considered to influence food insecurity: human development index, conflict exposure and CPI-based inflation. **The results show a statistically significant relationship between temperature anomaly and food insecurity.**

Using the same model, we can project the level of food insecurity in each of the 45 countries under two conditions: first at a 0°C temperature anomaly (1992-2016 average) and then at a +1°C anomaly[1]. All else being equal, any difference between projections results only from the 1°C difference in temperature anomaly.

RESULTS

Across the 45 countries included in this analysis, a 1°C rise in temperature leads to an additional 70M people being projected to be food insecure (table 1). This represents a 4.8 percentage point increase in the share of food insecure population in those countries.

Looking at 84 countries with WFP presence, we are potentially looking at an additional 276M people becoming food insecure. This assumes the 45 countries in the dataset are representative of the global WFP footprint and that a similar percentage of the total population becomes food insecure following a 1°C temperature increase in those countries. This number is subject to a large amount of uncertainty and is very probably an overestimate – separate analyses suggest that WFP countries not included in the original model are not as sensitive to temperature change.

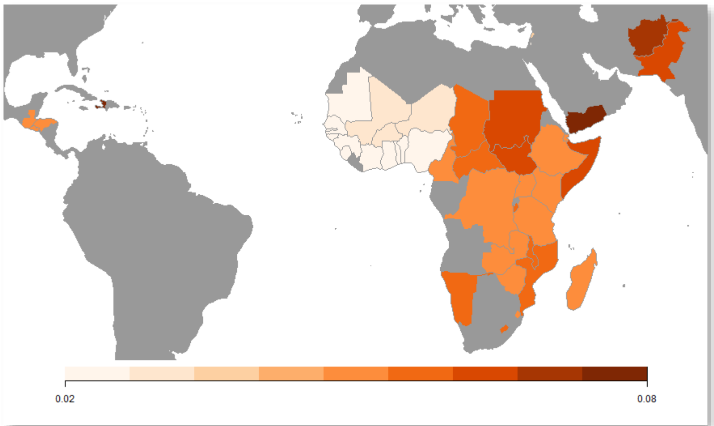
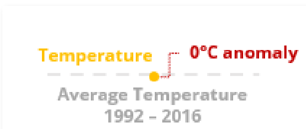


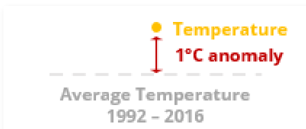
Figure 3. Projected rise in the prevalence of food insecurity (%) after an increase from 0 to 1°C temperature anomalies.

The increase in a country's food insecurity given a 1°C temperature increase is a measure of that country's temperature sensitivity. These can be mapped for each of the countries in the analysis (figure 3).

Haiti and Yemen show the largest temperature sensitivities, where a +1°C temperature anomaly could lead to a ~8% increase in the share of food insecure population.[2]

Temperature sensitivities can also be summarized by region by looking at the absolute and relative change in food insecurity given a 1°C increase in temperature across different UN georegions (table 2).





IPC 3+ Population	0°C anomaly	1°C anomaly	Difference
Number of people	252 million	322 million	**+70 million**
% of population	17.3%	22.1%	**+4.8 percentage pts**

Table 1. Model projections of number of people food insecure for different temperature anomalies in the 45 countries analyzed

Note: (1) *Projections use the most recent measures of conflict and inflation as found in the training data* ***(2)*** *Possible sources of bias in the analysis are discussed in following paragraphs*

	Number of countries in original dataset	Regional increase in number of food insecure population	Regional increase in share of food insecure population (%)
Caribbean	1	894,701	+7.82
Central America	3	1,721,980	+5.01
Eastern Africa	13	23,539,776	+5.24
Middle Africa	4	7,812,505	+5.16
Northern Africa	1	3,139,388	+6.44
Southern Africa	3	349,943	+5.52
Southern Asia	2	18,637,094	+6.61
Western Africa	15	10,615,763	+2.49
Western Asia	3	3,291,815	+6.77

Table 2. Regional projections of number of food insecure people after an increase from 0 to 1°C temperature anomalies

Eastern and Western Africa regions have similar total populations, yet the Eastern Africa region shows more than double the temperature sensitivity of the Western Africa region. Many factors could explain this difference, including the methodology used to conduct the assessments. Indeed, some Western African countries use the Cadre Harmonisé for their assessments instead of the IPC: these are conducted regularly every year whilst IPCs are conducted to inform on food security only when there are emergencies. Thus, the sensitivity in Western Africa may appear lower because assessments are being made whether there are emergencies or not. In theory, Cadre Harmonisé assessments follow IPC protocols however this analysis does not allow for any potential effect from this difference.

Only 2 countries were analysed in Southern Asia: Afghanistan and Pakistan. Whilst Afghanistan shows a larger temperature sensitivity, regional numbers are heavily influenced by Pakistan which has a population more than five times larger than that of Afghanistan. Regional summaries will be influenced by both differences in countries' populations as well as their projected changes in food insecurity prevalence.

Caribbean and Northern Africa regions both show relatively large temperature sensitivities when looking at the increase in the share of food insecure population. However, the analysis includes only 1 country in each region – Haiti and Sudan, respectively – and both are presently experiencing elevated levels of conflict. It is possible that this increase in conflict is being conflated with temperature in the model, especially as there are no other countries analysed within those regions.

CONCLUSION

Projections made in this analysis are not linked to any particular time in the future. They are based on a given increase in temperature, with no indication of when this increase might happen. Moreover, regional aggregations inherently assume that those countries experience a 1°C increase at the same time, which may or may not be realistic; these regional projections are included to indicate the effects of wider ranging temperature increases (as might be expected under climate change).

There is not "one" effect of temperature on food insecurity: a 1°C increase in temperature can have a different effect depending on the initial prevalence of food insecurity or the differing levels of the other variables used in the analysis (development, conflict, inflation). Since the model uses the most recent values for these variables, the projected changes to food insecurity might therefore be considered the most likely as they are based on present conditions in those countries. Other models where the effect of a 1°C rise in temperature varies depending on the baseline temperature were investigated, but these were not noticeably better.

We identify an (aggregate) association between temperature and food insecurity. However, we do not model any particular mechanism by which temperature actually increases food insecurity. Results are based on a relatively simple analysis, but one must remember that drivers of food insecurity are diverse and complex.

For questions or more information, please contact:

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