Karonga Climate Profile: Summary Version

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Karonga Climate Profile: Key Messages

Karonga's climate

Karonga has a sub-tropical climate which is relatively dry. The rainy season runs from November/December to April the following year, and the dry season from June to October. The temperatures are warmest during October and November (just before the rainy season starts). It stays hot throughout the wet season and gets a little cooler during the dry season; temperatures are lowest from June to August.

- The average yearly rainfall amount is 1,100 mm/year.
- In the coldest month (July), the average daily maximum temperature is 27.4° C and the average daily minimum temperature is 17.2° C.
- In the warmest month (November), the average daily maximum temperature is 32.9° C and the average daily minimum temperature is 23.3° C.

Rainfall patterns

From one year to the next, it is normal for the seasonal rainfall to be quite unpredictable. Some years get as much as twice the long-term average rainfall amount, and some as little as half. Not only does the total amount of rainfall vary, but so does the number of days a year in which it rains, and the intensity of the rainfall.

The historical record shows it is normal for rainfall to vary from one decade to the next: the 1960s and 1970s were wetter than average, while the 1980s and 1990s were drier than average. The 2000s to the present were slightly wetter than the two decades before the 2000s, but not as wet as the 1960-70s.

It is also normal for the average amount of rainfall in a day (or the intensity of rainfall) to vary through time.

Temperature patterns

Karonga has a fairly week seasonal variation in temperature. In other words, the difference between the temperatures during the hottest and coldest time of the year is relatively small, around 6° C. The diurnal cycle (i.e. the difference between highest temperature during the day and the lowest temperature at night) may be more noticeable that the seasonal cycle. The average difference between the hottest and the coldest temperature within a day is just over 9° C.

From year to year, temperatures do not vary much in terms of the average monthly or seasonal temperature.

The variability of extreme temperature events through time has been high in Karonga. The number of hot days (days where the maximum temperature exceeds the 90th percentile[1] - which for Karonga is 33.5° C) can be less than 20 days per year or as much as 50 or even 60 days per year. A similar result is seen for hot nights (nights where the minimum temperature exceeds the 90th percentile, which for Karonga is 22.4° C), where the frequency of these events varies between less than 20 days to more than 80 days within some very extreme years.

Historical changes in the climate

Since the middle of the 20th century, the climate in Karonga has been changing: rainfall has decreased and temperatures have increased.

The average amount of rainfall has gone down over time. The number of days in which it rains during the year, the number of days in which there is heavy rain, the number of days in which there is extreme rainfall have also all gone down over time. The length of wet spells (i.e. in the number of days in which it rains in a row) has also gotten shorter.

In terms of average rain intensity, there has been no change over time.

The average annual and seasonal temperatures have gone up between the period 1948 – 2012. Both daily maximum and minimum temperatures have gone up over time (in other words, both days and nights have gotten hotter over time). The average temperature has gone up by between 0.1 and 0.2° C every ten years.

The frequency of extreme heat events (very hot days and nights) has also gone up over time. The number of very hot days has gone up by more than 3 days every ten years, while the number of very hot nights has gone up by more than 9 days every ten years.

The season in which very hot nights happen has also gotten longer over time. Historically, very hot nights happened mostly in November, but now they can happen from October through to February (of the following year).

[1] The 90th percentile is used to show the frequency of extreme events through time, in other words the 10% of most extreme events - for example the 10% of days with the hottest temperature in the weather data record, or the 10% of days with the heaviest rain in the record

Future climate change

The predictions for climate change in the future given here are taken from 15 different climate change models [2].

The future predictions for rainfall suggest that there will be no change in rainfall from the historical average (i.e. the average for the years from 1986 to 2005), or that rainfall will go down toward the end of the century. *Please see Table 1 for details*.

The future predictions for temperature suggest that both daytime and night-time temperatures will go up in the future. Night-time temperatures are expected to go up faster than daytime temperatures, and the number of extremely hot nights a year is predicted to go up much more than the number of extremely hot days. *Please see Table 2 for details*.

The models suggest that this increase in temperatures is because of human activities that lead to climate change (i.e. it is not because of natural variability in the climate).

These predictions for future climate change have been taken from global climate change models. Global climate change models cannot model what might happen at the local level very well: they give averages for large areas, and what might happen in a particular place might be quite different from these averages.

There are different climate change predictions, called 'statistically downscaled projections', that try to predict what will happen at local levels.

We have not presented the results of these statistically downscaled projections, because we have more confidence in the results from the global climate change models.

However, the results of the statistically downscaled projections are similar to those of the global climate change models:

- Rainfall will stay the same as the historical average (or go down after the 2050s, mainly because the number of rain days in a year will go down, while the intensity of rainfall will not change).
- By 2040 both the average daily maximum and minimum temperatures (i.e. the highest and lowest temperature in a day) may be between 1 - 2° C higher (warmer) than they are now.
- The number of extremely hot days and nights that happen in a year are expected to go up.

[2] No single climate change model can predict the future accurately, so a number of models are used to give an idea of the worst-case and best-case predictions for future climate

Table 1: Summary of projected climate changes for key rainfall variables

Rainfall variable	Predictions from climate change models
Rainfall Totals [mm/year]	About half of the climate change models predict that annual total rainfall will stay the same as the historical average, and about half predict that it will go down
Rainfall daily intensity [mm/day]	Most models suggest that rainfall intensity will not change in the future from from the historical average
Rainfall frequency [number of rain days a year]	Most models suggest that the number of rain days a year will stay the same as the historical average until the 2050s, and then will start to go down (i.e. there will be fewer rain days a year after the 2050s)
Heavy rainfall frequency (over 10 mm in a day) [number of heavy rain days a year]	Most models suggest that the number of heavy rainfall days in a year will stay the same as the historical average
Extreme rainfall frequency (over 90th percentile, i.e. over 31 mm a day) [number of extreme rain days a year]	Most models suggest that the number of extreme rainfall days a year will stay the same as the historical norm

Table 2: Summary of projected climate changes for key temperature variables

Temperature variable	Predictions from climate change models
Average Tmax [°C] [average daily maximum temperature]	By 2040 the average daily maximum temperature (the highest temperature in a day) may be between 0.5 - 1.5° C higher (warmer) than the historical average (i.e. the average for the years from 1986 to 2005) By the end of this century, the average daily maximum temperature may be between 2.5 - 6.5°C higher (warmer) than the historical average
Average Tmin [°C] [average daily minimum temperature]	By 2040 the average daily minimum temperature (the lowest temperature in a day) may be between 1 - 2° C higher (warmer) than the historical average By the end of this century, the average daily minimum temperature may be between 2.5 - 6°C higher (warmer) than it is now
Frequency of daytime extreme heat events (over 90th percentile, i.e. the hottest daytime temperature is more than 33.5 °C) [number of extreme heat days a year]	By 2040 there will be more very hot days in a year (i.e. days where the highest temperature is more than 33.5 °C). There are expected to be betweeen 10 and 40 more very hot days in a year than the historical average. At the moment, there are on average 36 days a year in which the highest temperature is more than 33.5 °C; so by 2040 there could be on average between 45 and 75 of these very hot days in a year By the end of the century, there are expected to be on average between 60 and 150 more very hot days in a year than there are now. So by the end of the century there could be on average between 95 and 185 of these very hot days in a year. So in the worst case, half the days in a year could be hotter than 33.5 °C
Frequency of nighttime extreme heat events (over 90th percentile, i.e. the lowest night-time temperature is more than 22.4 °C) [number of extreme heat nights a year]	By 2040 there will be more very hot nights in a year (i.e. nights where the lowest temperature is more than 22.4 °C). There are expected to be betweeen 20 and 120 more very hot nights in a year than there are now. Now, there are on average 36 nights a year in which the lowest temperature is more than 22.4 °C; so by 2040 there could be on average between 55 and 155 of these very hot nights in a year By the end of the century, there are expected to be on average between 100 and 300 more very hot nights in a year than there are now. So by the end of the century it is predicted that on average at least half the nights in a year could be hotter than 22.4 °C, up to every single night in a year.

The contents of this Working Paper reflect the views of the author only and not those of the UK Department for International Development or the Economic and Social Research Council.