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Explaining the January 2023 drought 'anomaly'

Dr Johan Malherbe, a researcher in soil, climate and water at the Agricultural Research Council, explores the effect of a very dry January on the rest of the planting season.

This January was very dry over most of north-eastern South Africa, including a large part of the summer-grain production region. Very little to no rain fell between 5 and 29 January over the northern half of the grain-production region in particular.

These conditions highlighted the absolute dependence of dryland maize cultivation on regular and adequate rainfall during summer.

With 2022/23 the third consecutive summer during which La Niña conditions dominated global atmospheric circulation patterns, the negative effects of too much rain, such as waterlogged lands, have been much more in the news than the negative effects associated with drought.

La Niña is the colder counterpart of El Niño in the broader El Niño-Southern Oscillation (ENSO) climate pattern, leading to intense storms in some places and droughts in others.

Historically, though, the limiting effect of drought on maize production far outweighs that of too much rain. This was demonstrated during the 2015/16 drought when maize production dropped by roughly 40% relative to the previous summer.

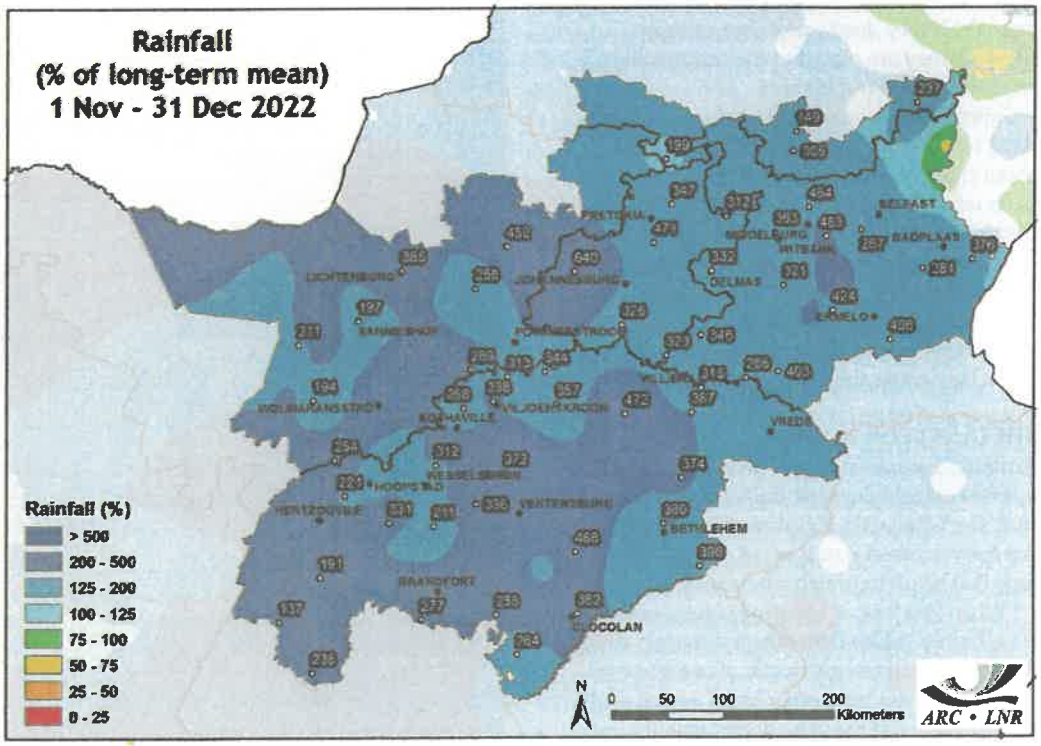
The dry conditions in January occurred during an otherwise wet summer. Rainfall over the summer-grain production region was significantly above the long-term mean (*see Figure 1*). However, sunny and dry conditions set in from early January and continued until 29 January over the northern half of the region, when scattered thundershowers returned.

Despite the return of rainfall to most of the region, total rainfall for the month fell dismally short of the long-term mean (*see Figure 2*).

Following the mostly dry conditions during January, the favourable conditions that set in from late January may remain in place, bringing an end to the dry period. This will also limit any negative effects associated with the low rainfall during the month.

MIDSUMMER DROUGHT

Seasonal forecasts, influenced by the current La Niña event in the Tropical Pacific Ocean, have consistently remained positive for above-normal rainfall through the summer. Often referred to as a midsummer drought, such dry conditions during



RIGHT:
Figure 1: Rainfall (% of long-term mean) for 1 November to 31 December 2022, focusing on the summer-grain production region. Numbers indicate the actual accumulated rainfall in millimetres at selected locations for the period.
PHOTOS: SUPPLIED

late December or January are not uncommon and may occur during an otherwise wet summer.

The midsummer drought is a climatological feature that occurs over large parts of the world where summer rainfall predominates, including the central to north-eastern parts of South Africa, where our main summer-grain production region is located. The intensity (temporal distribution of rainfall events and potential evapotranspiration associated with maximum temperatures), duration and spatial extent of such dry conditions during midsummer can result in reduced production. However, negative effects are limited through conservative cultivation practices, including cultivar choice and planting density.

A LOT CAN STILL HAPPEN WEATHER-WISE THAT MAY EITHER LOWER OR ENHANCE PRODUCTION

Moreover, rainfall during the more sensitive stages of maize development in February plays a much more important role in determining final yield.

At both Lichtenburg and Middelburg (located in the west and east of the production region respectively), rainfall records indicate that at least the first 28 days of January can be characterised as extremely dry, with only about 10% to 20% of the long-term average for this period recorded this year.

At both stations, this falls into the driest 10% of years for the period since 1920. Knowing these areas experienced very dry conditions during January, it is interesting to note that historical, detrended data since 1980 for the Lichtenburg and Middelburg regions indicates that maize yields are very weakly correlated to accumulated rainfall for up to a 25-day period from late December to about 20 January.

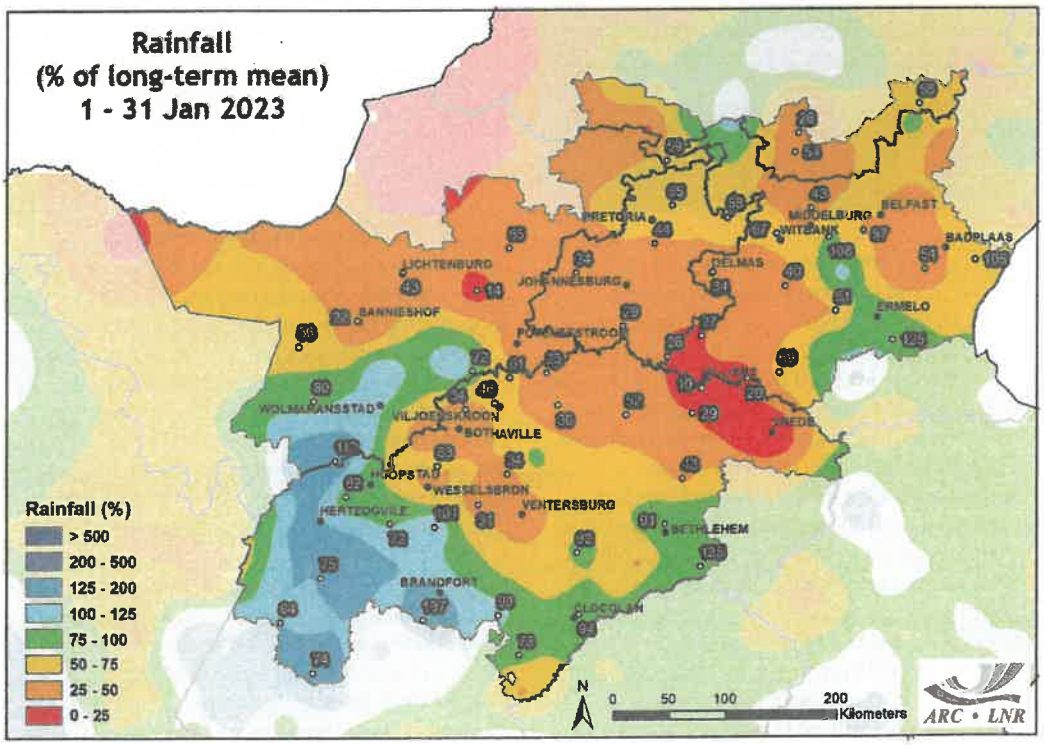
WEAK CORRELATION

The correlation between accumulated rainfall over a 25-day period, ending by late December or even by 20 January at Lichtenburg is weak compared with the much higher and significant positive correlations noted from late November to early December (closer to planting) and, again, from late January through February and early March (the production-sensitive stages of maize in the region).

At Middelburg, where the growing season for maize is earlier than in the west, significant correlations between 25-day accumulated rainfall and maize-yields are found also

ABOVE:
The midsummer drought highlighted the dependence of South Africa on dryland maize.
FW ARCHIVE

BELOW LEFT:
Figure 2: Rainfall (% of long-term mean) for January 2023, focusing on the summer-grain production region. Numbers indicated are the actual accumulated rainfall in millimetres at selected locations for the period.



FAST FACTS

January 2023 was very dry over most of north-eastern South Africa, despite wet conditions earlier in the season.

The midsummer drought is a climatological feature that occurs over large parts of the world where summer rainfall predominates.

The last few weeks of the summer rainy season are less likely to see a return of the very dry conditions that characterised much of January 2023.

closer to the planting window by late October (as well as late January to mid-February), but correlations are weak through much of December and on until late January.

With the dry conditions at Lichtenburg and Middelburg starting by late December or early January this year only, and with rain returning by late January, it can be expected that the effect of the drought will be limited to relatively small yield reductions if regular rainfall events occur through February and into March.

It is more likely that wetter conditions will remain in place during the latter part of the growing season, based on seasonal outlooks for the remainder of the rainy season as well as the behaviour of rainfall during previous La Niña summers since 1980. This holds true for both the western and eastern production regions.

ABOVE: The 2022/23 summer maize production season is far from over. FW ARCHIVE

Based on the 15 La Niña and 13 El Niño events during the 1980-2022 period identified by the Oceanic Niño Index used by the National Oceanic and Atmospheric Administration (NOAA), the tendency is for wetter conditions to be associated with La Niña rather than El Niño events.

At least since 1980, at both Lichtenburg and Middelburg, total 30-day accumulated rainfall by 28 February tends to be higher during La Niña summers compared with El Niño summers, the warm phase of the El Niño-Southern Oscillation. However, for the 30-day accumulated rainfall by 25 January the difference is much less distinct. For example, at Middelburg the inter-quartile range (75% of the values) is between 84mm and 176mm for the 30-day rainfall by 25 January during La Niña summers with a median value of 106mm. These values are similar during El Niño summers (inter-quartile range between 76mm and 134mm with a median value of 113mm).

The 30-day rainfall by 28 February, however, tended to be higher during La Niña summers than in El Niño summers: The inter-quartile range during La Niña summers is between 70mm and 149mm (38mm and 75mm for El Niño summers), while the median value during La Niña summers is 102mm (58mm during El Niño summers).

These figures suggest that during La Niña summers, such as the current summer, atmospheric circulation patterns will more likely result in normal to relatively wet conditions during February than during January.

FAR FROM OVER

The 2022/23 summer maize production season is far from over, and a lot can still happen weather-wise that may either lower or enhance production.

So far during the growing season, very wet conditions during early summer were followed by a midsummer drought lasting for most of January over a large portion of the summer-grain production region.

However, with the dry conditions mostly occurring during a period when yields are only weakly correlated with rainfall, maize yield reductions associated with water stress, though certainly present, will probably be relatively small if wetter conditions continue during the remainder of summer.

Moreover, above-normal rainfall during the preceding summers, as well as during November and December 2022 suggest above-normal plant-available water in high-potential soils, further reducing the potential negative effects of the event.

On the other hand, the midsummer drought will have depleted plant-available water, especially in more marginal areas, leaving the maize crop vulnerable should extended dry periods recur during the remainder of the summer.

Given the current La Niña event and seasonal forecasts for further wet conditions together with historical rainfall tendencies during La Niña summers since at least 1980, the last few weeks of the summer rainy season are less likely to see a return of the very dry conditions that characterised much of January 2023.

• *Email Dr Johan Malherbe at Johan@arc.agric.za.*

Rainfall maps by Philip Beukes, Agricultural Research Council – Soil, Climate and Water. Rainfall data from the ARC automatic weather station network; historical maize yield data from the Department of Agriculture, Land Reform and Rural Development. FW