

CLIMATE RESILIENCE

Forecasting the future: Free weather risk app empowers South African farmers

*The Agricultural Research Council (ARC) has developed a user-friendly app providing weather and water availability indices as part of a project funded by the Water Research Commission (WRC).
Article by Sue Matthews.*

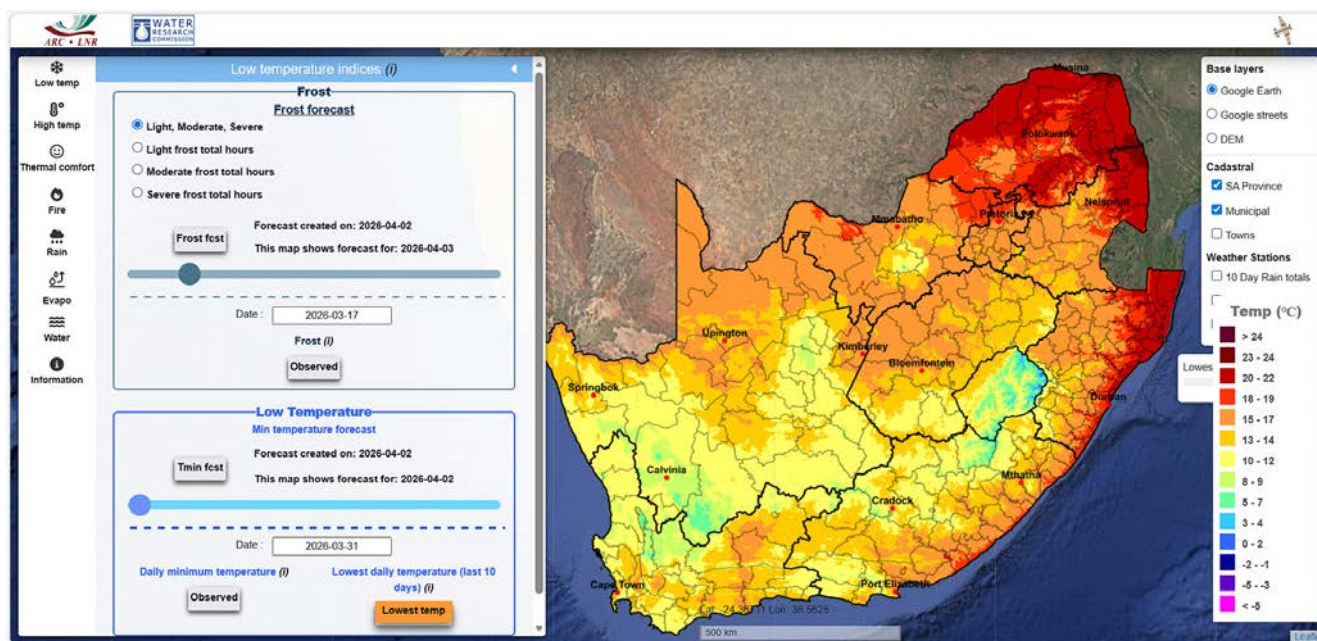


“Red sky at night, shepherd’s delight; red sky in the morning, shepherd’s warning,” the saying goes. For areas where weather systems primarily move in from the west, this old folk proverb has some scientific credibility. Not so for another common one that claims cows lying down is a sign of impending rain!

Fortunately, farmers of today have more accurate information at their fingertips. With a smartphone in their pocket and a good internet signal, they can check the weather forecast while out in their fields and prepare accordingly. Back in their home office, they can use their computer to peruse the seasonal outlook and recent rainfall records, or explore retrospective indicators derived from satellite imagery, such as the Normalised Difference

Vegetation Index (NDVI) depicting vegetation health. Well-resourced farmers might even install weather instrumentation and soil probes for site-specific data, and pay subscription fees for advisory services tailor-made for their farm.

The new app developed by the ARC’s Agrometeorology Division at the Soil, Climate and Water Campus makes information freely available for all. Named the Weather Risk app, it is designed to support short-term agricultural planning and decision-making, typically on daily to weekly timescales. Currently available only as a web-based tool for desktop and laptop computers, it will be useful not only to farmers but also to a variety of other stakeholders, including agricultural extension and field officers,



The Weather Risk app displays the index 'Lowest daily temperature (past 10 days)' for the period leading up to 31 March 2026, as selected in the corresponding date box and based on observed data from the ARC's weather stations. The forecast for minimum temperature can be displayed by toggling the button above the dashed line and then clicking along the slider to view the Day 1 to 7 forecast.

farmer organisations and cooperatives, seed and agrochemical companies, agricultural insurance providers, local government, policymakers and researchers.

"We recognise that a large proportion of the farmers that the ARC supports through research and development are smallholder farmers who may not have a computer, or they're in a rural area without good internet access," says project leader Dr Sarah Roffe, a Senior Researcher at the ARC. "But extension officers are more likely to have connectivity and can use tools like the Weather Risk app to interpret information, which they could then share with farmers via WhatsApp groups or SMS, so we see them as a key target audience."

Ensuring the app filled a genuine gap and provided relevant information to users in a clear, easily accessible way was an important part of the WRC-funded research project. A literature review was conducted to identify rainfall, temperature, and water availability indices widely used in South Africa, and an evaluation of existing web-based weather and climate services (WCS) and the principles behind them was undertaken. Those initial steps revealed that stakeholder engagement was vital before deciding on the app's design and functionality, so a focus group meeting was held in Tzaneen in October 2023 to discuss needs and expectations. The participants – primarily representatives from national and provincial government departments, local municipalities and NGOs – completed a questionnaire that was subsequently refined and made available online for broader dissemination within the agricultural sector. Of the 42 online responses received, most were from individuals within national or provincial departments of agriculture (40.5%), the ARC (14.3%) or universities (9.5%) and the rest from agribusiness companies, associations or consultancies. The results yielded valuable insights on sector-specific perceptions about climatic risks, the uptake of existing WCS, as well as constraints associated with

accessing and using them.

Interestingly, while respondents indicated that they mainly use forward-looking WCS in the form of daily to seven-day weather forecasts, seasonal forecasts and early warning systems, the most frequently reported need was for access to historical weather and climate records. It is fitting, then, that the Weather Risk app provides recent historical information, currently from 2023 onwards, derived from the ARC's network of more than 600 weather stations countrywide. Rather than displaying raw data, though, the app allows indices such as 'Daily minimum temperatures', 'Heat index (human thermal comfort)', and 'Days since last rain' to be mapped. Clicking anywhere on the colour-coded map displays the pixel value at that location, although these values should be treated with some caution. This is because the weather stations are not evenly distributed across South Africa, and the data they record is summarised and interpolated to produce daily GeoTIFF files at a 1 km grid resolution. As such, the indices provide a useful overview of conditions but may not fully capture farm-scale microclimatic influences, such as slope orientation, windbreaks and small water bodies.

Although weather station data can be purchased from the ARC, indices typically provide more intuitive and actionable information on past weather and climate conditions for agricultural decision-making. Clicking on the (i) next to each of the app's indices links to the supporting text in the User Guide, which includes a dedicated section on agricultural relevance and practical application. As an example, the index 'Maximum daily rainfall (last 30 days)' represents the highest single-day rainfall total recorded over the previous 30 days from the date selected using the drop-down calendar. The User Guide states: "This index is useful for evaluating the effects of intense rainfall on agricultural systems. For crop farmers, it helps identify



Project leader Dr Sarah Roffe introduces the Weather Risk app at the ARC's internal stakeholder testing workshop.

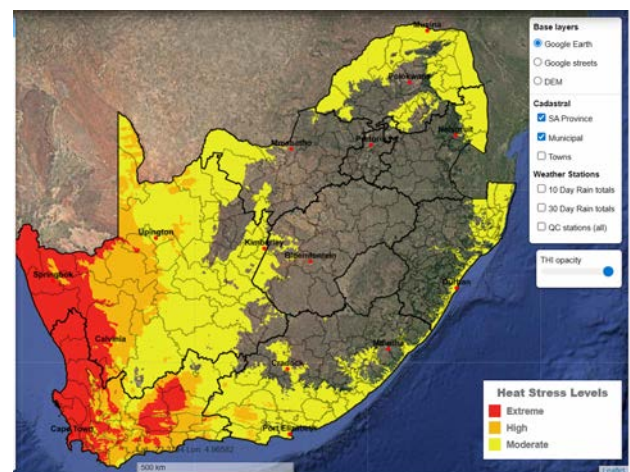
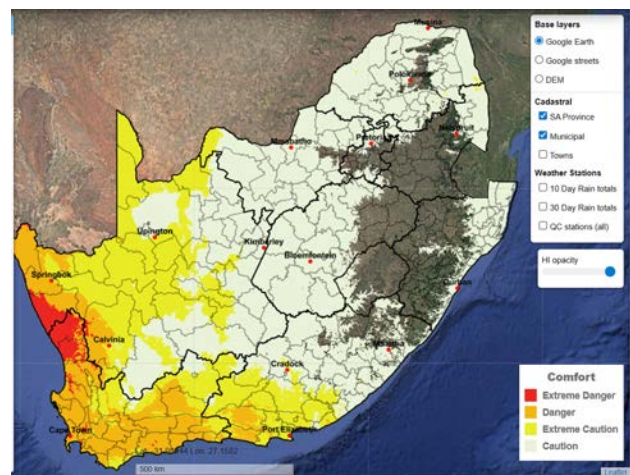
areas at risk of erosion, surface runoff or waterlogging, all of which can damage soil structure and reduce plant health. For example, a farmer who observes a recent extreme rainfall event might inspect fields for ponding or adjust nutrient application schedules to account for leaching. For livestock farmers, the index supports decisions around grazing access and infrastructure maintenance. Heavy rainfall may limit access to paddocks, damage roads or fencing, or increase the risk of animals becoming trapped in wet conditions, prompting changes in movement plans or sheltering arrangements."

The research report also provides a number of case studies, using indices derived from various weather station observations and selected gridded datasets, including ERA5-based temperature and rainfall datasets. These are global reanalysis products produced by the European Centre for Medium-Range Weather Forecasts (ECMWF), which assimilates satellite and weather station observations from around the world into a numerical weather prediction model to generate hourly data spanning 1940 to the present. One case study, for example, examined how well ERA5 datasets capture heavy rainfall events across South Africa, while another assessed their ability to represent extreme low temperature events during winter. A case study focusing on climate indices derived from ARC weather station data explored the indices' relationship to agricultural outcomes – more specifically, the effect of seasonal thermal conditions on cattle production in the Thabazimbi district in Limpopo Province, and the effect of summer temperatures, rainfall and potential evapotranspiration on maize production in the Koppies district in the Free State Province. Taken together, the case studies effectively demonstrate the value of climate indices in providing a bridge between complex data and practical decision-making, while highlighting dataset-specific differences, context dependence and sources of uncertainty that must be taken into account in operational use.

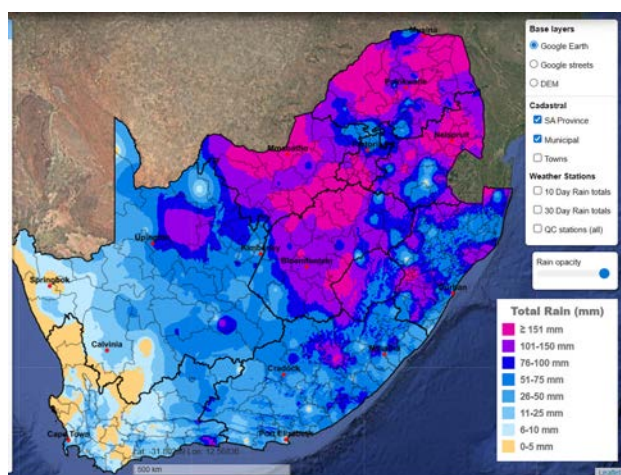
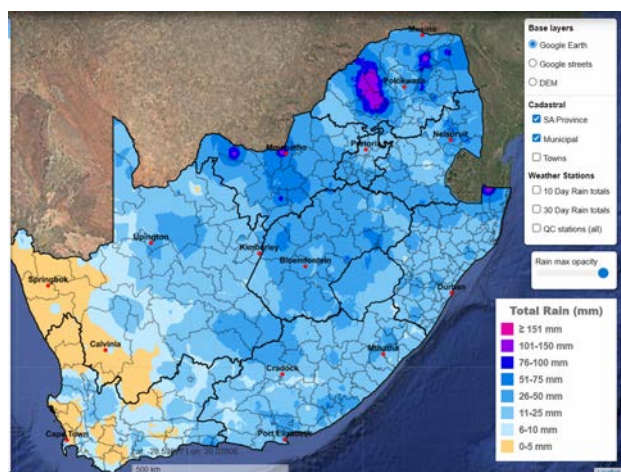
The indices currently available in the Weather Risk app are as

follows:

- **Low temperature indices:** Frost, Daily minimum temperatures, Lowest daily temperature (last 10 days)
- **High temperature indices:** Daily maximum temperature, Heat stress days (last 10 days), Highest daily temperature (last 10 days)
- **Thermal comfort indices:** Heat index (human thermal comfort), Temperature-humidity index (livestock thermal comfort)
- **Fire danger index (FDI)**
- **Rain indices:** Daily rainfall, Number of rain days (last 30 days), Days since last rain (up to 60 days), Maximum daily rainfall (last 30 days), Total rainfall (last 10 and 30 days)
- **Evapotranspiration indices:** Daily total potential evapotranspiration (PET), Total PET (last 10 and 30 Days)
- **Water availability indices:** Irrigation extent per quaternary catchment, Blue water irrigation demand, Monthly surface water anomaly, Groundwater harvest potential.



The images above depict 'Thermal comfort indices' for 11 March 2026, when the western parts of South Africa were experiencing a heatwave. On the top, the 'Heat index (HI)' for humans shows that conditions were potentially dangerous for farm workers unless activities were adjusted. On the bottom, the 'Temperature-humidity index (THI)' indicates the risk of heat stress in poultry. Separate THI values can be displayed for goats, sheep, cattle and pigs.



The above images for 31 March 2026 reveal the difference between the indices 'Maximum daily rainfall (last 30 days)' on the top, showing the highest single-day rainfall total recorded over the previous 30 days, and 'Total rainfall (last 30 days)' on the bottom, showing the cumulative rainfall total recorded over the same period.

Of these, the water availability indices are based on datasets obtained from external data providers, and only the 'Monthly surface water anomaly' index updates regularly; the rest are static layers representing long-term hydrological conditions. All the other indices are based on ARC weather station data and are updated in near-real time, typically with up to two days of delay.

"That's just the time it takes for us to be able to load the observation data onto the site," explains Roffe. "The data from the ARC weather station network has to be checked by a team of technicians who do quality control on a daily basis, so the process is slightly slowed by weekends or by any technical glitches."

While looking back at recent conditions helps farmers and other stakeholders understand the current situation, they really want to know what weather impacts they can anticipate in the short term. Several of the app's indices include daily forecasts over a seven-day period. By selecting the forecast button and then clicking along a slider, the map will display individual forecast days during that period. For some indices, a seven-day total or average forecast can be viewed by selecting the far-right end of the slider.

"Our forecast runs every morning at 7:30, it takes about two hours, and then by 11:30 it's updated on the app," says Roffe. She explains that the ARC uses the Weather Research and Forecasting (WRF) model, a numerical weather prediction model originally developed by the United States' National Center for Atmospheric Research (NCAR) but now maintained and extended by an international user community. The WRF model dynamically downscales data from the NCEP/NOAA Global Forecast System (GFS) from a 28 km grid to a 12 km grid to produce the app's forecasts for South Africa. The User Guide advises caution in interpreting these forecasts because validation is ongoing and forecast skill may vary across regions, seasons and variables.

A few months prior to the Weather Risk app's public release in December, the project team hosted two one-day workshops with ARC staff members from a wide range of disciplines to test the app and gather feedback. The insights obtained have guided refinements to the app and identified priorities for future development, such as including advisory-style features to help farmers apply the information provided in the app.

In March, two launch events were held to showcase the app and demonstrate its practical value to stakeholders. The first targeted government departments and agricultural organisations such as AgriSA and FANRPAN, while the second reached a broader audience of interest groups.

"We had good attendance, with people there from insurance companies, a leading commercial bank, government, academia and research institutes, plus a few farmer groups," says Roffe, speaking a few days after the second event. "The farming community doesn't often come to events like this, so we still need to do some proper engagement with them. The session was very interactive, though, and a lot of useful feedback came our way."

It is still early days for the Weather Risk app, so it should be viewed as an operational service that is being tested, refined and enhanced as feedback is incorporated and the robustness of indices and datasets is evaluated. In any case, the app's outputs are best used for situational awareness, and decision-making should always be informed by local expertise and multiple information sources.

Clearly, though, the app is a welcome addition to the ARC's stable of tools for sharing information – the monthly *Umlindi* climate watch newsletter, the Agricultural Drought Early Warning System (ADEWS) platform, and the subscription-based ARC Weather App offering access to the ARC's weather station data.

"We felt it's very important that we create this app because the ARC has all this data and is mandated to support the agricultural industry," says Roffe. "So for those of us in the Agrometeorology Division, developing tools like this forms part of our goals in striving to support farmers as best we can."



The Weather Risk app is available at: <https://www.weatherrisk.arc.agric.za/>