UNDERUTILISED CROPS

Underutilised crop species offer options for drought mitigation in South Africa

Underutilised crop species can be a valuable option for drought mitigation in South Africa write Tafadzwa Mabhaudhi, Hillary Mugiyo, Vimbayi Chimonyo and Albert T. Modi.

The Centre for Transformative Agricultural and Food Systems (CTAFS) of the University of KwaZulu-Natal (UKZN) was established to contribute to building resilient and sustainable healthy food systems, with a focus on rural resource poor households. This derives from a realisation that rural resource poor households remain vulnerable to food and nutrition insecurity, which is being worsened by challenges of climate change.

In South Africa, there has been an increase in the occurrence and severity of extreme weather events such as floods, heat stress and more importantly, drought. The latter weather phenomenon has been accompanied by poor rainfall distribution, late start of the season, early cessation of the rainy season and extreme temperatures. For agriculture this means poor crop productivity and significant yield losses. Such impacts on productivity are detrimental to farmers, particularly rural resource poor households, who rely on rainfed crop production as the main livelihood strategy, and for their food and nutrition security. Understanding drought can aid in formulating sustainable adaptation strategies and building resilience of farmers.

What is drought?

Drought is a complex phenomenon. There are four types of

drought: 1) meteorological, 2) hydrological, 3) agricultural, and 4) socio-economic drought. Of importance to food and nutrition security is agricultural drought, which happens when there is a lack of sufficient water in the surface soil layers to support crop growth.

Why is drought an important phenomenon in South Africa?

South Africa is considered the 30th driest country in the world, and the country's water profile is rapidly moving from water-scarce to water stressed. The country's annual average rainfall fluctuates around 500 mm, which is far below the world's average of 860 mm per annum. Rainfall is unevenly distributed, with about 50% of the rain falling on 15% of the land. It is in most of the remaining 85% of the country where rural inhabitants are concentrated.

Severe dry episodes in South Africa are often associated with the effects of El Niño–Southern Oscillation (ENSO). The 2015/16 ENSO induced drought, one of the strongest events of recorded history, had tremendous negative impact on agriculture due to water scarcity. This further led to serious food and nutrition insecurity for the majority of the population in South Africa and the region (Nhlamo et al, 2019).

Evidence suggests that the frequency and intensity of drought due to ongoing climate change is increasing, placing many families at greater risk of food and nutritional insecurity. There is an urgent need for South Africa and the region to develop drought adaptation strategies that will mitigate the risks associated with drought. Part of this requires generating context-specific knowledge on the occurrence of drought and developing tailored solutions for these areas.

Where in South Africa is drought severe?

Figure 1 shows the long-term seasonal time series of the Vegetation Drought Response Index (VegDRI) for South Africa. Vegetation Drought Response Index is a hybrid index that combines traditional climate-based drought indicators, satellite-derived vegetation metrics and biophysical information to show maps of drought. The VegDRI-South Africa map shows a variation of very severe drought 16%, severe drought 34%, moderate drought 38%, slight drought 11% and no drought conditions 1% detected over South Africa. Over the Northern Cape and Eastern Cape provinces, drought is very severe to severe, indicating acute water scarcity. Moderate to no drought conditions are reported from the central to eastern regions of South Africa.

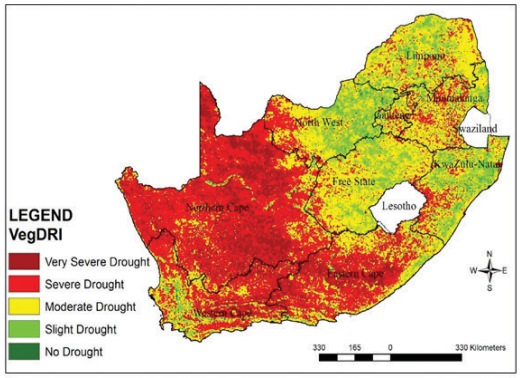

Figure 1. Drought occurrence and severity across South Africa.

Underutilised crop species as a drought mitigation strategy

Currently, delineation of South Africa's rainfed agricultural land use is for a few major cash crops such as maize, sugarcane and soybean. This reflects a lack of agro-biodiversity, which culminates in increased vulnerability of agriculture to climate risks such as drought. An example is the 2015/16 ENSO drought that caused South Africa to import more than 30% of its annual cereal grain requirements due to poor harvests.

Neglected and underutilised crop species (NUS) are reported to be suitable for marginal agro-ecologies. They can help build the resilience of rainfed cropping systems in the wake of climate variability and change. NUS can offer options for increasing productivity, especially in marginal areas, as they are locally adapted and would not strain the environment further. The promotion of indigenous crops such as sorghum, millets, bambara groundnut, cowpea (***Vigna unguiculata),*** taro, and leafy vegetables such as amaranth and wild mustards is integral to ensuring that households consume diverse diets. Identifying areas that are suitable for NUS production could assist farmers to adapt to drought.

Sorghum - also known as "Mabele thoro", "Amazinba" or "Amabele" is the second most important cereal in SA after maize. Sorghum is adapted to warm climates and possess characteristics that make it a drought-tolerant crop. According to Figure 2, there is about 2% of the calculated arable land of South Africa (12 655 859 ha) that is highly suitable (S1), that is, land having no limitations, to produce sorghum. Moderately suitable (S2) land constitutes the most substantial proportion with 61%. In comparison, marginally suitable (S3) and unsuitable (N1) includes 33% and 4%, respectively, of calculated arable land. Large areas of suitable (S1 and S2) land were concentrated in eastern provinces of the country and suitability intensity decrease towards western regions. The suitability map for sorghum suggests that the crop can be grown in areas that experience slight to moderate drought (Figure 1).

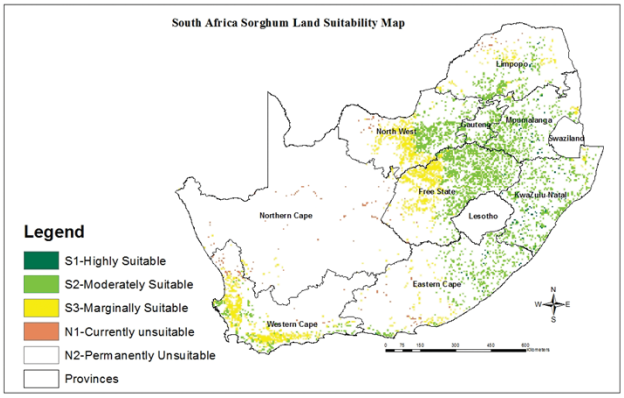

Figure 2. Suitability of sorghum (Sorghum bicolor) across South Africa

Cowpea –also known as "imbumba", "indumba" or "isihlumaya" is a legume crop mainly produced by smallholder farmers in South Africa under rainfed conditions. The crop is well known for its drought-tolerance and can grow in areas with rainfall ranging from 400 to 700 mm per annum. Figure 3 shows the suitability of cowpea, across South Africa. The distribution of land suitable

for cowpea production was consistent with that of sorghum. The trend was that land designated as moderately suitable (S2) constituted 56% of calculated arable land of South Africa (12 655 859 ha), and this was followed by S3 and S1 with 39 and 3%, respectively.

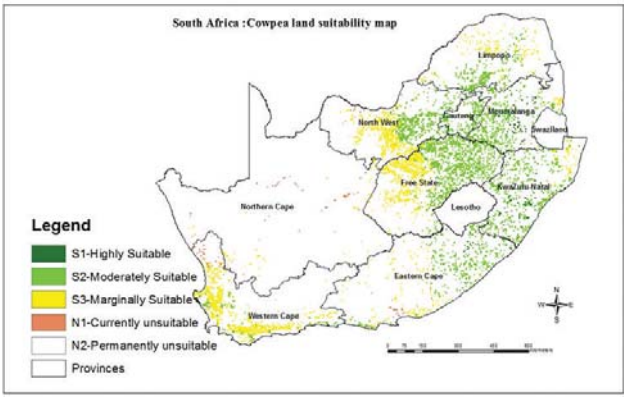

Figure 3. Suitability of cowpea (Vigna unguiculata) across South Africa

Amaranth – often considered a weed in conventional cropping systems, is a popular African Leafy Vegetable that is highly nutritious and shows remarkable drought tolerance. The land suitability analyses indicated that amaranth is highly suitable across South Africa S1=8%, S2=81%, S3=11%, and of calculated arable land of South Africa (12 655 859 ha) and this is because the crop has a short growing period and low water requirement.

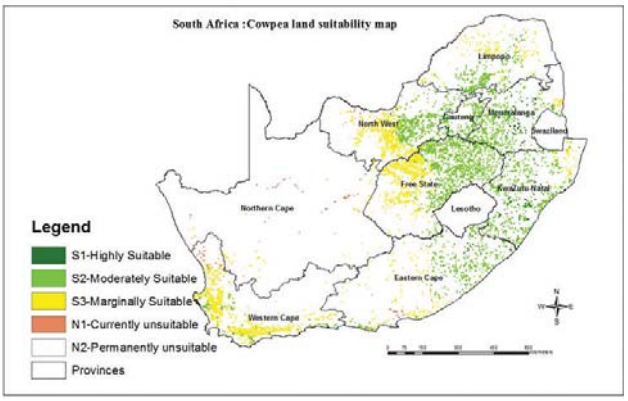

Figure 4. Suitability of amaranth (Amaranth spp) across South Africa

Other strategies to consider

Under limited water availability, agriculture needs to consider strategies that increase water productivity. In response to frequent droughts, an increase in the area under irrigation may seem an obvious solution to mitigating drought. However, considerations need to be given to the availability of water and energy for irrigation expansion and the accessibility of irrigation services to different farming groups in the country. Under marginal farming systems, irrigation is an expensive option and not always readily accessible. Although tapping into South Africa's groundwater resources has been suggested, the extent to which these can contribute to expanding the area under irrigation is unknown given the challenges of quantifying and pumping these resources. Therefore, smallholder farmers currently lack access to water, energy, infrastructure and technical skills to irrigate.

Alternatively, farmers can explore strategies such as rainwater harvesting and soil water conservation techniques, which involve inducing, collecting, storing and conserving runoff water for agriculture. The drawbacks to this are that, apart from scale issues, rainfall has become more erratic and droughts more frequent. Hence, the feasibility of this approach under frequent drought is challenging.

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