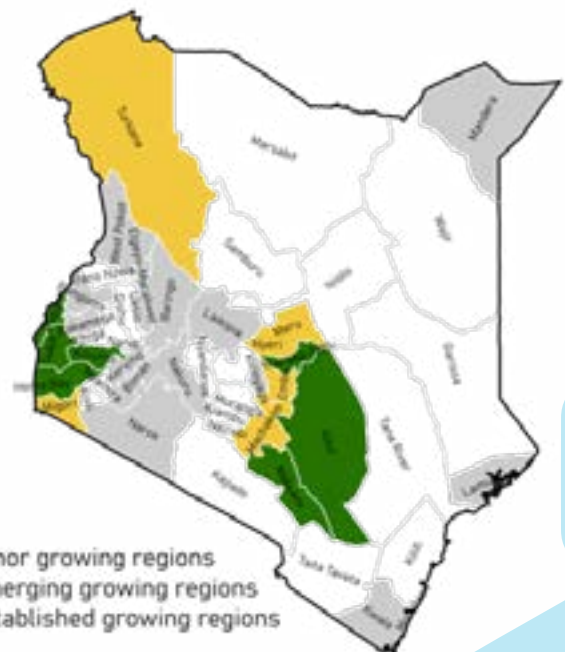




Climate Risk and Opportunities Sorghum in Kenya

Sorghum is Africa's second most important cereal because it is the primary source of daily calories for 300 million sub-Saharan Africans. Sorghum is a staple food crop for many low-income households in Kenya. It is typically grown by small-scale, resource-poor farmers and is mainly used for home consumption.

The country has approximately 240,000 small-scale bioethanol production industries. sorghum farmers with farm sizes ranging from 1 to 1.5 acres/ household. Presently, sorghum production is about 4-5 bags / acre at the farm level (1 bag represents to 100 kg). Recently, sorghum is increasingly becoming important as cash crop especially with contract farming for the brewing, baking and Kitui, Tharaka-Nithi, Homa Bay, Kisumu, Siaya, Makeni, Busia, and Meru are the major producing-area counties, producing sorghum in >10000 ha. Kitui is the county's largest producing-area county, cultivating around 65383 ha.



Note: RCP 8.5 emission scenario has been used to assess the climate change events and impacts. For future analysis, the 2050s (2006-2050) timesteps were used. For the current, the period 1981-2005 had been used. MAM refers to March, April, and May. OND refers to October, November, and December.

Data source: Ensembled CORDEX data.

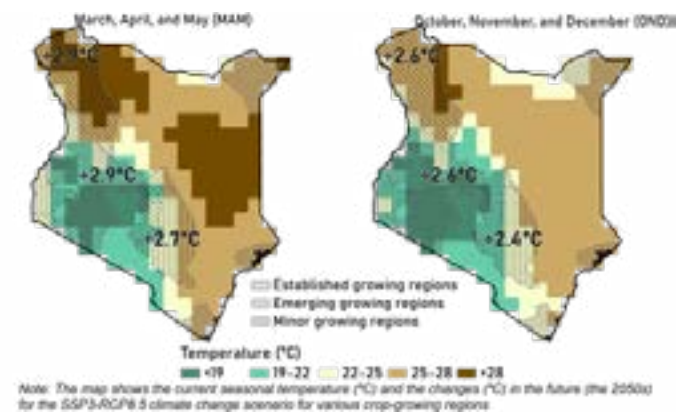
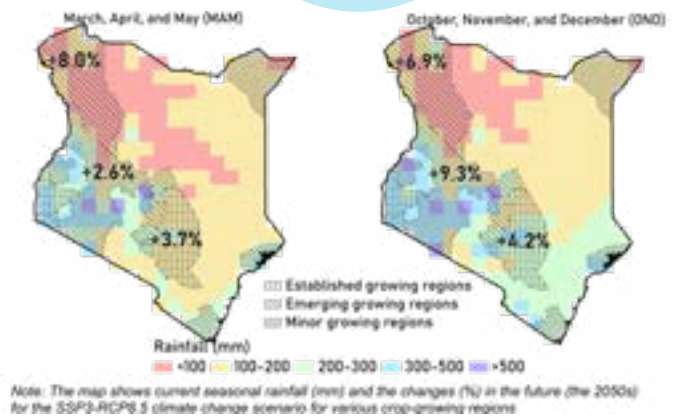
Future climate

Rainfall: On average sorghum growing areas are expected to face an increase in rainfall in both seasons in 2050. The highest increase in rainfall is projected for Turkana. In the OND season, minor sorghum growing areas such as Baringo are likely to receive more rainfall in future.

Flood: In the OND season flood risk will probably increase due an increase in rainfall and wett spells.

Temperature: In the 2050s, the temperature in the sorghum growing counties is expected to rise. In the MAM season the temperature will probably increase by +2.7 to + 2.9 °C. . Turkana is likely to face the highest increase in temperature. In the OND season the increase in temperature is slightly lower, +2.4-+2.6°C.

Note: RCP 8.5 emission scenario has been used to assess the climate change events and impacts. For future analysis, the 2050s (2006–2050) timesteps were used. For the current, the period 1981–2005 had been used. MAM refers to March, April, and May. OND refers to October, November, and December.

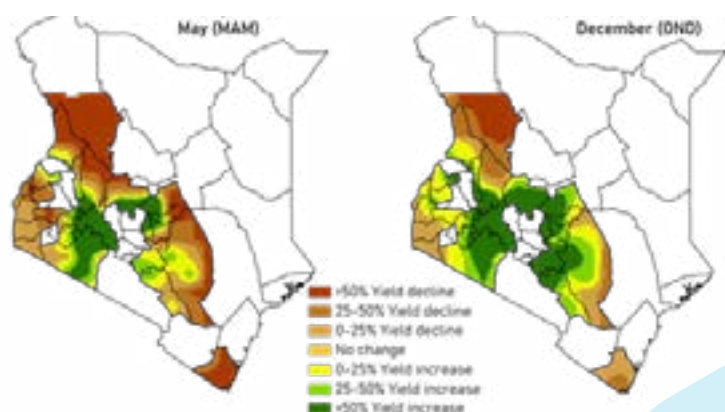


Sorghum crop productivity changes (%) in the future

In the 2050s, sorghum yield in the country is expected to increase in a few counties from the major growing counties. Machakos, Embu, Nyeri and Laikipia are likely to face an increase in productivity (>50% yield increase).

Other sorghum growing areas, however, will probably face a decrease in production such as Turkana (> 50% yield decline) and Homa Bay, Kisumu, Siaya, Busia (25-50% yield decline).

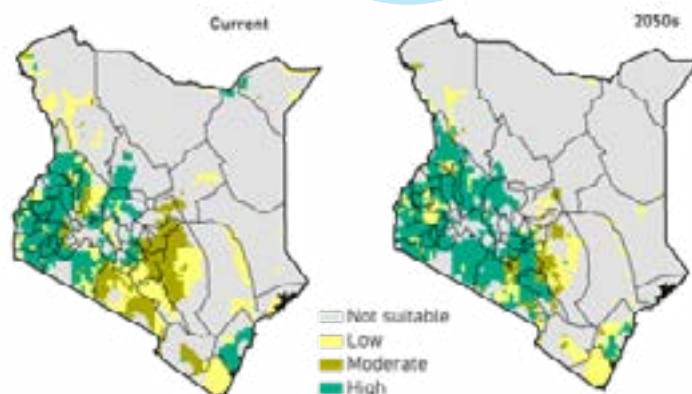
Overall, the yield decline is likely to be more sever in the MAM season than in the OND season due to higher rainfall in the OND season.



Sorghum crop-growth suitability

Overall, the suitability for sorghum production will probably increase in future.

Parts of Narok county will change from moderately suitable to highly suitable. Parts of Nairobi area are also likely to face an increase in suitability, from moderately to highly suitable. The suitability for sorghum in Western part of Makueri county is likely to change significantly (from low suitability to moderate/ high suitability).



The probability of drought risks

In March, Meru, one of the major sorghum-growing counties, is projected to have 4.1% of the area under high drought risk.

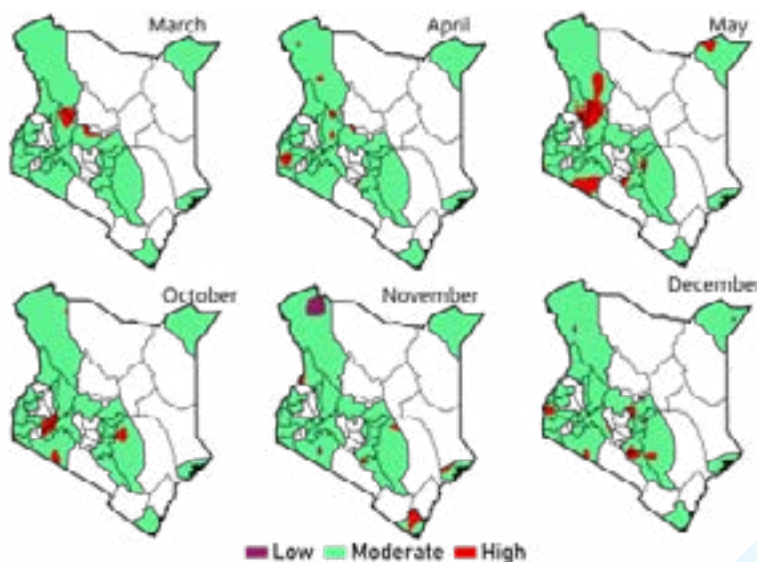
In April, a considerable amount of area from the major sorghum-growing counties, Homa Bay (30%), Machakos (3.5%), and Siaya (20%), are projected to be at high risk of drought.

In May, Machakos, one of the major sorghum-growing counties, is projected to have 23% of the area under high drought risk.

In October, Kisumu, Kitui, Homa Bay, Machakos, and Nakuru counties are projected to have 1-8% of the area under high risk.

In November, Machakos is projected to have 3.3% of the area under high drought risk.

In December, a considerable amount of area from the major sorghum-growing counties, Machakos (13.7%), Meru (15%), Kitui (3.6%), Tharaka-Nithi (3%), and Siaya (38.4%), is projected to face drought risk.






The probability of drought risks has been analyzed based on the Standardized Precipitation Index (SPI). The calculation of SPI is done based on the record of long-term precipitation for 45 years (2006-2050). To assess the risk, we calculated the occurrence of droughts over 45 years (2006-2050) for each month in rainy seasons (MAM and OND) and then calculated the probability by applying the following formula:

$$\text{Probability of drought risks} = \frac{\text{No. of droughts}}{\text{Total years (45)}} \times 100$$

Note: In drought analysis, more than 30% of drought occurrence are classified as high-risk region, 10 to 30% of occurrences are classified as Moderate risk, and less than 10% of occurrences has been classified as Lower Risk.

Climate change adaptation strategies

Adaptation measures are listed based on the discussion with the CRAFT team from Kenya under the following objective, "To establish suitable adaptation strategies that will increase the adaptive capacity and resilience of the actors within the value chains." The listed adaptation measures mainly focused on the sorghum value chain in Kenya.

Climate risks	Impacts	Adaptation measures	Impact on resilience
Drought 	Delay in land preparation, forced maturity, crop stress, reduced quality & yield, and less area ploughed.	Drought/Pest and disease tolerant varieties, early maturing varieties, soil water measures (terraces, zero/minimum tillage, mulching, ripping, subsoiling, planting basins, zai pits), and enterprise diversification.	<ul style="list-style-type: none"> • Increase in resilience • Enhanced water retention • Reduction in soil erosion • Improved soil structure and fertility • Reduction of risk in yield losses
Intense rainfall (Floods) 	Delay in land preparation, planting and harvesting, crop destruction, leaching of fertilizers, increased post-harvest spoilage (high humidity, rotting, molding, and aflatoxins).	Minimum tillage by use of herbicides, manual land preparation and weed control (uprooting and cutting back), Soil water conservation measures (ripping, subsoiling, terracing, and cut-off drains).	<ul style="list-style-type: none"> • Increase in resilience • Reduction in risk of water logging • Reduction in soil erosion • Reduction in yield losses due to flood risks
Soil degradation 	Crop stress, reduced quality & yield, and crops will be susceptible to pests and diseases.	Fertilization, manure application, crop residual tillage, crop rotation, and pesticide application.	<ul style="list-style-type: none"> • Increase in resilience • Improved soil structure and fertility • Enhanced water retention • Reduction in risks of yield losses

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