

## 4: Kenya



**In brief:** Vulnerable to frequent droughts in some regions, flooding likely in others.

**Right Now:** Endemic severe droughts have left communities struggling to cope with repeated shocks to their livelihoods.

**Future climate change risks:** A sea level rise of just 0.3 metres would render 17 per cent of Mombasa uninhabitable.

**Emissions of CO<sub>2</sub> per capita:** 0.3 metric tons – almost thirty times less than Ireland

### 4.1 Introduction

Kenya's socio-economic development is already highly susceptible to climate variability and climate-related extreme events.<sup>115</sup> Agriculture accounts for 67 per cent of employment, and 30 per cent of the total population are pastoralists in semi-arid areas. Approximately 85 per cent of the land area is classified as arid or semi-arid, dependent on short rainy seasons for water.<sup>116</sup> If, as the science indicates, we can expect longer dry seasons and more rainfall falling in shorter periods of time, the effect on water availability and quality will be severe.

Climate change projections indicate that yields of staple crops of maize and beans will decline over the coming decades and that Kenyans will face increasingly serious food security issues in the next 40 years due to water stress and droughts in semi-arid regions. In other parts of the country, more extreme rainfall events makes flooding likely, which will also impact on crop and livestock production.<sup>117</sup> Both droughts and floods are expected to increase in frequency and result in the displacement of communities and migration of pastoralists resulting in conflicts over natural resources. In particular, areas in which agriculture is currently marginal and dominated by pastoralism are the most vulnerable to changing climatic conditions. Each disaster takes its toll on community resilience and adaptive capacity, making successive disasters increasingly difficult to contend with.

according to Kenya's government, citing rainfall that has become irregular and unpredictable, extreme and harsh weather that is now the norm, and some regions experiencing frequent droughts during the long dry season while others experiencing severe floods during the short rains.<sup>118</sup> Kenya's National Climate Change Response Strategy highlights that observed temperature trends between 1960-2006 show general warming over land locations except for the coastal zone that shows cooling trends. The minimum temperature has risen by 0.7 – 2.0 °C and the maximum by 0.2 – 1.3 °C, depending on the season and the region. In areas near the Indian Ocean, maximum temperatures have risen much like in other areas but minimum temperatures have either not changed or become slightly lower.<sup>119</sup>

The Fourth and the Fifth Assessment Reports of the Intergovernmental Panel on Climate Change point to the occurrence of extreme precipitation changes over Eastern Africa such as droughts and heavy rainfall.<sup>120</sup> Kenya has been vulnerable to precipitation extremes events: 2003 was the wettest in 70 years in some parts of Kenya. The years 2003-2006 were marked by drought with the country receiving only 50 per cent of expected rainfall. Early 2010 saw serious flooding after weeks of heavy rainfall and was identified as the worst flood in more than a decade. Drought conditions between 2008-2011 badly affected pastoralist communities in the north east of Kenya, where some 70 per cent of livestock died.<sup>121</sup>

Research has indicated that there has been an increase in seasonal mean temperature in many areas of Kenya over the last 50 years.<sup>122</sup> In addition, warming of the near surface temperature and an increase in the frequency of extreme warm events has been observed for countries bordering

### 4.2 Observed Climate Variability and Change

Evidence of climate change is 'unmistakeable'

the western Indian Ocean between 1961 and 2008.<sup>123</sup>The frequency of dry years is increasing while rainfall has declined significantly since the mid-1970s. In particular, reductions in rainfall and increases in the frequency of dry years threaten critical surplus crop growing areas in central Kenya. If such trends continue the amount of prime arable land could diminish substantially.<sup>124</sup>

### 4.3 Projections of Future Climate Change

With continued emissions of greenhouse gases, global climate models show warming projected for all seasons in all regions of Kenya, except for coastal regions.<sup>125</sup>Results for Kenya show that, compared to the 1961-1990 average, a medium high emissions scenario produces warming of around 4°C by the end of the century in both seasons.<sup>126</sup>This is consistent with projections from the most recent IPCC report, which indicate considerable warming for the region of east Africa, with the degree of warming greatest for higher greenhouse gas emissions pathways (Figure 1). Under a business as usual scenario, with no policy changes to reduce global emissions, the average warming across all models shows temperature increases of approximately 4.5°C by the end of the century. When the range of projections from individual models is examined, some show temperature increases approaching and exceeding 6°C by the same period. Under ambitious global greenhouse gas emission reductions (represented by RCP2.6) temperatures are expected to increase by approximately 1°C by the end of the century, however, even under this ambitious scenario increases in mean annual temperature above current conditions still approach 2°C for some models.

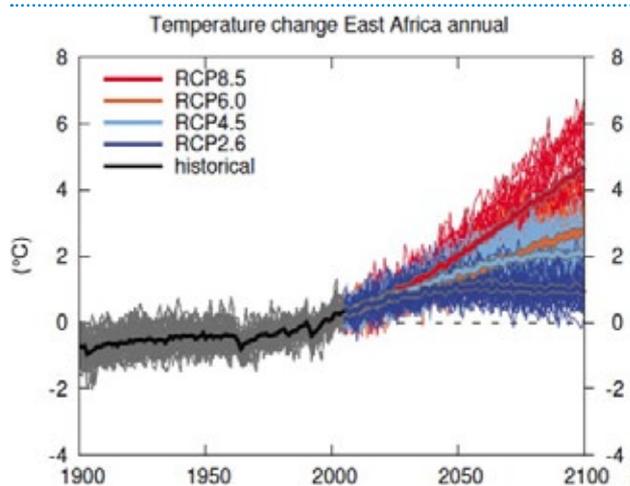


Figure 1 Projected changes in annual temperature relative to 1986-2005 under different greenhouse gas emissions pathways for East Africa. Red is business as usual emissions (RCP8.5), dark blue represents ambitious reductions in global emissions (RCP2.6) Thin lines denote a single model projection; thick lines show the mean simulation for multiple climate models. (Source; IPCC, 2014)

It is uncertain whether total rainfall will increase or decrease but, in common with other regions, it is expected that rain is more likely to fall as extreme events. Kenya is projected to experience increases in heavy precipitation with high certainty alongside an increase in the number of extreme wet days by the mid-21st century.<sup>127</sup> Increases in rainfall extremes are likely to translate into greater flood and drought risks nationally affecting disaster management and local livelihoods.

Sea level rise presents a significant risk to Kenya's second largest city Mombasa which is also the region's largest sea port. The city has very high levels of poverty.

**Sea level rise of only 0.3 metres would submerge an estimated 17 per cent of Mombasa, with large areas becoming uninhabitable due to flooding, or will become agriculturally unsustainable due to salt water flooding.<sup>128</sup>**

Impacts of sea level rise on Mombasa are likely to be felt nationally and across the region due to its strategic economic importance. The most recent IPCC report indicates that over the period 1901-2010 global mean sea level rose by approximately 0.19 metres.<sup>129</sup> Under all greenhouse gas emissions scenarios sea level will continue to rise over the coming century. For the most ambitious scenario (RCP2.6) sea level rise by the end of the century relative to the period 1981-2005 will likely

be 0.26-0.55 metres. For the unabated emissions scenario, estimated sea level rise for 2100 is 0.52 – 0.98 metres.<sup>130</sup>

## 4.4 Food Production and Climate Change

In Kenya climate change is having far reaching negative effects on the already precarious food security situation for both crop cultivators and pastoralists.<sup>131</sup> In recent years droughts have become frequent, reducing production of maize, the staple food crop, sugarcane and coffee, worsening Kenya's food security.<sup>132</sup>

Extreme precipitation events including drought have the ability to create poverty traps. For instance, crop failures in 2009 placed an estimated 10 million Kenyans at risk of hunger, malnutrition and starvation.<sup>133</sup> The FAO has reported that in 2011 maize production in the Eastern Province of Kenya dropped by 8 per cent due to a poor harvest caused by early cessation of the 2011 short rains, attributed to changing climatic conditions.<sup>134</sup> At the other end of the spectrum, increases in floods are expected to exert considerable impacts on food security, for example, heavy rains in 2002 caused floods on farms and mudslides, which forced tens of thousands to leave their homes in Kenya. Such extremes of drought and deluge are likely to increase over the coming century.

Climate change is expected to increase agricultural pests and diseases, particularly ticks and tick-borne diseases in East Africa.<sup>135</sup> Changing weather patterns could expand the distribution of ticks causing animal disease in particular Theileriosis (East Coast Fever) disease, which causes anaemia and skin damage that expose cattle to secondary infections.<sup>136</sup> Ticks and tick-borne diseases will specifically exacerbate the growing food insecurity among the pastoral community in Kenya.<sup>137</sup>

## 4.5 Access to water

Rising temperatures, associated increases in evaporation losses and changes in rainfall, together with increases in the frequency and magnitude of extreme events are expected to impact negatively on water resources in eastern Africa.<sup>138</sup> In Kenya water supplies are projected to be affected by increases in temperature and local variability of precipitation.<sup>139</sup> Most water for domestic use and other uses is derived from rivers

whose recharge depends on rainfall.<sup>140</sup> Extreme climate change events are already changing the water cycle that in turn affects water availability and runoff and thus may affect the recharge of rivers across Kenya.<sup>141</sup>

Kenya's per capita water availability is very low and likely to decrease with climate change in combination with population growth and environmental degradation.<sup>142</sup> At the present time, 35 per cent of people are reliant on drinking from unimproved water sources such as ponds, streams and rivers that are often contaminated.<sup>143</sup> Meanwhile, water demand is predicted to rise by 2020.<sup>144</sup>

Access to water is most difficult in arid and semi-arid regions of Kenya where livelihoods are derived from livestock keeping. Any reductions in surface run-off are likely to impact negatively on pastoral livelihoods through drying of water sources.<sup>145</sup> These losses are likely to be exacerbated by climate variability and change over the coming decades and, consequently, increase pressure on water resources.<sup>146</sup>

## 4.6 Gender

Kenya has made considerable advances in both climate change strategy, and gender mainstreaming – but there is very little overlap between the two.<sup>147</sup> Gender considerations in climate change policy are rare – despite evidence of the ways in which climate change is affecting women in particular. Changes in water availability under climate change are likely to exacerbate existing burdens on women in relation to water collection. Women are more affected when the quantity of water and/or its accessibility changes. Research also shows the extra burden carried by women in the aftermath of disasters deteriorate women's adaptive capacity in Kenya.<sup>148</sup>

A study of pastoralists in the remote Turkana province of Kenya clearly shows the gender dimension to climate-change related conflict and food insecurity. Women are particularly vulnerable in times of conflict, being less likely to flee during raids given their responsibility towards their children.<sup>149</sup> If a woman survives and her husband does not, she has poorer customary rights to the land, water and livestock.

## Thiga Nanuaga is still getting used to seeing green fields again.

The 65-year-old farmer has lived his whole life near to the village of Chuka in the Tharaka district of central Kenya, but increased drought over recent years was making it more difficult to survive.



Farmers in this region have traditionally relied on two rainy seasons each year. With no other way of getting water to their land, the rain was vital if crops were to grow. When the

rains came, farmers could grow enough food to sustain their families through the dry period. When the rains did not come, however, people went hungry.

***“We had to wait for the rain for our crops to grow,” explains Thiga. “The rains are disappearing so it was getting more difficult every year. Life was very hard. We experienced hunger very often.”***

Thiga, who lives with his wife, Alice, and their two young children, received a lifeline earlier this year when his farm was connected to a Trócaire-funded irrigation project which brings water directly from a river to over 1,400 farms in the area. The irrigation project means that people are no longer reliant on the rain for their crops.

***“The irrigation has made a big difference,” he says, proudly displaying his thriving crops. “We don’t have to wait for the rain any more so we can plant all year round. We are growing crops throughout the year.”***

The irrigation project has transformed this community. However, across Kenya millions of farmers are still reliant on rain to grow crops. With rains becoming more erratic and less predictable, hunger is on the rise.

***“The rains are getting less by the year,” says Thiga. “When I was young there was plenty of rain but not anymore. It is going to be very difficult for people who do not have irrigation. I do not know how they will continue.”***



## 4.7 Migration

Rural-urban migration in Kenya is accelerated during periods of drought such as in 2008-2011.<sup>150</sup> During these drought conditions many pastoralists migrated to peri-urban areas increasing significantly their vulnerability and dependency on food aid.<sup>151</sup>

For pastoralists, migration is influenced by livestock deaths and acute food shortage due to depletion of pasture and water for livestock. For example, during the severe droughts in 2000, the Maasai pastoralists moved as far as the slopes of Mount Kenya (approximate distance of 29 km) and the Aberdare ranges (approximate distance of 38 km) in search of pasture and returned to their base afterwards.<sup>152</sup> Conflicts that are sparked by dwindling pasture and water resources also contribute to migration. In the event that - pastoralists lose their herd, they often migrate to peri-urban and urban areas to seek alternative

livelihoods. Research shows that migration has increased school drop-outs significantly with school going children migrating with families in search of food, water and pasture for their livestock.<sup>153</sup> An increased incidence of droughts under climate change is likely to increase rural-urban migration and exacerbate urban vulnerability.



## 4.8 Health

Malaria is a major cause of death in Kenya and has a large negative impact on farm labour. Women and children are particularly vulnerable.

**Consensus is growing in Kenya that the malaria epidemic is connected to changing climate conditions.<sup>154</sup>**

Highland areas, especially in East Africa, will likely experience increased malaria epidemics as temperatures increase and areas above 2,000m, with temperatures currently too low to support

malaria transmission are affected.<sup>155</sup> One study of Wajir County in Kenya showed that extreme climate events were associated with a large malaria epidemic in 1997/1998 and 2006/2007, resulting in high admissions to Wajir Hospital and a weekly malaria incidence of 40–55 cases per 1000 population per week in all persons and children.<sup>156</sup>

Research also argues that climate change is expected to increase stunting among children in the country.<sup>157</sup> The poorest people that depend on locally grown crops will disproportionately suffer with increased health risks likely to compromise labour needed for crop and livestock production. Rift Valley fever (RVF) epidemics in Kenya are associated with precipitation and temperature.<sup>158</sup> Projected climate change could further exacerbate its incidence and spread. In 2006–2007 uninterrupted rainfall and the worst flooding in the county for over 50 years, was linked to an outbreak of RVF in the county.<sup>159</sup>

## 4.9 Economic impacts

Climate change impacts in Kenya could threaten past development gains and constrain future economic progress. Periodic floods and droughts cause major macro-economic costs and reductions in economic growth. Future climate change will likely lead to additional and potentially very large economic costs. Additional net economic costs (on top of existing climate variability) could be equivalent to a loss of almost 3 per cent of GDP each year by 2030 in Kenya.<sup>160</sup> Costs include potential threats to coastal zones (sea-level rise), health burdens, energy demand, infrastructure, water resources, agriculture and loss of ecosystem services. While the costs of adaptation are only emerging, an initial estimate of immediate needs for addressing current climate as well as preparing for future climate change for Kenya is \$500 million / year (for 2012).<sup>161</sup> The cost of adaptation by 2030 will increase: an upper estimate likely to be in the range of \$1 to 2 billion / year.<sup>162</sup>

## 4.10 Looking to the future

As droughts occur with greater and greater frequency in Kenya, continuous preparedness and adaptation measures are needed for communities to be able to cope. Trócaire's programme in Kenya works to build community resilience, which involves improving management of natural

resources, community-managed disaster risk reduction, protection of the environment and advocating for favourable policies, including climate change policies. The programme focuses on improving food security, promoting the sustainable management of natural resources for improved livelihood security and advocating for policies, laws and institutions that support sustainable livelihoods. Recent successes include increasing the diversity of livelihoods and food groups, reducing the distance to water and establishing and working with community-based groups, such as Natural Resource Management and Community Managed Disaster Risk Reduction committees, and linking them to government structures and systems. The picture above shows Thiga Nanuaga's green fields- his farm was connected to a Trócaire-funded irrigation project benefiting 1,400 farms in his area.

Kenya is moving in the right direction in creating an enabling environment to respond to climate change, and Trócaire partners are active participants in this process. Partners have contributed to developments in Climate Change Policy, the Community Land Policy and the Forest Act, which are integral to ensuring people can access the natural resources such as land and forestry that they need to build resilience and sustainable livelihoods.



*An irrigated field stands beside land that has not received irrigation. The increasingly erratic nature of rainfall in central Kenya means that farmers are struggling to survive without irrigation.*

## 4.11 Summary of Findings



There has been an increase in seasonal mean temperature in many areas of Kenya over the last 50 years. An increase in the frequency of extreme warm events has been observed for the region between 1961 and 2008. Observational evidence shows that the frequency of dry years is increasing while rainfall has declined significantly since the mid-1970s.



Warming is projected for all seasons in all regions of Kenya, except for coastal regions. Under a business as usual scenario, the average warming across all models shows temperature increases of approximately 4.5°C by the end of the century. Sea level rise presents a significant risk to Kenya's second largest city Mombasa which is also the region's largest sea port.



Kenya is projected to experience increases in heavy precipitation with high certainty alongside an increase in the number of extreme wet days by the mid-21st century. Increases in rainfall extremes are likely to translate into rising flood and drought risks for Kenya with implications for disaster management, development planning and local livelihoods.



Net economic costs of climate change could be equivalent to a loss of almost 3 per cent of GDP each year by 2030 in Kenya. Costs include potential threats to coastal zones (sea-level rise), health burdens, energy demand, infrastructure, water resources, agriculture and loss of ecosystem services. While the costs of adaptation are only emerging, an initial estimate of immediate needs for addressing current climate as well as preparing for future climate change for Kenya is \$500 million / year.



In Kenya climate change is having far reaching negative effects on the already precarious food security situation for both crop cultivators and pastoralists. Climate change is expected to increase agricultural pests and diseases, particularly ticks and tick-borne diseases in East Africa.



Rising temperatures, associated increases in evaporation losses and changes in rainfall, together with increases in the frequency and magnitude of extremes events will impact negatively on water resources. In Kenya water supplies are expected to be affected by increases in temperature and local variability of precipitation.



Consensus is growing in Kenya that the malaria epidemic is connected to changing climate conditions. Highland areas, especially in East Africa, will likely experience increased malaria epidemics as temperatures increase and areas above 2,000m, with temperatures currently too low to support malaria transmission are affected.



There is very little overlap between climate change strategies and gender mainstreaming policies in Kenya. Women are particularly badly affected by water shortages, disasters, and climate change-induced conflict in Kenya.



Rural-urban migration in Kenya is accelerated during periods of drought such as in 2008-2011. Conflicts that are sparked by dwindling pasture and water resources contribute to migration. An increased incidence of droughts under climate change is likely to increase rural-urban migration and confound urban vulnerability.