CLIMATE CHANGE & CROP DIVERSITY

Climate change is putting pressure on the agricultural systems that underpin our food and nutritional security.

IMPACTS IN OUR WORLD

Globally, negative impacts including higher average temperatures, more frequent extreme weather events, changes in rainfall patterns, and increased pressures from plant diseases and pests will make it more difficult for crops to survive and thrive. Regionally, climatic changes will impact agricultural productivity in unique ways, calling for distinct solutions so as to adapt agriculture to a changing environment.

NORTH AMERICA

- Average crop yields decline by 2050 and more steeply by 2100
- Benefits for fruit production in the Great Lakes region, but late season heat stress challenges US soybean yields
- Reduced precipitation restricts water availability as irrigation demands increase

LATIN AMERICA & CARIBBEAN

- In temperate areas, soybean, wheat and pasture productivity increases
- Drier soils and heat stress reduce productivity in tropical and sub-tropical regions
- Increased salinization and desertification in arid zones of Chile and Brazil

SUB-SAHARAN AFRICA

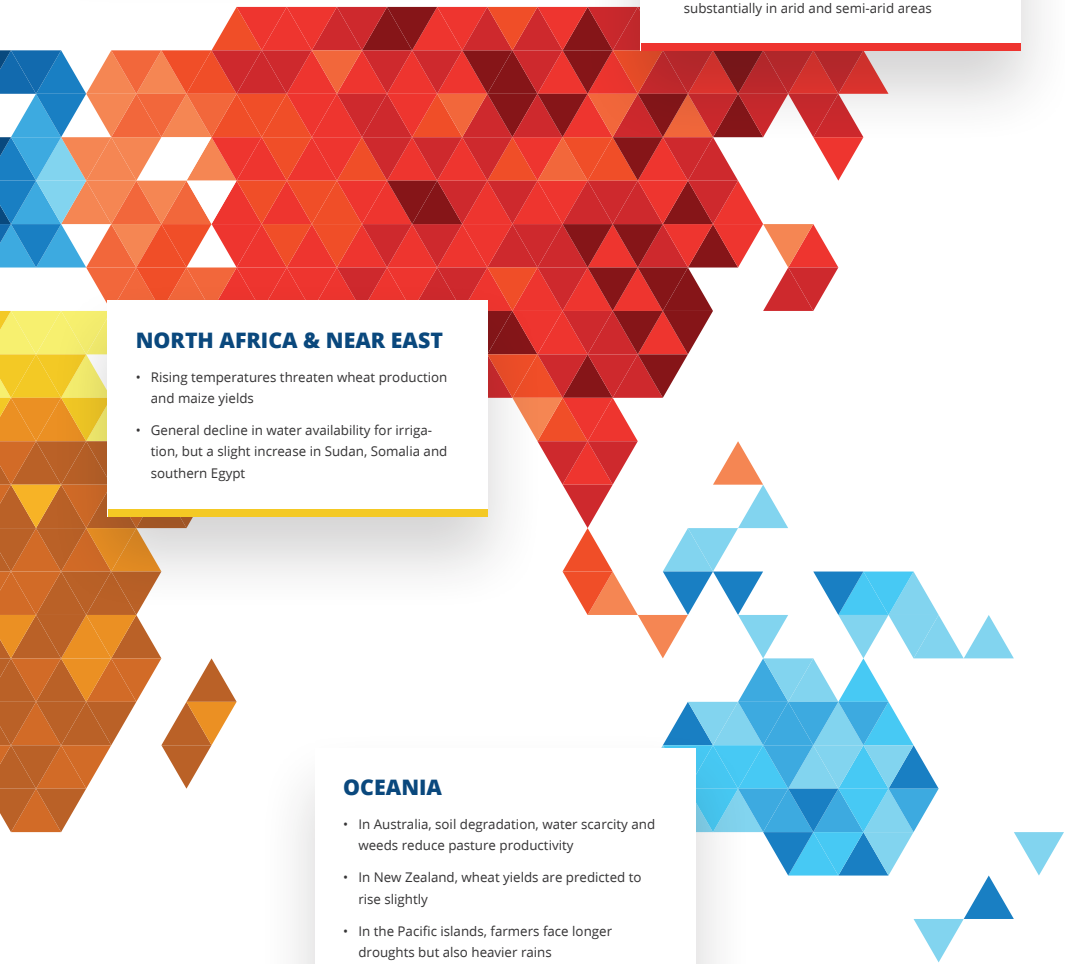
- Overall lower average yields of cereals, especially maize
- More extremely dry and wet years
- Much of southern Africa is drier, but rainfall increases in East and West Africa
- Rangeland degradation and drought in the Sahel reduces forage productivity

EUROPE

- Crop productivity in temperate and polar regions will increase, but initial benefits in mid-latitude countries turn negative with higher temperatures
- Climate-induced variability in wheat production increases in Southern and Central Europe, with increasing desertification pressures in the South

ASIA

- Agricultural zones shift northwards as freshwater availability declines in South, East and Southeast Asia
- Higher temperatures during critical growth stages will lower rice yields in most areas
- Demand for scarce irrigation water increases substantially in arid and semi-arid areas



NORTH AFRICA & NEAR EAST

- Rising temperatures threaten wheat production and maize yields
- General decline in water availability for irrigation, but a slight increase in Sudan, Somalia and southern Egypt

OCEANIA

- In Australia, soil degradation, water scarcity and weeds reduce pasture productivity
- In New Zealand, wheat yields are predicted to rise slightly
- In the Pacific islands, farmers face longer droughts but also heavier rains

SOURCE: CLIMATE CHANGE EFFECTS: TAKEN FROM STATE OF FOOD AND AGRICULTURE REPORT 2016, FAO, PAGES 5, 24-25

ADAPTING AGRICULTURE TO CLIMATE CHANGE

Crop varieties that can withstand climate change challenges are essential for fighting hunger and malnutrition and achieving global food security.

The development of new crop varieties that can cope with heat, drought, flooding and more variable weather may be the single most important step we can take to adapt the world to climate change.

Here are five of the world's most important crops for food and nutritional security. In their unique ways, these crops are helping our agriculture systems adapt to—and even mitigate—climate change.

CASSAVA

Cassava provides food security and incomes for hundreds of millions in Africa, Latin America and Asia and fortunately is a rare crop that will flourish under climate change.

The crop excels in high temperatures and persists through drought, falling dormant until rains return. However, climate change is also raising the risk of disastrous epidemics. Ex situ conservation is needed to secure cassava diversity against disease and the loss of wild habitats.

So when cassava diversity is under threat, plant breeders look to tropical America, where cassava was first domesticated.
The majority of unique landraces still exist in South and Central America, alongside their wild relatives. The largest collection of cassava resides at CIAT in Colombia, while an African collection is located at IITA in Nigeria. To build a more efficient and secure global system for cassava conservation, the Crop Trust supported research in partnership with CIAT and Katholieke Universiteit to perfect cryobanking, a technique for freezing plant tissue in liquid nitrogen.

In a separate effort, Crop Trust partners in the Crop Wild Relatives project gathered available data on existing collections of wild relatives and their locations to map out regions where the greatest un-collected diversity of wild cassava might still be found.

IMPACT:
LATIN AMERICA, SUB-SAHARAN AFRICA, ASIA

FORAGES

ILRI, located in Ethiopia, maintains a global forage genebank for the highland tropics and makes productive and disease-resistant forages available to smallholders.

These forages are not just helping farmers adapt to climate change—they also mitigate its causes. ILRI has sent germplasm from its collection of Napier grass to the Brazilian Enterprise for Agricultural Research (EMBRAPA), in order to cross these with higher yielding and more nutritious varieties.

One of these is Brachiaria grass, cultivated in Latin America and Asia. As animals graze on Brachiaria, carbon is returned to the soil through deep roots and manure. CIAT has found that in areas of high rainfall, the best lines of Brachiaria can sequester even more carbon than an equal area of forest.

Some species also produce a unique chemical that halts the microbial process of nitrification, suppressing the release of the potent greenhouse gas nitrous oxide and keeping nitrogen in the soil. Like ILRI, the CIAT genebank also offers forages directly to farmers. CIAT scientists have further combined their collections for forages resistant to drought and flooding, preparing farmers and their livestock for future weather extremes.

IMPACT:
LATIN AMERICA, SUB-SAHARAN AFRICA

RICE

For half the world, rice makes up 80% of every meal. However, declines in freshwater availability, evaporation from higher temperatures, and a scramble for irrigated water resources are all rising with climate change, making saltwater a greater threat than ever to farmers cultivating vulnerable, low-lying coastal fields.

Rice is one of the most salt-sensitive food crops, and salinity is a major limiting factor. So far, IRRI and its partners have developed more than 100 elite lines of rice with high salt tolerance. These provide the yields, grain quality and disease resistance that are expected of an improved rice variety, but perform better than most in salty soils.

With a gene named Saltol, IRRI has found that these lines can raise yields on such land from less than 1.5 tons per hectare to more than 3.5 tons. When breeders introduce salt tolerance and other traits into increasingly stressed modern rice, they are drawing on the global diversity of a crop with over 100,000 distinct types. The Crop Trust funds the conservation of this diversity in perpetuity.

IRRI's screening of the international rice collection it holds found that around 17% showed useful levels of salt tolerance. The Crop Trust provides IRRI with long term funding to conserve this resource forever.

IMPACT:
GLOBAL

POTATO

Climate change is raising the stakes—for Andean farmers, for wild species, and for the world's potato crop as a whole.

Increasing temperatures have pushed potato farmers up the mountains in Peru year by year as diseases and pests creep up the slopes. Unfortunately, there's only so much further to climb. Wild relatives, too, are on the retreat.

Climate change is powering the spread of late blight as warmer temperatures bring the disease to new regions and raise its impact in others. Potato growers in South America, Central Asia, and even Northern Europe are already seeing resurgent blight risk. This is why we need the full genetic diversity of the potato and its wild relatives. Fortunately, thousands of samples of this diversity are conserved at CIP in Peru, with essential long-term funding from the Crop Trust.

There are over 4,000 edible varieties of potato left in the world today, most of which were created by farmers in the Andes of South America. CIP, the world's largest potato genebank, contains thousands of samples of related wild species as well. Such wild relatives hold enormous genetic variety and potential. Even more diversity is stewarded by Andean farmers, who still harvest potatoes in every shape, color and size.

IMPACT:
GLOBAL

PIGEON PEA

In 2011 and 2012, farmers in the Horn of Africa were struck by the region's worst drought in 60 years, causing crop failures and a deadly food crisis across the region.

Rain failures like these will become even more common with climate change. Pigeon pea, however, offers one solution for many farmers in South Asia, Central America and Africa. Pigeon pea diversity includes faster-growing types, producing a harvest in about three or four months, beating drought before it arrives.

With recognition of its role in food security, pigeon pea is a high priority research subject with a fully mapped genome. International collection of pigeon pea is held by ICRISAT, conserving over 15,000 accessions in India and Kenya. Additionally, the Crop Trust has supported the national genebanks in Kenya and the Philippines to regenerate and characterize hundreds of their own samples. More answers to drought tolerance may lie in the sixteen wild species that grow in tough environments. With partners in a project to collect and conserve the wild relatives, the Crop Trust has identified areas where more of this wild diversity might be collected—such as northern Australia, where wild species have grown in isolation since the end of the Ice Age.

IMPACT:
SOUTH ASIA, CENTRAL AMERICA, SUB-SAHARAN AFRICA, OCEANIA

CROP TRUST

The Crop Trust provides sustainable financial support for some of the most important collections of crop diversity globally, managed by the 11 international CGIAR agricultural research centers.

Alongside these partners, the Crop Trust works to ensure the conservation, availability and use of crop diversity in order to cope with a changing climate and other challenges. All countries rely on agricultural diversity originating from other regions of the world, and all countries will inevitably be affected by climate change.

With your support, we can together secure the foundation of our food, our agriculture, forever.

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