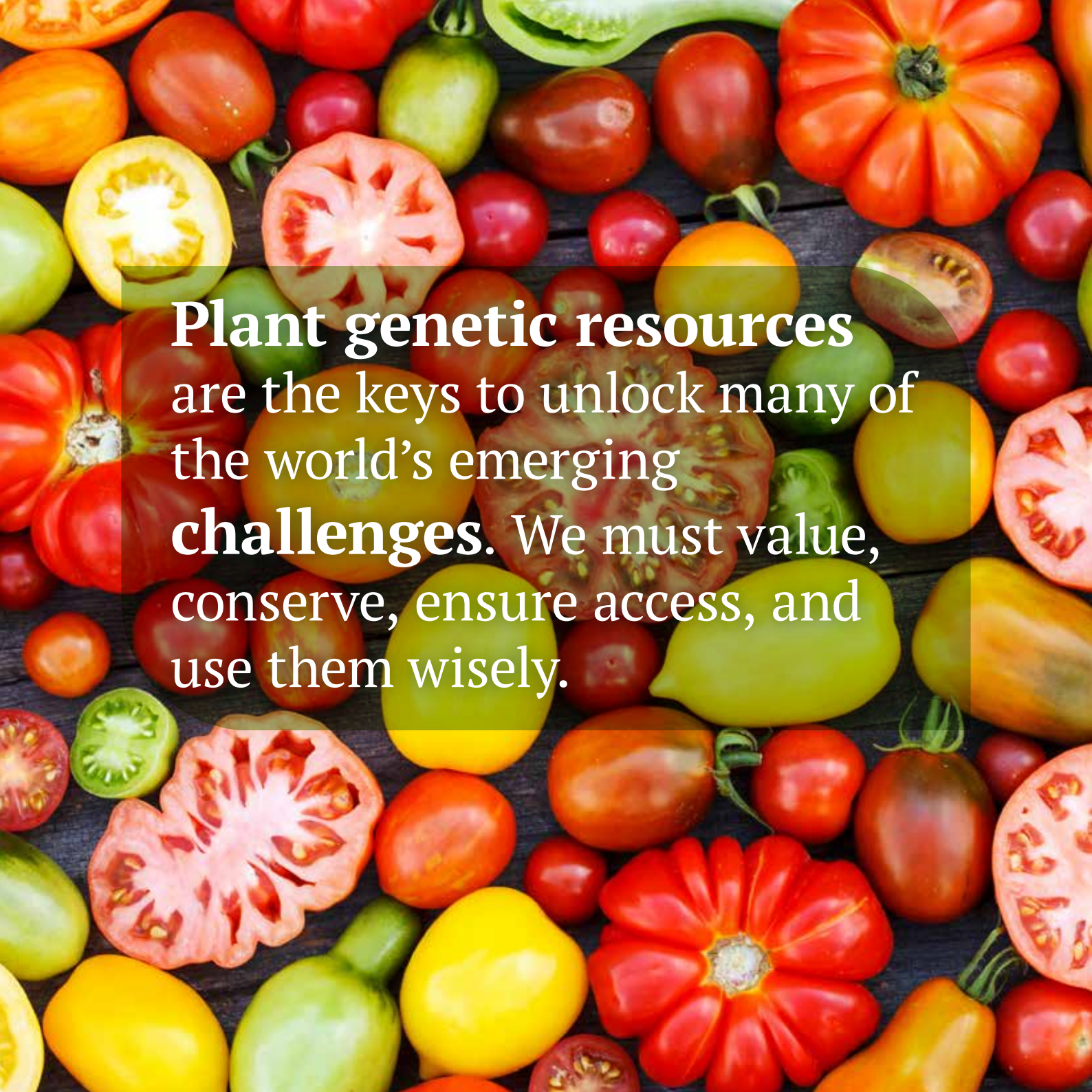
International Seed Federation
Seed is Life

A Guide to Genetic Resources


Plant genetic resources are the keys to unlock many of the world's emerging **challenges**. We must value, conserve, ensure access, and use them wisely.

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1 FAO website, accessed 31 October 2018 – http://www.fao.org/seeds/en/

1. INTRODUCTION

Humans have cultivated plants for more than 10,000 years, selecting the plant varieties that best suit our needs. Today, plants still provide us with more than 80 percent of our nutrition, playing an essential role in our food and nutrition security.[2] They also provide us with fiber, clothing, shelter, and energy.

However, our world is changing fast. Food production is coming under pressure as the global population grows and our climate changes. Land and water are in short supply. Diseases and pests transfer from one region to another.

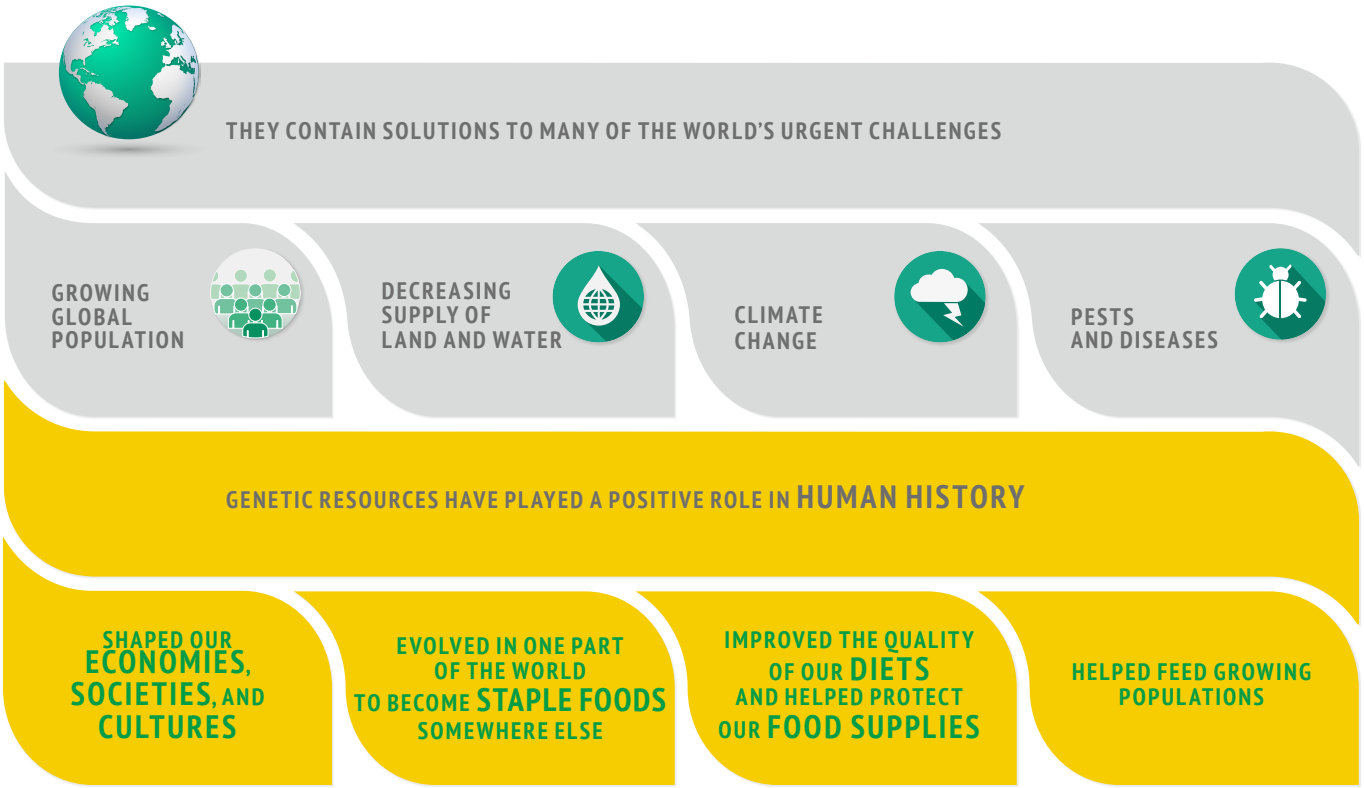
Genetic resources are the keys to unlock many of these emerging challenges. They are the materials that contain functional units of heredity. And by valuing, conserving, and using them wisely, we can continue to innovate and adapt our existing plants.

By shaping our economies, societies, and cultures, genetic resources have played a positive role in our history too. Crops that evolved in one part of the world have often become staple foods somewhere else. These exchanges improved the quality of our diets, protected our food supplies, and helped feed growing populations.

This guide lays out the importance of genetic resources to protect human needs, by explaining how they underpin our food and nutritional security while sustaining our environments. It also explains how the public and private sectors can work together to conserve and share the benefits of these critical resources for future generations.

2 FAO website, accessed 31 October 2018 - http://www.fao.org/seeds/en/

GENETIC RESOURCES ARE A KEY TO OUR FUTURE



2. THE WORLD NEEDS IMPROVED PLANT VARIETIES

According to the United Nations, the world's growing population will require 60 percent more food by 2050.[3] This growing food demand places extra pressure on farming and requires farmers to choose their seeds even more carefully. They typically have just one chance in a year to produce a sufficient harvest. Crop failure is expensive to farmers and society alike.

Meanwhile, climate change adds another layer of challenge. Increased temperatures, shifting rainfalls, and extreme weather events affect agriculture all around the world. Changing climates bring outbreaks of pests and diseases. Soil fertility is also changing. Less land is available for food production.

In the past 150 years, however, a deeper understanding of genetics has allowed us to adapt plants more and more effectively. The latest breeding methods and tools allow plant breeders to link specific genes to specific characteristics and to make very precise improvements. We can improve our seeds, making them more productive, reliable, and resilient.

In the fifteen year period from 2000 to 2014, plant breeders increased average crop productivity for nine core food crops in the European Union by an average of 20 percent. This work has saved more than 55 million cubic meters of fresh water and reduced emissions by more than 3.4 billion tons of direct CO2. Even as the amount of agricultural land in Europe has declined, improved seeds have helped boost food production to feed an additional 100 to 200 million people.[4]

More productive and reliable harvests can reduce the demands on land and water too. In turn, this improves environmental sustainability with local and global benefits.

3 FAO website, accessed 31 October 2018

4 Steffen Noleppa, "The economic, social and environmental value of plant breeding in the European Union", HFFA Research Paper 02/2016

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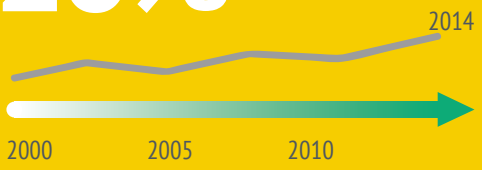


FOR 9 CORE FOOD CROPS

THIS WORK:

SAVED

MORE THAN **55 million** CUBIC METERS OF FRESH WATER

REDUCED

EMISSIONS BY MORE THAN **3.4 billion** TONS

BOOSTED FOOD PRODUCTION

TO FEED AN ADDITIONAL **100 to 200 million** PEOPLE[5]

5 Source: Steffen Noleppa, "The economic, social and environmental value of plant breeding in the European Union", HFFA Research Paper 02/2016

More than 150 world leaders adopted the 17 Sustainable Development Goals (SDGs) to help address global challenges such as poverty and environmental degradation, at an historic United Nations Summit in September 2015.

GENETIC RESOURCES AND IMPROVED SEEDS CONTRIBUTE TO THE UNITED NATIONS' SUSTAINABLE DEVELOPMENT GOALS (SDGs):

SDG2

More productive, reliable harvests mean fewer people going hungry.

The SDGs all have targets and indicators.
Under SDG2, for example,

Target 2.5 includes:

- genetic diversity of seeds and cultivated plants,
- soundly managed seed and plant banks,
- access to and fair sharing of benefits.

SDG1

More productive, reliable harvests help farmers escape from poverty.

SDG8

Improved seeds increase productivity and revenue for farmers.

SDG13

Improved seeds help farmers adapt to climate change.

SDG15

Access and Benefit Sharing schemes help protect vital ecosystems.

SDG17

Public and private sectors collaborate to protect genetic resources.

3. GENETIC RESOURCES ARE KEY TO IMPROVING VARIETIES OF PLANT

Plant breeders improve plants by selecting genetic resources with key characteristics, crossing them and selecting the very best outcomes from subsequent generations. Plant breeding takes time, knowledge, and effort.

It takes up to 15 years to develop and test a new plant variety, depending on the species. It can be an expensive process too. Seed companies spend 10 to 20 percent of their revenue each year on research and development. This compares with 13 percent for healthcare and 1 percent for the energy industry.

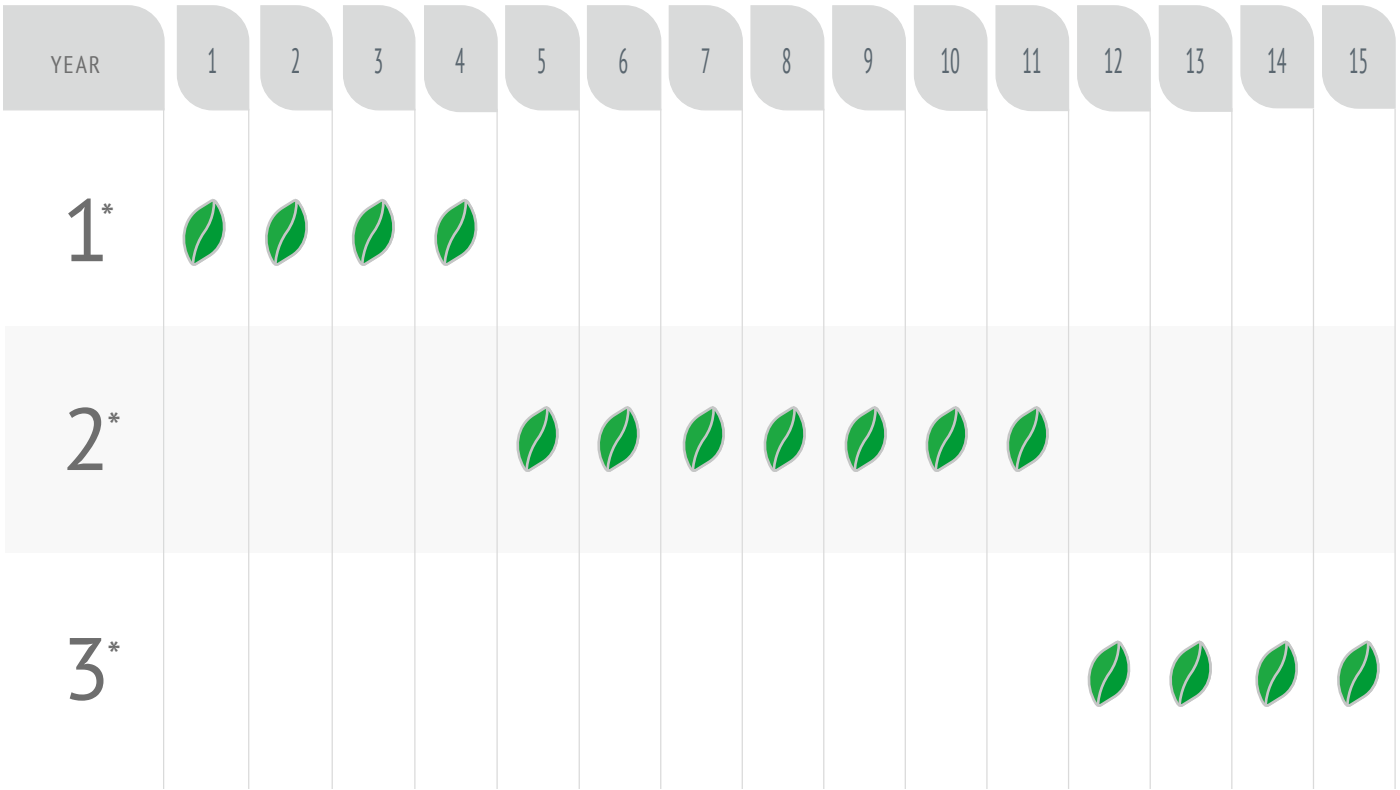
Once the germplasm has been selected and collected, plant breeders must examine it before they can know the germplasm's true genetic value. This process, known as characterization, can take up to five years. Sometimes, after months or years of work, plant breeders will find nothing of value in the genetic resources.

Each year, plant breeders cross hundreds of these genetic resources to produce thousands of improved varieties. The improved varieties are tested repeatedly. Taking shifting consumer demand into account, they are assessed under specific growing conditions in different regions.

Breeders work mostly with modern varieties, the so-called "elite" genetic resources. Sometimes they look beyond modern varieties to develop a valuable attribute, such as resistance to new pests or diseases, nutritional content, or flavour. They might use non-elite varieties, such as landraces, heirlooms, or crop wild relatives, which come mostly from public or private gene banks.

The conservation of genetic resources is like having an insurance. By having a larger pool of genetic resources, plant breeders are more likely to find solutions that farmers and others need. This means that efforts to conserve genetic resources are critically important. These genetic resources may contain the traits that future generations will need.

TIMELINE: THE DEVELOPMENT OF AN IMPROVED SEED VARIETY CAN TAKE UP TO 15 YEARS



*1
SELECTION, COLLECTION, AND CHARACTERIZATION OF PLANT MATERIAL

*2
REPEATED CROSSING OF PLANT VARIETIES, TRIALS, AND EVALUATION

*3
REGISTRATION, TIME-LIMITED INTELLECTUAL PROPERTY APPLICATION, SEED PRODUCTION, LICENSING, CERTIFICATION, AND COMMERCIALIZATION OF IMPROVED VARIETIES"


Despite their immense importance, some plant genetic resources are inaccessible or highly vulnerable to loss. Good policies and their implementation are vital for conservation and sustainable use.

4. ACCESS AND BENEFIT SHARING (ABS) POLICIES

Despite their importance, some plant genetic resources are inaccessible or highly vulnerable to loss. Good policies and their implementation are essential to ensure that plant genetic resources are accessible and conserved. Policies must be straightforward to implement from both an operational and legal viewpoint in order to sustain the conservation and use of genetic resources.

An access and benefit sharing (ABS) framework is sometimes used as an incentive to conserve genetic resources. When a user benefits commercially from access to a genetic resource, the user shares a portion of those benefits with the provider. Examples of ABS schemes are the International Treaty on Plant Genetic Resources for Food and Agriculture (IT PGRFA) and the Nagoya Protocol.

To help users of GR understand which regulation is applicable, ISF developed GRIT (Genetic Resources Interactive Tree):

www.worldseed.org/our-work/plant-breeding/genetic-resources/#grit

THE INTERNATIONAL TREATY

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA):

- Promotes the sustainable use of plant genetic resources for food and agriculture
- Administered by the Food and Agriculture Organization of the United Nations (FAO)
- In force since June 2004
- Has a Multilateral System (MLS) for 64 key crops
- Works with a Standard Material Transfer Agreement (SMTA) for access and benefit sharing (ABS)
- 144 Member States in 2019
- ISF's preferred ABS system

CONVENTION ON BIOLOGICAL DIVERSITY

Convention on Biological Diversity

The Convention on Biological Diversity (CBD):

- Recognizes the importance of conserving biodiversity, including ecosystems, species, and genetic resources
- In force since December 1993
- 196 Member States in 2019
- Codifies ABS concept

THE NAGOYA PROTOCOL

The Nagoya Protocol:

- Supplementary agreement to the CBD
- In force since October 2014
- 97 Member States in 2019
- Provides legal ABS framework for all genetic resources (animal, plant, fungus, microbe...)
- Requires user and provider to negotiate bilateral contracts - Prior Informed Consent (PIC) and Mutually Agreed Terms (MAT)
- ISF notes that this ABS system is burdensome, complex, and negatively affects plant breeding and innovation.

BENEFIT SHARING

Benefit sharing can take many forms. It can be mandatory or voluntary, monetary or non-monetary.

Mandatory: benefit sharing is mandatory when user and provider have agreed to the ABS terms, for example, in a contract.

Voluntary: benefit sharing is voluntary when users go further than legally required. Examples of voluntary benefit sharing can be found at on the European Seed Association website:

www.euroseeds.eu/voluntary-benefit-sharing-activities-european-seed-industry

Monetary: benefit sharing is monetary when users pay money to the provider, for example, by paying a percentage of profits made from the plant genetic resources.

Non-monetary: benefit sharing is non-monetary when users provide support, such as capacity building, sharing facilities and equipment, or the preservation of genetic resources on behalf of a country or local organization.I

In Peru, plant breeders and universities are helping to develop new quinoa varieties and preserve the genetic resources of Peru's existing varieties. This will make Peru's quinoa more resilient to climate change.

In Ethiopia, plant breeders have donated seeds and technical knowhow, supporting farmers on a pilot project to achieve tomato yields that were five times higher than with traditional seeds.

In Thailand, plant breeders are building research and development capacity in order to increase yields and allow smallholder farmers to boost their incomes too.

GENE BANKS

Plant breeders established the first large-scale seed collections centuries ago and still provide invaluable support today. The international network of CGIAR gene banks receives support from governments and other institutions. Many other important international, regional and national collections also act as libraries of genetic resources, continuing to play an important role today and for the future.

SVALBARD GLOBAL SEED VAULT

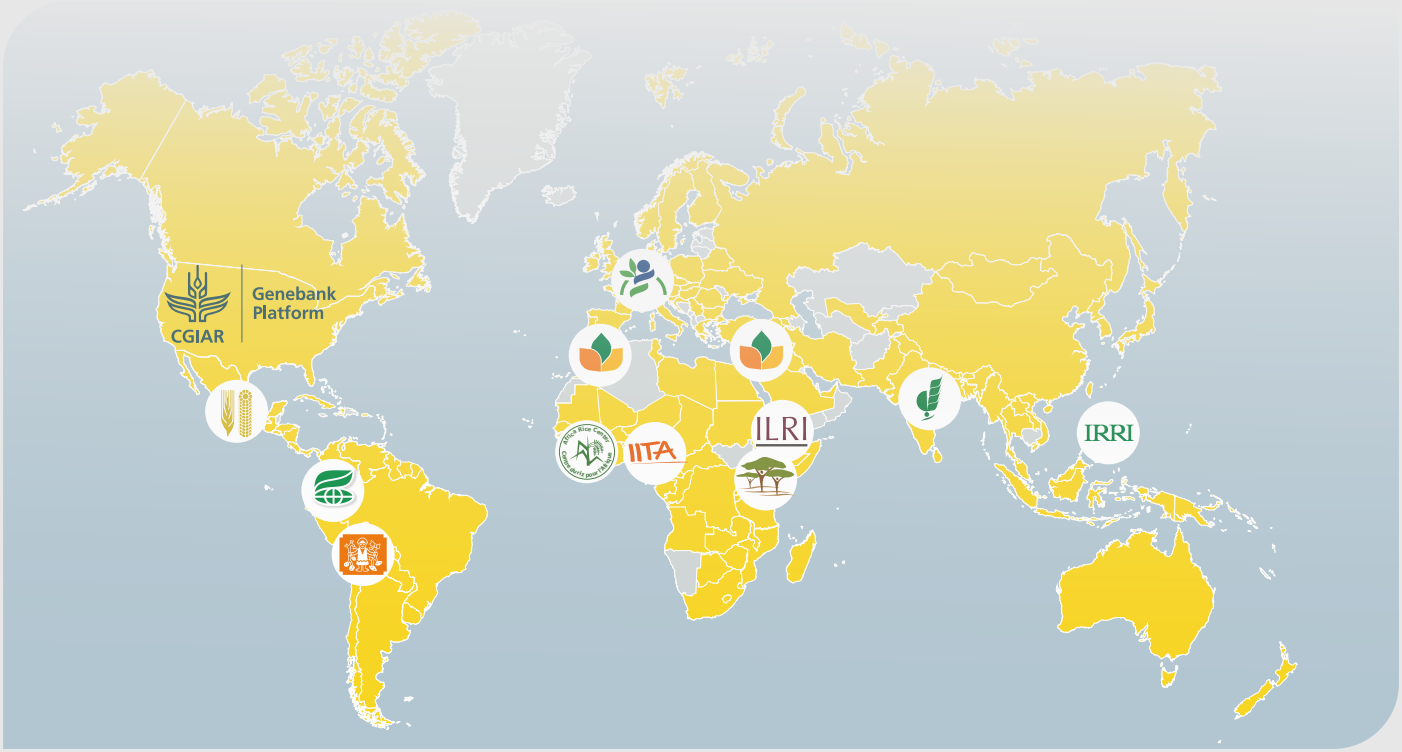
- Lies deep inside a remote Norwegian mountain
- Capacity to store 4.5 million samples. Currently holds 1 million samples.
- Samples come from almost every country in the world.
- A key donor is the Crop Trust, a non-profit linked to the CGIAR and UN's FAO.
- It is a safety deposit for gene banks and not directly accessible for users.

CONSORTIUM OF INTERNATIONAL AGRICULTURAL RESEARCH CENTERS (CGIAR)

- Global research partnership
- Manages 11 genebanks around the world
- Distributed 700,000+ samples between 2012 and 2017 mostly to public institutes in countries on the map marked in yellow
- About two thirds of all germplasm is for developing countries
- Some CGIAR gene banks are members of ISF

CGIAR manages gene banks in the following countries:

AfricaRice • Cote d'Ivoire
IITA • Nigeria
Bioversity International • Belgium
CIMMYT • Mexico
ICARDA • Morocco and Lebanon
CIAT • Colombia
ICRISAT • India
ILRI • Ethiopia
CIP • Peru
IRRI • Philippines
ICRAF • Kenya



5. GLOSSARY

Access and benefit sharing (ABS) refers to the concept that access to genetic resources should be explicitly linked with benefit sharing. ABS is the CBD's third objective.

Biodiversity is the variety of life on earth. It comprises variability within species, among species, and of ecosystems. It also refers to the complex relationships among living things and between living things and their environment.

Convention on Biological Diversity (CBD) is an international treaty with three core goals: the conservation of biological diversity, the sustainable use of the components of biological diversity, and the fair and equitable sharing of benefits that arise from the utilization of genetic resources. The CBD entered into force in 1993.

Elite Genetic Resources are modern varieties developed by plant breeders for commercial purposes. The majority of commercial breeding relies on these elite resources.

FAO is the UN's Food and Agriculture Organization (FAO), which leads international efforts to defeat hunger. Based in Rome, the FAO acts as a neutral forum where member-nations meet as equals to negotiate and to debate policy.

Genetic resources are genetic material of actual or potential value. They are material of plant, animal, microbial or other origin containing functional units of heredity.

Germplasm are living genetic resources such as seeds or tissues that are maintained for the purpose of animal and plant breeding, preservation, and other research uses. These resources may take for example the form of seed collections stored in seed banks, pollen collections, plants/trees growing in nurseries, etc. They can range from collections of wild species to elite, domesticated breeding lines that have undergone extensive human selection.

GRIT (Genetic Resources Information Tree) is the ISF's tool to provide an initial understanding of the ABS legislation applicable to any situation. It demonstrates the ISF's commitment to the fair and legal exchange of genetic resources.

An **heirloom** is an old-time variety, handed down through multiple generations of families and within communities. Heirlooms are open-pollinated varieties. Often they are grown and maintained by gardeners and farmers, particularly in isolated or ethnic minority communities in the western world.

IT PGRFA is the International Treaty of Plant Genetic Resources for Food and Agriculture, which came into force in 2004. Over 140 countries are party to the IT PGRFA.

A **Landrace** is a locally adapted variety of plant. Isolated from other populations of the species, it may have adapted to its natural or cultural environment.

Multilateral System (MLS) is designed to facilitate access to - and exchange of - plant genetic resources. It is part of the FAO's International Treaty of Plant Genetic Resources for Food and Agriculture (IT PGRFA).

Mutually agreed terms (MAT) are a core principle of access and benefit sharing, in which both user and provider agree both the conditions of access and the benefits to be shared between the parties.

Nagoya Protocol is a supplementary agreement to the Convention on Biological Diversity, which provides more detail and basic rules on access and benefit sharing.

Plant breeders research plant and crop-based agriculture in order to develop new crop varieties. A plant breeder might be an individual, a farmer, researcher, or even a public institute or private company.

Plant variety is a unit of botanical classification with a more precisely defined group of characteristics than a species. Selected from within a species, a plant variety can be propagated from generation to generation.

Prior informed consent (PIC) is a core principle of access and benefit sharing, in which a user obtains permission from a provider before accessing genetic resources.

Standard Material Transfer Agreement (SMTA) is a standard contract mandatory for parties wishing to receive material under the FAO's multilateral system (MLS). The contract is fixed and cannot be re-negotiated.

The Sustainable Development Goals (SDGs) are 17 goals that form a universal call to action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity. These goals came into effect in January 2016.

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