





IN FARMERS' FIELDS: BIODIVERSITY & AGRICULTURE



AGRICULTURAL BIODIVERSITY IS CRUCIAL FOR PRODUCING FOOD AND OTHER AGRICULTURAL PRODUCTS. USING IT ENHANCES FOOD SECURITY AND NUTRITION, AND HELPS FARMERS ADAPT TO CLIMATE CHANGE

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Like water and air, **agricultural biodiversity** is a basic resource that we literally could not live without. But the importance of agricultural biodiversity is not well understood and so it is not properly valued. The result is that agricultural biodiversity is under threat both in the wild and in farmers' fields. This is a threat we cannot afford.



WHAT IS AGRICULTURAL BIODIVERSITY?

Agricultural biodiversity includes the different **ecosystems, species** and **genetic variability** that contribute to food production. Some components of agricultural biodiversity, such as livestock breeds and crop varieties, are actively managed by farmers and scientists. Others, such as soil microbes and many pollinators, provide valuable services without being actively managed.

The variation within plant and animal species enables them to evolve and adapt to different environmental conditions.

Farmers and professional breeders depend heavily on agricultural biodiversity, which allows them to develop plant varieties and livestock breeds that can resist pests and diseases, can adjust to changing climates, and have higher nutritional value.



WHAT DOES **BIODIVERSITY** HAVE TO DO WITH **AGRICULTURE?**

Agriculture depends on the diversity of relatively few plant and animal species. Approximately 250 000 plant species have been identified, 7 000 of which can be used as food. But only 150 crops are cultivated on any significant scale worldwide and only three (maize, wheat and rice) supply nearly 60 percent of the protein and calories in the human diet.

Given its heavy dependence on just a few food species, humanity relies on the diversity within these species to survive. This diversity can be considerable. For example, there are tens of thousands of different varieties of rice, developed by farmers over millennia. The International Rice Research Institute in the Philippines holds about 110 000 samples of different rice varieties in cold storage.



THE THREE MAIN FOOD CROPS WORLDWIDE:

MAIZE

© Curt Carnemark/World Bank

WHEAT

© Britta Skagerfält/Global Crop Diversity Trust

RICE

© IRRI



Crop varieties may differ in plant height, yield, seed size or colour, nutritional qualities or flavour. They may respond differently to cold, heat or drought. Some varieties have the ability to withstand pests and diseases that would prove fatal to others.

In the wild, biodiversity is the result of **natural selection**: the evolution of animals and plants to meet the challenges of their environment. In the field, this is the result of thousands of years of human activity. In addition, tremendous agricultural biodiversity has been created through the careful selection of useful traits by farmers, plant breeders and researchers. Today, modern biotechnology is changing the way agriculture is done (see box: "Biosafety and Agriculture").

The use of **biodiversity** is the key to productive agriculture. Farmers continually require new plant varieties that can produce high yields under different environmental circumstances without large amounts of fertilisers and other agrochemicals. Crop diversity provides farmers and professional plant breeders with options to develop, through selection and breeding, new and more productive crops that are nutritious and resistant to pests and diseases.

Livestock farmers also need a broad gene pool to draw upon if they are to improve the characteristics of their animals under changing conditions. Traditional breeds, suited to local conditions, survive times of drought and distress better than exotic breeds and, therefore, frequently offer poor farmers better protection against hunger.

The global agricultural labour force includes approximately 1.3 billion people, about a fourth (22 percent) of the world's population and nearly half (46 percent) of the total labour force.

Source: MILLENNIUM ECOSYSTEM ASSESSMENT, 2005



Bananas are the fourth most important crop after rice, wheat and maize. If all the bananas grown in the world each year were placed end to end, they would circle the Earth 1 400 times!

A BANANA TREE IN THE DEMOCRATIC REPUBLIC OF THE CONGO.
© Strong Roots



THE MULTIPLE BENEFITS OF AGRICULTURAL BIODIVERSITY

Agricultural biodiversity is a resource that is available to everyone. In fact, some of the world's poorest countries are the wealthiest in terms of agricultural biodiversity.

Agricultural diversity underpins dietary diversity, which contributes to lower mortality, greater longevity and a decrease in diseases normally associated with affluence, such as obesity, heart disease and diabetes.

Agricultural biodiversity can improve **agricultural productivity** without costly inputs. Another benefit of agricultural biodiversity is somewhat intangible and difficult to quantify, but not less important. It relates to the sense of national pride

and identity that arises when people come to understand the value of their traditional native foods.

Yet another advantage of agricultural biodiversity is that it buffers yields. Total harvests may be lower in a diversified production system, but they are more stable from year to year. This suits small farmers in rural areas, who seek to minimise risk – ensuring that there will always be some food for their families – rather than to maximise productivity.



AGRICULTURAL DIVERSITY IS A SOURCE OF NATIONAL PRIDE AND IDENTITY.

BREAD SELLER IN TAJIKISTAN.

© Gennadiy Ratushenko / World Bank [www.flickr.com/photos/worldbank/4249171838], page 121

LOCAL MARKET IN KYRGYZ.

© Nick van Pragg/World Bank



AGRICULTURE DIVERSITY HELPS TO MINIMISE RISK. DIFFERENT POTATO VARIETIES CAN GROW UNDER DIFFERENT CONDITIONS, AND CAN BE USED FOR A VARIETY OF DISHES. IN SOME COMMUNITIES IN THE HIGH ANDES, FARMERS WILL GROW FOUR OR FIVE SPECIES OF POTATOES ON A SMALL PLOT OF LAND. MANY OF THESE FARMERS STILL MEASURE THEIR LAND IN 'TOPO', THE AREA A FAMILY NEEDS TO GROW THEIR POTATO SUPPLY. THE SIZE OF A TOPO VARIES: IT IS LARGER AT HIGHER ALTITUDES BECAUSE THE LAND NEEDS MORE TIME TO LIE FALLOW AND RECOVER BETWEEN PLANTINGS COMPARED TO LOWER ALTITUDES.

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BIOSAFETY AND AGRICULTURE

Ulrika Nilsson, CBD

For over 10 000 years, farmers have selected and saved their best seeds and animals for breeding so that future generations of plant varieties and animal breeds would have better qualities in terms of size, taste, growth rate or yield. In recent years, new techniques, called modern biotechnology, have allowed scientists to modify plants, animals and micro-organisms at rates faster than they can with conventional methods.

Scientists can take a single gene from a plant or animal cell or from a bacterium and insert it in another plant or animal cell resulting in a **living modified organism** (LMO). LMOs are commonly known as genetically modified

organisms (GMOs), even though LMOs and GMOs have different definitions. Although modern biotechnology can potentially improve human well-being, for example by improving agricultural productivity, there is concern about possible risks that LMOs may pose to biodiversity and human health.

In response, world leaders adopted the Cartagena Protocol on **Biosafety**, a supplementary agreement to the Convention on Biological Diversity. The Protocol works to protect biodiversity by encouraging the safe transfer, handling and use of LMOs. It does so by establishing rules and

procedures for regulating the import and export of LMOs from one country to another. As of October 2011, 161 Parties (160 countries and the European Union) have adopted the Protocol.

The Protocol describes two main procedures. One is for LMOs intended for direct introduction into the environment, such as live fish and seeds. It is called the Advance Informed Agreement (AIA) procedure. The other is for LMOs used for food, feed or processing (LMOs-FFP), such as tomatoes. Under the first procedure, countries must assess if the LMOs could pose any risks. Based on the results of the risk



assessment, a country can decide whether or not to import the LMO.

Under the second procedure, countries that approve LMOs-FFP for domestic use and placement on the market must inform other countries and provide relevant information through a central information exchange mechanism known as the Biosafety Clearing-House (BCH). If a country decides to import an LMO that is to be released into the environment, it must communicate its decision and a summary of the risk assessment to the BCH. Countries must also make sure that LMOs shipped from



THE FIRST COMMERCIALY GROWN LMO, A TOMATO MODIFIED TO RESIST ROTTING, WAS INTRODUCED IN 1994.
© FAO/Olivier Thuillier

one country into another are safely handled, transported and packaged. Shipments of LMOs must be accompanied by documents that clearly specify their identity and any requirements for their safe handling, storage, transport and use.

If you're interested in biosafety issues, you can encourage your government

to become a Party to the Protocol if it is not already, inform others about biosafety issues, discuss possible public educational activities on biosafety with your teachers, design awareness material on biosafety to use in your community, or create a youth biosafety network to exchange information.





THREATS TO AGRICULTURAL BIODIVERSITY

With the advent of modern agriculture, untold numbers of locally adapted crop varieties were replaced by genetically uniform, high-yielding modern varieties. In China, for example, between 1949 and 1970, the number of wheat varieties grown by farmers dropped from about 10 000 to 1 000. Farmers in India once grew 30 000 rice varieties.

Today, 75 percent of India's rice crop comes from just 10 varieties. Only 20 percent of the maize varieties known in Mexico in 1930 can be found there now. Overgrazing, climate change and changes in land use are also taking a toll on the diversity still available in the **wild relatives of crops** and other wild species.

Extinction is a natural process. Species have emerged, flourished, and died out over the ages. What is alarming is that, due mainly to human activity, today's rate of extinction is thousands of times greater than the rate at which new species appear. This threatens the life-sustaining systems of our planet.

In the past 100 years, as much as 75 percent of the genetic diversity of agricultural crops may have been lost.

THE IMPACT OF CLIMATE CHANGE

As the world's human population increases, environmental problems are intensifying. Climate change may bring about drastic changes in the world's ecosystems and threatens to destabilise weather patterns, leading to an increase in the incidence of severe storms and droughts.

Agricultural biodiversity is our best hope for dealing with the threat that climate change poses to agriculture. Farming systems will definitely have to adapt as weather patterns change. The good news is that the most diverse farms – those that have and use the most diversity – will be better able to withstand the shocks and unpredictability of climate change.

Using agricultural biodiversity to develop crop varieties that can withstand high temperatures or that are

drought-tolerant could help farmers deal with the effects of climate change, allowing them to grow their crops even as conditions get harsher.

The bad news is that climate change will have an impact on what we grow and where we grow it. The consequences could be dire for people living in the most vulnerable regions of the world. Recent research found that by 2055, more than half of the 43 crops studied – including cereals such as wheat, rye and oats – will lose land suitable for their cultivation. This loss

will be particularly large in sub-Saharan Africa and the Caribbean, regions that have the least capacity to cope. And wild crop relatives – an important source of diversity – are also at risk. In 2007, scientists used computer modeling to predict the impact of climate change on the wild relatives of staple food crops. They found that, in the next 50 years, as many as 61 percent of the 51 wild peanut species analysed and 12 percent of the 108 wild potato species analysed could become extinct as a result of climate change.



THE GUARDIANS OF DIVERSITY

All over the world there are people who dedicate their lives to safeguarding agricultural biodiversity and to using it to improve their lives and the lives of others. They are the Guardians of Diversity: individuals whose passion for diversity is helping – in small ways and large – to create a healthier, more food-secure world.

The Guardians of Diversity are farmers, researchers, writers and artists. They include Adelaida Castillo, who conserves 80 varieties of quinoa on her farm in the Peruvian Andes in memory of her son who died tragically in a motorcycle accident. They include well-known Japanese artist Mitsuaki Tanabe, who uses his art to communicate the urgent need for conserving wild rice and protecting the habitats where it grows. And they include Valeria Negri, a plant scientist at the University of Perugia in Italy, who has devoted her life to rescuing endangered Italian crop diversity.

ADELAIDA CASTILLO DISPLAYS A PLAQUE NAMING HER A CHAMPION CUSTODIAN OF DIVERSITY, AN HONOUR SHE WAS AWARDED FOR HER QUINOA COLLECTION.

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MITSUAKI TANABE AND HIS SCULPTURE OF WILD RICE THAT HE DONATED TO THE GLOBAL CROP DIVERSITY TRUST.

© Global Crop Diversity Trust

VALERIA NEGRI WITH HER GARLIC, PEAS AND TOMATOES.

© T. Tesai



HOW YOU CAN BE A GUARDIAN OF DIVERSITY

Talk to your parents and grandparents about the foods they used to eat when they were your age. Ask them to tell you about their food memories. Do any foods have particular meaning for them? Is it still possible to find the fruits and vegetables they used to enjoy when they were young? Write down everything they say in a notebook and compare the results with your schoolmates, who will have also interviewed their older relatives. Discuss the similarities and differences in the answers, and think of some of the reasons that people might have given different answers.

Try to find the seeds of one or more of the fruits or vegetables mentioned in the interviews with your parents and grandparents. Grow it in your garden or on a windowsill. Find out as much as you can about the plant: how it grows, how it is used, how it is eaten. With your classmates, create a book of recipes using only local, traditional plants. Eat local foods whenever you can.

Be inspired by the stories of the Guardians of Diversity at www.diversityforlife.org.

LEARN MORE

- :: Agricultural Biodiversity Weblog: agro.biodiver.se
- :: Bioversity International: www.bioversityinternational.org
- :: The Cartagena Protocol on Biosafety: <http://bch.cbd.int/protocol>
- :: The Global Crop Diversity Trust: www.croptrust.org
- :: The International Year of the Potato: www.potato2008.org