

# Pack 110

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**Backgrounder on seeds and seed breeding**

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**Introduction**

The majority of human food starts as seeds, especially the seeds of cereal crops, legumes, nuts, vegetables, and fruit. Seeds are generally defined as embryonic plants developing inside a protective outer covering called a seed coat. Planting materials such as cuttings are also included in the broad definition of “seed,” as they are used to propagate varieties of many plants. With these kinds of planting materials, a new plant grows from a fragment of the parent plant, for example, a cutting, tuber, vine, or bulb.

More than 65% of Africans depend on rainfed agriculture for labour and livelihoods. These farmers produce about 80% of the food consumed by African families. Most African farmers struggle with erratic rainfall patterns and low-nutrient soils and grow on less than two hectares of land. In order to feed their families and produce for local markets, they attempt to maximize their productivity and manage the risks of production and marketing by growing a variety of crops for different growing seasons, using intercropping systems, and adapting their planting practices to climate change. This is only possible when farmers have ready access to sufficient quantities of high quality seeds that are well-adapted to local cropping patterns and local soils and climate, among other conditions. Small-scale African farmers currently obtain less than 10% of their seeds from the formal seed sector, with the remainder coming from saved seeds, local markets, friends and neighbours, and other traditional seed systems.

***Why is this subject important to listeners?***

* Almost all food crops begin as seeds. The quality and characteristics of the seed strongly influence the yield and qualities of the harvested crop.
* Seeds can also be consumed as food in several forms, including spices, beverages, and cooking oils. Seeds and seed products are also fed to livestock.
* It’s important to know how policy and legislation in different countries impacts on farmers’ ability to use, breed, and sell seeds. *(See section below on* Seed Laws and Global Seed Marketing*.)*
* Everyone has a right to food and this begins from and is founded on seeds and seed diversity.

***What are some key facts?***

* Seeds have been the basis of human communities and societies for all of recorded human history. They are the heart of healthy food systems and the basis of the food we consume.
* The commercial seeds on the market today are the product of thousands of years of selection and breeding by farmers who have nurtured thousands of varieties, adapting them to changing conditions with each growing season. Some varieties are resistant to diseases or pests. Others are tolerant of weather extremes like drought or floods or early frosts. Some have better yields or better nutrition.
* Though new varieties are continually being introduced, globally, we have lost a good proportion of *farmers’ varieties* (for definition, see below) over the last 100 years, and continue to lose older varieties. This loss of biodiversity hampers efforts to ensure food security, adapt to climate change, reduce environmental degradation, protect nutritional security, reduce poverty, and ensure sustainable agriculture.

***Is there misinformation about this subject that I should cover?***

* That hybrid seeds are genetically engineered (transgenic).
* That improved seeds are always a better choice than farmers’ or traditional or local seeds.
* That GM seeds are sterile. There is no technology currently used in plant breeding that renders seeds sterile.

***Gender aspects of seeds***

* Traditionally, women harvested and preserved seeds, and planned for the next season’s plantings, especially for vegetables and for crops grown in kitchen gardens. As hybrid seeds (which are not bred to be saved) have become more common, women are less able to exercise this kind of control over farm planning, in part because hybrid seeds may require capital investments in seeds and required inputs. And because women generally pay more attention than men to household diet and nutrition, this can have a negative impact on household nutrition and food supply when seeds are not readily accessible, affordable, and well-adapted to local conditions.
* Women’s criteria for choosing and saving seeds are often different than men’s criteria. Men may think mostly about production and yield, suitability for soil type, and suitability for storage. Women may also highly value cooking time, meal quality, nutrition, taste, resistance to pests and diseases, and ease of collection, processing, and preservation.
* In pre-colonial times, African women preserved a large number of varieties of many crops, partly through seed exchange systems. This diversity of varieties protected against weather uncertainties and disease or pest outbreaks—if one variety was susceptible to a pest or disease, another was resistant. Colonial extension services eliminated multi-cropping in many areas, and many projects and agencies continue to promote monocultures, which can contribute to the loss of local varieties. Without mixed cropping and other practices to maintain crop diversity, this reduction in diversity can result in crops that are more vulnerable to diseases, pests, and changing weather.

***Predicted impact of climate change on seeds***

* *Yield*: It is predicted that, over the next several decades, yields for many crops, including cereals such as maize, may be reduced because of climate change.
* *Pollination*: Over the next 50 years, crops may lose key pollinators. Also, the timing of plant flowering and the timing of the emergence of pollinating insects may change in different ways in response to warmer temperatures, leading to a mismatch between the timing of flowering and the availability of pollinators, with potentially large effects on pollination of food crops.

**Seed diversity**

The vast majority of food crops grown all over the world originated in the Global South. With the loss of many traditional varieties of food crops in the last few centuries, there has been a narrowing of the gene pool for food crops.

This genetic narrowing is a problem because having a wide diversity of varieties helps farmers (and plant breeders) to effectively manage diseases and pests. The “Irish potato famine” of the 1850s and the Southern corn leaf blight in the US in the 1970s were serious problems partly because a large percentage of growers planted the same few susceptible varieties of potato and maize. A very large percentage of potato and maize plants were susceptible to the disease organisms that caused potato blight and corn leaf blight disease.

Increasing concentration in the seed industry can also lead to reduced diversity. Marketing policies for larger companies often focus on uniformity rather than diversity. Though many farmers believe the contrary to be true, larger companies are less likely to distribute locally-adapted varieties and more likely to distribute hybrid varieties that are broadly adapted to large regions.

Small-scale farmers plant a variety of seeds to ensure that at least some will produce food under whatever conditions arise. Access to a range of seed varieties underpins farmers’ ability to recover after a bad season and plan for future seasons, especially in an era of climate variability and extremes. Seed diversity provides the basis for a nutritious, reliable, culturally acceptable, and sustainable food production system.

***Types of seeds and types of seed breeding***

Farmers in sub-Saharan Africa face a variety of challenges related to seed, for example, fake seeds, failing crops and reduced yields, and lack of access to diverse types of seeds or specific desired varieties. There is a lot of debate and a lot of misinformation about genetically engineered seeds, and there is also a lot of misinformation about “improved” seeds, hybrid seeds, open-pollinated seeds, and farmers’ or traditional varieties. This section gives definitions for each of these kinds of seeds.

1. *Farmers’ or traditional seeds*: These are also called land races, peasant races, creole seed, folk seed, local varieties, indigenous varieties, and other names. These are the crop varieties that have been bred by farmers over decades or centuries to have qualities that are desirable to farmers, including good taste and nutrition, high yield, good cooking quality, ease of management, resistance to pests and diseases, and the ability to provide a decent yield in unfavourable environmental conditions (drought, flooding, etc.) Farmers breed these qualities into a variety by selecting desirable plants at harvest, then saving and planting the seeds of those plants. This is how farmers bred crops for thousands of years, and is thus largely responsible for the variety of food crops we grow and eat today.
2. *Genetically engineered (GE) seeds*:GE plants are plants whose genetic identity has been modified with genetic engineering techniques. In most cases, the aim of genetic engineering is to introduce a characteristic to a plant that does not occur naturally in the plant species. Unlike other types of breeding, GE techniques can introduce characteristics from unrelated species into the genetic makeup of a variety. Examples of characteristics introduced by genetic engineering into food crops include: resistance to particular pests, diseases, or environmental conditions such as drought; reduction of spoilage; tolerance of chemical inputs (such as specific herbicides); and increased amounts of specific nutrients. To date, almost all GE crops grown in the world were bred to be either insect-resistant or herbicide-tolerant or both, with a tiny percentage devoted to other traits, including drought resistance in maize and soybeans, non-browning in apples, or higher digestibility in alfalfa (lucerne).
3. *Hybrid seeds*: A hybrid variety is one that is developed through the controlled cross-breeding of two different but related parent plants. The result of this cross is called an “F1 hybrid cultivar,” or hybrid variety. This breeding is intended to produce new, desirable traits in a predictable manner, traits that may be more challenging to create through open pollination. A major difference between hybrid and open-pollinated (see below) seeds is that, if you plant a seed from an open-pollinated seed variety, keep it well isolated and save it for seed, you will get offspring that are reasonably similar to the parents. If you plant a hybrid, save it for seed, and then attempt to grow out the seed, the next generation will be a random mix of the parents’ DNA, and the individual plants will be very different from each other. Hybrid maize was first developed in the US in 1909, and first sold commercially in 1926. Hybrid maize was first introduced to Africa in Zimbabwe in 1960.
4. *Improved seeds*: The term “improved seeds” does not have a technical or standardized meaning. Rather, it’s a term that is used to refer to seeds that are bred by plant breeders to have specific qualities, for example, high yield, resistance to important diseases or pests, and tolerance of environmental conditions such as drought or waterlogging. Improved seeds may be open-pollinated or hybrid varieties.
5. *Open-pollinated seeds*: Open-pollinated varieties are produced by cross pollination within a population of plants with generally recognizable and uniform characteristics and appearance. However, there is usually some variation within the population, leading to greater genetic diversity within the variety.

**Seed laws and global seed marketing**

Plant breeders' rights (PBR), also known as plant variety protection (PVP), are legal rights granted by national governments to breeders of new varieties of plants. Such rights give breeders exclusive control over the propagating material (materials such as seeds, cuttings, divisions, and tissue culture) and harvested material (cut flowers, fruit, foliage) of new varieties for a specified time period, often 20-25 years.

All countries (with the exception of Least Developed Countries) that are members of the World Trade Organization (WTO) are legally required to adopt some form of PVP law. More than three dozen countries in sub-Saharan Africa are members of the WTO (see <https://www.wto.org/english/thewto_e/countries_e/org6_map_e.htm>).

New varieties are granted protection after a variety of tests (called DUS—see below) to determine whether the new variety is:

1. *Distinct:*The new variety differs from other known varieties in one or more important botanical characteristics, for example, height, maturity, colour, etc.;
2. *Uniform:* The plant’s characteristics are consistent from plant to plant within the variety; and,
3. *Stable:* The new variety’s characteristics are the same from generation to generation or, with hybrid varieties, for one reproductive cycle.

Plant breeders’ rights empower breeders to bring lawsuits to enforce their rights and recover damages for violation of their rights (usually in the form of claiming royalty payments). For example, companies that hold the rights to varieties bred to be resistant to a specific herbicide have sued individuals for allegedly growing those seeds deliberately without paying royalties to the company.

Farmers’ varieties cannot be protected under breeder’s rights because the offspring of farmer varieties are genetically varied; in other words, they are considered to not be sufficiently *stable*. Also, the conditions and testing requirements for protected species are far too onerous and expensive for smallholder farmers to comply with.

Various types of laws and policies affect whether farmers can plant, save, replant, and sell or exchange seeds. In some cases, laws which cover plant breeders’ rights may allow farmers to use seeds of protected varieties for their own planting on their own holdings, but prohibit them from selling those seeds or exchanging them with other farmers without the written approval of the seed breeder or paying royalties to the rights’ holder.

Several regional organizations in Africa have developed PVP laws. *Table 1* shows three of these organizations, the countries that belong to them, and the predicted impact of existing or proposed PVP laws on farmers’ right to save, use, and sell their seeds.

It should be noted that breeders’ rights are limited to those varieties which are protected under PVP laws. It should also be noted that, alongside these regional initiatives, many countries have established their own PVP laws, which in some cases are not consistent with regional initiatives. In some countries, regional initiatives are automatically legal instruments in the country, while other countries require country-level regulation to bring them into force.

Finally, it should be noted that these regional initiatives may conflict with the farmers’ rights agreed to by countries who have ratified the ITPGRFA (International Treaty on Plant Genetic Resources for Food and Agriculture) that, subject to national law, enshrines farmers’ rights to plant, grow, exchange, and sell protected seeds.

There are other national and regional laws and regulations, for example the Seed and Plant Varieties Bill in the East African Community, which seeks to establish systems for variety introduction, registration and commercialization; and production, certification, distribution, and marketing of seed within and into the EAC region, including plant variety protection systems. These national and regional laws and regulations also have an impact on farmers’ seed and food security.

**Table 1: Farmers' rights to re-use seeds of varieties protected under regional seed laws**

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| --- | --- | --- | --- |
| **Organization** | **Member countries** | **Impact on farmers’ seed saving and sales/exchange** | **Status of law** |
| **ARIPO** (African Regional Intellectual Property Organization) | **Botswana, The Gambia, Ghana, Kenya, Lesotho, Liberia, Malawi, Mozambique, Namibia, Rwanda, São Tomé and Príncipe, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe** | Farmers can re-use seeds of protected varieties on their own farm, but cannot market (or exchange) such seed or materials harvested from the seed with other farmers. | Arusha Protocol adopted in July 2015, regulations adopted in 2017, but has not yet come into force because it requires four member states to ratify before it can come into effect. |
| **SADC** (Southern Africa Development Community) | Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe. | Farmers can re-use and exchange seed of protected varieties for non-commercial purposes “within reasonable limits” subject to safeguarding the interests of the holder of the breeder’s right. | Adopted in August 2017, and so far has been signed by 6 countries. It will come into force once 2/3rds of the Member States bound by the Protocol have ratified. |
| **OAPI** (African Intellectual Property Organisation - Organisation Africaine de la Propriété Intellectuelle) | Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Republic of Congo Republic, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Ivory Coast, Mali, Mauritania, Niger, Senegal, and Togo | Farmers can re-use seed on their own farm, but cannot market (or exchange) such seed with other farmers. | Discussions are currently underway to have the OAPI replaced by a pan-African organization for Intellectual Property (OPAPI). |

These regional initiatives are opposed by some civil society organizations, who argue that they erode farmers’ rights and farmers’ informal seed systems, with detrimental impacts on their right to food and food security. Seed laws are defended by many breeders, seed companies, governments, and institutions, who contend that they allow plant breeders and plant breeding companies to recoup the large investments they make in developing a new variety, which can take 7-15 years. Without this kind of protection, they argue, there would be insufficient incentive to breed the kinds of new varieties that convey huge benefits on farmers and on society as a whole. Critics reply that, because breeders are more likely to invest in varieties that are uniform enough to qualify for protection, the market for non-protected, non-uniform varieties will diminish, and farmers’ varieties will become increasingly marginalized.

While many breeders maintain that the criteria of distinctiveness, stability, and uniformity protect farmers from poor seed quality, critics argue that restrictive seed laws will result in the displacement of more genetically diverse, non-homogeneous varieties (e.g., locally adapted seeds and open-pollinated varieties) with high-yielding varieties that are adapted to and dependent on inputs such as chemical fertilizers and pesticides.

**Where can I find other resources on this topic?**

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***Key definitions***

*Inbreeding*: In plants, inbreeding is the production of offspring by breeding individuals that are closely related genetically.

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