ADDRESSING FOOD SECURITY IN AFRICA

The plant variety protection system

From the African Community of Practice on Management for Development Results at the African Capacity Building Foundation

Case Study
N° 87

SYNOPSIS

According to the latest estimates of the State of Food Insecurity in the World, the prevalence of hunger in the Africa region declined by 30 percent between 1990–1992 and today—from around one person in three to about one in four. This progress largely stems from agricultural productivity gains, based on improved plant varieties and reflecting the Kenyan government's decision in the early 1990s to invest in new plant varieties and improved production techniques. Kenya's introduction of plant variety protection (PVP) in 1997 brought many benefits, as recorded over seven years from 1997 to 2004. Multiple varieties were developed and released into the Kenyan market. This case study highlights the benefits of the PVP system—also called "plant breeders' rights" (PBR)—in meeting global challenges, particularly of climate change and food insecurity, using Kenya's experience of the PVP system.

Key findings. Plant breeding will stay a major contributor to increased food security while reducing input costs, greenhouse gas emissions, and deforestation—mitigating the effects of population growth and climate change, among other stresses. An effective system of PVP is a key enabler for investment in breeding and the development of new varieties of plants. Other gains were stronger public–private plant breeding partnerships, including close relationships with international research institutes, the emergence of new breeding entities such as university researchers and private farmer-breeders, and increased private investment in breeding new plant varieties.

Key lessons. During its 50 years of development and application, the International Union for the Protection of New Varieties of Plants (UPOV) system has proven effective in encouraging the creation of new varieties of plants and in introducing those varieties into agricultural and horticultural practice. Plant breeding is important for meeting the multiple challenges of a fast-changing world. Improved varieties and high-quality seeds are required for productive agriculture in developing nations.

Key recommendations. African countries are strongly encouraged to join UPOV and implement a PVP system for their sustainable agricultural development and maintain the last decades' agricultural productivity gains, which stemmed from improved plant varieties. African countries are also encouraged to join and strengthen regional systems of PVP such as the Arusha Protocol on Regional Protection of New Varieties of Plants, administered by the African Regional Intellectual Property Organization (ARIPO) or the PVP system for African Intellectual Property, based in West Africa for French-speaking countries.

Introduction

Agriculture is the backbone of the economy and employment in most developing countries, including Africa's. Its share of the gross domestic product is often more than 50 percent and, in some countries, up to 80 percent of the active population earn their living in agriculture. But in most of these countries,

agricultural productivity is extremely low, with yields varying from year to year. A large proportion of this agricultural activity is subsistence farming that generates no financial income and is often insufficient to feed farmers' families.

In these circumstances, agriculture is unable to contribute to a country's overall economic development and, even less, to respond to the challenges of feeding a growing population, relieving rural poverty, and mitigating climate change. One of the reasons for poor agricultural performance in many developing countries is a lack of progress in improving the performance of traditional plant varieties. In contrast, the advent of modern plant breeding has enabled yields—previously stagnating or declining—to increase steeply.

Plant breeding is a long and expensive exercise; it requires know-how and investment in terms of time and financial resources. According to the World Intellectual Property Organization (WIPO), it takes about nine to 15 years to create a new variety with improved features and a few years more for farmers to introduce it to the market (WIPO 2010).

Improved varieties account for more than 50 percent of overall yield increases for important crops in Europe. The remaining growth comes from improved agricultural techniques, including fertilizers, and better pest and disease control. But yield improvement is not the only major objective in modern plant breeding: others include resistance to environmental and biological stress, and quality International Union for the protection of New Varieties of Plant (UPOV 2005).

Government measures and increased public and private investments in the seed sector are long-term requirements for agriculture to assure food security in the face of population growth and climate change.[1] This was the conclusion of the September 2009 Second World Seed Conference. At that meeting, intellectual property (IP) protection was deemed necessary to any sustainable contribution of plant breeding and seed supply. The meeting concluded that an effective PVP system is a key enabler for investment in breeding and in developing new varieties of plants. The conference also considered that membership in the International Union for the Protection of New Varieties of Plants (UPOV) was important in that it instilled in breeders the confidence to introduce new varieties.

The objective of this case study is to showcase Kenya's success and create awareness of how African countries can use the Plant Variety Protection (PVP) system as part of their climate change adaptation measures to encourage innovation and investment in plant breeding and to solve the challenges of food insecurity, among others.[2]

This study was developed through desk reviews of data, including the literature—mainly published reports on PVP systems and on implementation in Kenya by WIPO, the Food and Agriculture Organization of the United Nations, the Kenyan government, and research institutions. It reviewed extensive field experience and contextualized the UPOV 2005 report on the impact of PVP in the current African environment, addressing food security in Kenya and in Africa at large. Qualitative and quantitative techniques of data analysis methods were applied.

[1] This conference, "Responding to the Challenges of a Changing World: The Role of New Varieties and High Quality Seed in Agriculture," was co-organized by the Food and Agriculture Organization of the United Nations, the Organisation for Economic Co-operation and Development, the International Union for the Protection of New Varieties of Plants, the International Seed Federation, and the International Seed Testing Association.

[2] According to the World Resources Institute, mitigation and adaptation are two main policy responses to climate change: Mitigation addresses the root causes, by reducing greenhouse gas emissions, while adaptation seeks to lower the risks posed by the consequences of climatic changes. Both approaches are necessary, because even if emissions are dramatically decreased in the next decade, adaptation is still needed to deal with the global changes that have already been set in motion.

An overview of plant variety protection

PVP is a form of IP right granted to the breeder of a new plant variety. According to this right, certain acts in exploiting the protected variety require the prior authorization of the breeder (UPOV 2005). The UPOV Convention—adopted in 1961, entering into force in 1968, and amended in 1972, 1978, and 1991—seeks to promote an effective system of PVP to encourage the development of new varieties of plants for the benefit of society. Key to an effective system are incentives for breeders to develop new varieties, and assurance that lack of suitable protection is not a barrier to those varieties' availability (UPOV 2010).

Conditions required for variety protection

To grant the breeders' rights, the variety should be tested in the field (growing in the series of trial or seasons for certain years), and it should satisfy the following "DUS" criteria (Distinct, Uniform, and Stable):

(i) Distinct—clearly distinguishable from any other variety whose existence is a matter of common knowledge at the time of filing an application.
(ii) Uniform—deemed so if, subject to the variation that may be expected from a particular feature of propagation, it is sufficiently uniform in its essential character.
(iii) Stable—if its essential characteristics remain unchanged when tested in the field for several growing cycles.
(iv) The variety should also be novel—the plant should be new, and not on sale or disposal earlier than one year in the territory or four years in another territory (six years for trees or vines) from the application filing date.
(v) The variety should have a "prescribed variety" denomination (a name).

After meeting these criteria, the breeder will be given the breeder's right, which is territorial and normally ranges between 15 and 25 years, depending on the variety of the plant, tree, or vine (Rivoire 2014).

UPOV membership

In August 2015, UPOV itself had 73 members (figure 1, shown in green). Sixteen states and one intergovernmental organization have initiated the procedure for acceding to the UPOV Convention (shown in brown), and 23 states and one intergovernmental organization have been in contact with the Office of the Union for assistance in developing laws based on the Convention (shown in orange).

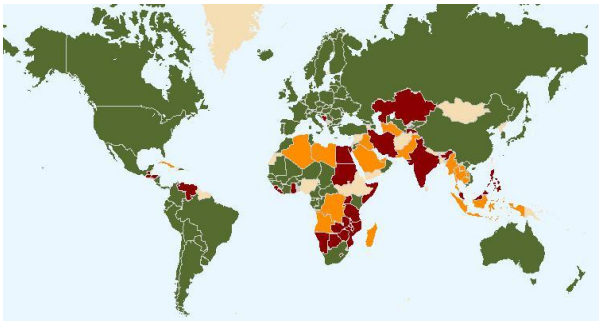

Figure 1. UPOV membership, August 2015

Source: UPOV 2016a.

The UPOV system and small and medium enterprises

UPOV has numerous benefits to small and medium enterprises (SMEs) (UPOV 2005), and should therefore attract them into agriculture. Some of the benefits are:

- *Lower barriers to entry into the breeding sector:* PBR has features tailored to provide a favorable balance between scope and exceptions in promoting plant breeding. The "breeder's exception" plays a key role for SMEs, by allowing all breeders to use protected varieties for further breeding, thus reducing barriers to entry for SMEs wanting to enter the plant breeding business. SMEs can therefore benefit by sharing the developments made by the whole sector.
- *Lower costs and simplified filing procedures in foreign countries:* UPOV has developed model application forms for PBR, denominations, and technical questionnaires, which members have incorporated into their own documentation.

Hence the information requested in PBR applications is the same (or very similar) in all UPOV member states. Further, this application system is simple and does not require the service of special IP agents. For SMEs, this means lower costs and simplified filing procedures in foreign countries.

- *Harmonized system of variety examination:* Seeking internationally harmonized PBR, UPOV developed general principles for examining DUS. Additionally, for many species or other plant groupings, UPOV has developed specific guidelines (the UPOV Test Guidelines) for examining DUS, which are followed by national authorities. UPOV has achieved a high degree of harmonization in the variety examination of PBR applications, making it possible to cooperate in several ways:
    - *Testing on behalf of another authority:* By means of bilateral agreements, a UPOV member can request another member to run the DUS testing on its behalf. This type of agreement is important for testing crops for which there may be no technical expertise locally or where only few applications are filed and a testing system is not yet developed.
    - *Mutual recognition of DUS test reports:* This is another form of bilateral agreement that allows two UPOV members that have the technical *capability* to carry out DUS testing for a given species to mutually accept the technical report made by the other member, thus avoiding unnecessary duplication of tests.
    - *Centralized testing:* In some cases, the designated authority may not itself run the DUS testing. It can designate testing centers for this purpose to test the varieties under the *supervision* of and following the Test Guidelines developed by the authority based on UPOV Test Guidelines. There could be more than one center for a given species in the same UPOV member state. It is also possible that a central testing center could be agreed on between several UPOV members.
    - *Breeder involvement:* The breeder can be involved in different forms of cooperation within DUS testing, ranging from a "total breeder" testing system to various degrees of cooperation with the designated authority. As in other forms of cooperation, it maximizes the use of all information, minimizes the time spent on DUS examination, and can provide access to a breeder's specialist resources. All these means of cooperation in testing procedures automatically save time and costs for the breeders and ensure harmonized testing criteria.

How can small and medium enterprises use plant breeders' rights?

- *Return on investment:* The PBR system enables breeding companies to achieve a return on their investment in breeding programs, via a legal framework, and allows them to continue their breeding activity. SMEs can take advantage of their empirical knowledge and create and then protect their new plant varieties.
- *Licensing investment:* Breeding SMEs can develop a licensing strategy to reinforce their presence in the local market and expand their activity abroad by entering into a partnership with foreign companies. PBR can provide the basis for the transfer of technology to compete in the market. Universities and national agricultural research institutes may take advantage of PBR and play a key role in the process.
- *Facilitating access to foreign markets:* A basic principle of the UPOV Convention is that the nationals and residents of any member receive the same treatment as

accorded to the nationals of all other members. Breeders can protect their varieties in other countries and therefore broaden their market. The high degree of harmonization in examining PBR applications between UPOV members facilitates filing of applications in foreign countries.

- *Development of SMEs in the plant/seed propagation sector:* Seed multipliers benefit from increased demand for the seed of new varieties. Due to the natural extensive coverage of agricultural activity, breeders in many cases let seed multiplier companies handle the seed multiplication and distribution of their protected varieties. Very often the seed producer is a cooperative of farmers or a family-owned company working in the region where they have settled. These SME seed multipliers can obtain a license from the holder of the PBR for producing and marketing the new protected varieties bred by others.
- *Developing the agricultural sector:* A reliable legal framework is a very effective tool to attract the best foreign varieties and rapidly enhance productivity, competitiveness, and income in national agriculture/horticulture. Some markets may have demand for specific agricultural products, such as ornamentals and exotic fruits. Sometimes an entirely new branch within agriculture/horticulture may be created. In such cases, the cultivation of foreign varieties is necessary to meet these markets' demand. Agricultural/horticultural trade companies or growers' associations can obtain licenses to exploit protected foreign varieties and make commercial agreements with traders abroad to export their products.
-

Overview of food security in Africa

The prevalence of undernourishment in Sub-Saharan Africa declined from 33 percent to 23 percent between 1990–1992 and 2014–2016 (FAO 2015). However, the total number of undernourished people continues to increase with an estimated 220 million in 2014–2016 against 175.7 million in 1990–1992. The Western African countries are better off as they reduced the proportion of hungry people by 60 percent. Against the World Food Summit goal of halving the absolute number of undernourished, the subregion reduced the number of undernourished people by 11 million since 1990–1992. The Eastern and Southern Africa subregions also made some progress toward the Millennium Development Goal target; Middle Africa is lagging behind on both targets (figure 2).

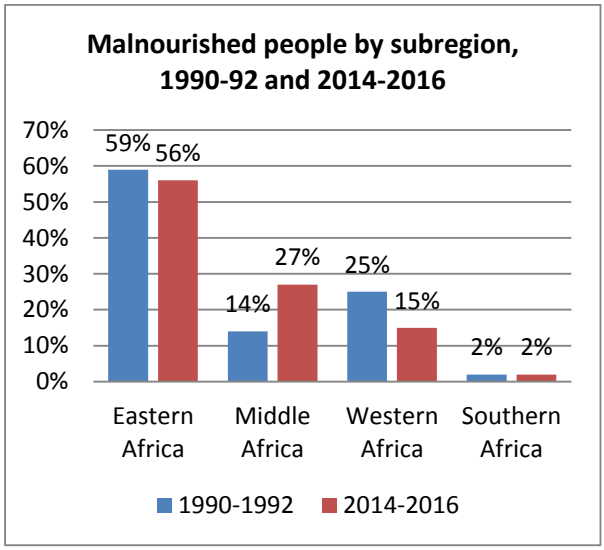

Figure 2. Malnourished people by region 1990–1992 and 2014–2016

Source: FAO 2015.

The Kenya case study

Country overview

Two-thirds of Kenyans[3] depend on the crops they grow and the animals they keep for their livelihoods and survival. Yet much of the country is classified as arid or semi-arid. The increased frequency of

[3] https://www.farmafrica.org/kenya/kenya.

drought and competition over scarce water resources, coupled with the outbreak of animal disease, has left pastoralists especially vulnerable to hunger. Lying within the tropics and exposed to a dry climate, Kenya suffers from low agricultural productivity. Only 20 percent of its land mass is arable. However, agriculture is the mainstay of the country's economy, contributing 30 percent of gross domestic product, 50 percent of export earnings, and some 70 percent of employment. The main crops are coffee and tea (mainly for export), maize (corn), ginger, rice wheat, sweet potatoes, sugarcane, and bananas (Farm Africa 2016).

Agricultural research was initiated in Kenya during the late 19th century by the colonial powers. At present, plant breeding and related activities account for a major proportion of the budget allocation to research. These activities are carried out by about 10 institutions, but are largely dominated by the public Kenya Agricultural Research Institute (KARI). KARI's research efforts are supplemented by universities, tertiary institutions, nongovernmental organizations, community-based outfits, and private companies.

Maize is the most important crop in breeding programs because it is the main staple food crop. Grain legumes, vegetables, and fruits are also well represented in breeding programs. Up to the present the plant breeding budget was mainly allocated to line development and evaluation, but the percentage of resource allocation for germplasm enhancement has been increasing over the years (Elijah et al. 2010).[4]

Kenya's Vision 2030 recognizes the role of research in technology generation and creation of new knowledge, all of which are vital to national development. Vision 2030 also places great importance on value addition in agriculture and livestock as a means of raising rural household incomes as captured by the Agricultural Sector Development Strategy 2010–2020. In implementing the second medium-term plan, the government reformed the National Agricultural Research Systems by creating the Kenya Agricultural and Livestock Research Organization.

In the past decade, Kenyan governments have made significant structural and economic reforms that have contributed to economic growth, but the country still faces development challenges including poverty and inequality, and vulnerability to internal and external economic shocks. Moreover, similar to many other African countries, Kenya faces challenges for example, on climate change and population growth. Global warming affects weather patterns that call for traditional agriculture practices to absorb more new technology. And as Kenya's population is increasing, by around 1 million a year—it recently stood at an estimated 45.5 million (World Bank 2015), up from 20 million in 1970—food productivity and the production area need to increase, and plant varieties and species under cultivation to diversify further (Wambugu and Muthamia 2009). Although shortage of arable land constrains expansion, a measure of relief has come from arid-land farming technologies, and the enforced shift of some farmers from subsistence to commercial farming.

The plant variety protection system in Kenya

The government introduced a PVP system in 1997 and, to instill confidence in foreign breeders, acceded in 1978 to the UPOV Convention. Yet provisions to protect plant varieties were first introduced in Kenya by the Seeds and Plant Varieties Act of 1972, which became operational in 1975. It provides for the grant of proprietary rights to persons having bred or discovered varieties of plants. The Act was revised in 1991, while in 1994 regulations for implementing PVP were introduced. The system came into effect in 1997 (UPOV 2005). Kenya acceded to the 1978 Act of the UPOV Convention on May 13, 1999.

[4] http://www.fao.org/in-action/plant-breeding/our-partners/africa/kenya/en/ (accessed February 22, 2016).

Legislation is being revised for accession to the 1991 revision, recognizing emerging national and international developments in the seed industry. Kenya grants PBR for all plant genera and species other than algae and bacteria (UPOV 2005). The Kenya Plant Health Inspectorate (KEPHIS), set up in 1997, administers PBR and serves as a liaison office with UPOV (Kibet 2014). KEPHIS protects newly bred/discovered and developed plant varieties on the basis of international standards, that is, DUS, as well as novelty and denomination. After a breeder applies for protection or registration, KEPHIS conducts the tests on payment of fees equivalent to $600. The breeder must generate his or her own description before submitting an application for official tests, as it forms part of the technical questionnaire. These tests allow for comparison of candidate variety with all other known varieties of comparable characteristics. The tests done by KEPHIS are the official and confirmatory tests and last for two years (or seasons) and are normally carried out on site (Sikinyi 2010). KEPHIS maintains a breeders' register and varieties list. The breeder must consent to any commercial exploitation.

The enforcement of rights is the responsibility of the rights owner (Sikinyi 2010; 2014). However, the law provides for the plant breeder whose rights are infringed to seek redress in the courts of law by means of damages, injunction, account, or otherwise. The 1978 Act (as revised) also provides for a Plant and Seed Tribunal to determine any disputes arising. KEPHIS, as the designated authority for phytosanitary, seed certification, and PVP matters, helps enforce PBR through licensing and certification (Sikinyi 2010; 2014).

An applicant can request "protective direction" (interim protection) when applying for PVP. This gives similar rights to the full grant of rights, and ends when a final decision is made, or at such earlier time as the law provides. DUS examination for PVP uses central testing. KEPHIS carries out variety testing, cooperates in DUS testing with UPOV members, and conducts tests on breeder premises for special cases.

Plant breeders' rights

When a variety is protected in Kenya, the holder of the PBR is entitled to a reasonable compensation for anything done during the application period which, after the grant of rights, would constitute an infringement (Sikinyi 2010). This includes the following:

a) The act in respect of the propagation material of protected variety shall require the authorization of the breeder, that is:
   i. Production or reproduction (multiplication).
   ii. Condition for purposes of propagation.
   iii. Offering for sale.
   iv. Selling or other marketing.
   v. Exporting.
   vi. Importing.
   vii. Stocking for any purposes mentioned in (i) to (iv) above.

b) The breeder may make his or her authorization subject to condition and limitation of the laws applying in the territory. There are some exceptions to the PBR (where the breeder's authorization is not needed), either compulsory or optional. Compulsory includes the Act done; private and noncommercial purposes; experimental purposes; and breeding of other varieties. Optional includes seed saved on farm from the protected variety, which can be used for propagation on the farmer's own holdings, within reasonable limits and subject to safeguarding the legitimate interest of the breeder (WIPO 2010). The above conditions are included in Kenyan law (Sikinyi 2010).

Developing the seed industry

Development of the Kenyan seed industry started in the early 20th century and was supported by research on food, and on industrial and export crops, which supplied seeds and planting material. The commercial seed sector started when the Kenya Seed Company was set up in 1956, in Kitale, to produce pasture seed for the colonial settlers. The

company continued to play a predominant role until the industry was partially liberalized in the mid-1980s. Full liberalization came in 1996. After this, companies entered the seed business, and by 2004 there were 46 registered seed companies largely dealing in cereals—maize, wheat, barley, oats, triticale, and sorghum; oil crops—rapeseed, sunflower, pulses, vegetables, pasture seeds; other horticultural seeds; and Irish potatoes. The number of firms rose to 73 by mid-2009. The increase in the number of such firms is testimony to the value given to seed-quality matters and to the importance of improving agricultural production.

The government initiated research on coffee, pyrethrum, tea, sugarcane, major cereals (maize, wheat, sorghum and millet, rice), horticultural crops, and cotton and tree crops. Kenya certifies seeds under seed programs of the Organisation for Economic Co-operation and Development and the seed rules of the International Seed Testing Association.

Institutional arrangements for developing varieties

The Ministry of Agriculture is responsible for creating and promoting an enabling environment for the seed industry. It facilitates research; provides advisory and information services; reviews policies and the regulatory framework; and assures sanitary and phytosanitary measures.

Previous plant variety development was done mainly by KARI for food, horticultural, industrial, pasture, and fodder crops; the Kenya Forestry Research Institute for tree-seeds; the Coffee Research Foundation; the Pyrethrum Board of Kenya; the Kenya Sugar Research Foundation; the Tea Research Foundation of Kenya; universities; seed companies; and International Agricultural Research Centers. Rose breeders have organized themselves into the Kenya Breeders Group, which represents about 13 international breeders. (KEPHIS was discussed above).

Impacts of plant variety protection on Kenya's food security

A thriving horticulture sector

The country's diverse agro-climatic conditions allow for a wide range of crops, including agricultural and horticultural crops from tropical, subtropical, and temperate plants (FAO 2009; UPOV 2015; Sikinyi 2014). The horticultural sector, particularly floriculture, experienced the most growth during the 1990s in production volume and acreage, varietal improvements, and the number of growers and exporters. The sector is the third-highest earner of foreign exchange after tourism and tea (Sikinyi 2014). Its products account for 55 percent of all horticultural exports.

This trend was boosted by PBR. The markets have dictated the type of varieties to be grown, particularly in the horticultural sector (the varieties of roses that fetch the highest prices, consumer preferences for the cabbages grown, the French beans or green beans resistant to rust, and so on). Exports of Kenyan roses to the European market climbed steeply from €129 million in 1997 to €208 million in 2003 (Kibet 2014). In 2016, Kenya is the lead exporter of cut roses to the European Union with a market share of about 38 percent. Approximately 65 percent of exported flowers are sold through the Dutch auctions, although direct sales are growing. In the United Kingdom, supermarkets are the main retail outlets (Flowerweb 2016).

More applications for plant variety protection filed

There was a slow rate of application in the initial stages, though 2001 saw a sudden surge from domestic breeders, reflecting awareness among breeders in public institutions of the need to protect their varieties and to exploit the notion of "varieties" in the UPOV Convention. Kenyan breeders submitted 376 (38.4 percent) of the 980 cumulative PVP applications (table 1), foreign applicants 604 (61.6 percent) (Sikinyi 2010).

Table 1. Applications filed, 1997–2008

Year	*Number of applications*		
	Domestic/Kenyan breeders	*Foreign breeders*	*Total*
1997	11	128	139
1998	42	33	75
1999	16	45	61
2000	24	45	69
2001	164	33	197
2002	11	27	38
2003	7	25	32
2004	16	44	60
2005	53	44	97
2006	0	54	54
2007	28	64	92
2008	4	62	66
Total	376	604	980

Source: UPOV 2005 and Sikinyi 2010.

Increased number of local crop varieties and domestic breeders

Local varieties for such crops as Irish potatoes, maize, sorghum, bush bean, French beans, wheat, finger millet, sunflower, chickpea, cowpea, dolichos, cotton, and rapeseed increased to 394 in 2012 /13 (table 2). Applications for the protection of varieties of agricultural crops have been filed mainly by domestic breeders. Public breeding institutions are important for crops such as maize, pyrethrum, and tea. For maize, private breeders have been active as well. Some new varieties are bred jointly by private sector and public breeders for crops such as wheat, maize, and dry beans (Kibet 2014).

Crops such as cassava, maize, sorghum, sweet potatoes, and wheat are widely used by subsistence farmers. As PVP titles are in the hands of public institutions, these farmers can use the propagating material of protected varieties under the privilege conditions by, for example, exchanging seed among themselves (Sikinyi 2009; 2010).

Table 2. National performance trials for 394 crop variety evaluated in 2012–2013

Crop	*2nd season 2012*	*1st season 2013*	*Total*
Irish potato	53	83	136
Maize	15	111	126
Sorghum	38	5	43
Bush bean	10	6	16
French bean	3	13	16
Wheat		14	14
Finger millet		11	11
Sunflower		11	11
Chickpea		6	6
Cowpea	3	3	6
Dolichos		5	5
Cotton		2	2
Rapeseed		2	2
Total	122	272	394

Note: Kenya's National Bureau of Statistics shows that by end-2008, 344 applications had been filed for agricultural crops, for 35.1 percent of all PBR applications. Domestic breeders submitted 338 (98.3 percent) of the applications in the agriculture sector, and foreign breeders 6 (1.7 percent).

Source: Kibet 2014.

More breeding entities

University scientists, who previously conducted academic research, became more interested in breeding commercial varieties, increasing the number of commercial breeders in Kenya (Sikinyi 2014). Lines that had been developed for academic purposes were improved for protection and commercialization. The number of breeding entities for food crops nearly doubled from 41 in 1990–1996 to 81 in 1997–2003 (table 3).

Table 3. Number of breeding entities per crop, Kenya, 1990–1996 and 1997–2003

Crop	*1990–1996*	*1997–2003*
Maize	9	16
Dry beans	5	9
French beans	1	4
Macadamia	1	2
Tea	2	5
Sweet potato	3	4
Sugarcane	1	1
Cassava	3	4
Irish potato	1	1
Pyrethrum	1	2
Sunflower	2	5
Cotton	1	2
Millet	2	4
Sorghum	3	8
Barley	1	2
Rice	1	3
Wheat	2	5
Cowpeas	2	4
Total	41	81

Source: UPOV 2005.

Increased investment in plant breeding

Investment has increased in breeding and commercializing new varieties, mainly in physical facilities and technology. It has, however, decreased in public institutions, especially in land acreage and financial allocations for plant breeding. Public and private breeders have started jointly developing new varieties for some crops, such as wheat and maize.

Improvement of released varieties

Previously, varieties were assessed for release on the basis of their yield performance. But after the introduction of UPOV technology, varieties are released on other attributes. For instance, it is a requirement that new maize varieties must have a specified level of tolerance/resistance to turcicum blight and gray leaf spot, as a minimum, as well as other characteristics. Other aspects include quality, such as quality protein in maize, baking quality in wheat, disease and pest resistance, and brewing quality in barley. These requirements have demanded improvements among varieties already released. For example, some maize varieties are being converted to quality protein maize with resistance to abiotic and biotic stresses. The number of superior varieties developed over 2003–2013 increased from 23 to 285 (figure 3).

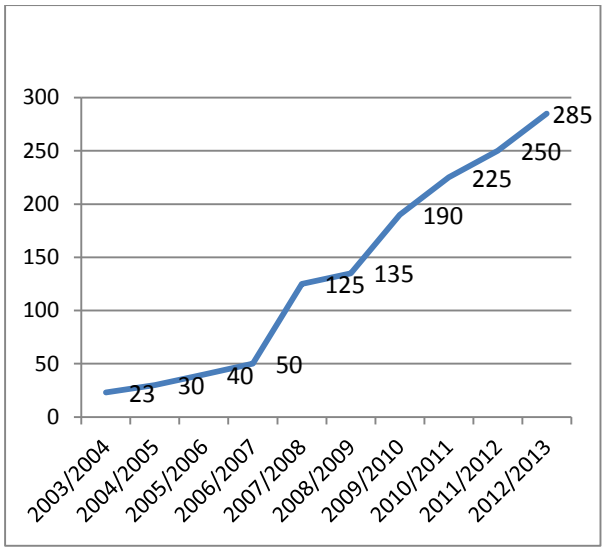

Figure 3. Number of superior varieties developed between 2003 and 2013 in Kenya

New varieties

Improved varieties and high-quality seeds are basic requirements for productive agriculture. The provision of the "breeder's exemption" under the UPOV Convention allows breeders to develop new varieties of French beans resistant to rust using the released or protected varieties as sources of variation.

Other foreign varieties are widely used for breeding new vegetable and fruit varieties adapted to Kenya's environment while meeting the demand of European and Middle Eastern consumers (Sikinyi 2009; 2014).

Better access to foreign-bred materials

Most of the applications for PVP in Kenya have been from foreign breeders (55 percent). This demonstrates increased availability of foreign germ plasm, which can be used further in developing improved varieties in accordance with the above breeder's exemption. For example, a breeder at Moi University has developed a number of lines from an introduced French-protected variety crossed with a local bean variety that has rust resistance (FAO 2009).

Between 1997 and 2003, applications for foreign varieties climbed. The introduction of foreign varieties, especially in horticulture, brought the flower industry in Kenya many opportunities and varieties (Sikinyi 2010; 2014) (table 4).

Table 4. Varieties in Kenya, 1997–2008, after introduction of the PVP system

	Plant species	*Number of applications*
1	Roses	460
2	Maize	132
3	Tea	39
4	Wheat	32
5	Alstroemeria	31
6	Limonium	24
7	Pyrethrum	23
8	French bean	20
9	Chrysanthemum	19
10	Calla lilies	15

Source: Sikinyi 2014.

The introduction of foreign varieties increased the number and range of improved varieties available to the farmers. The number of maize varieties produced and marketed in Kenya increased, and as most of these varieties were superior to previous ones in yields, pest and disease tolerance, nutritional qualities, early maturity, and tolerance to abiotic stress, and as maize is a staple for 80 percent of Kenyans, the impact has been profoundly beneficial for food security (Kibet 2014).

Increased employment

The horticultural industry employs an estimated 2 million people directly in breeding, production, packaging, and transport. It supports another 3.5 million people indirectly in marketing, hospitality, container manufacturing, and so on.

More farmers

There are more than 160 professional-size growers, who include small-scale (less than 4 hectares), medium-scale (10–50 hectares), and large-scale (more than 50 hectares) growers. In the early stages of development, a few large-scale growers dominated the industry, though a decade or so ago saw more than 100 medium- to large-scale growers (UPOV 2005).

Impact on number of breeders/investment in breeding

The PVP system encouraged new types of breeder, such as private breeders, researchers, university scientists, and farmers (Sikinyi 2014). It is also associated with partnerships, including public–private cooperation. Domestic companies have also extended their partnerships with farmers for on-farm production of newly bred varieties (Sikinyi 2014).

Assessment of the outcomes

During its 50 years of development and application, UPOV's PVP system has proven effective in encouraging the creation of new varieties of plants and in introducing those varieties into agricultural and horticultural practice. This case study provides a Kenyan experience that many other African countries might be able to learn from.

In August 2015, UPOV had 73 members, of which only three were African countries with full membership (table 5). This paltry rate needs to be improved if Africa is to address food security in the era of climate change.

Table 5. Status of UPOV membership, as of August 24, 2015

Membership to UPOV	*Total*	*African*	*Remarks*
Total members of UPOV	73	3	Kenya, Morocco, and South Africa
States and intergovernmental organizations that have initiated procedures for acceding to the UPOV Convention	16	5	Egypt, Ghana, Tanzania, Zimbabwe; African Regional Intellectual Property Organization
States and intergovernmental organizations that have been in contact with the Office of the Union for assistance in the development of laws based on the UPOV Convention	23	7	Algeria, Libya, Mozambique, Namibia, Sudan, Zambia; Southern African Development Community
Memo item: country members of the African Intellectual Property Organization, which already has regulations on plant breeders' rights that are implemented. Some varieties are protected	-	16	Benin, Burkina Faso, Cameroon

Source: UPOV 2016b.

Plant breeding is important for meeting the multiple challenges of a fast-changing world. Improved varieties and high-quality seeds are required for productive agriculture in developing nations like those in Africa.

Efforts of public and private sectors in plant breeding are crucial and have provided an enormous contribution to global agriculture (yield, resistance to biotic stresses, tolerance to abiotic stresses, harvest security, quality traits including nutritional value, and so on). Plant breeding has the ability to contribute greatly to solving some of the challenges ahead such as food security, hunger alleviation, poor nutritional value, and high input costs. Plant breeding and related disciplines and technologies help mitigate the effects of population growth, climate change, and other social and physical challenges. Intellectual property protection is crucial for a sustainable contribution of plant breeding and seed supply. There are still many tools and traits in the pipeline that will prove to be very necessary for the continued supply of high quality varieties and seeds.

Conclusions

Plant breeding will stay a major contributor to increased food security while reducing input costs, greenhouse gas emissions, and deforestation—mitigating the effects of population growth and climate change, among other stresses. An effective system of PVP is a key enabler for investment in breeding and the development of new varieties of plants. For this reason, a country's membership in UPOV is an important global signal for breeders to have the confidence to introduce new varieties to that country. African countries are therefore strongly encouraged to join UPOV and implement a PVP system for their sustainable agricultural development and maintain the last decades' agricultural productivity gains, which stemmed from improved plant varieties.

African countries are also encouraged to join regional systems of PVP such as the Arusha Protocol on Regional Protection of New Varieties of Plants, administered by the African Regional Intellectual Property Organization (ARIPO) or the PVP system for African Intellectual Property, based in West Africa for French-speaking countries.

References

FAO (Food and Agriculture Organization of the United Nations). 2009. Proceedings of the Second World Seed Conference. Responding to the challenges of a changing world: The role of new plant varieties and high quality seed in agriculture. Rome.

_____. 2015. Regional Overview of Food Insecurity: African Food Security Prospects Brighter Than Ever. Accra, Ghana.

Jördens, Rolf. 2010. "Benefits of Plant Variety Protection." World Intellectual Property Organization Magazine, June. http://www.wipo.int/wipo_magazine/en/2010/03/article_0007.html#1.

Kibet, Simeon. 2014. "The Role of New Varieties of Plants in Improving Agriculture in Kenya." Presentation at the Regional Workshop on the Draft ARIPO Protocol for the Protection of New Varieties of Plants, Harare, Zimbabwe, October 29–31.

Rivoire, Ben. 2014. "The International Union for the Protection of New Varieties of Plants." Presentation at the Regional Workshop on the Draft ARIPO Protocol for the Protection of New Varieties of Plants, Harare, Zimbabwe, October 29–31.

Sikinyi, Evans. 2009. "The Impact of PVP System in Kenya." Presentation at the 2nd World Seed Conference, Rome, Italy, Sept 8–11.

_____. 2010. Baseline Study/Survey Report on Seed Sector in Kenya. Nairobi, Kenya: African Seed Trade Association.

_____. 2014. "Benefits of PVP for Famers and Growers: Example from Kenya." Presentation at the Regional Workshop on the Draft ARIPO Protocol for the Protection of New Varieties of Plants, Harare, Zimbabwe, October 29–31.

UPOV (International Union for the Protection of New Varieties of Plants). 2005. Report on the Impact of Plant Variety Protection. Geneva. http://www.upov.int/export/sites/upov/en/publications/pdf/353_upov_report.pdf.

_____. 2016a. Members of the International Union for the Protection of New Varieties of Plants. Geneva. http://www.upov.int/members/en/.

_____. 2016b. International Union for the Protection of New Varieties of Plants. Geneva.

Wambugu, P. W., and Z. K. Muthamia. 2009. The State of Plant Genetic Resources for Food and Agriculture in Kenya. Rome: FAO.

ACKNOWLEDGMENTS

This knowledge series intends to summarize good practices and key policy findings on managing for development results (MfDR). African Community of Practice (AfCoP) knowledge products are widely disseminated and are available on the website of the Africa for Results initiative, at: http://afrik4r.org/en/ressources/.

This AfCoP-MfDR knowledge product is a joint work by the African Capacity Building Foundation (ACBF) and the African Development Bank (AfDB). This is one of the knowledge products produced by ACBF under the leadership of its Executive Secretary, Professor Emmanuel Nnadozie.

The product was prepared by a team led by the ACBF's Knowledge and Learning Department (K&L), under the overall supervision of its Director, Dr. Thomas Munthali. Within the K&L Department, Ms. Aimtonga Makawia coordinated and managed production of the knowledge product while Dr. Barassou Diawara, Mr. Kwabena Boakye, Mr. Frejus Thoto and Ms. Anne François provided support with initial reviews of the manuscripts. Special thanks to colleagues from other departments of the Foundation who also supported and contributed to the production of this paper. ACBF is grateful to the African Development Bank which supported production of this MfDR case study under grant number 2100150023544.

The Foundation is also immensely grateful to Dr. Annett Elly and Peter Stephanie, the main contributor, for sharing the research work contributing to the development of this publication. We also thank reviewers whose insightful external reviews enriched this knowledge product. The Foundation also wishes to express its appreciation to AfCoP members, ACBF partner institutions, and all individuals who provided critical inputs to completing this product. The views and opinions expressed in this publication do not necessarily reflect the official position of ACBF, its Board of Governors, its Executive Board, or that of the AfDB management or board.