



THE SEED SECTOR IN AFRICA

Status Report and Ten-year Action Plan (2020-2030): A Summary

African Union Commission

February 2021

Acknowledgements

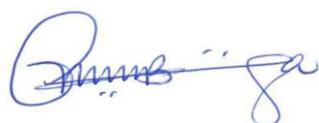
Seed sector development has been on the agenda of Heads of State and Government since 2005. Recognition of the importance of access to quality seed in enhancing agricultural production and productivity ought to be accompanied by development, efficient and effective implementation of national seed laws and seed regulations or decrees. It is my belief that this report will help to advance the understanding of the seed sector and biotechnology, increase Africa's ability to consolidate the gains made in the last decade and address the challenges faced in order to realize Malabo Commitment III on ending hunger and malnutrition. Concerted efforts are required at continental, regional and national level in identification of strategic interventions in key areas including:

- (i) Enhance policy and regulatory framework for an efficient seed system;
- (ii) Improve strategies for the collection, conservation, utilization and exchange of plant and animal genetic resources, seed and planting materials;
- (iii) Develop better variety/breed improvement programmes and seed production technologies;
- (iv) Strengthen seed production systems;
- (v) Enhance development of quality assurance systems with improved stakeholder contributions;
- (vi) Improve seed storage, marketing and distribution channels;
- (vii) Develop improved disaster preparedness and response to seed insecurity;
- (viii) M&E, Knowledge Management and communication;
- (ix) Enhance biotechnology uptake for an efficient seed system in Africa;
- (x) Cross cutting issues on environment, women and youth.

The Commission is committed to fostering evidence based planning, implementation, monitoring and evaluation in the seed sector and hence a systematic regular review process to enable publication of such a report every two years. Cognisant of the importance of alignment, harmonization and coordination among multiple stakeholders, the Commission has constituted an African Seed and Biotechnology Platform to optimise knowledge sharing and management, peer review, mutual learning and accountability.

This Inaugural report has been produced with funds from the EU building on the knowledge from a workshop held in September 2019 funded by Member States. The report has benefitted from the research and efforts of various authors and experts who contributed in writing of different sections of the report and/or review of sections and the overall draft of this Seed Sector Status report.

The African Union Commission would like to express deepest gratitude to all the authors and co-authors as well as reviewers who made completion of this report possible.



Dr Godfrey Bahigwa
Director Rural Economy and Agriculture
AUC

Foreword

The African Union Commission-Department of Rural Economy and Agriculture (AUC-DREA) has been leading continental efforts in initiating and developing strategies to facilitate agricultural and rural transformation through improving productivity and growth. In this context, DREA coordinates implementation and monitoring of policies, strategies and programmes to contribute to the effective implementation of relevant AU Decisions including Assembly/AU/Dec. 135(VIII) that endorsed the African Seed and Biotechnology Programme (ASBP) as a strategic framework for the development of the seed sector in Africa in 2007.

In the context of the Comprehensive Africa Agriculture Development Program-Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods, DREA coordinates the implementation of the ASBP as part of the commitment to ending Hunger in Africa and overcome poverty. Sustainable production and access to quality and affordable inputs for crops, livestock and fisheries is an imperative to realize Agenda 2063's Aspiration 1 on economic transformation, inclusive growth and environmental stability as well as modern agriculture. Therefore, the coming into force of the African Continental Free Trade Agreement (AfCFTA), creates a sense of urgency for harmonizing continental seed policy instruments to enhance effective and efficient seed systems. It is encouraging to note that cross-border seed trade regimes have improved significantly over the years and hence a harmonized seed sector policy legislation and regulatory framework is timely.

AUC-DREA recognizes the importance of multi-sectoral engagement and co-ownership in seed development, conservation and access to improved seeds and hence commends the efforts of the various stakeholders that have contributed to the publication of the Status Report of the Seed Sector in Africa. The Report provides a synthesis of the current status of the seed sector in Africa. It is my hope and desire that the lessons contained in this book will inform development and investment in country-owned and country-led comprehensive and strategic approaches to overcoming current barriers and obstacles in seed sector and enhanced application of biotechnologies and methodologies. Simultaneously, the Commission has availed the 2020-2030 Action Plan on ASBP to facilitate the incorporation of seed development, conservation and access to improved seeds into Regional and National Agricultural Investment and Food Security Plans.

Considering that seed is one of the most crucial elements in the livelihoods of agricultural communities, sustainable and reliable production as well as access to quality and affordable seed will advance agricultural production and productivity for the attainment of food security and nutrition in Africa. Through the ASBP's service delivery mechanisms, capacity development, partnership and outreach, we will together contribute towards the shared interests enshrined in the SDGs and Agenda 2063.



Amb. Josefa Sacko
Commissioner, Rural Economy and Agriculture
African Union Commission

Executive Summary

This is a summary version of a report prepared at the request of the Department of Rural Economy and Agriculture (DREA) of the African Union Commission (AUC). The main report was discussed in the *Workshop to review a draft Seed Sector Status Report in Africa and to develop an Action Plan for the African Seed and Biotechnology Program (ASBP)* that took place in Nairobi on December 2-6, 2019. The objectives of the workshop were to review the status of the seed sector in Africa, and, informed by the findings of the report, to develop an Action Plan for the ASBP. The workshop was jointly facilitated by the Food Security Desk of the AUC, AfricaSeeds and The African Seed Access Index (TASAI).

The main report covers eight components: i) Collection and Conservation of Plant Genetic Resources section provides an overview of the international policy environment for plant genetic resources and the status of genetic conservation in Africa; ii) Research and Development section highlights the number of active breeders for the four priority crops, the number of varieties released and sold, and the status of agricultural biotechnology in Africa; iii) Industry Competitiveness; focuses on active seed companies in each country, volumes of seed sold, sales of top four companies in a country, market share of government parastatals and the time taken to import and export seed; iv) Policy and Regulations section provides an overview of the status of seed policy environment at national and regional levels, and discusses implementation areas that include variety release, seed inspection services and seed subsidy programs; v) Institutional Support highlights the status of four key institutions/ categories of institutions that support seed sector development. These include the seed regulatory agencies, the national seed trade associations, the seed laboratories that are accredited by the International Seed Testing Association (ISTA), extension services and rural agro-dealer networks; vi) Service to Smallholder Farmers discusses availability of seeds in small packages and seed prices; vii) Animal seeds discusses livestock development challenges and priority interventions for the African animal sector; and viii) Cross cutting issues discusses considerations for inclusion of gender and youth in seed systems.

Section 1 was contributed by the National Agricultural Research Organization (NARO)/ Commission on Genetic Resources for Food and Agriculture (CGRFA). Sections 2-6 of the report draw primarily from data collected by TASAI, which has conducted research on the seed industry in 20 African countries to date. Section 7 was contributed by the International Livestock Research Institute (ILRI), while Section 8 was contributed an invited gender expert in collaboration with Makerere University (Uganda). In addition, the report benefited from several contributions from participants at the ASBP Expert Consultation Workshop facilitated by AfricaSeeds and held in Abidjan, Cote d'Ivoire from 18 to 20 September 2019. Institutions represented included seed and technology experts from FARA, CORAF, AGRA, AfricaSeeds, Africa Rice, COMESA and seed departments in several national governments. Information on farmer saved seeds and the status of seed sectors in Egypt and Sudan was added during the workshop.

TASAI studies focus on the formal seed system and have thus far covered Burkina Faso, Burundi, Democratic Republic of Congo (DRC), Ethiopia, Ghana, Liberia, Madagascar, Malawi, Mali, Mozambique, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Uganda, Zambia and Zimbabwe. Four priority crops in terms of area harvested and food security were covered in each country. The priority cereal crops were maize, rice, sorghum, wheat, millet and teff. Priority legumes were beans, cowpea, groundnut, pigeon pea, sunflower and soya bean. In each country, the method used entails: (i) Data collection

and analysis covering the four-priority cereal and legume crops and (ii) Surveys of the seed companies/producers based on any of the four crops. In addition, information was sought from relevant key actors such as the government seed regulatory authorities, ministries of agriculture, breeders working on any of the four crops, and a few NGOs and development partners with focus on seed sector development.

Main Findings in Collection and Conservation of Plant Genetic Resources

There is **commendable effort to conserve plant genetic resources through genebanks**. Most of this effort is through collaborative national, regional and international programs. However, a significant portion of germplasm accessions remains uncharacterized or not properly documented.

Systematic surveying and inventory of Plant Genetic Resources for Food and Agriculture (PGRFA) *in situ* remain **underdeveloped** due to lack of funding, human resources, knowledge and coordination. Lack of readily available characterization and evaluation data leads to low use of PGRFA in breeding programmes.

Main Findings in Research and Development

Maize dominates public breeding programs in most countries in terms of investments in research and development. In most countries, maize breeders account for at least half of the active breeders for the top four priority food crops. Maize dominates most national variety release catalogues with at least two-thirds of the varieties released in the past three years and accounts for 80% of the varieties in the COMESA Regional Catalogue.

Strong rice breeding programs in West Africa: Rice is one of the key staple crops across the region. Africa Rice is more active in West Africa than in any other region. Its headquarters is in Cote d'Ivoire and four of its five country offices are in West Africa.

Under-funded public breeding programs: A common problem in the seed sector in most African countries is that public breeding programs – which rely almost entirely on government funding – do not receive enough support to carry out their intended mandate successfully. In some cases, breeders receive royalties for their varieties, but these funds are not sufficient to sustain the breeder's work.

Emerging private sector breeding programs: Some established private seed companies now employ their own breeders. Often, the breeders work in close collaboration with the NARIs and CGIAR institutions. Their varieties are sold in the countries where the seed companies are active. Countries that have the highest satisfaction rating on adequacy of breeders across the four priority crops were South Africa and Zimbabwe. The two countries have active private breeding programs.

Some countries do not have formal variety release procedures: The variety release process is either in its infancy, or not yet operational in countries such as Rwanda, Liberia, Sierra Leone, and Burkina Faso. Consequently, these countries do not have a national variety catalogue.

Unavailability of basic seed: Funding constraints faced by many NARIs pose challenges to the supply of basic seeds for seed producers. The unavailability of basic seed constrains the seed production phase of the supply chain. The entry of private seed companies in this field is promising to even out the supply of basic seeds.

Low rate of commercialization of many varieties: Many of the varieties being developed by public research institutions are not being commercialized by the private sector. This indicates ineffective utilization of public resources, governments and the private sector.

Main Findings on Industry Competitiveness

Growth of local private seed companies: Apart from South Africa, Zambia and Zimbabwe, at least three quarters of the active seed companies in most countries are local. In addition, African-owned seed companies are expanding their presence through foreign direct investments, strategic partnerships, subsidiaries, and acquisitions.

Role of Government in seed production is diminishing – but there are exceptions. Government-owned seed companies still operate in Ethiopia, Kenya, Madagascar, Tanzania, and Zimbabwe. However, except for Ethiopia and Kenya, the market share of the government parastatals in most cases is less than 10%.

Notable improvements in regional seed import and export processes. Cross-border seed trade regimes have improved significantly over the years. For most countries, the seed import/export process takes, on average, less than 30 days. In Tanzania, Uganda, and Zambia, the process can take less than 10 days. These improvements have been driven by efforts to harmonize seed regulations and the uptake of IT-based systems to

Main Findings on Policy and Regulations

Good policy instruments – weak implementation: Most African countries have up-to-date seed policy instruments, including a national seed law and seed regulations or decrees. However, in most cases, these instruments are not fully utilized as a result of non-functional institutions and shortages of skilled personnel. Weak enforcement of seed quality control measures carries through all stages of the seed value chain and affects the quality of seed available to farmers.

Most public seed inspectors are under-funded: Public seed inspectors in most countries are overstretched. This opens opportunities for production and sale of poor-quality seeds. Countries should provide their regulatory authorities adequate resources and personnel so that they can be effective.

Steady effort towards private seed inspectors. Kenya, South Africa, Zambia, and Zimbabwe are the only countries that have more private than public seed inspectors today. This has translated to greater efficiency in seed inspection services, and high satisfaction levels by seed companies. Over the past few years, Ghana, Malawi, Mozambique, Nigeria, Tanzania, and Uganda have made substantive steps in training and accrediting independent seed inspectors to complement current government efforts.

Potential challenges implementing government seed subsidy programs: Most African countries implement some form of seed subsidy program. These programs differ in the scope of crop, seed distribution system, and management arrangements. Unfortunately, implementation of these programs ends up disrupting the private sectors' investments in seed marketing and distribution. In addition, payments to seed companies and seed producers are not made promptly leading to cashflow constraints.

Persistent challenge of fake/ counterfeit seed. Fake seed continues to be a significant challenge in all countries. Over the past few years, several countries are implementing several innovations aimed at addressing the problem. For example, in Kenya and Nigeria, the seed regulatory agencies in collaboration with the private sector have launched security labels which are placed on seed packages. The labels are a mark to distinguish whether the seed has been tested and certified.

Main Findings on Institutional Support

Important role of national seed associations. The South African National Seed Organization (SANSOR) in many respects is a model national seed trade association. SANSOR provides a wide range of services to the seed industry, and its members rate the association's performance as excellent across key service areas. Other associations such as the National Seed Trade Association of Ghana (NASTAG), the Seed Entrepreneurs Association of Nigeria (SEEDAN), the Seed Trade Association of Kenya (STAK), Seed Trade Association of Malawi (STAM), Zambia Seed Trade Association (ZASTA), Tanzania Seed Trade Association (TASTA) and the Uganda Seed Trade Association (USTA) are well-recognized and have a good working relationship with the government aimed at addressing critical issues affecting the industry.

Countries moving steadily towards ISTA accreditation. Only 10 seed laboratories from 8 African countries have been accredited by the International Seed Testing Association (ISTA). While the number is low, an additional 10 laboratories are in the process of attaining their ISTA accreditation. This bodes well for countries' commitments to seed quality.

Main Findings on Service to Smallholder Farmers

Importance of rural agro-dealer networks and revamped extension services. There is a need for companies to develop sustainable seed distribution systems with rural agro-dealer networks. The role of the government is to register, train, and accredit existing agro-dealers, to ensure that they have the necessary capacities to sell agricultural inputs to farmers. The role of the private sector is to work with these agro-dealers as the main distribution channel for certified seed to farmers. Governments should support rural extension services since they serve a critical area of training farmers on best agricultural practices.

Main Findings on Animal Seeds

African livestock holds significant potential and technologies to enable implementation of robust seed and breeding programs are now available. However, there is need for sustained and substantial support from African institutions. Multi-country approaches and regional/platform approaches are the way to go for performance recording and genetic evaluations.

There is a need for a strong Africa-wide professional institution to technically and sustainably support and scale the on-going Centre for Tropical Livestock Genetics and Health (CTLGH) and CGIAR-led initiatives.

Africa should start building the right institutional frameworks and support systems now, so as not to continue hick-hiking on genetic gains from elsewhere or depending on out-sourced solutions and institutions.

Main Findings on Women and Youth

The capacity of women and youth to take action as value chain actors in the seed systems can be enhanced by increasing their decision-making power in agricultural projects, especially those focused on seed.

Relationships/social capital that increase women and youth's capacity for action (agency) and the enabling environment (structure) are necessary. This can be achieved by giving women and youth greater voice as members of households and communities and by addressing key areas of disempowerment. It can also be achieved by designing projects that consider needs, preferences, and constraints that women and youth face.

There is a need to improve the enabling environment (institutions, regulations, policies and norms) such that they allow women and youth to participate more fully in a seed value chain (and, by extension, in the economy as a whole). This should be facilitated by policies/legal frameworks that take into consideration gender issues, and which will create an enabling environment for full engagement by women and youth in the seed sector.

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List of Acronyms

AATF	African Agricultural Technology Foundation
AfCFTA	African Continental Free Trade Area
AGRA	Alliance for a Green Revolution in Africa
AFSTA	Africa Seed Trade Association
AMU	Arab Maghreb Union
AUC	African Union Commission
CAADP	Comprehensive Africa Agriculture Development Program
CASC	Central Administration for Seed Certification
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Centre
COMESA	Common Market for Eastern and Southern Africa
CORAF	Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles
CTLGH	Centre for Tropical Livestock Genetics and Health
EAC	East African Community
ECCAS	Economic Community for Central African States
ECOWAS	Economic Community for West African States
FAO	Food and Agriculture Organization of the United Nations
GM	Genetic modified
GMO	Genetically modified organisms
ICARDA	The International Center for Agriculture Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IITA	International Institute for Tropical Agriculture
INERA	Institut de l'Environnement et de Recherches Agricoles
ISAAA	International Service for the Acquisition of Agri-biotech Applications
ISTA	International Seed Testing Association
LCIC	Legacy Crop Improvement Centre
NARIs	National Agricultural Research Institutes
NASC	National Agricultural Seed Council
NASTAG	National Seed Trade Association of Ghana
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
OFAB	Open Forum for Agricultural Biotechnology
PASS	Program for Africa's Seed Systems
PGRFA	Plant Genetic Resources for Food and Agriculture
QDS	Quality-declared seed
SADC	Southern African Development Community
SANSOR	South Africa National Seed Organization
SEEDAN	Seed Entrepreneurs Association of Nigeria
SLeSCA	Sierra Leone Seed Certification Agency
STAK	Seed Trade Association of Kenya
STAM	Seed Trade Association of Malawi
TASAI	The African Seed Access Index
TASTA	Tanzania Seed Trade Association
UPOV	International Union for the Protection of New Varieties of Plants
USTA	Uganda Seed Traders Association
WACCI	West Africa Centre for Crop Improvement
ZASTA	Zambia Seed Trade Association

Introduction

Setting the Scene: The Role of Agriculture in Africa's Development

Agriculture is the mainstay of most Sub-Saharan African economies, contributing 54% of employment and 15% of Gross Domestic Product (World Bank, 2019). Agriculture's central economic role makes its development a key component for overall economic growth and the reduction of food insecurity. However, Africa is facing daunting food security challenges as a result of population growth and climate variability and change. Africa currently has an annual population growth rate of 2.52% (Worldometers.com, 2019). At this rate, Africa's population is expected to double by 2050 (United Nations, 2019) and is projected to surpass that of Asia by 2075 (United Nations, 2017). This rapid population growth is accompanied by socioeconomic changes such as urbanization, changing food preferences, changing livelihood structures, industrialization, and changing relationships with the global economy.

Africa's development priorities are spelt out in Agenda 2063 – the blueprint for African Union's economic development. Specifically, Agenda 2063 identifies agricultural development as a high priority, as detailed in the Comprehensive Africa Agriculture Development Program (CAADP) and further elaborated in the Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods. The Malabo Declaration (June 2014) specifies seven key commitments including boosting intra-African trade in agricultural commodities and services¹. These commitments were advanced by the launch of the African Continental Free Trade Area (AfCFTA) which seeks to harness market and trade opportunities locally, regionally, and internationally (AU 2018).

While there is demonstrated political will to expand intra-regional trade, African countries face challenges in this regard. On the plus side, regional integration is on the rise, and this has contributed to reduced tariffs. However, the inefficient application of non-tariff measures, such as Sanitary and Phytosanitary (SPS) regulations, remains an impediment to effective trade. Reducing these bottlenecks is an important aspect of trade facilitation.

At the farm level, yields must increase if surpluses available for trade are to be realized. As Figure 1 shows, current yields of staple cereal crops in Africa are low and near stagnant at around 1 ton/ha for maize, as compared to 4 tons/ha in other developing regions (McCauley, 2015). Figure 1 illustrates the challenge clearly, juxtaposing the steep increase in population growth against the near-stagnant growth in yields. To ward off food shortages, productivity per unit of land must increase, as further increases in land area are not sustainable. Key to increasing productivity is adoption of high-yielding varieties, fertilizers, and other inputs. Of all the inputs, high-quality seed is perhaps the most important, as it determines the upper limit of what farmers can achieve. Improving access to new high-yielding and climate-

¹ Boosting intra-African trade is aligned with Sustainable Development Goal 17.11, which aims to significantly increase the exports of developing countries, with a view to doubling the least developed countries' share of global exports by 2020.

smart hybrid varieties requires increasing seed production and expanding distribution through increased competition in the seed system.

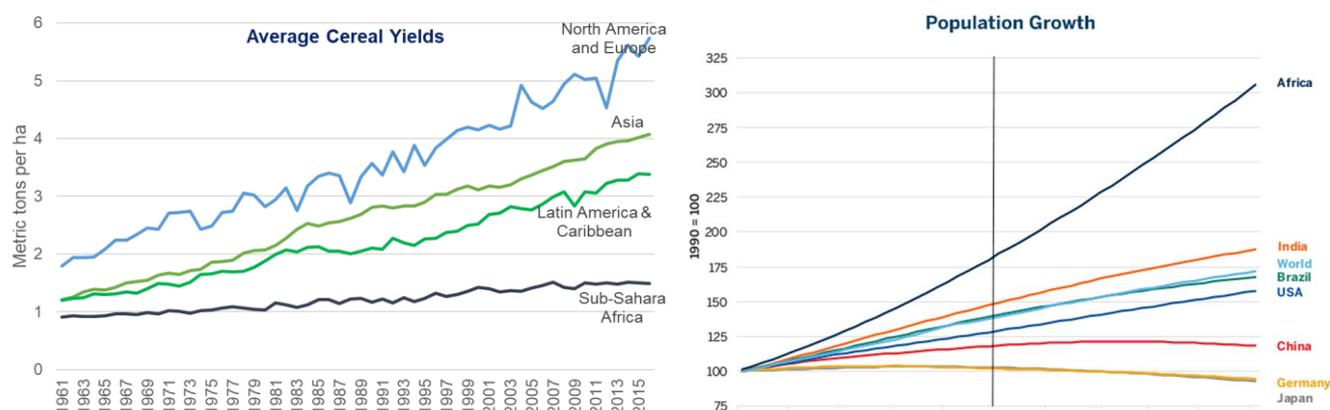


Figure 1: Comparison of cereal yields and human population growth by major regions (Source: FAOSTAT, 2018 and UNDP 2018)

African Seed Systems: An Overview

A seed system is a means through which farmers gain access to quality seed of appropriate crop varieties or animal species². The benefits of seeds to food security and agricultural productivity cannot be overemphasized: well-functioning seed systems are critical to improving food and nutrition security, resilience, and livelihoods of smallholder farmers in Africa (McGuire and Sperling, 2013).

Good quality seeds of appropriate varieties are produced through high-quality breeding programs that, at their best, generate new and improved varieties in response to changing farmer needs and agro-ecological conditions. However, breeding programs are only one component of a seed system³; in addition, elements such as production, marketing and distribution, relevant regimes for regulation, and quality assurance form part of the system. In a well-functioning seed system, all elements work together synergistically, supporting and underpinning each other. In Sub-Saharan Africa seed systems are characterized by inefficiencies and bottlenecks, ultimately hindering agricultural productivity and endangering food security. Given the enormous impact seed systems have on food security and livelihoods, understanding – and fixing – these constraints hold great potential for improving the standard of living in Africa’s agricultural communities.

Broadly speaking, seed systems in African countries can be classified into two categories: formal and informal. In addition, in some countries there is an ‘intermediate’ Quality Declared Seed (QDS) system.

The formal sector focuses on the breeding and evaluation of improved varieties and the production and sale of certified seed. It is regulated by governments. The formal seed system value chain consists of the following generic steps:

² While crop and animal seeds have a lot in common, key elements of animal seeds are discussed in Component 7 of this report.

- *Variety development and plant breeding* are carried out by the National Agricultural Research Institutes (NARIs), the International Agricultural Research Institutes of the Consultative Group on International Agricultural Research (CGIAR), universities, and to a lesser extent by private seed companies. The output of this stage is breeder, also known as pre-basic seed.
- *Variety registration and release* are managed by a government entity; these processes follow procedures outlined in the country's seed laws and regulations. Varieties approved through this process are registered in the national variety catalogue.
- *Seed production and processing* is undertaken by seed companies, seed producers and seed associations, all of which multiply basic seed to produce certified seed. The production of certified seeds is inspected by authorized agencies at different stages of growth and at harvest time. Once approved, certified seed is packaged and labelled with the basic characteristics of the variety.
- *Marketing and distribution* of certified seed is undertaken by seed companies/producers, who distribute the seeds through various channels including agro-dealer networks. In some cases, NGOs and government agencies may distribute certified seeds.

The informal sector refers to the system in which farmers produce, obtain, maintain, and distribute seed resources from one growing season to the other (FAO, 1998). A significant number of smallholder farmers in Africa still relies on this sector. This sector thrives in part due to limited dissemination of good agronomic practices that enhance the adoption of improved varieties, low availability of improved varieties, and limited access to agro-dealer networks. The sector is not regulated by government policies and regulations, and the standards are guided by indigenous knowledge and local social structures.

While the two sectors are distinct, in practice, the same farmer may engage in both, utilizing each to obtain different seeds to meet diverse needs.

The Quality Declared Seed System (QDS) presents a “compromise solution” to achieve seed quality assurance. Originally developed by the FAO in 1993, it offers countries with limited resources a solution to ensure that seed quality is less demanding in terms of cost and human capacity than full seed quality control systems yet guarantees a satisfactory level of seed quality (FAO 2006). Unlike the informal system, QDS production requires the inspection of fields and laboratory analysis of a minimum of 10% of seed plots and the QDS seed offered for sale (FAO 2006). QDS is “used for those crops, areas and farming systems in which highly developed seed quality control activities are difficult to implement or make relatively little impact” (FAO, 2006: 6); which, in practice, often means use by farmer groups and non-governmental organizations (NGOs) who find the requirements of a full quality control process difficult or cost prohibitive. The utilization of QDS is limited to the geographical area where the seed is produced; usually it is sold within a radius of 20km from where it is grown.

Animal and plant seed have a lot in common and face similar challenges. However, there are differences within crops and livestock species, and between the two. Plant seed may refer to seeds/kernel, cuttings, tubers, seedlings, etc., while animal seed may refer to embryos, fertilized eggs, semen (sexed), dams (such as heifers), sires (such as bulls), day-old chicks, juveniles, and fingerlings. Animal seed systems, like crop seed systems, are the vehicles through which farmers get good quality seed of the germplasm they want and need. Features of functional seed systems include seed rules and regulatory

framework, seed quality and quality assessment systems, seed production and delivery systems, and seed security and rehabilitation.

The Role of the African Union Commission in Seed Sector Development

The Commission of the African Union, as an intergovernmental Secretariat, coordinates the implementation of the mandates and decisions of African Union Heads of States and Governments (HoSG). Several Declarations of the HoSG have emphasized the potent role of a viable seed sector in promoting accelerated African agricultural growth and transformation (A3GT). Following the principles of subsidiarity – recognition that issues should be handled by the lowest or least centralized competent authority – the AUC promotes efficiency in development project delivery, while recognizing the roles of Regional Economic Communities (RECs) and Member States as implementation units; hence its scope of involvement is at the continental level. The AUC uses its convening power to advocate, inform and align policies for consistency, and to coordinate, and mobilize support activities to RECs and Member States in their development of the seed sector. Through mobilizing partners' support and effective stakeholders' involvement, the AUC produces, validates and domesticates frameworks and blueprints on crop and animal seeds development and access by farmers.

The AUC mobilizes Member States to generate consensus on the implementation of international instruments and conventions related to seed sector development and modern biotechnology. These include international processes related to access and benefit-sharing led by the UN's Food and Agriculture Organization (FAO), the World Health Organization (WHO), the United Nations Convention for the Law of the Sea (UNCLOS) and the World Intellectual Property Organization (WIPO). The AUC also coordinates engagement of Member States in the International Plant Protection Convention (IPPC), the Convention on Biological Diversity and its Cartagena Protocol on Biosafety as well as other International Treaties, Global Biodiversity Frameworks, and the United Nations Framework Convention on Climate Change (UNFCCC) coordination mechanisms.

About the African Seed and Biotechnology Programme (ASBP)

In 2005, the African Union was requested through the Assembly Decision, in Sirte, Libya to develop the African Seed and Biotechnology Programme (ASBP) as the continental seed programme and framework to counter the threat of potential danger of imported seeds on the African continent. The FAO held consultations with seed-industry stakeholders in Africa to prepare the relevant document⁴ which was approved at the Eighth Ordinary Session in Addis Ababa, in January 2007. The African Seed and Biotechnology Programme (ASBP) came into being in 2008.

The overall goal of ASBP is to contribute to increased food security and to nutrition and poverty reduction in Africa through the establishment of effective and efficient seed systems and enhanced application of biotechnology and methodologies within the seed sector. The programme is based on an inter-related set of components, implemented at national, regional and continental levels, to collectively provide a strategic approach to address the main barriers and challenges to improving the seed sector.

⁴ <https://www.africa-seeds.org/en/our-mission/asbp/>

About The African Seed Access Index (TASAI)

Seed systems in Africa are significantly more complex than in developed economies, making diagnosis and mapping of the bottlenecks associated with them more challenging. Recognition of these challenges prompted the creation of The African Seed Access Index (TASAI) in 2015. TASAI is a tool that allows for assessment of the health of a country's seed system using a comprehensive set of indicators to map out bottlenecks whose improvement will lead to a better-functioning and dynamic system that is responsive to farmers' needs. More broadly, TASAI has been designed to promote the creation and maintenance of enabling environments that will accelerate the development of competitive seed systems serving smallholder farmers. It is this enabling environment that TASAI monitors and compares across African countries. TASAI's intended outcome is improved access to locally adapted, affordable, and high-quality seeds of improved varieties by smallholder farmers in Sub-Saharan Africa.

TASAI studies have been conducted in 20 countries to date, using an assessment tool it developed. Twenty indicators in five topical areas give a comprehensive picture of a country's seed sector. Data collection focuses on four grain and legume crops important to food security in each country⁵. Findings from this research are distilled into reports and briefs, and widely disseminated both in the country and at important seed-sector meetings. TASAI works closely with local stakeholders in the target countries to ensure that its research remains up-to-date and relevant.

⁵ Apart from South Africa, the TASAI research has focused primarily on crops bred through conventional methods, simply because those are the crops cultivated and consumed in most African countries. While TASAI is aware of and stays informed on the latest thinking around GMOs, its work and findings do not express an opinion on the issue.

Component 1: COLLECTION AND CONSERVATION OF PLANT GENETIC RESOURCES

The fundamental objective of conservation of plant genetic resources is the maintenance of genetic diversity within each of the plant species with a known or potential value in order to ensure availability for exploitation by present and future generations (Paroda & Arora, 1991). Plant genetic resources are highly regulated materials and represent the bedrock of any crop improvement program. Although many African countries have assented to international treaties or conventions and have developed related national seed policies, overall, regulation of the process of collection, conservation, utilization, and exchange of plant genetic resources and seeds has been limited. Reasons include lack of financial support from governments and a lack of human capacity and essential tools and equipment.

International Conventions for Plant Genetic Resources

Membership to international conventions, treaties and standard-setting bodies is desired as it assists in addressing various issues of the exploitation of plant genetic resources for human use. To that end, African countries have striven to join or participate in the following international arrangements:

- Global Plan of Action (GPA) for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (PGRFA)⁶;
- International Plant Protection Convention (IPPC)⁷;
- International Treaty on PGRFA⁸;
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity (CBD)⁹

In addition, in order to benefit from the synergistic effects of global standard-setting organizations in international seed trade, African countries have joined the seed schemes of the Organisation for Economic Co-operation and Development (OECD); the International Seed Testing Association (ISTA); and the International Union for the Protection of New Varieties of Plants (UPOV). Biosafety Regulation has become of great interest to many countries, particularly because it offers a tool for plant breeding and partly due to the importance of its regulatory relationship with genetically modified organisms (GMO) in traded seed. African countries have adopted Intellectual Property legislation (including in some cases

⁶ PGRFA priority activities include strengthening of seed systems through support to on-farm management and improvement of PGRFA; promotion of sustainable support to agriculture through diversification of crop production and broader diversity of crops, and development of new markets for local varieties and diversity-rich products.

⁷ IPPC's three primary aims are development and implementation of International Standards for Phytosanitary Measures; exchange of official phytosanitary information to facilitate trade; and technical – assistance programmes to assist developing countries develop national capacity to meet their international phytosanitary obligations under the IPPC and SPS Agreement, and to facilitate trade.

⁸ The aim of the treaty is the conservation and sustainable use of PGRFA, and fair and equitable sharing of benefits derived from their use.

⁹ This protocol aims at protecting biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology.

sui generis or specialized protection regimes). Despite these activities, achievements on local germplasm characterization have been limited.

Status of Conservation of Plant Genetic Material

One of the most common ways to preserve genetic material is through gene banks, which preserve planting material in various forms including *in vitro* storage, synthetic embryos, frozen cuttings from the plant, or seed stock. At present Africa has 42 national gene banks in 23 countries, which hold close to 300,000 accessions (Table 1). Gene banks are supported by NARIs. East Africa has the most gene banks and accessions in – 24 gene banks in eight countries. The countries with the most accessions are Ethiopia (over 80,000) and Kenya (over 50,000).

Table 1: Status of Plant Genetic Resources (PGR) in Africa, by region

Region	Number of accessions	Number of gene banks	Number of countries
Eastern Africa	158,626	24	8
Northern Africa	109,187	5	5
Southern Africa	15,632	5	5
Western Africa	7,892	8	5
TOTAL	291,337	42	23

In addition to the national gene banks, the CGIAR institutions maintain their own gene banks for their mandate crops. The CGIAR gene banks are maintained as a global public good under the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The resources in these facilities are available for breeding, research, and educational purposes. Four CGIAR institutions maintain gene banks in Africa – Africa Rice (for rice), the International Center for Agriculture Research in the Dry Areas (ICARDA) (for barley, chickpea, lentils and wheat), ICRISAT (for pearl millet, sorghum, pigeon pea, groundnut, chickpea, and finger millet) and IITA (for groundnut, cowpea, maize, soybean, African yam bean, banana, cassava, and yam). Table 2 shows the location of and number of accessions at these CGIAR gene banks in 2018.

Table 2: CGIAR gene banks in Africa (as reported on the various organizational websites)

CGIAR institution	Location of gene bank(s) in Africa	Mandate crop(s)	Number of accessions in 2018
AfricaRice	Cote d'Ivoire, Benin & Nigeria (with IITA)	Rice	22,000
ICARDA	Morocco	32,790 (barley), 15,749 (chickpea), 14,597 (lentils), 43,923 (wheat)	107,059
ICRISAT	Kenya, Nigeria, Zimbabwe	Pearl millet, sorghum, pigeon pea, groundnut, chickpea, finger millet, 5 small millets	43,353
IITA	Benin and Nigeria	Groundnut, cowpea, maize, soya bean, Africa yam bean, banana, cassava, yam	28,028

Component 2: RESEARCH AND VARIETY DEVELOPMENT

In Africa, National Agricultural Research Institutes (NARIs) have been the dominant producers of improved varieties of all crops. However, research institutions in most countries are overstretched in their quest to develop varieties with climate-smart characteristics, yield advantages, and pest and disease tolerance. This section assesses the number of active breeders by crop and country, the number of crop varieties released and sold to farmers, and the status of agricultural biotechnology in Africa. The information on breeding efforts and number of varieties is drawn mainly from findings from two of TASAI’s twenty indicators.

Number of Active Breeders

The number of breeders is used as a proxy to assess the health of a country’s breeding program. An “active breeder” is defined as one who is either developing or has developed and released at least one variety of the focus crops surveyed in the year surveyed. According to the most recent data, Ethiopia has the most active breeders (74), followed by South Africa (53). In Ethiopia, nearly all (72 of 74) of the breeders work in the public sector (Figure 2). Plant breeding and variety release is the mandate of the Ethiopian Agricultural Research System (EARS), which comprises the Ethiopian Institute for Agricultural Research (EIAR), the Regional Agricultural Research Institutes (RARIs), and Haramaya, Hawasa, Jimma, Bahir Dar, and Mekelle Universities. The remaining two breeders are employed by two private seed companies. In contrast, in South Africa, only six out of the 53 breeders (two for maize, one for soya bean, and three for wheat) work in the public sector at South Africa’s two Agricultural Research Council (ARC) institutions¹⁰. The rest are employed by private companies. Of the countries surveyed by TASAI, those with the fewest number of breeders (9 for the four priority crops) are Burkina Faso, Liberia, and Mali.

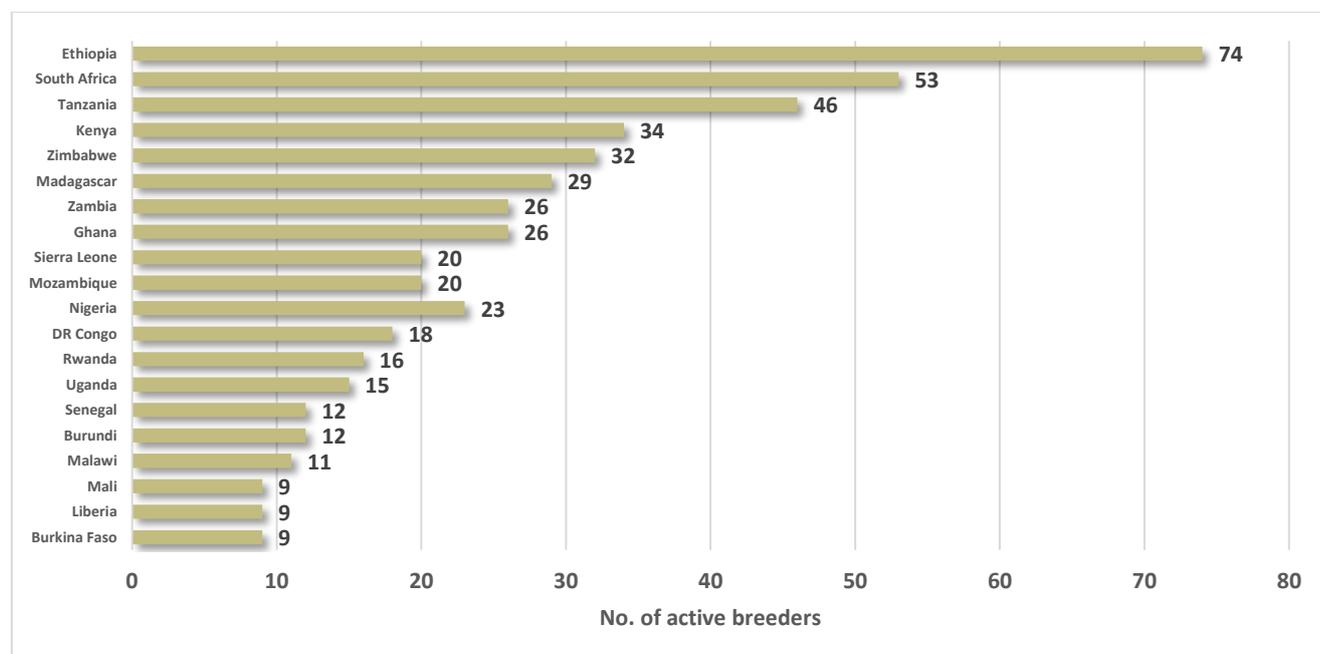


Figure 2. Number of active breeders for the four priority crops by country

¹⁰ It is important to note that the South Africa figures do not include breeders at public universities; all public universities with a faculty of agriculture employ at least one plant breeder; some, such as the University of the Free State, employ up to eight.

Development partners have supported the training of breeders. For example, between 2007 and 2016 the Program for Africa’s Seed Systems inside the Alliance for a Green Revolution in Africa (AGRA) supported 493 crop breeders at the Masters and Ph.D. level, most of whom were then employed by their respective NARIs. Another example is the West Africa Centre for Crop Improvement (WACCI) at the University of Ghana, Legon – an Africa Centre of Excellence for training plant breeders, seed scientists, and technologists from across Africa. Working in collaboration with Cornell University in the USA, WACCI trains approximately 25 Ph.D. and Masters-level breeders each year.

Varieties Released

National laws and regional regulations require that newly developed varieties undergo a series of tests before they can be registered and formally released for commercialization. As the final step of the process, newly released varieties are to be added into a national plant variety catalogue. However, the required steps are not always followed to completion, or not followed systematically.

New variety releases (maize, tracking three years)

Figure 3 shows the number of maize varieties released over a recent three-year period¹¹ in the 20 countries surveyed by TASA. As maize is the most consumed cereal in Sub-Saharan Africa, it is also the easiest to track. The highest number of maize varieties were released in South Africa – 236. This is over twice as many as the next country in the ranking, Kenya (98 varieties). However, South Africa is an outlier because the maize varieties include genetically modified (GM) varieties: these are developed from newly released maize hybrids but are registered as new varieties. The rest of the countries surveyed released fewer than 50 varieties. No country besides South Africa has released GM maize varieties. Four countries – Burkina Faso, Madagascar, Mali, and Sierra Leone – did not release any new maize varieties in the past three years. The reasons for the lack of variety releases vary: in Sierra Leone, it is likely due to the fact that the country only has one maize breeder, while in Burkina Faso, the variety release process was only formalized in 2014, and no varieties were released from 2015 to 2017.

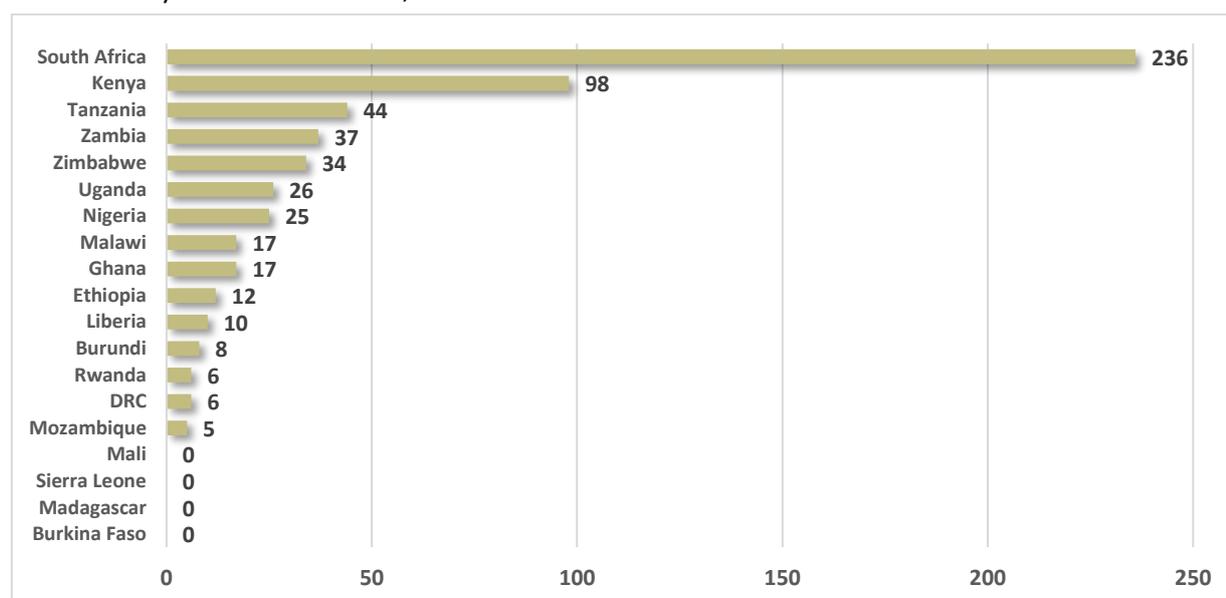


Figure 3. Number of maize varieties released in the last three years.

¹¹ For South Africa, Tanzania, Zambia, Zimbabwe, Malawi, the data is for 2014-2016. For Ghana, the data is from 2017-2019. For all the others, the data is for 2015-2017.

New variety releases (10 years, maize and other crops)

In addition to maize, data was collected on other crops released over the past ten years in five African countries – Egypt (CASC 2017), Ghana (NASTAG 2019), Kenya (KEPHIS 2019), Nigeria (NACGRAB 2019), South Africa, Tanzania (TOSCI 2014), and Zimbabwe. The data was obtained from the respective national variety catalogues. A significant limitation to this exercise is that catalogues are not up to date in all countries, nor are they easily available. Thus, the information below (Table 2) represents what was readily available at the time of writing this report. The comparisons are made for maize, other cereals (rice, millet, sorghum and wheat), legumes (bean, soya bean, cowpea and groundnut), vegetables (tomato, cucumber, pepper, and leafy vegetables), roots and tubers (cassava, potato, sweet potato, and yam), and pasture and other grasses.

Table 3: Number of varieties released over the last ten years for key crops based on recent reports¹²

Crop category	Egypt (2010-2019)	Ghana (2010-2019)	Kenya (2008-2017)	Nigeria (2009-2018)	Sudan (2009-2019)	Tanzania (2007-2016)	TOTAL
Maize	137	37	237	82	19	82	594
Other key cereals (rice, millet, sorghum, wheat)	58	16	67	49	47	16	253
Legumes (bean, soya bean, cowpea, groundnut)	41	35	66	23	4	25	194
Vegetables (tomato, cucumber, pepper, leafy veg)	504	4	7	8	18	10	551
Root and tubers (cassava, potato, sweet potato, yam)	123	35	72	32	18	31	311
Pasture and other grasses	27	0	8	0	0	0	35
TOTAL	890	127	457	194	106	164	

Source: National variety catalogues.

As Table 3 shows, the highest number of varieties were registered in Egypt (890) and Kenya (457), which is evidence of vibrancy in research and variety development by both the private and public sectors in these countries. By crop and crop category, most varieties were released for maize (ranging from 19–237 per country), which is not surprising given the crop’s dominance in consumption in many African countries. Looking at other cereal crops, Kenya, Nigeria, and Sudan have recorded the highest numbers of varieties released: Nigeria for rice (26 varieties), Kenya and Sudan for sorghum (25 varieties each). Egypt reports the highest number of variety releases among legume crops, led by sugar beet with 172 varieties. Under the roots and tubers category, Egypt and Kenya stand out with the most variety releases for the same crop (potato), 116 and 40, respectively. Finally, in the category of pasture and other grasses, including those used for fodder, few varieties were released: 27 in Egypt and 8 in Kenya. The small number of releases is notable in part because the livestock industry is important across Africa, yet the number of releases does not necessarily reflect this.

Although not captured in Table 3, some dryland cereal and legume crops are also gaining popularity across the continent: between 2009 and 2019 ICRISAT, in collaboration with NARIs and the private sector, has facilitated the release of 137 varieties of bean, chickpea, cowpea, finger millet, groundnut,

¹² Numbers in table are aggregates for the various crop varieties in the category; data is used from most recent source (year).

pearl millet, and sorghum in seven African countries – Burkina Faso, Ethiopia, Ghana, Mali, Nigeria, Tanzania, and Uganda¹³.

Regional harmonization and variety releases

As part of the effort towards the regional harmonization of seed regulations, the Common Market for Eastern and Southern Africa (COMESA) and the Economic Community of West African States (ECOWAS) each maintain a *regional* variety catalogue. The COMESA catalogue is managed by the COMESA Secretariat, while the ECOWAS catalogue is managed by a regional agricultural research institution, the *Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles* (CORAF) under the mandate of ECOWAS. While they each intend to foster regional trade in seeds, the variety release processes in the two economic communities are different. In the ECOWAS region, varieties released in any member state are automatically eligible for inclusion in the ECOWAS catalogue. In contrast, in the COMESA region, inclusion is not automatic: the owner of the variety must apply for the variety to be included in the COMESA catalogue, and the application carries a fee. The ECOWAS catalogue has five times more varieties than the COMESA catalogue (Table 3), primarily due to the difference in the process and costs of adding varieties onto the respective catalogues. Another reason is that the seed industry has yet to reap the benefits of having a common regional variety catalogue because most countries in the COMESA region have yet to fully operationalize the COMESA Harmonized Regulations at the country level. In contrast, most countries in ECOWAS readily accept importation of varieties that are listed on the ECOWAS catalogue.

Table 4: Number of varieties in the COMESA and ECOWAS Catalogues

Crop/ crop category	Number of varieties in 2019	
	COMESA Variety Catalogue	ECOWAS Catalogue of Plant Species
Maize	20	29
Other key cereals (rice, millet, sorghum and wheat)	2	46
Legumes (bean, soya bean, cowpea and ground nut)	0	38
Vegetables (all types)	0	0
Roots and tubers (cassava, potato, sweet potato and yam)	3	19
Pasture and other grasses (all types)	0	0
TOTAL	25	132

Source: COMESA Variety Catalogue, ECOWAS Catalogue of Plant Species

Connection between breeders and varieties released

Not surprisingly, the number of active breeders correlates with the number of varieties released. In general, among the countries surveyed by TASAI, the countries with the highest number of breeders – Ethiopia, Kenya, South Africa, and Tanzania – also release the highest number of varieties. Further, in the countries with the most variety releases, a significant portion of varieties are owned and released by private companies. A notable exception is Ethiopia, which has the highest number of breeders and one of the highest numbers of variety releases; the entire process is run by government institutions. This indicates that it is possible for government to run a successful variety release program; in most cases, the involvement of the private sector is a positive contribution.

¹³ <http://seedsystems.icrisat.org/>

Number of Varieties Sold

TASAI tracks the number of varieties sold to assess the vibrancy of a country’s seed sector. The number reported for each country is the aggregate of the data reported by individual seed companies or producers, making sure that nothing is double counted. Maize has the highest number of varieties sold, which is not surprising, as it partly correlates with the number of breeders working on maize and the number of varieties released, where maize also features prominently. In addition, most maize varieties sold are hybrids – unlike open-pollinated varieties (OPVs) that can be saved and replanted, farmers need to purchase new seeds for planting every season. Figure 4 shows the available data for the number of maize varieties sold by country. The highest number of maize varieties sold were in South Africa (236 varieties, which include hybrid, OPV and GM varieties), Zambia (88 varieties), Kenya (65 varieties)

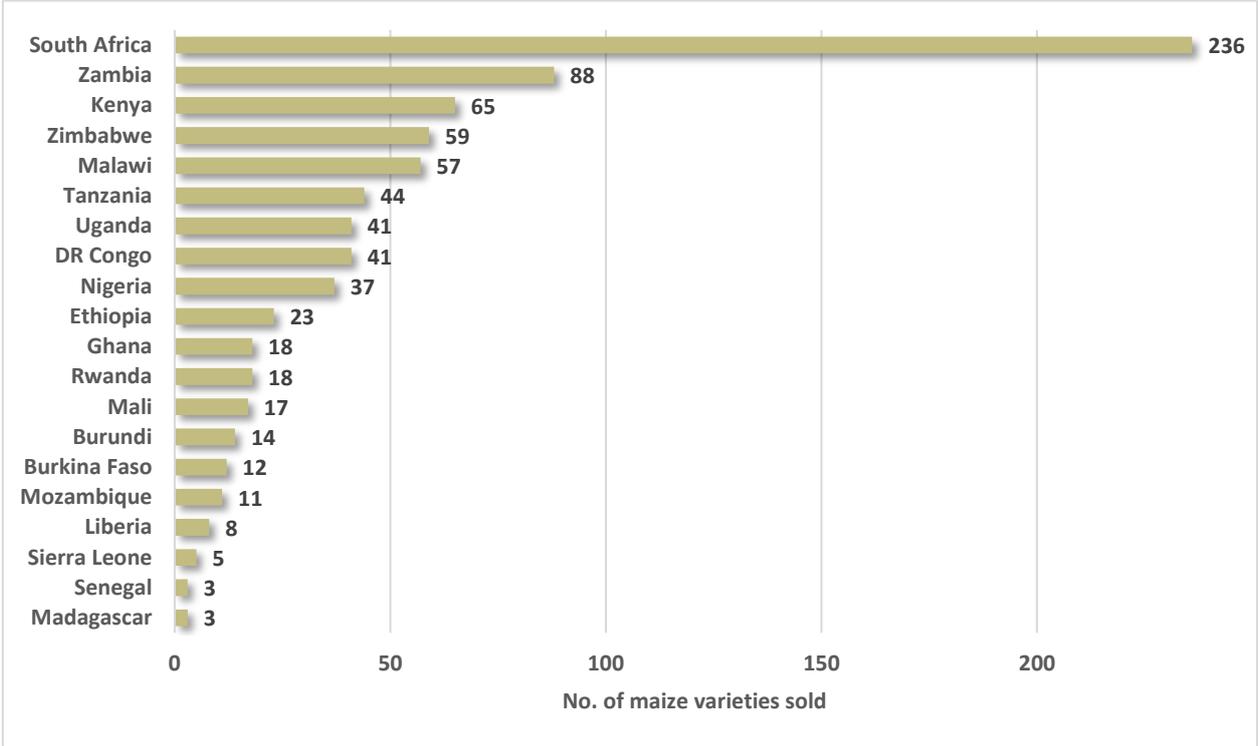


Figure 4. Number of maize varieties sold and Zimbabwe (59 varieties). These countries have vibrant private sectors that develop and commercialize both hybrid and OPV maize varieties.

Rice is the second most important staple crop in Africa, popular primarily in West Africa and the island nation of Madagascar. Not surprisingly, the countries that sell the highest number of rice varieties are in these regions, led by Madagascar (44 varieties) and followed by Senegal (24 varieties) and other countries in West Africa (Figure 6).

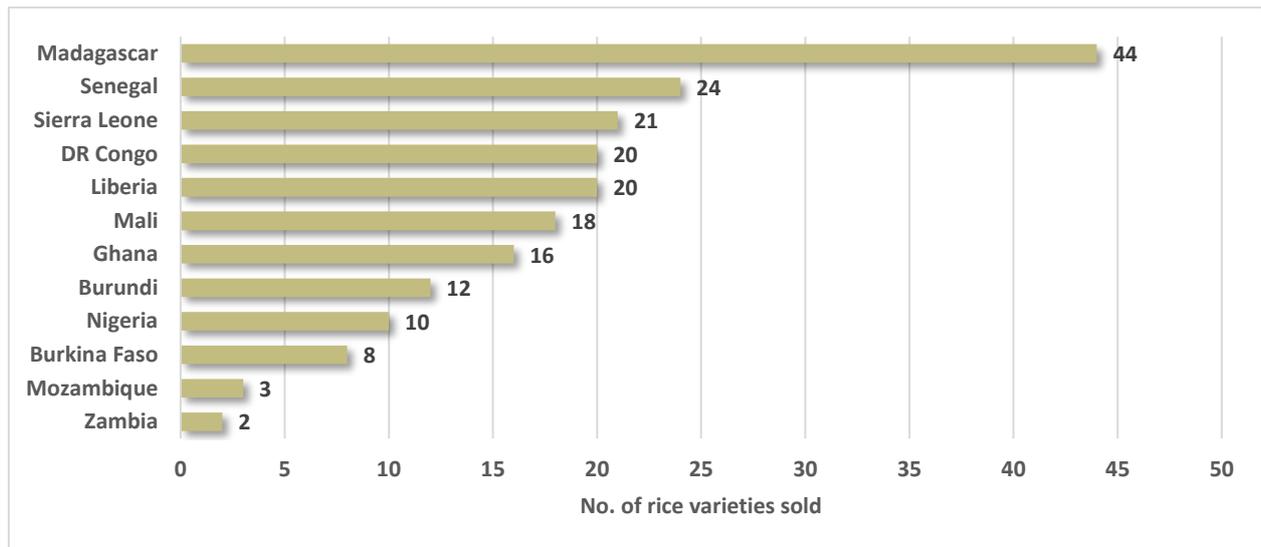


Figure 5: Number of rice varieties sold

Availability of Foundation Seed

Foundation seed, also known as basic seed, is multiplied by seed producers and companies to produce certified seed that is then sold to farmers. In most countries, the primary sources of foundation seed are the National Agricultural Research Institutes (NARIs) and the CGIAR centers. In addition, several private companies release their own varieties and maintain their own foundation seed. These companies have their own breeders and seed technologists, and the appropriate in-house capacities and infrastructure.

Insufficient access to foundation seed is a common problem for seed producers. Often, the NARIs do not have adequate resources (e.g., land, machinery and equipment, technological and financial resources) to produce the quantities required by seed companies and other producers. Such constraints make it difficult for the NARIs to operate effectively and monitor off-site seed production.

Recognizing a gap in the system, over the past five years, several private seed companies have started to specialize in the production of foundation seed. Examples include the Legacy Crop Improvement Centre (LCIC) in Ghana, which produces foundation seed for maize, cowpea and rice, or the Multi-Seed Company (MUSECO) in Malawi, which produces beans, soya beans and groundnut. In Mali, Doun Ka Fa produces cowpea and millet, while another company, Qualibasic Seed Company (QBS), with headquarters in Kenya and seed production facilities in Zambia and South Africa, focuses on hybrid maize. In Burkina Faso, companies are in talks with *Institut de l'Environnement et de Recherches Agricoles* (INERA) and the Ministry of Agriculture to explore similar arrangements. It is reasonable to expect that the entry of these new types of seed producers would ease the shortage of foundation seed; however, a systematic analysis of their impact has yet to be carried out.

Status of Agricultural Biotechnology in Africa

Biotechnology is defined as a set of tools/techniques that uses living organisms (or parts of organisms) involving biological processes to make or modify a product, improve plants, trees or animals, or develop microorganisms for specific uses (ISAAA, 2014). Agricultural biotechnology has led to the development of tools and techniques to develop new varieties or improve existing varieties.

While advances in molecular biology, genomics, and biotechnology have revolutionized agriculture, bringing great benefits for human population, their application in agriculture raises particular questions that inspire widespread controversies and debates on ethical, scientific, and social issues. Despite the persistent controversies, the quest to meet the demands of agriculture in Africa will remain dependent on the effectiveness on the generation, adoption and scaling of agri-biotech tools and strategies, predicated on balancing technologies and global security on the one hand, and organic and conventional farming on the other, in an ecosystem that ensures that maximum benefits are derived from genetics and biotechnology without compromising future needs.

The use of these tools and techniques has already improved agricultural productivity and increased resistance to pests and diseases in many parts of the world including Africa. Most staple food crops in Africa, such as rice, maize, cassava, sorghum, cowpea, and potato, have benefitted from the use of molecular markers for crop improvement and these tools are being applied to more crops (including orphan crops where molecular resources are currently being developed). However, weak capacities, lack of regulatory frameworks and paucity of resources, among other factors, have delayed wider generation and adoption of biotechnology on the continent.

Genetic modification

Genetic modification (GM, also *genetically modified*) is one of the more widely cited examples of agricultural biotechnology. Key commercial traits that have been genetically modified in plants include abiotic stress, altered growth/yield, disease resistance, herbicide resistance, insect resistance and pollination control systems. Transgenic research (in maize, cassava, rice, cotton and cowpea) has been initiated in Africa with equal emphasis on the creation of enabling environments and knowledge systems to support the successful application and use of GM technology on the continent.

According to the International Service for the Acquisition of Agri-biotech Applications (ISAAA), by 2019, 44 countries¹⁴ worldwide had approved the commercialization/planting/importation of GM crops within their territories. Of these, seven are in Africa: Burkina Faso, Ethiopia, Kenya, Nigeria, South Africa, Sudan, and Swaziland. The approved crops are canola, cotton, cowpea, maize, rice, sorghum, and soya bean. Specifically, transgenic Bt cotton has either been released or is nearly ready for release in Nigeria, Sudan, Burkina Faso, Kenya, Ethiopia, Tanzania, and Malawi. Similarly, significant progress towards the release of GM varieties has been recorded for Bt cowpea (in Nigeria, Ghana, and Burkina Faso) and for Bt/drought-tolerant maize (in Kenya, Mozambique, Ethiopia, Nigeria South Africa).

Of these eight countries, only Sudan and South Africa engaged in the commercial production of GM crops in 2017. In the other six countries, approval has been granted, but commercial production has not yet started. In Africa, South Africa is by far the most advanced in terms of commercialization of GM crops. The country has 2.7 million hectares of GM cotton, maize, and soya bean under cultivation. The large area under GMO cultivation in South Africa has resulted in a high number of varieties released in the country. The June 2019 National Variety List consists of about 200 varieties of GM yellow maize, 180 varieties of GM white maize, 100 varieties of GM soya bean and 11 varieties of GM cotton.

¹⁴ Including the European Union, which is counted as one country

More recently, Nigeria is also emerging as a new frontier for GM technology, having approved GM cotton and GM cowpea for commercial cultivation. In June 2018, cotton was the first genetically engineered crop in Nigeria to be registered and released by the varietal release committee. This new variety has been engineered to resist pests, leading to significant reduction in the use of pesticide, a 37% increase in yield, and a higher quality cotton that brings 50% more profit to farmers (NABDA 2018). Significant progress has been recorded in Nigeria in recent times. Following the release of new Bt cotton in 2018, the country released a new Pod Borer Resistant (PBR) cowpea variety for commercialization in December 2019. Other GM crops in the pipeline in Nigeria include Nitrogen-use Efficient, Water-use Efficient and Salt-Tolerant (NEWEST) rice; African bio-fortified sorghum (ABS); Bt maize; herbicide-tolerant soybeans, and virus-resistant cassava enhanced with iron and zinc.

COMESA is the only regional economic community with a regional policy on biotechnology. The COMESA Policy on Biotechnology and Biosafety (2012) provides guidelines for the commercial planting and trade in GM products, as well as the utilization of emergency food aid that has GM content. Cameroon, Kenya, Morocco, Tunisia, and Uganda are all at various stages of enacting biotechnology and biosafety laws.

Gene editing

The latest frontier in biotechnology is gene editing. The development of gene-edited crops, particularly those derived through Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology, allows for creating new traits without introducing foreign DNA. This represents a turning point in agribiotech systems, with significant economic implications within Africa. Although this new generation of biotechnological techniques emerged primarily in the United States and Europe, Africa is a strategic destination and market for some of the products arising from them. For example, the US Department of Agriculture (USDA) has made it clear that CRISPR-Cas edited crops can be cultivated and commercialized without the usual rigorous biosafety regulations that GM crops are subjected to. This has paved way to the release of new CRISPR plants including drought-tolerant soya bean, green bristle grass with delayed flowering time, and white button mushrooms with anti-browning properties (Genetic Literacy Project 2018). The fact that gene-edited crops are not subject to the same biosafety scrutiny as conventional GM crops has occasioned reflection and actions around capacity development and strengthening of Africa's seed system.

The need for regulations and awareness raising

Despite ongoing adoption and introduction, GM crops remain controversial in many countries due to concerns about the safety of GM crops to public and environmental health, including unfounded fears that GM crops would replace conventional varieties, thereby making farmers dependent on private seed companies or that GM crops will lead to a loss of export markets for certain trade-sensitive countries (Waithaka et al., 2015, Wafula et al., 2012). Such concerns notwithstanding, there is increasing awareness around the opportunities these new technologies offer, so the next few years will likely see a growing number of transgenic crops in the African market, and there is optimism that both conventional genetically engineered crops and gene-edited crops will transform commercial agriculture in Africa. Achieving this requires proactive measures and multi-stakeholder engagement, to advance the development of coherent, science-led, and evidence-based strategies on biotechnology on the continent.

Development through partnerships

The drive to catalyze the generation of these technologies has in part been due to strong partnership among major stakeholders in the region. The African Agricultural Technology Foundation (AATF) and the International Service for the Acquisition of Agri-biotech Applications (ISAAA) are two key institutions in Africa leading the advancement of biotechnology on the continent. The AATF facilitates and supports negotiation for technology access and delivery and formation of appropriate partnerships to manage the development and deployment of innovative technologies for use by smallholder farmers in Sub-Saharan Africa. The AATF is leading several biotechnology projects for product commercialization in maize, cowpea and rice. Through the Open Forum for Agricultural Biotechnology (OFAB), the AATF supports countries that have embarked on developing regulatory frameworks to create an enabling environment for biotechnology. The ISAAA¹⁵ is a not-for-profit organization that promotes the benefits of crop biotechnology in developing countries through knowledge-sharing initiatives and the transfer and delivery of proprietary biotechnology applications.

¹⁵ ISAAA <http://www.isaaa.org/>

Component 3: INDUSTRY COMPETITIVENESS

Industry competitiveness can be defined as the sustained ability of firms and industry to capture market share and grow the market through productivity improvements (World Bank 2017). In the context of the seed industry, and following the TASAI indicators, we assessed industry competitiveness by looking at four variables: the number of active seed companies, the volume of seed produced or sold, the market share of any government parastatal, and the performance of seed imports and exports. We detail each below.

Number of Active Seed Companies/Producers

National and regional seed laws and regulations define requirements for seed production, marketing, and trade. Countries with strict seed laws governing the production of high-quality seeds require registration for activities such as seed production, processing, marketing and storage. In these countries, only seed companies with the requisite human resources and facilities can meet the requirements for seed production. In contrast, countries with less stringent requirements governing seed production tend to have a wider range of producers, including seed companies, seed cooperatives, seed associations, and individual seed producers. Apart from the seed companies, the other producers often operate informally, which makes it more challenging to gather data about them.

Figure 6 shows that of the countries surveyed, Nigeria, has the highest number of active seed companies¹⁶ (106) that produce and market certified seed for the key food crops (Figure 7). This is followed by Madagascar (48), and Mali and South Africa (41 each). Nigeria's leading role is not surprising given that it is Africa's most populous country. The rest of the countries surveyed reported numbers ranging from 4–30, with the average number of seed companies around 20. Importantly, most of these figures represent a significant change since the year 2000, when the seed sector was just beginning to liberalize in Africa and few countries had more than one or two companies. Nevertheless, the rate of change has not been even: in some countries, such as Sierra Leone, Burundi, and Liberia, the seed industry is still in its infancy, and, accordingly, the number of active companies is small.

¹⁶ This only refers to seed companies, and not the other categories of seed producers like seed cooperatives, seed associations, and individual seed producers.

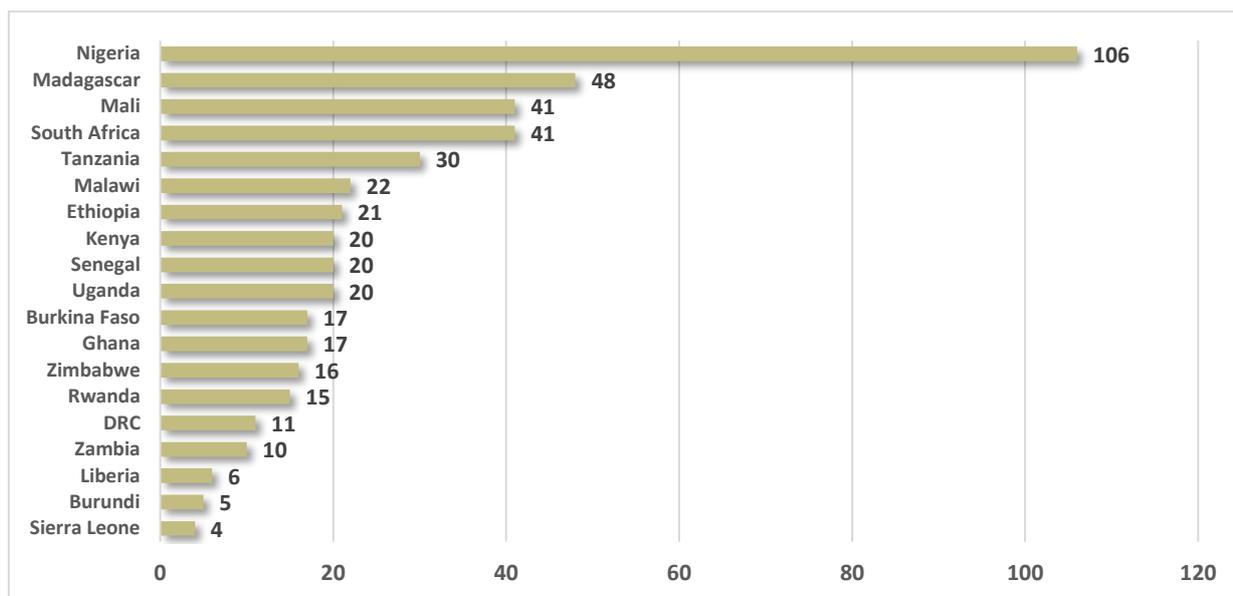


Figure 6. Number of active seed companies in African countries

The ownership of seed companies in African countries can be disaggregated as either local, other African or non-African. Figure 8 shows the ownership of seed companies that produce and market maize seed in 12 African countries. Most seed companies in Africa are locally owned and managed, that is, owned and managed by nationals of that country. This is especially the case in West Africa: all seed companies in Burkina Faso, Liberia, Mali, and Sierra Leone are locally owned. In contrast, in Eastern and Southern Africa (DRC, Kenya, Malawi, Tanzania, Rwanda, South Africa, and Uganda) some companies are owned either by other Africans or by non-Africans.

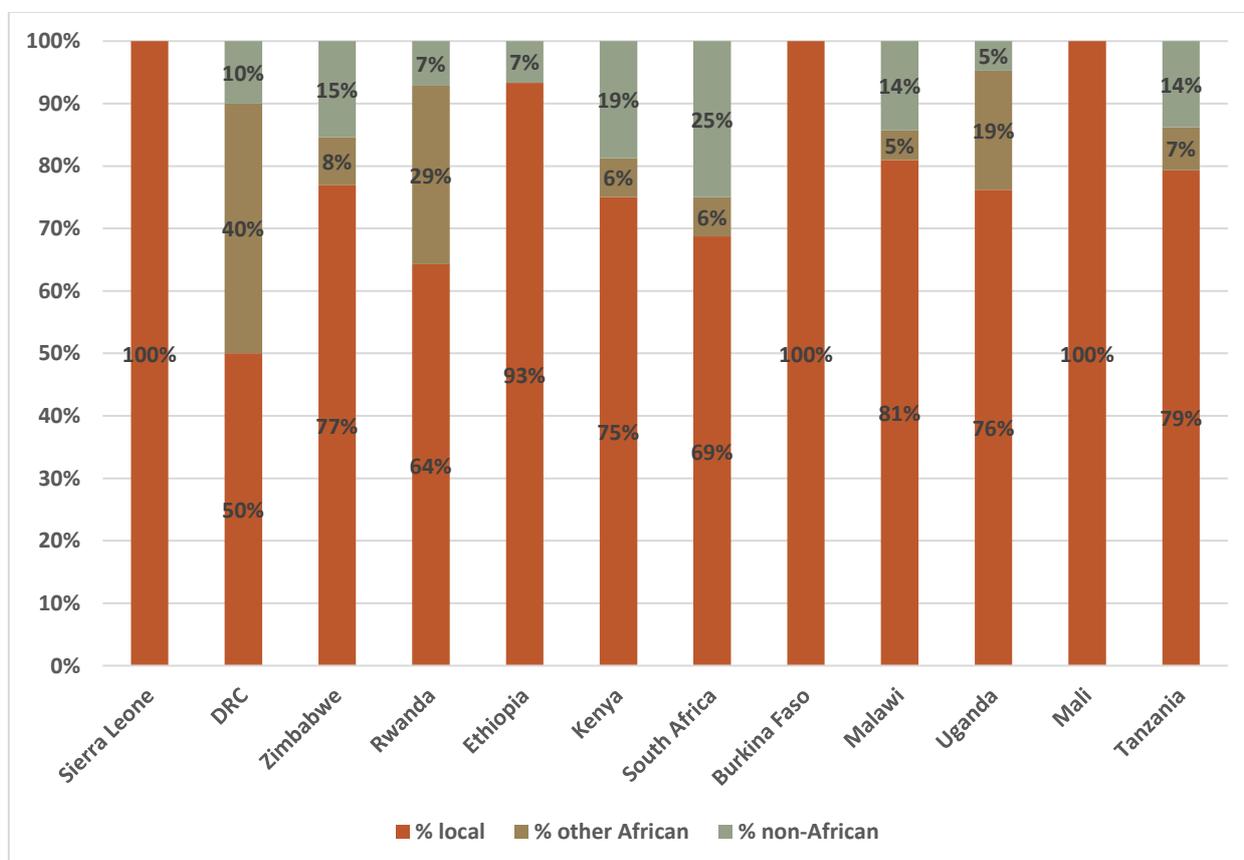


Figure 7. Ownership of seed companies in Africa

In terms of market share, African-owned seed companies are the key players in the seed industries in nearly all the African countries surveyed by TASAI. Non-African multinational seed companies, though very active in some countries in East and Southern Africa, do not control most of the seed market share for the key food crops. Taking the example of maize seed – except for Zambia, in countries¹⁷ like Kenya, Malawi, Tanzania and Zimbabwe, where these companies are very active, non-African multinational seed companies contribute between 20% and 38% of the maize seed market. In Zambia, the non-African multinational seed companies contribute 59% of the maize seed market share.

Total Sales of Certified Seed

Seed sales are calculated as the aggregate volume (in metric tons) of individual sales of certified seed by the seed companies/producers in each country. Maize and rice seed are two of the most widely produced and sold seeds across the continent. According to TASAI’s findings, the countries that sell the highest volumes of certified maize seed include Zimbabwe (44,150 metric tons in 2016), Kenya (43,954 metric tons in 2017), South Africa (33,223 metric tons in 2016), Zambia (33,018 metric tons in 2016), and Ethiopia (27,756 metric tons in 2016) (Figure 8). It is notable that all these countries are in East and Southern Africa, where maize is the main staple crop. Some of these countries have a long history in maize seed production and commercialization. In addition, some of the leading seed companies in these countries are regional or multinational businesses that have built seed production and distribution systems over the years.

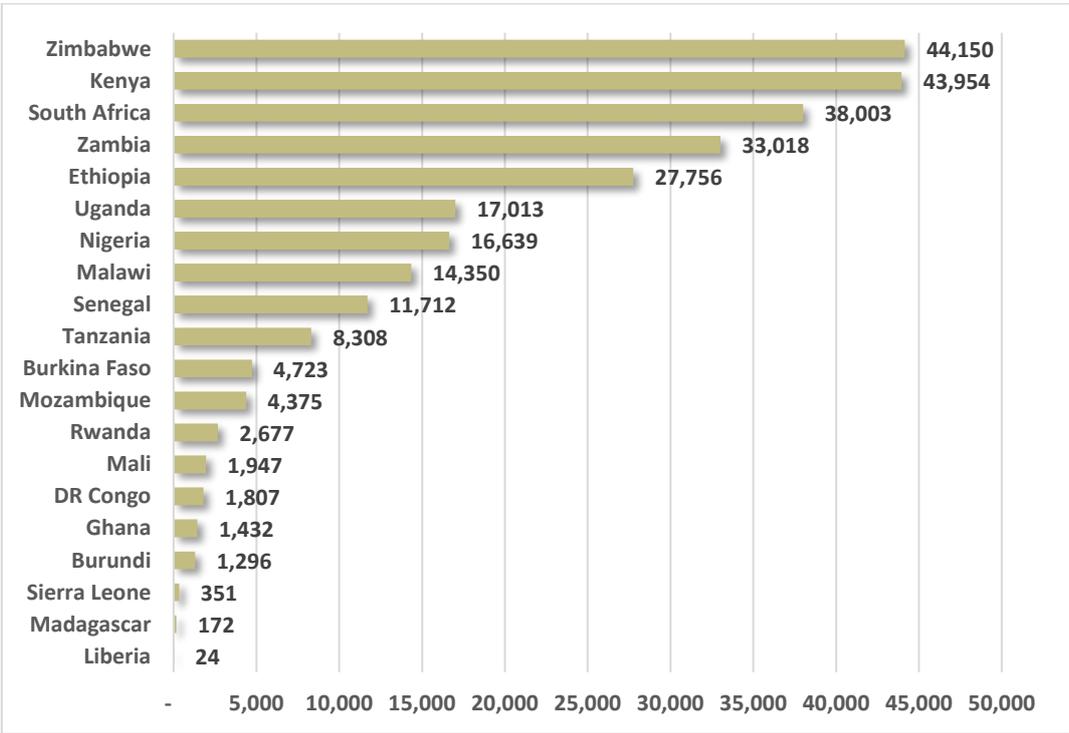


Figure 8. Total sales of certified maize seeds (in metric tons)

When it comes to rice, with the exception of Egypt (25,676 tons in 2018), the countries that sell the highest volumes of this crop are all located in West Africa and include Nigeria (38,607 tons in 2017),

¹⁷ Non-African owned seed companies are also active in South Africa. However, data on market share was not readily available

Senegal (12,485 tons in 2016), Burkina Faso (4,334 tons in 2017), Sierra Leone (3,065 tons in 2017), and Mali (2,295 tons in 2017) (Figure 9).

Nigeria is a net importer of grain rice. The high rice seed sales are driven by the government’s push to increase rice production as an import substitution strategy. Except for Nigeria, most of the rice seed produced in these countries is produced not by seed companies, but by individual seed producers, seed associations, and seed cooperatives.

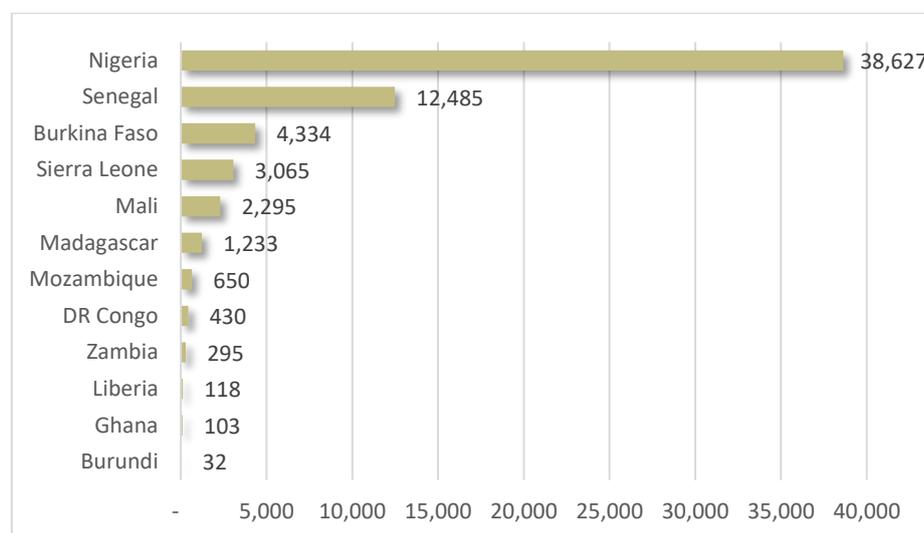


Figure 9. Total sales of rice seeds (in metric tons)

Market Share of Government Parastatals

Of the 20 countries studied by TASA, government parastatals are actively involved in the production and marketing of certified seeds in only four countries – Ethiopia, Kenya, Tanzania, and Zimbabwe. This is a notable reduction from the early 1990s when government-owned seed companies were the monopoly player in the production and marketing of certified seed. While market shares of the companies vary by crop, in these four countries, government parastatals are more dominant in Ethiopia and Kenya than in Tanzania and Zimbabwe.

Kenya has seven government-owned entities registered as seed companies. They include the national agricultural research institutes, public universities, and state-owned limited companies. The combined market share for these companies is 64% of maize seed, 17% of sorghum seed, and 50% and 70% of bean and cowpea seed, respectively.

In Ethiopia, a large share of the seed market is controlled by government enterprises – the Ethiopian Seed Enterprise at the federal level, and five regional seed enterprises. The combined market share of government parastatals by crop in 2016 was 59% (maize), 77% (wheat), 62% (teff), and 83% (sorghum).

Two government parastatals are active in Zimbabwe’s seed sector. ARDA Seeds, registered in 1988 as a subsidiary of the Agricultural and Rural Development Authority¹⁸, produces certified seed for a variety of crops, and Zimbabwe Technological Solutions (ZTS), registered in 2014, only produces maize seed. By

¹⁸ <https://spiked.co.zw/arda-seeds-where-farmers-are-assured-of-a-bumper-harvest>

crop, the combined market share of these two companies is small – 3% for maize, 3% for beans, 4% for soya beans, and 6% for sorghum.

In Tanzania, the government seed parastatal, Agricultural Seed Agency (ASA), was created in 2006 as an agency of the Ministry of Agriculture to produce, market, and distribute seed. ASA produces seed for three crops – maize, bean and soya bean – though its market share for two out of the three crops was low in 2016, the year when TASA last collected data in the country. ASA seed accounted for 0.5% of the maize seed market, 3.9% of the bean seed market, and about 43% of the soya bean seed market. The high soya bean market share was due to the fact that the government parastatal was one of only two companies producing the crop that year.

Length of the Seed Import and Export Process

For seed of a variety to be exported to another country, the variety needs to be registered in the national variety catalogue of the importing country. In East and Southern Africa, most companies that are engaged in export are regional and thus will have a branch in the importing country. It is this local office that applies for variety registration and release in the destination country. In West Africa, the process is different, as varieties released in a member country are automatically added to the ECOWAS catalogue. This also means that it is sufficient for exporting companies to have a buyer in the importing country instead of its own branch. Apart from the above difference, the import process is standard – the exporting company obtains a phytosanitary certificate from the country of origin, which is then used to request an import permit from the relevant authority in the country of import.

The share of seed imports and exports to overall sales (in metric tons) varies by country. For example, of the countries surveyed, among net maize seed exporters, exports range from 8% (Uganda) to 60% (Zambia) of total volume of sales. Sorghum seed exports account for 20% and 45% of overall sorghum seed sales in Kenya and Uganda, respectively. Among the four key crops, maize is the most traded seed in most countries, accounting for 69% of Burkina Faso's seed exports in 2018, 94% of Kenya's seed exports in 2017, and 59% of Uganda's seed exports in 2017. Apart from these four countries, other maize seed exporting countries include South Africa, Tanzania, Zambia, and Zimbabwe. Other commonly exported seed includes rice, sorghum, and soya bean seeds. Rice seed exporters include Burkina Faso, Cote d'Ivoire, Mali and Nigeria. Sorghum seed exporters include Burkina Faso, Kenya, and Uganda. Soya bean seed exporters are South Africa, Zambia and Zimbabwe.

The length of the seed import process is calculated as the number of days from the time an import permit is requested to the time when the seed is cleared at the border. For most countries, the seed im-

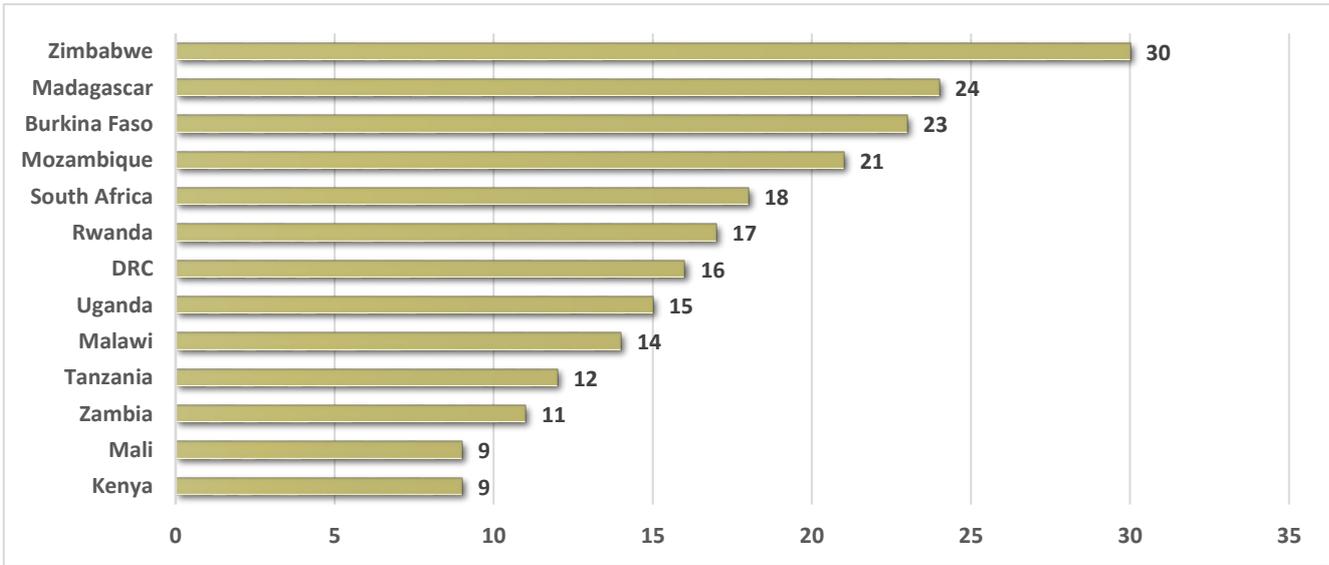


Figure 10. Number of days taken for imports (in days) port/export process takes, on average, less than 30 days. In Kenya, Tanzania, Uganda, and Zambia, due to the automation of import procedures, the process takes at most 15 days (Figure 10).

Component 4: SEED POLICY AND REGULATIONS

Nearly all 20 countries surveyed by TASA have a seed policy at some stage of formulation, adoption, or implementation. However, in most cases, the crucial step of implementation is lacking effectiveness, in effect reducing the impact of the policy.

This section assesses the status of national seed policies, seed laws, and various regulatory instruments. In addition, the section assesses three key areas of implementation of these policy frameworks – variety release systems, seed inspection services, and seed subsidy programs.

Status of Seed Policy Framework

Most African countries have national seed policies and/or seed laws and their accompanying implementing instruments, including seed regulations and ministerial orders or decrees. Notable exceptions to this are Cape Verde, Democratic Republic of the Congo (DRC), Djibouti, Guinea Bissau, and Mauritius, which do not have any seed law or regulations. Mozambique has no seed law or policy; the instrument guiding the seed sector is a strategic plan for development of the agricultural sector.

At the regional level, three regional economic blocs have passed seed regulations: COMESA adopted its Harmonized Seed Regulatory System in 2014, ECOWAS passed the ECOWAS Seed Regulations (C/Reg.4/05/2008) in 2008 (ECOWAS, 2008); and harmonized seed regulation in the SADC region was adopted in 2013 after two thirds of the member states ratified the memorandum of understanding for implementation of the SADC Harmonized Seed Regulatory System (Feed the Future, 2016). The regionally harmonized regulations govern three main areas: variety release, seed certification, and phytosanitary control.

Economic Community of West African States (ECOWAS): This regional community has 17 member states.¹⁹ Overall, Burkina Faso, Guinea, Niger, and Nigeria are at the most advanced stages of implementation of the harmonized regulations. Most ECOWAS member states have national seed laws and regulations. In addition, with the exception of Guinea Bissau and Mauritania, all the countries have ratified the ECOWAS Seed Regulations, which require national governments to establish a seed fund (for various seed sector activities in the country); provide guidance on seed quality control and certification as well as seed production; institute a national catalogue of plant varieties and species; and establish national seed committees. The ECOWAS Seed Regulations recognize four seed classes: parent material, pre-basic seed, basic seed, and certified seed. Implementation of the ECOWAS Regulations is coordinated by CORAF. To assist countries to implement the ECOWAS Regulations, CORAF is putting in place procedure manuals for variety release, for seed certification, for seed import and export, as well as regulations for seed quality control and for phytosanitary control.

Common Market for Eastern and Southern Africa (COMESA): As of March 2019, only seven of the 19 AU Member-States – Burundi, Egypt, Kenya, Rwanda, Uganda, Zambia, and Zimbabwe – had aligned (through domestication) their national seed regulations with the COMESA Harmonized Seed Regulation. The har-

¹⁹ See Appendix 2 for a listing of regional organizations and members states.

monization process is ongoing in most of the other countries and has just started in Madagascar, Seychelles, and Sudan. The African Agricultural Technology Foundation (AATF), with support of the African Development Bank (AfDB)'s Technologies for African Agricultural Transformation (TAAT) program, is working collaboratively with the COMESA Secretariat to fast-track domestication and implementation of the regionally harmonized seed regulation. The COMESA regulation recognizes four seed classes – pre-basic seed, basic seed, first generation certified seed, and second-generation certified seed. The COMESA regulations require Distinctness, Uniformity and Stability (DUS) and Value for Cultivation and Use (VCU) tests for two seasons and proof of release in two member states to add a new variety to the COMESA Plant Variety Catalogue, and the application process incurs a fee. Four categories of COMESA seed labels have been printed to effect transboundary seed sales, and modalities are being worked out with member States and the private seed companies. Although Quality Declared Seed (QDS) is not part of the harmonized regulations, countries such as Ethiopia, Rwanda, Uganda, and Zambia recognize it as a seed class.

Southern African Development Community (SADC) has 15 member states (Appendix 2). The SADC Harmonized Seed Regulatory System took effect in 2013 when 10 member states signed the Memorandum of Understanding on their implementation (Feed the Future 2016). Under SADC regulations the harmonized regulations do not replace or override national seed laws (Keyser et al., 2015). SADC regulations recognize breeder seeds, pre-basic seed, basic seed, first-generation certified seed and second-generation certified seed. They also recognize QDS.

East African Community (EAC): Harmonization efforts are underway in the East African Community (EAC), which has six member states (Appendix 2). Draft versions of the EAC Seed Bill, EAC Seed Regulations (Seed Certification; Plant Variety Evaluation and Release; Plant Variety Protection). as well as the East African Seed Standards for six crops (maize, sorghum, sunflower, soybean, groundnut, and potato) are currently in the final stages of approval. The EAC Seed Bill has been forwarded to the East African Legislative Assembly for debate and adoption.

Length of the Variety Release Process

The first step of the variety release process is applying for release of a variety for commercial use. The application generally includes results from the National Performance Trials, as well as those from Distinctness, Uniformity and Stability (DUS) tests and/or Value for Cultivation and Use (VCU) tests. If an application is successful, approval for variety release is granted by the relevant authority and the variety is registered in the national variety catalogue.

Of the 20 countries surveyed by TASAI, the countries with the shortest release time are Burundi (13 months), Zimbabwe (18 months), South Africa (20 months), and Mali, Mozambique and Zambia (all 24 months). The longest release times were registered in Ethiopia (46 months), Madagascar (43 months), Ghana (42 months) and Kenya (38 months). The main reason for the long delays in releasing varieties is inefficiency on the part of government agencies in charge of the release process, primarily due to constraints on financial and human resources. The slow process leads to further delays during field evaluations and in convening the National Variety Release Committee (NVRC).

Of the countries surveyed, four (Burkina Faso, Liberia, Mali, and Rwanda) either do not have a formal variety release process or have processes that are in their infancy.

Adequacy of Seed Inspection Services

Seed inspection is a key element of the enforcement of seed regulations. Depending on the country, seed inspection may be the mandate of the public or the private sector – or a combination of the two. Egypt has the highest number of seed inspectors (341), all of whom are employed Central Administration for Seed Certification (CASC). Of these, 195 are permanent employees while 146 are temporary. South Africa has the second highest number of seed inspectors (180), all of whom are in the private sector: they are trained by the South African National Seed Organization (SANSOR) and are either employed by SANSOR, the government’s accredited seed certification authority, or by private seed companies. SANSOR also has an in-house seed testing committee that meets the requirements of the International Seed Testing Association (ISTA). Following South Africa, Zambia has 118 seed inspectors, 83 of whom are private. Countries with the smallest number of inspectors are Rwanda (8), Burundi (7), Sierra Leone (5), and Liberia (1), all employed by the public sector.

In most African countries the effectiveness of seed inspection is hampered by shortages of personnel and funding. Inadequacies in field inspection lead to the production and sale of sub-standard certified seeds, and the proliferation of fake seeds in the country. To overcome challenges in public seed inspection services, some countries now train and accredit private seed inspectors. Countries with the most advanced seed sectors, such as South Africa, Zambia, Zimbabwe, and Kenya, have allowed private seed inspectors for some time. Other countries such as Nigeria, Tanzania, Ghana, Burkina Faso, and Uganda, are in the process of authorizing private seed inspectors.

Efforts to Stamp Out Counterfeit (“Fake”) Seed

The prevalence of fake seed is a common problem facing the seed industry in Africa. TASAI tracks as an indicator the number of reported cases, although it is likely that most cases are not reported, so the number of reported cases may represent less than half the actual prevalence. That said, based on existing data, the highest number of cases of fake seeds has been reported in the DRC – 185 in 2016. In other countries surveyed, the number of incidents reported is lower; the next highest number – 52 cases – is reported in Zimbabwe.

One indication the reported numbers are underestimates may be that, when asked, seed companies in all countries report that counterfeit seeds are a major concern for them (TASAI, 2019). Companies also report that the main sources of fake seed are seed companies, seed distributors, retailers, and other agents who purchase low-quality seed for the relief market. Government subsidy programs are another unwitting enabler of trade in fake seeds, especially those with weak and unpredictable seed procurement arrangements that do not have sufficient checks on the sources and the quality of seeds.

African countries have initiated a range of solutions to combat the challenge of counterfeit seed. In Nigeria, the National Agricultural Seed Council (NASC) has embarked on a farmer awareness effort using radio and print media. Further, the NASC is developing two IT-based solutions: one, the National Seed Tracker, will enhance the traceability of seed from the farm to the point of sale. The second solution is an electronic authentication system called SEEDCODEX, which will allow farmers to receive feedback

through SMS on the authenticity of the seed they have purchased. In Kenya, the Kenya Plant Health Inspectorate Services (KEPHIS)²⁰ and the Seed Trade Association of Kenya (STAK) have introduced security labels on seed packages. When scratched, the labels reveal a unique 12-digit code, which the buyer can send via text message to a designated phone number, and, in a matter of seconds, receive a response confirming whether the seed in the package purchased has been tested by KEPHIS. The introduction of these tools is recent, so their impact on the prevalence of fake seeds is not yet known; however, if they are able to make a dent in the problem, other countries are likely to follow with their own programs. AATF with support of AfDB’s TAAT program is working on modalities for developing a catalogue of credible seed and agro-input suppliers, an effort that is expected to culminate in accreditation of suppliers and stamping out of counterfeit seed.

Status of Seed Subsidy Programs

Government subsidy programs are intended to increase farmers’ utilization of improved seeds, with the objective of improving food security in rural areas. African countries have utilized seed subsidy programs over the past few decades with mixed success. Out of 21 countries surveyed by TASAI, 10 had implemented seed subsidy programs. Table 5 shows the percentage of seed sold to subsidy programs as a percentage of total seed sales (measured in metric tons). The percentage of seeds sold to government as part of the subsidy programs ranged from a nearly negligible 2% in Kenya to 100% in Rwanda.

Table 5: Percentage of seed sold as subsidy for key food crops

Country	% of seed sold as subsidy	Seed subsidy distribution arrangements
Kenya	2%	private (agro-dealers)
Zimbabwe	7%	public (govt. warehouse)
Mozambique	16%	private (voucher)
Zambia	38%	private (e-voucher)
Tanzania	46%	private (voucher)
Uganda	48%	public (military)
Malawi	70%	private (voucher)
Burkina Faso	70%	testing e-voucher
Ghana	>90%	PPP ²¹ (MoFA ²² & retailers)
Rwanda	100%	PPP (APTC ²³ & Agro-dealers)

The method of distribution of the seed varies by country. Malawi, Tanzania, and Zambia use a voucher system, which is administered by private seed companies and agro-dealers. In Ghana and Rwanda, seed is distributed through a partnership between private retailers and government offices at the district or provincial levels.

²⁰ KEPHIS is the seed regulatory agency in Kenya.

²¹ Public-Private Partnership

²² Ministry of Food and Agriculture

²³ Agro-Processing Trust Corporation

The main challenge with subsidy programs is that payments from the government are often late, resulting in cash-flow shortages for seed companies. One example of this is from Nigeria, where the seed subsidy program has yet to pay seed companies for seed that was delivered under the government's Growth and Enhancement Strategy (GES), which ran from 2012 to 2015. According to the Seed Entrepreneurs' Association (SEEDAN), the outstanding amount is approximately US\$1.5 million. Seed companies in Burkina Faso, Malawi and Rwanda have also complained of government payment delays.

Component 5: INSTITUTIONAL SUPPORT

Several institutions and facilities have been established with the purpose of supporting the development of the seed industry at various stages of the seed value chain. This section assesses the status of the national seed regulatory authorities, the national seed trade associations, and seed laboratories accredited by the International Seed Testing Association (ISTA).

Quality of the National Seed Trade Association

National seed trade associations serve as platforms for the private sector to work with government to address challenges in the industry and jointly implement solutions. The membership of national seed associations includes seed companies, seed growers, seed cooperatives, individual seed producers, and at times agro-dealers. There are 24 national seed associations in Africa. In addition to the countries surveyed by TASAI (Figure 13), there are associations in Benin, Egypt, Niger, Sudan, South Sudan, and Tunisia.

Figure 13 shows satisfaction ratings recorded for seed association member companies surveyed by TASAI from 2016 to 2018. Only the South African National Seed Organization (SANSOR) was rated as “excellent” (81%)²⁴. Most of the associations were rated as “good” (ranging from 60–80%). Seed associations in Malawi, Tanzania, Zambia, Ethiopia, Uganda, Burkina Faso, Senegal, and Kenya were all in this group. Associations in this group have established an effective working relationship with government through which seed companies have a platform for engagement on seed sector issues, are active in national seed sector activities, and have acceptable governance structures in place. For example, SANSOR is rated high because of its effectiveness in delivering key services to seed companies, such as seed certification, seed inspection, and phytosanitary services. The Seed Trade Association of Kenya (STAK) has a seat on six government committees related to seeds and agriculture and convenes at least 7 seed industry stakeholder meetings every year. Associations like STAK, SANSOR, STAM (Malawi), and USTA (Uganda) implement good governance practices as outlined in their respective constitutions and governance instruments, regularly hold elections, convene regular board meetings, and conduct an annual audit.

²⁴ All TASAI survey scores are based on industry self-reporting of satisfaction, that is, seed companies’ rating of their own association. The following scale was used: 0–19.99% (extremely poor), 20–39.99% (poor), 40–59.99% (fair), 60–79.99% (good), and 80–100% (excellent).

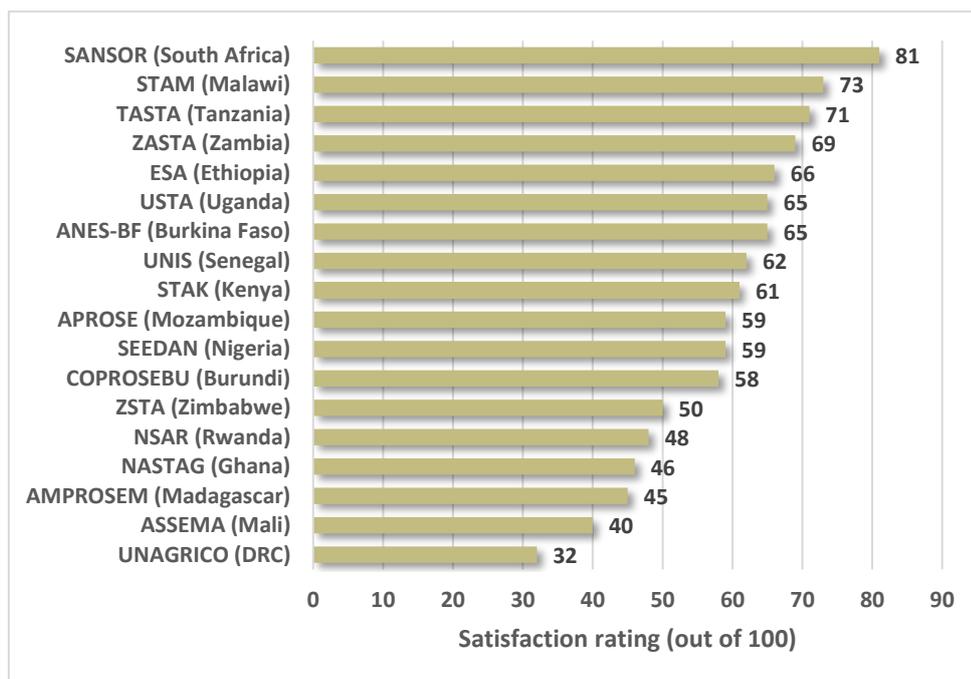


Figure 11: Satisfaction rating of seed trade associations (out of 100%)

Accreditation by ISTA

The not-for-profit International Seed Testing Association (ISTA) sets standards for seed testing and analysis. ISTA accredits seed laboratories that meet international standards and rules. Once accredited, these laboratories are permitted to issue ISTA certificates for the seed they test, which are required in the international trade of seeds.

To date ISTA has accredited more than 130 seed laboratories globally, only ten of which are in African countries. Of the ten, eight are government seed laboratories – in Egypt, Kenya, Malawi, Senegal, South Africa, Tanzania, Zambia, and Zimbabwe – while two belong to private companies – in South Africa and Uganda. In addition, another ten laboratories are at varying stages of the process of applying for and meeting the requirements of ISTA accreditation. These labs are in Botswana, Ethiopia, Kenya, Nigeria, South Africa (three privately owned labs), Tunisia, and Zimbabwe.

Component 6: SERVICE TO SMALLHOLDER FARMERS

Farmers' access to quality certified seed is affected by several factors including the price of seed, the presence of a rural seed distribution network, and the availability of seed in small packages. These factors combine to make affordable, high-quality seed accessible to African farmers.

Concentration of Rural Agro-dealer Network

TASAI assesses the quality of services to smallholder farmers by tracking the concentration of agro-dealers, measured as the ratio of the number of farming households per agro-dealer outlet; the smaller the number of households per agro-dealer, the more saturated the agro-dealer network, and by implication, the better the quality of service. Among the 21 countries surveyed, Zimbabwe leads with 438 households per agro-dealer, while the DRC comes in last with 43,882 households per agro-dealer (Figure 12). Apart from Zimbabwe, other countries with a wide network of rural agro-dealers include Kenya, Ghana, Malawi and Uganda. In most countries, agro-dealers are required to register with the relevant government regulatory agency. In Malawi, the Seed Trade Association of Malawi (STAM) maintains a registry of active agro-dealers.

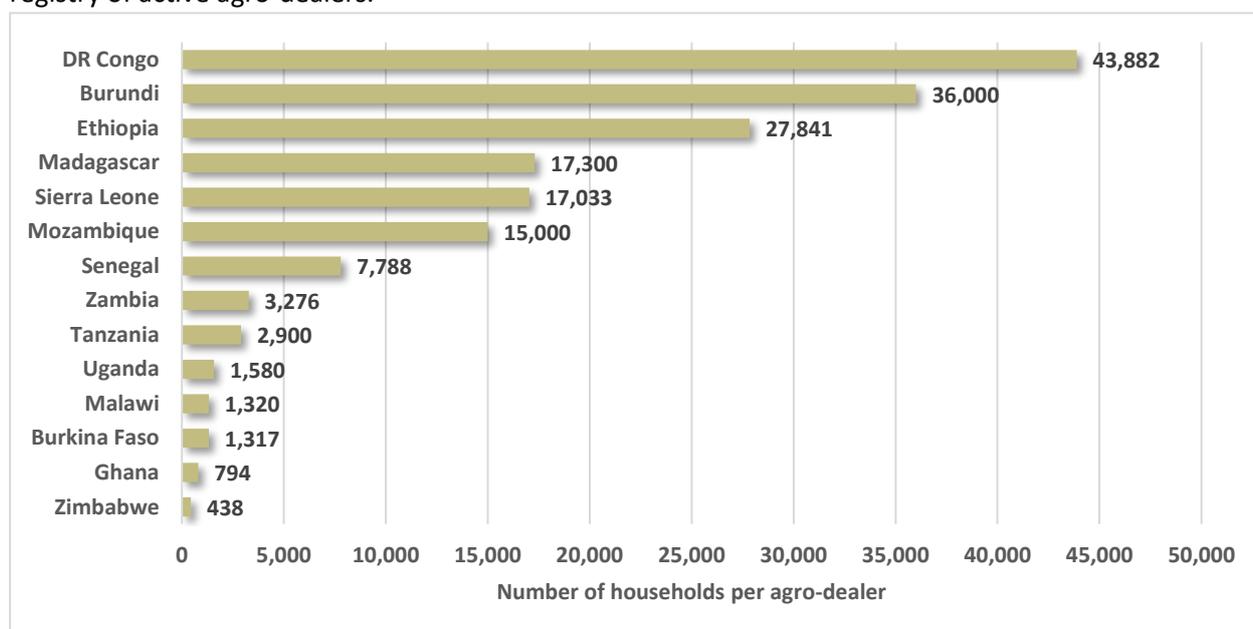


Figure 12. Number of households per agro-dealer

In countries with a relatively well-developed private seed industry, seed companies build relationships with agro-dealers, since they are the main distribution channel for certified seed to farmers. In Kenya, seed companies work with between 20 and 3,000 agro-dealers each.

Availability of Seed in Small Packages

National seed laws and regional seed regulations both require that all certified seed sold to farmers be packaged and labelled. However, in practice this is not always the case. In fact, slightly more than half of the seed producers in Liberia (60%) and Burkina Faso (55%) and fewer than half of the seed producers in Mali (40%) sell their seed in packages. Of the seed that is sold in packages, the sizes of the packages vary considerably. Since most of the farming in Africa is done on small farms, seed needs to be packaged proportionally to this farm size. By small package size we mean 2kg or less. Benefits of small packages are two-fold: First, the small packages provide a quantity of seed suitably scaled to the parcels of

land cultivated by most smallholders. Second, packages as small as 100 grams can be offered at a low cost, or even for free as a promotional strategy. Farmers can plant the seed to test it or as a demonstration.

Seed-to-Grain Price Ratio

Assuming stable prices at planting time, the seed-to-grain price ratio reflects the extent to which a variety is improved, as reflected in the cost of production and the costs of transacting in the seed market (Nagarajan & Smale, 2005). While the high seed-to-grain price ratios imply reduced affordability by smallholder farmers, they also reflect the level of seed quality, productivity, and overall higher-valued addition through seed treatments.

Among the food crops, hybrid maize has the highest seed-to-grain price ratio. This is expected given the high cost of production of hybrid maize varieties. The countries with the highest ratio for hybrid maize are South Africa at 34.4:1, Zambia at 13.4:1, Rwanda at 9.9:1 and Zimbabwe at 9.3:1. The high ratios in South Africa reflect a mature market and farmers who can afford the significantly more expensive hybrid varieties, while Zambia and Zimbabwe reflect relatively mature markets with a well-established demand for improved maize varieties²⁵. The high cost in Rwanda is mainly because all the hybrid maize is imported. The countries with the lowest ratios for hybrid maize are Malawi (4.2) and Mozambique (4.8).

TASAI also tracks the price-to-grain ratio of open-pollinated varieties (OPV) of maize, since in many countries, smallholders use OPV maize more often than hybrid varieties; in fact, some countries only sell OP maize varieties (e.g., Liberia, Madagascar, Senegal, and Sierra Leone). As expected, the price-to-grain ratio for OPV is lower than for hybrid varieties, ranging from the highest, 10:1 in Zambia, to the lowest, 1.4:1 in Sierra Leone.

Average prices per kilogram of hybrid maize were highest in South Africa (US\$ 8 per kg), while in the rest of Africa ranged from US\$0.9 per kg (Nigeria) to US\$3.1 per kg (DRC), with the average around US\$2 per kg.

²⁵ “Evidence reported by Heisey et al. (1998) for maize, another heavily out-crossing crop, suggests that widespread adoption of hybrids by small-scale farmers in developing countries is associated with a seed-to-grain price ratio of 10 or below during the initial phase of seed industry development. Seed-to-grain price ratios rise sharply during the maturity phase of the seed industry, often stabilizing in the range of 25:1 to 30:1.” (Heisey et al. 1998; cited in Nagarajan and Smale 2005).

Component 7: ANIMAL SEEDS

Current and Planned Programs on Livestock Seed Sector Development

Quality issues with seeds

Whether it originates from a plant or an animal, seed generally present the same quality issues, among which the major ones are genetic merit, viability, vigor and purity, freedom from pests and diseases, and suitability (appropriateness to specific production systems). Many of the current challenges affecting the movement and trade of seed (for both plants and animals), as well as its management and use to improve productivity, relate to one or more of these quality issues. Other long-standing constraints in sustainable animal seed breeding include inadequate extension services and support to farmers, lack of comprehensive training packages and materials, high cost of inputs and poor marketing support. Availability and efficient delivery of quality seed has long been recognized as one of the prerequisites for livestock development.

The need for a strong African animal seed sector

Many arguments support the development of a strong African livestock seed sector. These include Africa's rich animal diversity, which provides the fundamental biological basis for livestock production. This diversity is a unique asset, which if well managed has the potential to transform and sustain the livestock sector within-breed selection, leading to increased and sustained genetic potential as compared to breed replacement and crossbreeding. Unfortunately, that animal diversity is largely uncharacterized and limited efforts have been made so far to systematically conserve it, despite the risks of erosion and inadequate commercialization. Despite recent efforts, gaps regarding the standards for documentation, use and exchange of animal germplasm still exist. Therefore, there is a need to integrate genetic improvement, advanced reproductive technologies, and genetic resource conservation.

In livestock and fish production, seed is one of the most significant resources. A robust and sustainable livestock and fish industry can only thrive in the presence of production and supply of optimal quality and quantity of seed stock in a farming system, supporting genetic gains and rapid growth. In Africa, chronic shortages of the seed that best suits the different production systems (that is, farmers' needs) is one of the greatest constraints to livestock development, making African farmers dependent on imported exotic seed stocks and supplies, most of which are not appropriate to the local conditions.

Priority general interventions for the African animal seed sector

It should be noted that climate change is heavily impacting the African livestock industry, and farmers on the continent will have to adopt practices and technologies that can cope with the new climatic conditions and emerging consumer demands. This requires a vibrant seed sector that is able to unlock the potential of locally adapted breeds, while applying existing and innovative new technologies. There are huge opportunities for improving and formalizing the livestock seed systems and integrating these to meet the rapidly changing needs of African consumers as well as international market needs. Critical steps to achieving these are: designing and implementing programs that can identify appropriate livestock seed; developing and promoting local systems for efficient multiplication and delivery of the desired seed; and having effective regulations and training on the appropriate use of seed. These priority interventions for the African animal seed sector should take into consideration the development of

technical standards and protocols for the exchange and use of genetic materials (including property rights and benefit-sharing mechanisms, implementation of national genetic improvement and conservation strategies, and support to countries to develop and implement comprehensive National Action Plans for Animal Genetic Resources as part of the Global Plan of Action (GPA) for Animal Genetic Resources, adopted in 2007).

At the African level, a regional or sub-regional *ex situ* conservation facility should be established and be informed, co-designed and technically supported by a competent authority such as the African Animal Breeding Academy (AABA). This development should take into consideration the Consolidated Plan of Action (CPA) of the Science, Technology and Innovation Strategy for Africa 2024 (STISA-2024), “The strategy further defines four mutually reinforcing pillars which are prerequisite conditions for its success. These pillars are: building and/or upgrading research infrastructures; enhancing professional and technical competencies; promoting entrepreneurship and innovation; and providing an enabling environment for STI development in the African continent²⁶.”

The African Union should facilitate functional relationships between academia, research institutions, industry, government, and continental bodies for effective and sustained programming; for example, the Africa Centres for Disease Control and Prevention (Africa CDC) was created for emerging diseases, including zoonoses. This will provide room for emerging platforms like the African Animal Breeding Academy to assist African institutions in setting up and managing multi-country genetic evaluation platforms (including data capture, storage, access, and analysis), re-tooling and refreshing existing professionals in research and teaching, and taking specific actions to address climate change impacts (e.g., the role of genetics in both mitigation and adaptation). Such actions call for coordination mechanisms able to consider the specificities and diversity of the regional settings.

Dissemination of improved genetics

Immediate past and ongoing programs have clearly demonstrated that significant gains can be realized among locally adapted African animal populations, so long as appropriate seed systems are put in place, properly regulated, and technically supported. Emerging information and communication, genomic, and reproductive technologies present new opportunities that can make Africa’s animal industry vibrant – thus contributing to Africa’s food and nutritional security and improving rural incomes and environmental health – and, given Africa’s rich animal diversity, in the near future the-go-to place for improved tropical animal seed.

Past and current initiatives demonstrate that Africa’s strong animal seed system could support the accumulation of genetic gain, through:

- Genetic improvement dissemination platforms with community and cooperative farms to boost service uptake.
- The promotion of efficient traditional and new reproductive technologies with laboratory and biotech support and supplies.
- Breeding schemes and conservation platforms to conserve genetic gain and protect diversity.

²⁶ https://au.int/sites/default/files/newsevents/workingdocuments/33178-wd-stisa-english_-_final.pdf

- Recruitment and sensitization of farmers to produce and disseminate quality animal seeds, and promotion of youth's livestock seed enterprises.
- Support for research on surrogate host development for conservation and dissemination of elite genetics, tackling the constraints of infrastructure, such as power and liquid nitrogen availability, for animal seed cryopreservation.

Component 8: WOMEN AND YOUTH

According to the latest statistics by the International Labour Organization, in Africa, women's participation rate in agriculture is 55% (cited by World Bank, 2019). Most female African farmers combine their roles as seed custodians and small-scale food producers with their role as primary family caretakers. In these combined roles, women in Sub-Saharan Africa contribute extensively to food processing and marketing, household nutrition, and natural resource management. They are also the predominant source of labor for agri-businesses and agro-industries (FAO 2018). Yet, women's deficits in agricultural productivity range between 20–30% (Mukasa and Salami 2016). Closing such gender gaps could increase production and consumption by 1.5% to 10% and reduce poverty by 1.2% to 13% on the continent (Mukasa and Salami 2016). Gender-transformative approaches are therefore important for accelerating agricultural growth, shared prosperity, improved livelihoods, and eliminating hunger and malnutrition on the Continent.

In Africa, as in other parts of the world, women's roles, relations and opportunities are shaped not only by gender, but by other social dimensions such as race, class, culture, income, education, age, ethnicity, indigeneity, and geography. Similarly, when it comes to access to good quality seed and other inputs, these factors intersect with gender and determine women's access, often resulting in lower productivity and crop yield by female farmers in Africa.

Women in Africa are responsible for most harvesting and post-harvesting activities; therefore, when it comes to seed management, women are involved with the selection, cleaning, conditioning, preservation, sharing, and use of seeds (Amri and Kimaro, 2010). However, more often than not, they perform these functions in the informal sector. In contrast, men, who are generally more involved in growing commercial crops, have better access to and benefit more from formal systems.

Having less access to productive land and to important aspects of the formal seed system, such as improved seeds, extension services, fertilizer, markets, and training, results in overall lower rates of adoption of agricultural technologies by female farmers (FAO 2018). The gender gap in the formal sector results in costs to households, seed companies, agro-dealers and African countries' economies (FAO 2018).

African youth also constitute an important resource for agricultural productivity, which is fundamental for economic development in Africa (IFAD, 2014; Afande et al., 2015). Young people are among the most productive in any society, given that they are resilient, persevering, and resourceful stakeholders in developmental processes. Compared to the older population, youth are the ideal catalysts for agricultural developmental change given their greater ability and willingness to adopt new ideas, concepts and technology, which are all critical to changing the agriculture sector (Brooks et al. 2013). The seed sector in Africa needs to tap into these assets to boost the quality and quantity of seeds on the continent.

African women and youth share some of the same basic challenges described above in accessing and producing quality seeds. It is, therefore, imperative that strategies and interventions to improve the seed system value chain bring women and youth into the equation. Applying a gender perspective to analyze and improve seed systems will help to overcome or at least reduce existing biases in access to, availability of, and use of quality seed of improved varieties.

Appendix 1. African Seed and Biotechnology Program (ASBP) 10-year Action Plan

COMPONENT 1: Enhance policy and regulatory framework for an efficient seed system		
Level	Output	Activities
Continental	International conventions and treaties for management and sustainable use of plant and animal genetic resources for food and agriculture implemented	Raise awareness concerning international obligations among decision-makers on issues and opportunities
		Review and update existing PGRFA regulatory measures to involve the interest of all players in the seed sector
		Awareness creation and advocacy on importance of utilizing seed of locally adapted breed/varieties of crops and exploring the opportunity of pasture seed sector development.
		Facilitate the effective participation of AU MS and the African voice in international fora on genetic resources, biotechnology and biosafety in food and agriculture.
		Compile and disseminate information on legal frameworks to facilitate the development of regional and continental-wide variety catalogues and to harmonize legal frameworks across Africa (crops and animal seed certification, animal quarantine, breed release, etc.).
	Continental policies on the management and sustainable use of plant and animal genetic resources harmonized	Develop continental frameworks for the harmonization of policies related to plant and animal genetic resources, biotechnology and biosafety in food and agriculture Support domestication of continental frameworks into regional policies, frameworks and regulations A robust animal Feed Policy and institutional framework (pasture/fodder/forage)
Continental	Seed, biotechnology and biosafety policies and regulatory frameworks harmonized at continental level	Assess status of biosafety regulations in the MS
		Strengthen the Regional harmonization of seed and Biotechnology policy
Regional	Harmonize regional biosafety policy	RECs and continental level
National	National seed and biotechnology policy gaps addressed	Assess and review national seed and biotechnology policies
	International instruments domesticated	Establish implementation status
		Develop/update policy implementation plan to facilitate vibrant seed system (national and regional level),
	National seed policies, systems, and activities analyzed, reviewed and endorsed	Prepare national seed compendiums, and review and verify compendium information to support establishment of integrated policies for seed system development, including germplasm conservation, characterization, utilization and improvement, application of biotechnologies, variety release and seed production and distribution. Establish a policy and regulatory framework to facilitate the establishment of small seed enterprises.

	Stakeholder analysis of the animal and forage seed sector and establishment of a database of animal seed industry stakeholders
Policies to promote sustainable use and management of genetic resources developed and implemented	Develop national policies for the conservation of genetic resources in line with regional continental and global instruments, frameworks and guidelines

COMPONENT 2: Improve strategies for the collection, conservation, utilization and exchange of plant and animal genetic resources, seed and planting materials

Level	Output	Activities
Continental	International best practices and standard for surveying, collection and conservation of GR promoted	Take inventory of continent best practices and provide guidelines to MS
	Capacity for ex-situ conservation enhanced	Develop guidelines for the establishment of regional gene banks
		Strengthen African networks of gene banks to increase the availability and use of germplasm and associated information.
	Capacity for <i>in situ</i> conservation enhanced	Develop guidelines for the harmonization of in situ conservation of transboundary genetic resources for food and agriculture
		Develop guidelines for continent-wide collection and conservation strategies for major and minor genetic stocks that are important for food security and nutrition security
		Develop guidelines and tools for the characterization and gene profiling of African genetic resources
		Document and disseminate best practices for in situ conservation (including incentives measures and indigenous knowledge)
Exchange and movement of genetic material facilitated	Assess existing measures facilitating genetic material transfer in Africa	
	Develop model material transfer Agreements for common use	
	Promote the application of technologies (including biotechnology) for conservation, sustainable use and characterization	
Regional	Regional gene banks for <i>ex situ</i> conservation are operational	Awareness creation on the access and benefit sharing of the Nagoya protocols
		Establish/strengthen 5 regional gene bank
	Regional germplasm collection, safe handling and conservation strategies in place, and gene bank networks established for improved germplasm exchange	Prepare regional priority conservation strategies for germplasm most at risk of being lost.
		Implement collaborative measures to collect and conserve indigenous breeds/varieties and knowledge.
		Develop country-based regional databases to better track the status of genetic of regional interest.
		Establish regional procedures for the safe movement and exchange of genetic resources.
	Increase regional collaboration for germplasm collection, conservation and exchange	Conduct regional training courses to develop best practices in regional initiatives for germplasm conservation, breeds/varietal improvement and exchange
Operationalized regional gene banks for cryo-conservation of AnGR and pasture seed		
Domestication and adoption of the legal, technical and administrative SOPs for the regional gene banks		
	Development/domestication and implementation of regional strategies/frameworks for conservation and sustainable use of AnGR	

		<p>Production systems, Phenotypic, genomic Characterization of the indigenous livestock using the CIM-TOOL</p> <p>Prepare regional priority conservation strategies for germplasm most at risk of being lost, and implement collaborative measures to collect and conserve indigenous breeds and traditional knowledge</p> <p>Develop country-based regional databases to better track the status of animal breeds and forage of regional interest and concern</p> <p>Establish regional procedures for the safe movement of AnGR including by, conducting training courses on zoo sanitary guidelines and animal seeds handling, and quality maintenance practices for safe movement</p> <p>Development/adoption of regional legal framework for crossbreeding, movement of animal seeds</p> <p>Establish regional training courses to develop best practices in regional initiatives for germplasm conservation, breed improvement and exchange</p> <p>Development of biocultural protocols for specific indigenous transboundary breeds</p> <p>Upgrade the infrastructural capacities of the gene banks</p> <p>Develop an identification and traceability tool for tracking of genetic resources, mainly the transboundary breeds</p>
National	Sustainable utilization of African genetic resources supported	<p>Establish/strengthen national <i>in situ</i> and <i>ex situ</i> gene bank</p> <p>Support on-farm and community-based conservation initiatives</p> <p>Support breeding program to support variety/breed improvement</p> <p>Support diversified formal and informal farmers seed system standards such as: QDS, PGS, etc.</p> <p>Enhance the nutritive profile and climate resilience of selected species through bio fortification and genetic enhancement</p> <p>Conservation, development and improvement of locally adapted breeds</p>

COMPONENT 3: Develop better variety/breed improvement programmes and seed production technologies

Level	Output	Activities
Continental	Strengthened programmes for breed and variety development	Create a platform to promote technology exchange among holders and advanced research institutes.
		Review existing mechanisms for animal and forage seed production and exchange and design harmonized policies, legal frameworks and procedures
		Prepare national animal and forage seed compendiums, review and verify compendium information to support establishment of integrated policies for breed/variety seed system development, including germplasm conservation, characterization, utilization and improvement, application of biotechnologies, breed release and seed production and distribution.
		Coordinate development of breed improvement strategies at the regional and national levels in collaboration with NARS, the CGIAR centers, private sector and other partners
		Promote technology transfer, including proprietary technologies in partnership with technology holders, AU-IBAR A-TIC Hubs and advanced research institutes
		Promote the development and maintenance of information dissemination systems to facilitate technology transfer
		Coordinate and support the development of training programme materials on modern technologies, including biotechnologies for breed/variety development
		Strengthen relevant institutions/organizations (including farmer-based organizations) to better meet national requirements, in-line with international norms as applicable
		Provide government support, including the provision of basic seed relevant services, to emerging seed sector entrepreneurs to enable their long-term success
		Determine best practices for the multiplication and release of, in particular, public varieties, to local and private seed entrepreneurs, including developing best approaches for royalty and maintenance arrangements.
Regional	Agro-ecological characterization enhanced through the establishment and strengthening of germplasm exchange networks.	Develop and strengthen animal and forage Seed Market Information System
		Support the establishment and maintenance of crop-based networks to perform germplasm exchange and multi-locational evaluation.
		Coordinate capacity building for agro-ecological characterization and interpretation
		Stocktaking of reproductive technologies that apply to animal and forage seeds sectors
Regional	Improve access to Assisted Reproductive Biotechnologies (N/R)	Dissemination of AnGR seed technologies
		Piloting of assisted reproductive technologies through call for proposals
		Documentation of best practices and lessons learnt
		Establish the strengths and weaknesses of the existing variety development programs
Regional	Strengthened programmes for breed and variety development	Coordinate development of variety improvement strategies at the regional and national levels in collaboration with NARS, the CGIAR centers, private sector and other partners.
		Coordinate and support the development of training programme materials on modern technologies, including biotechnologies for variety development.

National	Improve availability of pasture/fodder/forage Seed (foundation seed/ multiplication of certified) for specific ecologies (N/R)	Characterize Forage accessions/ varieties (N/R) by ecological zones
		Pilot commercial production of pasture seed production for dissemination through call for proposals
		Dissemination and monitoring and evaluation of utilization by farmers
	Human resource and infrastructure Capacity development for animal seed improvement to sustain genetic gain	Assess human resources capacity to implement priority activities of the African animal Seed and Biotechnology Programme, and implement strategies for required capacity building
		Assess research capability and infrastructure necessary to support implementation of priority activities of the African animal Seed and Biotechnology Programme, and enhance research capacity and infrastructure, as required.
		Competitive scholarships provided to students at regional level to study animal seed technology/production
		Summer school programmes in animal seed technology/production developed and implemented at regional level
	Capacities in human resources and institutional arrangements for germplasm management, variety improvement and biotechnology applications strengthened	Inventory of the existing status
		Pyramidal structuring of breeding programs for specialization, establishment of pedigree records and herd book
		Increase investment in seed and biotechnology programs
Strengthen research capacities and capabilities		
Influence the knowledge institution programmes for animal seed technology/production	University degree programmes developed for seed technology/production	
	Capacity building of extension agents in the use of reproductive technologies for cryo-conservation and to accelerate the genetic gain	

COMPONENT 4: Strengthen seed production systems		
Level	Output	Activities
Continental	African organizations and institutions and locations for specialized seed production identified and promoted	Establish the strengths and weaknesses of existing seed production systems Analysis of seed production systems, capabilities and comparative advantage conducted and published. Continental Centre of excellence along the seed value chain established
	Informal seed sector mainstreamed	Create awareness among regional and national actors and other stakeholders on the contribution of the informal seed sector to food and seed security and issues that need to be addressed to enhance the contribution of this essential seed sector. Establish sustainable and competitive informal seed system
	Availability of seed at the regional level improved	Inventories of existing regional arrangements for production, exchange and availability of seed conducted.
National	National seed production systems strengthened	National capacity to manage germplasm, release varieties and supply seed increased Determine best practices for the multiplication and release of, in particular, public varieties, to local and private seed entrepreneurs, including developing best approaches for royalty and maintenance arrangements. Strengthen relevant institutions/organizations (including farmer-based organizations) to better meet national requirements, in-line with international norms as applicable
	Establishment and development of community-based breeding and conservation programs	Development/Strengthening of breeders' farmers associations
		Identification, Production/multiplication, and dissemination of quality breeding stocks
		Increased Stakeholder engagement and capacity development in the production of quality animal seed especially at grass root level
	Availability of early-generation seeds for multiplication improved	Capacity building of pastoralists for livestock and forage value addition
		Multiplication of breeder and basic seed strengthened, particularly in relation to public varieties

COMPONENT 5: Enhance development of quality assurance systems with improved stakeholder contributions		
Level	Output	Activities
Continental	Quality assurance and standards harmonized	Strategies and codes of conduct for quality assurance of key African breeds and varieties developed and being implemented.
		Continental standards and protocols for seed testing and quality control for seed not addressed by the international standards developed
		ICT based mechanism for seed quality assurance (testing, certification, traceability), etc. developed
Regional		Develop regional animal breeds and forage variety catalogues (standards, true to type descriptors, etc.).
		Enhancement of quality assurance systems
		Develop a model code of conduct for the availing and use of quality seed in emergency situations
		Information system established and tracking developed for regional animal and forage seed trade
		Genetic evaluation and certification system (Quality assessment) for animal and forage seed
		Systematic identification, registration, electronic data capture and management
		Coordinate and oversee development of strategies with relevant partners to develop continental wide models for quality assurance
		Prepare a model code of conduct for the use of quality seed in emergency situations, to assist country and regional planning efforts
National	Develop better regulations for seed quality assurance, in line with regional frameworks and international standards	Genomic selection of superior strains/varieties
		Critical issues affecting national seed quality assurance identified and options to overcome obstacles identified
		Review the existing assurance system for strength and weaknesses to facilitate production of quality seed
		Develop continental seed database including a variety catalogue linked to national catalogues

COMPONENT 6: Improve seed storage, marketing and distribution channels		
Level	Output	Activities
Continental	Trade facilitation and markets expansion enhanced	Analyze trade barriers to facilitate Trade and markets expansion taking into consideration the non-technical barriers to trade
		Encourage plant and animal breeders right
	Information on seed trade within Africa significantly improved	Analysis and strengthened drivers to growth and development of the continent seed industry
	To improve continental animal seed marketing and distribution channels in partnership with the private sector, promote and strengthen smallholder animal seed enterprises	Conduct surveys to establish the current status of marketing and distribution strategies
		Expert consultation to develop and validate strategies to overcome constraints in continental and inter-regional trade, and widely disseminate the results to the private sector and regional organizations
		Organize training courses for farmers/farmer groups concerning establishment and management of small seed businesses, including group formation, access to microcredit etc.
		Support the poor and especially women seed entrepreneurs, so that they are empowered and not marginalized
Develop and provide technical training to farmer/farmer groups for quality seed production and marketing, including how to gain access to appropriate germplasm, technologies, and information		
Regional		Strategies developed for improved seed marketing and distribution.
		Promote/strengthen public-private partnerships and networking (National, regional, Continental)
National	Improved seed marketing and distribution channels	Continuously Promoted Enabling regulatory/business environment to attract private sector investment
		Invest in infrastructures and systems to facilitate seed industry development (lab, storage room, etc.
		Promote/strengthen public-private partnerships and networking
		Support for emerging seed entrepreneurs increased and strengthened
	Strengthen seed market information systems	
Strengthen extension services	Mainstream gender in extension services	
The informal seed sector is providing farmers with high quality seed in adequate quantities to meet their production needs.	Improved linkages among representatives and their organizations in the formal and informal seed sectors, and increased opportunities to share experiences	
	Strengthen the involvement of women and youth in the seed value chain	

COMPONENT 7: Develop improved disaster preparedness and response to seed insecurity		
Level	Output	Activities
Continental	Enhanced coordination and collaboration in planning the response to disasters that affect seed security across Africa	Disaster preparedness, response and management guidelines established and adopted Disaster preparedness, response and management platforms established.
		Monitor and report the impact of disasters on genetic resources and seed security
		Facilitate collaboration of concern partners to address possible effects of the disaster
Regional	Improved disaster preparedness, response and management systems	Regional and national programmes and frameworks formulated and implemented to enhance effective preparedness, response, and management to disasters affecting seed security
		Provide strategic guidance including funding strategies at the regional level for disaster preparedness response and management that integrate all genetic resources.
		Support disaster preparedness through provision of appropriate regional information systems on all genetic resources.
		Support the development of regional seed systems profiling/database for disaster preparedness, response and management.
		Develop and incorporate seed security assessment into Early Warning Systems.
		Establish and strengthen regional platform for coordination of disaster preparedness, response and management
National	Disaster preparedness, response and management to seed insecurity including threats to all genetic resources strengthened	National strategies on disaster preparedness, response and management developed and implemented
		Disaster preparedness, response and management coordination platforms and strategies implemented
		National information systems established
	Operationalize early warning systems and integrate participatory seed security assessments including the effects of slow onset disasters that affect all genetic resources).	Early warning systems operationalized and or enhanced.
	Design and implement capacity building programmes to strengthen capacity of all stakeholders in disaster preparedness, response and management.	Institutional, human, and technical capacity building strengthened
	Support seed and genetic resources restoration and recovery.	Genetic resources rescued and restored

Carryout ex-ante and post ante genetic resources status assessments in disaster affected communities, and environmental Impact assessments for areas earmarked for development	Ex-ante and post ante disaster reports produced
Assessment of analogous climates that can potentially provide genetic resources for disaster recovery and management	Assessment report produced

COMPONENT 8: Monitoring & Evaluation, Knowledge Management and communication		
Level	Output	Activities
Continental, Regional, National	Track the performance of Africa's seed sector	Document and disseminate best practices and lessons learnt along the seed value chain
		Develop set of indicators to track performance of Africa seed system
		Publish Biennial Report on the Status of the Seed Sector in Africa
		Establish a Knowledge management (KM) and information system (Web-based information platform established)
		Establish a Knowledge management (KM) and information system (Web-based information platform established)
		Policy Briefs and knowledge products developed and distributed to relevant ministries in different countries
Continental, Regional, National	The Governance of the ASBP functional	Establish and operationalized the governance structure of the ASBP Establish/strengthen seed policy implementation and Governance and monitoring bodies

COMPONENT 9: Enhance biotechnology uptake for an efficient seed system in Africa

Level	Output	Activities
Continental	Relevant technologies to accelerate the genetic gain and development of the African seed industries are identified	Stocktaking of advanced technologies in seed breeding and reproduction technologies
	Structured opportunities are provided to conduct a stakeholder and partnership analysis, and to identify opportunities for synergy, complementarity, enhanced strategic public private partnership collaboration and stakeholder engagement	
Regional	Some regional seed biotechnology gaps are addressed for the benefit of the stakeholders	Domestication and promotion of innovative technologies for quality seed breeding through the African AnGR regional, ILRI Forage Genebanks and Community-Based Breeding Programmes (CBBP)
	Through the hubs, the seed enterprise incubator graduates will have gained the skills to create jobs, commercialize new seed technologies, seed services delivery and strengthen local, national and regional economies.	Empowerment of the Regional seeds (crop and livestock) Technology and Innovation Incubation hubs in Africa (Seed-TiChubs) for acceleration of seeds technology uptake, production, dissemination and service delivery in Africa
	<i>in-situ</i> and community seed conservation, optimum productivity and value addition of indigenous breeds/varieties population will be promoted through provision of high-quality disease-free germplasm and related breeding services	Develop Regional Genetic Resource Centers (livestock and crop, adjoined to the regional Gene banks)
	Increase smallholders' adoption of new varieties. scientists connect closely to the channels that give farmers access to improved seed, and use the resulting crops	Support the demand-led and market-led seed breeding programmes across RECs and agricultural commodities
National		Greening seed: Incentive-Based Interventions for Reducing the Climate Impact of seed production in Africa

COMPONENT 10: Cross cutting issues		
Level	Output	Activities
Continental	Seed Systems Framework and a Gender and Youth Strategy	Gender responsive and inclusive policy
		Gender and Youth Action Plan and Golden Indicators
Regional	Seed systems framework and the Regional Gender and Youth strategy	Gender inclusive and responsive policies
National	Domesticate the gender and youth strategy	Context specific gender and youth action plan
	Integrate gender and youth into the existing policy framework	Established responsibility center/ established gender and youth focal center