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Strategic Document Strengthening Seed System

in the Case Countries



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PREFACE

Deliverable 3.4: Strategic document strengthening seed system in the case countries

The InnovAfrica is a consortium of 16 institutions comprising five and eleven organizations from Europe and Africa, respectively. It has been implemented in six African countries namely Ethiopia, Kenya, Malawi, Rwanda, South Africa, and Tanzania. InnovAfrica integrates innovative sustainable agricultural intensification systems (SAIs); innovative institutional approaches (IIAs); and innovative extension and advisory services (EASs) and validates its effectiveness towards achieving a sustainable food and nutrition secured Africa through innovation processes that are implementable, sustainable and contribute to higher productivity and incomes of smallholder agriculture. The SAIs, IIAs, and EASs interventions have been piloted in 12 study sites (two sites per country) representing different agro-ecological zones (AEZs) and socioeconomic conditions.

Two IIAs tested and promoted by InnovAfrica are Multi-actor Platforms (MAPs) and Integrated Seed Delivery System (ISDS). The InnovAfrica has established six MAPs (one per country) comprising smallholder farmers to policy makers. These MAPs have been engaged in the assessment of SAI, IIAs and EASs that provide multiple ecological, nutritional and socioeconomic benefits. MAPs have been instrumental in the transfer of knowledge, expertise and technologies generated by InnovAfrica outside the study sites. The ISDS focuses on the institutional underpinning of innovation processes in quality seed production and delivery to African smallholder farmers for a long-term seed security, particularly for crops that are important in food and nutrition security at household level. Currently, there are several efforts underway to breed and/or select locally adapted, high yielding and stress-tolerant varieties and to establish sustainable seed delivery systems to achieve food and nutrition security in sub-Saharan Africa (FNSSA). Seed systems includes legal institutions such as plant variety registration, seed certification, and a range of public, private, and civil society actors involved in the development, production, and dissemination of quality seeds. The government, private sector, CGIAR research centers, farmer organizations and NGOs have markedly different roles. InnovAfrica has introduced, tested, and analyzed these approaches in Ethiopia, Malawi, and Tanzania. In Ethiopia, InnovAfrica has worked closely together with the ISSD Ethiopia program (see below) through the shared partner Haramaya University and the seeds used in the SAI Farmer-led field experiments on Maize/Millet - Legume cropping system are sourced from the integrated seed system existing in the site. In Tanzania, farmer seed producer groups were engaged in seed production and Quality Declared Seed (QDS) production in close collaboration with the local branch of the agricultural research station of the national research organization and certification organization. In Malawi, seed and variety selection has been a central issue in the implementation of the EAS Farmer Participatory Research / Farmer to Farmer Extension (FPR+F2FE) which has been integrated with the Farmer-led field experiments on Maize/Millet - Legume cropping system in the country. Furthermore, the principle of harnessing the local seed system through participatory varietal selection and F2FE is fundamental for the *Brachiaria* forage grass testing and upscaling in Rwanda, Kenya, and Tanzania. At the policy level, the MAPs have been involved in discussions, giving feedback and dissemination of the concept of integrated seed delivery systems. Thus, ISDS,

has been mainstreamed across the innovation levels in InnovAfrica and the experiences from this work has also been shared in this report.

Sub Saharan Africa (SSA) is rich in diversity both for agroecology and the number of crops grown by farmers. The continent is known for low crop productivity, but the potential exists for increasing crop productivity by several folds simply by adopting better adapted crop varieties and other farm inputs like fertilizers, as well as the use of better agronomic practices. Most of the seed used in SSA are produced and disseminated outside the formal seed system. The number of improved crop varieties that are currently available are relatively small, restricted to a few crop species such as maize and often bred for a few traits and major production environments. The national agricultural research systems that are responsible for development of new crop varieties are limited in human capacity, infrastructure, and financial resources preventing them to address farmers' demand for new varieties of different crops. Moreover, the presence of private sectors in Africa to assume this responsibility is limited because of small and fragmented seeds market and weak enabling policy environments. The national governments, regional economic communities (RECs) and development partners all recognize importance of a quality seeds for food secured Africa and addressing the challenges of climate change. Several initiatives targeting seeds have been implemented for years in Africa including seed policy harmonization efforts of RECs for establishing a sustainable seed system. This document provides information about seed system and national seed policies in six InnovAfrica case countries, connects with regional efforts on seeds policy harmonization, and recommends some measures towards strengthening seed system in InnovAfrica case countries and Africa in general.

1. INTRODUCTION

Seed is one of the most important agricultural inputs for sustainable crop production that determine performance, quality, and productivity of agricultural crops. Seed is, *sensu stricto*, a fertilized ovule that contain the plant embryo and grow into a new plant in the appropriate growth conditions. In this document we extend the definition of seed to include different forms of plant genetic resources including seeds and vegetative planting materials that are used to propagate crops such as cuttings, bulbs, rhizomes, roots of local and improved crop varieties, wild relatives of crops, and other wild plant species. Seed contains all the genetic information i.e., genes and serves as vehicle for transferring genetic information from parents to the offspring. Genes determine several agriculturally important traits and confer plant growth and development, resilience to abiotic and biotic stresses, different quality parameters, and yield potential in crops. The first Green Revolution that commenced in 1960s was largely attributed to the development of improved seeds of different crop varieties particularly of wheat, rice, and maize (Dhiman et al. 2010; Thiesenhusen 1972). It is estimated that in the past fifty years, the genetic improvement and quality seeds have contributed about 50% increase in crop yields globally (FAO 2011a). Therefore, seed has been regarded as a key agricultural input for food and nutrition security, income, and livelihoods of the people. Moreover, seed is the delivery mechanisms of new traits in the form of new crop varieties therefore, a high-quality seed is vital for the profitable crop production (Grist, 1975).

To realize the full benefits of a new crop variety by African smallholder farmers, it is important to ensure that seeds are of high quality and they are locally available on time at affordable prices along with other farm inputs, such as fertilizers, irrigation, and mechanizations provision. Despite concerted efforts of various actors of agricultural development including national governments, regional economic communities (RECs), non-governmental organizations and development partners, many African seed systems are facing several challenges due to deficiencies in seed policy; ineffective seed production, distribution, and quality control systems; and limited access of farmers to improved seeds and other related farm inputs and credits. There are also reports on limited uptake of improved seeds by African smallholder farmers due to poor performance of high yielding crop varieties in nutrient-deficient soils of tropical Africa (Sánchez 2010).

2. SEED SYSTEM IN INNOVAFRICA CASE COUNTRIES

The prevailing seed systems in Africa can be broadly categorized into three groups as informal seed supply system (local seed supply systems), integrated seed supply system (community-based systems) and the formal seed supply systems (Wekundah 2012). Except for South Africa, the informal seed system is the major supplier of the seeds in other five InnovAfrica case countries (Mabaya & Mburu, 2016; Waithaka et al. 2019; Westengen et al. 2019). The relative contribution of each seed system to the national seed supply differs between the InnovAfrica case countries. The major characteristics of three seed supply systems are summarized below.

2.1 Informal seed system:

This is traditional seed system supplying majority of seed demand of farmers in many developing countries in the world. It is the dominant seed system in Sub-Saharan Africa (African Union 2008) including countries like Ethiopia, Kenya, Malawi, Rwanda, and Tanzania. Informal seed system mostly focuses on local varieties that have been selected for years and produced under local management. In this seed system, the produce from the previous harvest is saved and used as seeds or planting materials in the subsequent season. Farmers use the seeds produced by themselves and/or exchanges seeds with other farmers and farming communities, and sometimes grains purchased in the local market get their way to field as seed (Almekinders & Louwaars 1999). There is no seed certification involved in seed production, and distribution processes are not monitored or controlled by government policies and regulations but rather by local standards, social structures, and norms (McGuire 2001). After decades of introduction of improved varieties from formal breeding programs, also improved seeds are circulating in informal seed systems (Sperling et al. 2008, Louwaars & de Boef 2012). The fact that there is a lot of seed- and gene-flow between the formal and the informal seed system has led some authors to suggest that a better term to use is ‘farmers’ seed systems’ (Coomes et al. 2015). Informal seed system deals with a wide range of crops that are unattractive to commercially oriented seed companies but are part of the local and cultural food systems. Advantages of such systems include the preservation of locally adapted crop varieties with preferred traits such as taste, resistance to pests and adaptability to the cropping environments.

2.2 Formal seed supply system

The formal seed system is based on the scientific methodology of plant breeding (Sisay et al. 2017). The formal seed system involves various activities and institutions across the seed value chains from development and release of new variety to seed production, seed marketing and distribution to the end users that may include research institution, regulatory agencies, public seed enterprises, registered private producers, and registered seed cooperatives. In all six InnovAfrica case countries the formal seed supply system is operational for years and the private sectors are also involved but at different levels. The strongest involvement of the private sector is found in profitable seed markets such as hybrid maize, vegetable seed and other crops of high commercial value. Therefore, except in South Africa where presence of private sector and commercially oriented food producers are substantial, the public sector is a major player of formal seed system in the other InnovAfrica countries.

2.3 Integrated seed supply system

This is a hybrid of elements and approaches from both informal and formal seeds system which aims to improve local supply of quality seeds of different crop varieties to farmers (Okry 2011). Another term used is ‘intermediate seed sector’, specifically denoting approaches such as community-based seed production and community seedbanks (CSBs) (Sperling et al. 2020). Activities and institutions in this intermediate sector may work at one or several stages in the seed value chain, *inter-alia*: participatory plant breeding or variety maintenance at the variety development stage; participatory varietal selection at the evaluation stage; community based

seed production (by single farmers, farmer groups or cooperatives) at the production stage; alternatives to seed certification as quality approval such as ‘Quality Declared Seed’ (QDS), ‘truthfully-labelled’, and ‘farmer-guaranteed seed’ categories (Wekundah 2012; Westengen & Winge 2020; Sperling et al. 2020). Among the InnovAfrica countries it is only in Ethiopia that the intermediate seed sector is formally recognized in the national seed System Development Strategy as community-based seed production systems. The Ethiopian seed system development strategy is said to be ‘pluralistic’ as it allows and encourages support of all three seed system categories, formal, informal and intermediary.

3. SEED POLICY FRAMEWORK IN INNOVAFRICA CASE COUNTRIES

High quality seeds of new crop varieties are ways to increase crop yields, improve human nutrition, enhance crop resilience to abiotic and biotic stresses and adversity of climate changes in crop production and to meet growing demand for food and nutrition and in reducing rural poverty. Africa requires a functional and strong seed system that can deliver high performing crop varieties to millions of smallholder farmers on a regular basis. This will enable smallholders to attain food self-sufficiency, as well as to contribute to local, regional, and continental food markets. The prerequisites for this to happen are provision for Africa focused efficient plant breeding programs to ensure timely delivery of new crop varieties and government’s policies that favor domestic and regional seed markets, and international seed trade which requires government investment on building human capacity and infrastructure development. The domestic seed markets in Africa are relatively small and scattered therefore, the consolidation of these small and scattered markets into regional market can be important to facilitate for more private sector involvement in seed system development on the continent. This section provides information about seed system policies and governance in each InnovAfrica case country.

3.1 Ethiopia

The Ethiopian government formulated a national seed policy in 1992 to encourage the participation of private sector in the seed production and marketing, and to allow foreign private sector companies to undertake crop research on non-restricted crops. This led to other developments including the Ethiopian Seed Proclamation No.206/2000, National Variety Release Guideline 2000, Plant Breeders’ Right Proclamation 481/2006, and Ethiopian Seed Proclamation No. 782/2013. These developments have provided enabling environment in bringing Ethiopia’s seed sector in line with commercial interests, opening potential for new seed practices including QDS, provision for the importation of genetically modified organisms. Moreover, the Ethiopian government has Seed System Development Strategy in place to increase crop production and productivity by enabling proper management of the seed system (<http://extwprlegs1.fao.org/docs/pdf/eth172079.pdf>). Some recent developments in Ethiopian seeds sector includes: i) emergence of regional seed enterprises where regions select their priority areas to address location specific needs, and ii) increasing reliance on farmer-based seed multiplication involving farmers group at the local level. Seed policies in Ethiopia are broadly consistent with agricultural sector policies, including a strong emphasis on serving all of Ethiopia’s farmers, improving rural welfare, and directing considerable state support to ensure that targets

are met. However, there is still considerable reliance on central planning and such top-down approach often less supportive to local level initiatives.

In Ethiopia, the major player of formal seed system is public sector (Table 1). The Ethiopian Institute of Agricultural Research (EIAR), Regional Agricultural Research Institutes (RARIs) and Universities are responsible for developing the improved crop varieties, as well as for production of breeder seeds and pre-basic seeds. The National Variety Release Committee (NVRC) make decision on registration and release of new crop varieties. Ethiopian Seed Enterprise (ESE), Regional Seed Enterprises (RSE), Seed Producer Cooperatives (SPC) and private companies produce basic and certified seeds. The Ministry of Agriculture (MoA) and Regional Bureau of Agriculture (BoA) are regulatory bodies overseeing quality control seed production, processing, and marketing. The upscaling of new varieties is performed by MoA and extension structures of BoA. In the intermediate seed system, cooperatives/groups of farmers are involved in community-based seed production and marketing (ATA, 2015), and these cooperatives may be licensed for seed production and sale but not necessarily going through the formal seed certification scheme (Hassena & Dessalegn 2011).

Table 1: Roles of key players of formal seed system in Ethiopia (Mabaya et al. 2017a)

<i>Roles</i>	<i>Institutions</i>
Research and breeding	EIAR; RARIs; universities; ESE (and regional seed enterprises); CGIARs (CIMMYT & ICRISAT)
Variety release and regulation	MoANR
Production, processing, and packaging	ESE (and regional seed enterprises); local seed companies; MNCs; cooperatives
Processing and packaging	Local seed companies; MNCs; cooperatives
Education, training, and extension	ESA, seed companies, cooperatives, extension agents
Distribution and sales	ESA, seed companies, cooperatives, agro-dealers

Notes: CIMMYT - International Maize and Wheat Improvement Center; CGIAR- Consultative Group on International Agricultural Research; EIAR – Ethiopian Institute for Agricultural Research; ESA – Ethiopian Seed Association; ESE – Ethiopian Seed Enterprise; The ICRISAT - International Crops Research Institute for the Semi-Arid Tropics; MNCs – Multinational Corporations; MoANR – Ministry of Agriculture and Natural Resources; RARI – Regional Agricultural Research Institutes.

3.2 Kenya

Kenya has National Seed Policy in place that aims to develop, promote, and regulate a modern and competitive seed industry to ensure that there is sustainable supply of high-quality seed and planting material to Kenyan farmers (GoK 2010). Other seed policy instruments in Kenya include Seed and Plants Varieties Act, 2016 (CAP 326), Seed and Plant Varieties Amendment Bill 2016, Kenya Plant Health Inspectorate Services Act 2012, Plant Protection Act (Cap. 324), Crops Act (2013), and Common Market for Eastern and Southern Africa (COMESA) Seed Trade Harmonization Regulations 2014. The national policy and associated laws particularly Seed and Plants Varieties Act, 2016 (CAP 326) 2016 addresses all legislative issues relating to seeds and

plant varieties and seeks harmonization with other related acts and international agreements. Kenya is a home for at least 26 index seed companies with the headquarters of three seeds companies (East African Seed, Kenya Highland Seed and Kenya Seed Company).

The formal seed system in Kenya deals with crops that have substantial local and export markets including maize, beans, wheat, rice, vegetables, and cash crops like, tea, sugarcane, and cotton. Following the liberalization of the seed sector in 1996, various private sector companies have been registered and engaged in the seed business (Table 2). Kenya Plant Health Inspectorate Service (KEPHIS) is the government regulatory agency responsible for enforcing local and international seed regulation in variety release and regulation (Wakhungu et al. 2004). Kenya Agricultural & Livestock Research Organization (KALRO), CGIARs, university, local seed companies (LSC) and multinational companies (MNCs) are involved in research and breeding, as well as for breeder and foundation seed production.

Table 2: Role of key players of formal seed system in Kenya (Mabaya & Mburu 2016)

<i>Roles</i>	<i>Institutions</i>
Research and breeding	KALRO; CGIARs, universities; MNCs; local seed companies
Variety release & regulation	KEPHIS
Breeder and foundation seed production	KALRO; Universities; CGIARS; MNCs; local seed companies
Seed production	KALRO, local seed companies, MNCs, community organizations
Processing and packaging	KALRO Seed Unit, local seed companies; MNCs
Education, training, extension	Universities, Seed companies, extension agents, NGOs, rural agro-dealers
Distribution and sales	Private sector seed merchants; Kenya Seed Company, KALRO Seed Unit and other parastatals, rural agro-dealers; NGOs

Notes: KALRO - Kenya Agricultural & Livestock Research Organization; KEPHIS - Kenya Plant Health Inspectorate Service; MNC - Multinational Corporation; NGO - Non-Governmental Organization.

3.3 Malawi

The government of Malawi recognizes importance of a sustainable seeds industry for increased agricultural production and diversification. The seed sector in Malawi is governed by the law enacted by the Seed Act 1996 and was operating under the National Seed Policy 1993. The National Seed Policy 1993 was reviewed considering various developments that have occurred in the seed sector over years, as well as the needs of domestic and international seed markets and replaced by the National Seed Policy 2018. This new policy aims to strengthen seed regulatory framework, enhance seed quality assurance, and establish a robust seed certification system (MAIWD, 2018). Accordingly, various institutions are in places with designated roles along the seed system (e.g., variety release and regulation, seed production, extension, and sales of quality seeds). At least 24 seed companies are operating in Malawi (Mabaya et al. 2017b). Actors involved in formal seed system in Malawi and their respective role are summarized in Table 3.

Table 3: Role of key players of formal seed system in Malawi (Mabaya et al. 2017b)

<i>Roles</i>	<i>Institutions</i>
Research and breeding	DARS, IITA, CIAT, CIMMYT, MUSECO, LUANAR
Variety release and regulation	DARS, SSU
Seed production and processing	Seed companies, NASFAM
Education, training, and extension	Seed companies, LUANAR, DARS, STAM, SSU, DAES, NASFAM
Distribution and sales	Seed companies, agro-dealers, NASFAM

Notes: CIAT - International Center for Tropical Agriculture; CIMMYT – International Maize and Wheat Improvement Center; DAES - Department of Agricultural Extension Services; DARS – Department of Agricultural Research Services; IITA – International Institute of Tropical Agriculture; LUANAR= Lilongwe University of Agriculture and Natural Resources; MUSECO= Multi Seeds Company Limited; NASFAM – National Smallholders Farmers’ Association of Malawi; SSU – Seed Services Unit; STAM - Seed Trade Association of Malawi.

3.4 Rwanda

Rwanda enacted the Seed Act in 2003 and prepared the first national seed policy in 2007. The national seed policy was adopted by cabinet in 2017 and it is currently under review by the government (Waithaka et al. 2019). The major legislative framework governing seeds and plant varieties including the issue of plant variety protection and plant breeders’ right is the law N° 005/2016 of 05/04/2016. Other related legislations are in place for variety release, seed testing, and licensing for seed import and export. Rwanda has a well-established institutional set up with designated roles and responsibilities to ensure seed quality and available quality seeds to farmers. Rwanda hosts 15 seed companies of which five are foreign owned (Waithaka et al. 2019). The major actors involved in formal seed system in Rwanda and their respective role in the seed systems are summarized in Table 4.

Table 4: Role of key players of formal seed system in Rwanda (Waithaka et al. 2019)

<i>Roles</i>	<i>Institutions</i>
Research and breeding	RAB, foreign-owned seed companies
Variety release and regulation, inspection, and certification	RAB, MINAGRI, RALIS, RICA
Seed production	Seed producers (companies, seed cooperatives and individual seed producers)
Processing and packaging	Seed companies
Education, training, extension	RAB (extension officers), FFS facilitators, farmer promoters, NGOs
Distribution and sales	Government agencies (RAB, MINAGRI), seed producers, rural agro-dealers, NGOs

Notes: FFS – Farmer Field Schools; MINAGRI – Ministry of Agriculture and Animal Resources; NGOs – Non-Governmental Organizations; RAB – Rwanda Agriculture and Animal Resources Development Board; RALIS – Rwanda Agricultural Livestock Inspectorate Services; RICA – Rwanda Inspectorate and Competitiveness Agency.

3.5 South Africa

The seed sector in South Africa is guided by National Policy on Plant Improvement (2012) which is primarily regulated by the Plant Improvement Act, 1976 (Act No. 53 of 1976). Other major acts regulating the seed sector in South Africa include the Plant Breeders' Rights Act no. 15 of 1976 (as amended), the Agricultural Pests Act no. 36 of 1983 (as amended), and the GMO Act no. 15 of 1997 (as amended) (Derera & van der Walt, 2014). The seed system in South Africa has been evolved over decades and primarily serves commercial farmers and over 100 seed companies are members of the South African National Seed Organization (SANSOR). The key players on South African formal seed sector and their roles are presented in Table 5.

Table 5: Role of key players of formal seed system in South Africa (Derera and van der Walt, 2014)

<i>Roles</i>	<i>Institutions</i>
Research and breeding	ARC; MNCs; Local seed companies; Universities
Variety registration & regulation	SANSOR
Breeders and foundation seed production	ARC; MNCs; Universities; Local seed companies
Seed production	SME Seed Companies; MNCs; ARC
Education, Training, Extension	Seed companies; NGOs; ARC; Government
Distribution and sales	Private sector seed merchants; Agricultural supply outlets; Cooperatives

Notes: ARC – Agriculture Research Council; MNC – Multinational Corporation; NGO –SANSOR - South African National Seed Organization; SME – Small and Medium Enterprise.

3.6 Tanzania

Tanzania enacted Seed Law in 2003 and the National Agriculture Policy (2013) provides general policy guidance for agricultural input development including seeds. The seed act was amended in 2014 to strengthen the mandate of Tanzania Official Seed Certification Institute (TOSCI) to oversight the Quality Declared Seed sub-sector and convening seed sector reform. Other legal framework related to seeds includes the Plant Breeders' Rights Act (2002) and the Seeds (amended) regulation – 2017. A study about 4 years ago reported 63 seed companies registered under Ministry of agriculture but only 40 were active. The key players of Tanzanian formal seed sector and their respective roles are presented in Table 6.

Table 6: Role of key players of formal seed system in Tanzania (Mabaya et al. 2017c)

<i>Roles</i>	<i>Institutions</i>
Research and breeding	ARIs, ASA, MNCs, local companies, universities
Variety release and regulation	TOSCI, MoA (formerly MoAFSC & MoALF)
Seed production and processing	Seed companies, ASA, MNCs
Education, training, and extension	Seed companies, universities, TASTA, TANADA, ASA, TOSCI, NGOs, MoA, LGAs
Distribution and sales Seed companies, agro-dealers	Seed companies, universities, TASTA, TANADA, ASA, TOSCI, NGOs, MoA, LGAs

Notes: ARI – Agricultural Research Institute; ASA – Agricultural Seed Agency; LGAs – Local Government Authorities; MoA – Ministry of Agriculture; MoAFSC - Ministry of Agriculture, Food Security and Cooperatives; MoALF – Ministry of Agriculture, Livestock and Fisheries; NPT-TC – National Performance Trial Technical Committee; TANADA – Tanzania National Agro-Dealer Association; TASTA – Tanzania Seed Trade Association; TOSCI – Tanzania Official Seed Certification Institute.

4. SEED POLICY FRAMEWORK IN SUB SAHARAN AFRICA

The Köppen Climate Classification Map shows substantial climatic variations in Africa (<https://www.plantmaps.com/koppen-climate-classification-map-africa.php>) and high agro-ecological diversity. It provides opportunities for diversifying agriculture, but in the meantime demands for wide-ranging technologies including the quality seeds of diverse genetic background that can perform well in different production environments. The value of quality seeds for increasing crop productivity and resilience and subsequently for food and nutrition security and livelihood of people have been well recognized in Africa. Despite the rigorous efforts of different actors of seed system such as national governments, private sectors, non-governmental organizations, development partners, Sub Regional Organization (SROs), the Regional Economic Communities (RECs) and apex continental bodies like African Union (AU) and the Comprehensive Africa Agriculture Development Programme (CAADP) for years, farmers access to improved seeds on timely manner at affordable price has been a major challenge. A limited access of smallholder farmers to seeds of improved crop varieties is one of the major factors contributing to the low productivity of many staple food crops in Africa.

The East African Community (EAC), the Common Market for Eastern and Southern Africa (COMESA), the Southern African Development Community (SADC) and the Economic Community of West African States (ECOWAS) are four major RECs in Africa, and the InnovAfrica case countries are the members of one or more of these RECs (Fig. 1). Because of the potential seen in quality seeds in the transformation of African agriculture towards a food and nutrition secured well-off Africa, RECs have been working to provide legal and regulatory framework for regional harmonization and seed sector development. These RECs have set milestones for seed regulation harmonization for variety release, quality control and sanitary and phytosanitary measures (Kuhlmann 2015). For example, EAC to which four InnovAfrica case countries are members (Kenya, Malawi, Rwanda, and Tanzania), has made considerable progress on seed policy harmonization agreement among EAC member countries. Some of these milestones to be met

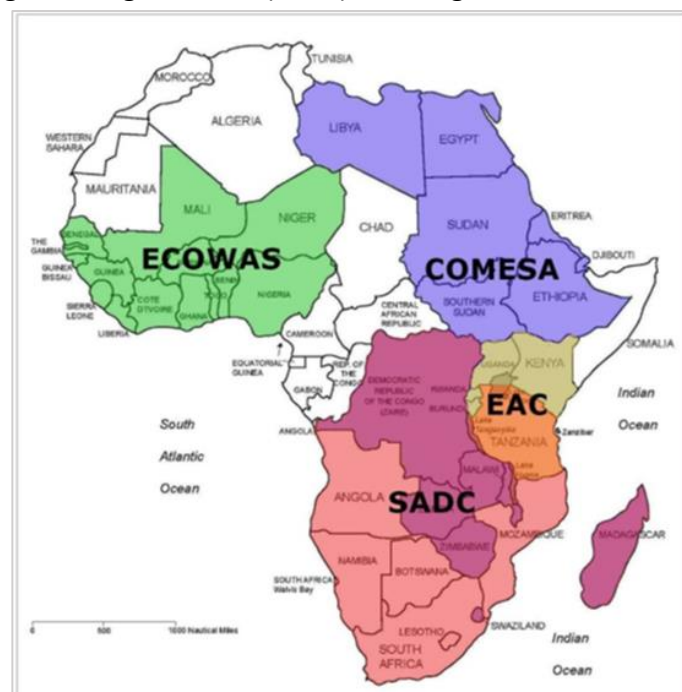


Fig 1: Composition of EAC, COMESA, SADC and ECOWAS (Kuhlmann 2015)

by members states within a given time period are - enacted legislation (Seed Act) accounting harmonization agreements, finalize of seed Act implementing regulations, conclude Plant Breeders Rights Act in accordance with UPOV 1991 and its implementing regulations, provision for autonomous certification agency and National Seed Trade Association, accreditation to Organization for Economic Co-operation and Development (OECD) and International Seed Testing Association (ISTA) seed testing rules, development of quarantine pest list and simplified export/import documentation procedures (Waithaka et al. 2011). As of now, Kenya has met all set milestones but one, and other member countries are working towards these milestones. Other RECs also have made similar progress towards regional harmonization of seed policy (<https://www.syngentafoundation.org/policy/seed-policy-africa>). The progress towards harmonizing seed policy and implementation of necessary legal and regulatory frameworks are at various stages in RECs member countries.

5. DEVELOPMENT OF SUSTAINABLE SEEDS SYSTEM

Seed systems are means to deliver high quality seeds of a wide range of varieties and crops to farmers and other stakeholders. A sustainable seed system ensures that the high-quality seeds are available to the farmers and other stakeholders on time at affordable price (FAO, 2020). As stated earlier in this document various seed systems that have been functioning in Sub-Saharan Africa can be broadly categorized into three types - informal seed systems, formal seed systems and integrated seed system. These seed systems vary in value chain structure and length, as well as in term of actors involved at the different stages of the value chain. An ideal seed value chain involves various process, activities, and actors from management of plant genetic resources, variety development, early generation seed production, seed multiplication, and seeds packaging, distribution, and marketing (ISSD, 2014). Of various factors contributing to seed systems function and markets, role of the policy, legal, and regulatory environment is often the first gateway to effective seed system (Kuhlman, 2015). The different factors contributing to seeds system function and market are briefly presented in the subsequent sections.

5.1 Seed regulation harmonization

The local seed markets in African countries are relatively small and scattered therefore achieving economies of scales requires access to regional and global seed markets. Therefore, RECs have been working with respective member countries to update seed regulatory framework as per harmonization agreement, accreditation of seed testing laboratories, and conclude plant breeder right. Many member countries are currently working on these milestones to open door for their participation in the regional and international seed markets. In 2008 EAC, COMESA and SADC agreed to develop a Tripartite Free Trade Area (TFTA) to harmonize trade regime of three RECs and was later launched officially in 2015 (Kuhlmann 2015). This TFTA will have implications on seed trade and other aspects of regional harmonization Though progress has been slow to implement regional seed regulation harmonization agreement, these RECs and member states are highly committed to bring this regional harmonization mission in fruition.

5.2 Research and breeding

Africa is characterized by high level of agro-ecological diversity within and between the countries. This agro-ecological diversity coupled with rain-fed agriculture, high rainfall variabilities, less fertile soils, other abiotic and biotic stressors, and tremendous diversity of crops grown by African farmers demands a wide range of varieties of different crops to maximize the crop production and productivity. The transformation of African agriculture with a few currently available new crop varieties is difficult thus need a substantial investment to develop new crop varieties adapted to target environments. The multiple breeding targets and heterogeneity in environment make plant breeding a complex and expensive business in Africa (FAO 2011b). This requires a coordinated research and breeding efforts of public entities, private sectors, and other stakeholders to breed new varieties taking national and regional breeding approaches. Use of plant genetic resources held at national and international genebanks and the use of crop's wild relatives should be used in the breeding program. Several crop breeding programs in Africa have been supported largely by donors funding, and dwindling donors supports over years have severely impacted the effectiveness these programs (FAO 2010). While looking at the importance of new crop varieties on crop productivity and its contribution to food and nutrition security, the African governments should gradually increase their investment on crop research and breeding programs.

5.3 Variety release and registration

Variety release and registration are important regulatory steps that determine the quality of seeds and how soon farmers will have access to a new variety. Most countries in SSA have very long variety release and registration periods, and the length and complexity of procedures vary between the countries. Usually, it takes 2-3 years to introduce new seed varieties in SSA even for those varieties present in neighboring countries (World Bank 2012). Other reports indicate even longer time taken for variety release and registration (Coulson & Bitrina 2012; Waithaka et al. 2011). The seed system harmonization efforts of RECs have developed a simplified protocol for variety evaluation, release, and registration. For example, EAC has provided standard for variety testing procedures in the region. Briefly, when a breeder identifies a potential genotype for release (through multilocation testing) it enters the National Performance Trials (NPT) along with the best performing existing commercial cultivars in the area where the new variety is going to be grown at least in one breeding station. Thereafter, the National Certification Agencies (NCA) validates the two season test results in the NPT prior release by the National Variety Release Committee (NVRC) and/or listed in the national variety catalogue (Waithaka et al. 2011). If a variety has already been released in one of the ECA member countries, then one season performance data and data from previous testing in similar agro-ecological zones would suffice. These procedures if implemented by member states not only shorten the time taken for variety release and registration but also reduce the cost associated with these processes and enhance farmers' access to news crop varieties.

5.4 Seed certification

The RECs have standardized the seed certification procedure in the respective regions. The seed certification scheme of ECA involves different procedures - field inspection, seed processing, seed testing, labelling, sealing, post control and post certification surveys. The field and laboratory

certification procedures are based on Organization for Economic Co-operation and Development (OECD) standards whereas most laboratory testing are performed as per International Seed Testing Association (ISTA) rules. These standardized seed certification and testing procedures have greatly improved relationships between regulators and seed companies in the ECA region. A joint certification exercises of member states has built confidence and capacity on the ground and joint inspection has identified strengths and weaknesses in the certification process amongst certification agencies. However, the failure to establish interagency certification for goods in transit is affecting the seed trade (Waithaka et al. 2011). The government agencies responsible for seed certification often have limited human and financial resources to meet the seed certification needs in the country. There has been report of high service fee charged by these regulatory authorities.

5.5. Phytosanitary measures

Stringent phytosanitary measures should be adopted during the international exchange of plant genetic resources to minimize the risk of introduction of dangerous pests, diseases, and noxious weeds. Therefore, RECs have adopted the procedure of International Plant Protection Convention (IPPC) and World Trade Organization (WTO) agreement on sanitary and phytosanitary (SPS) regulations and guidelines for plant introduction and phytosanitary procedures. The regulatory agency issues a phytosanitary certificate as well as the seed import/export documents. All member countries of RECS are required to prepare the quarantine pest lists and validate with National Plant Protection Organizations. However, the progress in the harmonization of phytosanitary measures has been affected due to porous borders, lack of capacity at border points for the provision of quarantine services in some member countries, lack of regional pest information system, and limited public awareness on phytosanitary issues.

5.6. Plant variety protection

Governments' action and increased public and private investments in the seed sector are essential to respond food security challenges in the face of population growth and climate change (Jördens 2010). Two most critical factors that promote the investments in the plant breeding and development of new crop varieties are intellectual property protection (IP) and an effective plant variety protection system (PVP). The International Union for the Protection of New Varieties of Plants (UPOV) seeks to provide and promote an effective system of PVP to encourage the development of new varieties for the benefit of society. All six InnovAfrica case countries have PVP law and Kenya, South Africa and Tanzania are UPOV members. Development of new crop varieties is a high resource demanding long-term task therefore the involvement of private sector to engage in plant breeding need commitment and strong support of the government providing an enabling environment that begins with PVP. It is important that PVP laws and implementation is adapted to the national and local context and a number of steps can be taken to avoid that laws enabling the private sector involvement comes at the expense of the legal space for farmers' seed systems to function (De Jonge et al. 2015; Herpers et al. 2017).

5.7 Seed import/export documentation

The involvement of member countries in the regional and international seed trade is necessary for the development of a sustainable seed system in the continent for enhancing access of

smallholders to high quality seeds of new crop varieties. Africa's share to global seed market has been estimated at less than 2% (Waithaka et al. 2011) limited to few crops such as hybrid maize, sunflowers, cotton, soybeans, wheat, and vegetables (Minde & Waithaka 2006). Seed import and export documentation systems that meet regional and international standards is a prerequisite for engaging in the international seed trade. Therefore, RECs have been working to harmonize the agreements in common phytosanitary regulations and certification standards among the member countries to simplify seed trade procedures and promote their involvement in regional and international seed trade.

6. MAJOR SEED SECTOR INITIATIVES IN AFRICA

6.1 Integrated Seed Sector Development Program

The Integrated Seed Sector Development (ISSD) Program is one of the important seeds sector initiatives in Africa that include ISSD-Africa, ISSD-Ethiopia, ISSD-Mozambique and ISSD Uganda. The ISSD-Africa was initiated in 2012, as an international community of practice that guides seed sector innovation and development in African to alleviate the problem of limited access to quality seed. The program supports the development of market oriented, pluralistic, vibrant, and dynamic seed sector in Africa for providing smallholder farmers' access to quality seed of superior varieties for enhanced food and nutritional security and incomes. The ISSD-Africa has been endorsed by the African Union Commission as it contributes to the implementation of the African Seed and Biotechnology Programme (ASBP) and the seed agenda of the Comprehensive Africa Agriculture Development Programme (CAADP). The ISSD program is based on following eight guiding principles.

- a) Foster pluralism and build programs on diversity of seed systems
- b) Work according to the structure of the seed value chain
- c) Promote entrepreneurship and market orientation
- d) Recognize the relevance of informal seed systems
- e) Facilitate interactions between informal and formal seed systems
- f) Recognize complementary roles of the public and private sector
- g) Support enabling and evolving policies for a dynamic sector
- h) Promote evidence-based seed sector innovation

The ISSD Ethiopia is considered one of most successful seeds sector initiatives in Africa. Some of the achievements of this ten year long program can be summarized as: i) Introduction of local seed business model to seed producer cooperatives and development organizations, ii) enhancement of pluralism in seed production, iii) significant increase in use of quality seed by farmers - 28% increase in between 2014 and 2016, iv) introduction of the concept of direct seed marketing, and v) establishment of independent seed regulatory authorities in the region to enforce regulation and improve delivery of public services including licensing, certification and quality assurance.

6.2 Program for Africa's Seed Systems (PASS) initiative

This is also a decade long initiative of the Alliance for a Green Revolution in Africa (AGRA) supported by the Bill & Melinda Gates Foundation and Rockefeller Foundation. The objective of the program was to breed a wide range of high yielding, locally adapted crop varieties with seed production and marketing campaigns headed by private, independent seed companies and agro-dealers (AGRA 2017). The four major themes of PASS program were as follows.

- a) Education for African Crop Improvement (EACI) for training of a new generation African crop breeders at MSc and PhD levels.
- b) Fund for the Improvement and Adoption of African Crops (FIAAC) to support breeding and official release of new crop varieties.
- c) Seed Production for Africa (SEPA) to support local seed entrepreneurs to establish companies
- d) Agro-dealer Development Program (ADP) to build agro-dealer networks to sell improved seed and other inputs to local smallholder farmers.

The PASS program has made significant achievements towards enhancing availability of improved varieties and quality seeds to smallholder farmers in Africa. The PASS model linked the breeding efforts on a wide range of high yielding, locally adapted crop varieties with seed production and marketing campaigns led by private, independent seed companies leading to agro-dealers' involvement in the creation of a viable seed system for African agriculture (The Economist 2016). Some of these achievements were approval of hundreds of improved varieties by the Africa's seed regulatory agencies; establishment of over 100 privates, independent seed companies that multiply, package, and sell seed to smallholder farmers; and provision for thousands of family-owned input supply shops in villages and rural towns selling new seed, fertilizers, and other inputs associated with modern farming methods (AGRA 2019). The PASS also increased number of input producers/manufacturers and distributors.

6.3 The African Seed Access Index

The African Seed Access Index (TASAI) is a tool that appraises the structure and economic performance of formal seed sectors, thus defining success for seed systems based on its ability to deliver the following outcomes for farmers: availability, accessibility, affordability, and quality. TASAI is a collaborative initiative of Cornell International Institute for Food, Agriculture and Development and Market Matters Inc. that monitors essential indicators to seed sector development at national level. It publishes an annual scorecard that captures the vibrancy and competitiveness of the formal seed sector in the African countries, which serve as powerful tool for government policy makers, development agencies, seed enterprises, and ultimately farmers. The TASAI seeks to promote the creation and maintenance of enabling environments for competitive seed systems serving smallholder farmers. TASAI seeks to measure, track, and compare across African countries. The intended outcome of this index is improved access to locally adapted, affordable, and high-quality seed of improved varieties by smallholder farmers in SSA. The TASAI is a useful tool for government policy makers, development agencies, seed enterprises, and ultimately farmers.

6.4 Seeds to Business Project (Seeds2B)

The Seeds2B is collaborative project of African Agricultural Technology Foundation (AATF) and the Syngenta Foundation for Sustainable Agriculture (SFSA). The Seeds2B aims to improve the performance of formal seed sector in SSA by linking public and private breeders with seed enterprises to facilitate market entry and expand product portfolios. The goal of the Seeds2B project is to contribute towards building the capacity of commercial seed sector and enhancing food security in SSA. The Partnership for Seed Technology Transfer in Africa (PASTTA) which is a part of SEED2B program promotes new, improved varieties of a wide range of strategic crops - beans, cowpea, groundnut, maize, pearl millet, pigeon pea, potato, sorghum, soybean, tomato, and vegetables, particularly publicly bred varieties. It builds 'South-South' links, enabling local distributors and seed companies to offer these varieties to farmers in Kenya, Malawi, Mali, Senegal, and Uganda.

7. MEASURES TO STRENGTHENING SEED SYSTEM IN AFRICA AND INNOVAFRICA CASE COUNTRIES

To better harness their potential for contributing towards food and nutrition security the three different types of seed systems (informal, formal, and intermediate) require different measures. Except for South Africa, the informal seed system supplies most seeds used in the other five InnovAfrica countries. It is important that governments recognize the contribution of informal seed system, make sure that there is legal space for them to operate and consider how the informal system can be mobilized to build capacity on quality seed production in the intermediate seed system approaches. In the following section, we list recommended measures in the three sectors with the view of facilitating for pluralistic seed systems.

7.1 Measures to strengthen the formal seed sector

An effective and sustainable formal seed system requires a strong policy support, skilled plant breeding team, modest research infrastructure and support, a robust breeding pipeline to develop new crop varieties, smooth variety release and registration process, seed multiplication, and network for seed marketing so that quality seeds of new varieties are accessible to farmers on time at affordable price. Therefore, the policy environment and strength of individual components of seed value chain determine the effectiveness of the seed system. The local seed markets are small and scattered in Africa therefore building regional seed market and increasing Africa's share in international seed trade are crucial for economically viable and sustainable seed system in Africa. Following the implementing ten years long PASS program by AGRA in eleven African countries including Ethiopia, Kenya, Malawi, Rwanda, and Tanzania identified the following gaps seen as limiting the growth of national and regional seed markets as: (i) restrictive seed policies in some countries, (ii) limited supply of breeder and foundation seed, (iii) insufficient penetration of seed markets by commercial seed suppliers, (iv) lack of awareness among farmers in outlying areas of the value of improved seed, and (v) supply gaps of improved crop varieties in some agro-ecologies. Based on review of relevant published work, authors own experiences and experience of other actors involved in seed sector in Africa including AGRA, FAO

and SSFA we have come-up with some recommendations that can have significant impact in strengthening seeds system in InnovAfrica case countries and in other countries in SSA.

7.1.1 Variety development and production of early generation seeds

The new crop varieties are bred for improving range of traits such as maximum response to inputs, high yields, superior qualities, resistance to pests and diseases, resilience to drought and other abiotic and biotic stressors. Development of a new crop variety is a lengthy process that takes two or more years in Africa and limited supply of foundation seeds to the institutions involved in seed multiplication further delay access to a new crop variety by farmers. Farmers in Latin America and the Indian subcontinent have achieved significant gains in the wheat, rice and maize productivity using high input responsive disease resistant varieties which resulted in Green Revolution and freed millions of people from hunger. However, these highly successful technologies elsewhere were less effective in Africa mainly due to less fertile soils to support high yield of improved varieties and extremely diverse cropping systems divided into many small, rain-fed agro-ecologies planted with range of crops (AGRA 2017). Therefore, new variety development efforts in Africa should consider prevailing diversity in cropping systems and agro-ecology diversities in Africa and a decentralized, more locally driven seed supply approach.

Production of early generation seeds are responsibilities of public sector in most InnovAfrica countries. These public sector entities have been historically less able to meet with the demand. They often deal with many varieties of multiple crops and they are also short on human capacity and financial resources. Moreover, most private seed sectors rely on varieties developed by public sectors therefore they also seek public sector support for early generation seeds. Therefore, it is essential to build the capacity of public sector and bring private sectors with technical competency in variety development and foundation seed production on board. For examples, AATF has launched Quali-Basic Seed Company to supply foundation seed of stress-tolerant hybrid maize varieties to the seed industry, and private sector institutions have been engaged in variety development and production of early generation seeds.

7.1.2 Improvement and harmonization of seed policies at national and regional levels

The importance of new improved crop varieties and high-quality seeds and their roles in food and nutrition security in Africa have been well recognized by all six InnovAfrica case countries and their respective RECs. Therefore, all member states and RECs have been working towards harmonizing the seed policies and certain aspect of seed regulations to strengthen seed system for increased access of high-quality seeds of improved crop varieties to farmers and to develop regional seed market and increase Africa's share in international seed trade (Kuhlmann 2015). The seed policy harmonization process initiated in late 1980s by SADC, in 1990s by ECA, and in 2000s by ECOWAS and COMESA have made some progress but the task is complicated by limited resource for supporting legal structure in most members countries, and membership of some countries in more than one RECs. The EAC, COMESA and SADC have agreed in 2008 to develop a joint Free Trade Area, but this is yet to come into full effect (Kuhlmann 2015).

7.1.3 Increased awareness of farmers, community leaders and extension agents

A low productivity and high yield gap are common in many farming systems in Africa. It is largely attributed to low adoption rates of improved seeds and related technologies like fertilizers and

irrigations. Many smallholder farmers are not aware on new technologies and the benefits these new technologies can offer to them. Similarly, community leaders and extension agents may not have been regularly updated on the new and emerging technologies and their contribution to food and nutrition security and incomes. Therefore, efforts to increase awareness is important for the adoption of improved varieties and other related technologies. This can be achieved through various means such as setting-up demonstration plots, trainings, organizing field days, communicating to farmers through agro-dealers, dissemination of information via radio, television and other communication means. These efforts to awareness will increase adoption of new technologies that leads to market for improved seeds and related inputs, increase in yield and a strong seeds system.

7.1.4 Input supply and credit provision

The use of digital information and communication technologies have been very effective means to communicate new technologies and their potential benefits to farmers and other stakeholders. This often generate farmers' interest to use those technologies. However, due to unavailability of seeds, fertilizers and other necessary inputs and lack of credit provision farmers are unable to adopt new technologies. Therefore, it is important to have input suppliers in proximity and institutions that provide credits to the farmers to try and adoption new technologies.

7.2 Measures to strengthen informal and intermediate sector

7.2.1 Expanding networks and markets for farmer preferred quality seeds

The involvement of government agencies and development partners in formal seed system have resulted in emergence of local, private, small & medium enterprise, and seed companies. Such efforts and programs enables complementarity with efforts from actors in formal seed system development. The intermediate sector represents an investment opportunity for actors such as NGOs and development agencies aiming at reaching groups that is harder to reach for the formal sector, in line with the Sustainable Development Goal agenda of leaving no one behind. Participatory Plant Breeding and Participatory Varietal Selection are general terms encompassing a range of ways of involving farmers in the development and selection of new varieties and one of the major benefits of these approaches is higher likelihood of adoption of the resulting varieties (Westengen & Winge 2020). Community Seed Banks (CSBs) can work as a back-up site and exchange hub for both local and improve varieties (Vernooy et al. 2015). In many cases CSBs are also integrated with community-based seed production and dissemination (Vernooy et al. 2020). The farmer seed production cooperatives supported by ISSD and the Ethiopian government is an example of how community-based seed production can be scaled up at national level. A prerequisite for such upscaling is government support also for appropriate quality control. This again entails a supportive legislation and policy framework. Taken together, such measures are likely to increase the availability of high-quality farmer preferred seeds, increase incomes of actors involved in the formal or intermediate seed supply systems and lower the risk of counterfeit seed sale. As the certified seed market expands, seed regulatory agencies should increase their capacity to effectively play their oversight roles to cope with increased need for inspection, seed certification and quality control.

7.2.2 Build on existing systems, do no harm

In November 2020, a group of seed scholars and practitioners issued a set of short-term and medium-term recommendations in the journal Food Policy ‘to help guide current seed aid response and to anticipate seed system development thrusts of the next two to three years’ (Sperling et al 2020). A key message in the statement is that investment in the seed sector can bring large benefits to farmers and societies, but while poorly conceived interventions that are not adapted to the local context can do serious damage. This is as true in the longer term as it is in the shorter (humanitarian aid) term. Among the features of the statement, we highlight three here:

- “It recommends support to all seed systems farmers might use - formal, informal and integrated systems.”
- “Heavy emphasis is placed on proper diagnosis of the problem(s) and learning from the immediate intervention (both actions of which are often treated as optional in real-time practice).”
- “(...) policy changes will have to be at the forefront of strengthening seed systems. Seed systems need to be better designed to serve all farmers. They need to function better during stress and non-stress periods; to offer diversity; and must reach last mile areas on an ongoing basis. Expanding quality options and opening up sale venues are the first policy areas that require immediate attention” (Sperling et al. 2020).

In line with this, we find the following short-term recommendation especially apt to quote as we conclude this report:

Support to existing seed systems and their linked markets should be a first focus - before outside emergency or development assistance is considered.

In terms of the formal seed system, this translates especially to attention on:

- Facilitating free movement of seed (“green channels”).
- Supporting/extending seed inspection capability.
- Relaxing import regulations.
- Understanding the impact on access to credit/financial institutions and how possible changes may influence the decisions farmers make.

In terms of the informal seed system, this translates to an emphasis on:

- Helping farmers to save the seed they have through targeted interventions including messaging and technical support on improved storage options technologies.
- Supporting local market actors and including traders to move locally produced seed among regions, if needed, and hold staggered market-day sales.
- Engaging market actors more generally to identify and mitigate COVID-related hurdles that weaken functionality” (Sperling et al. 2020).

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