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A synthesis of policy issues and recommendations towards enhancing access to and utilization of agricultural genetic resources for climate-change adaptation in East Africa: Report of a Regional Policy Workshop, 1-2 April 2021, Kisumu, Kenya. Bioversity International, Rome, Italy.

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CGIAR RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security CCAFS

The International Treaty ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Food and Agriculture Organization of the United Nations

NARO

KALRO Kenya Agricultural & Livestock Research Organization

TPRI Tropical Pesticides Research Institute

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AAK	Aquaculture Association of Kenya
ABS	Access and Benefit Sharing
ALVs	African Leafy Vegetables
ASDS	Alternative Seed Delivery System
AVRDC	World Vegetable Centre
BSF	Benefit-Sharing Fund of the ITPGRFA
BUZARDI	Bulindi Zonal Agricultural Research and Development Institute (Uganda)
CCAFS	Climate Change Agriculture and Food Security
CIAT	International Centre for Tropical Agriculture
CIGs	Common Interest Groups
COMESA	Common Market for Eastern and Southern Africa
CSA	Climate-Smart Agriculture
CSBs	Community Seed Banks
DUS	Distinctiveness, Uniformity, Stability
EA	East Africa
EAC	East Africa Cooperation
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GeRRI	Genetic Resources Research Institute (Kenya)
GHGs	Greenhouse Gases
GMO	Genetically Modified Organisms
HVTCs	High-Value Traditional Crops
ICT	Information and Communication Technologies
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual Property Rights
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
KALRO	Kenya Agricultural and Livestock Research Organization
KCSAP	Kenya Climate Smart Agriculture Project
KLBO	Kenya Livestock Breeders Organization
LVs	Leafy Vegetables
MLS	Multilateral System
NARO	National Agricultural Research Organization
NEMA	National Environment Management Authority (Uganda)
NGO	Non-Governmental Organization
NWO	Netherlands Research Counsel
NPGRC	National Plant Genetic Resources Centre (Tanzania)
OPVs	Open Pollinated Varieties
OSSS	Open Source Seed Systems
PBAK	Plant Breeders Association of Kenya
PELUM	Participatory Ecological and Land Use Management (Uganda)

PGRFA	Plant Genetic Resources for Food and Agriculture
PPB	Participatory Plant Breeding
PPD	Public–Private Dialogue
QDS	Quality Declared Seed
SADC	Southern Africa Development Community
SANREM	Sustainable Agriculture and Natural Resource Management Africa
SMTA	Standard Material Transfer Agreement
SPCs	Seed Producer Cooperatives
SPGRC	SADC Plant Genetic Resource Centre
STAK	Seed Traders' Association of Kenya
TAC-MLS/SMTA	Technical Advisory Committee on the Multilateral System and the Standard Material Transfer Agreement
TLVs	Traditional Leafy Vegetables
TOSCI	Tanzania Official Seed Certification Institute
UNCST	Uganda National Council for Science and Technology

Executive Summary

Climate change negatively affects farmers' production systems and leads to loss of genetic diversity. One key climate-change adaptation strategy is for farmers to sustainably use a broader range of crops and varieties that are either better adapted to their planting context or that will buffer against excessive crop losses as a result of unpredictable climate events and (resulting) pest and disease outbreaks. Accessing a wider range of genetic resources from different sources is also especially important to aid in the development of new traits for climate-change adaptation. Publicly managed genebanks are one of the main sources of this diversity. Access to genetic resources from these genebanks is available through the Multilateral System (MLS) of Benefit Sharing Fund (BSF) of the International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA). Through this system, genetic resources for research and breeding purposes are pooled and accessed using the Standard Material Transfer Agreement (SMTA).

Through several research projects in East Africa, the Alliance of Bioversity International and CIAT has carried out participatory research with farmers in Ethiopia, Kenya, Tanzania and Uganda using durum wheat, sorghum, finger millet and beans from the national genebanks. Farmers and breeders have selected the best performing varieties with important traits for climate-change adaptation. Some of these varieties are potential candidates for breeding programs, while others were so good that farmers prefer to use them directly. However, the SMTA does make provisions for the direct use and commercialization of materials exchanged through the MLS; circumnavigating this issue has been the main focus of the Regional Policy Workshop.

This workshop brought together stakeholders from the national genebanks, policymakers, farmer organizations and private sector actors to deliberate on the key challenges related to the direct use and commercialization of these varieties, and to explore the various options for seeking permission from providers for their direct use and commercialization in accordance with their national regulations.

Scope of the Regional Policy Workshop

This is the report of a Regional Policy Workshop, held Kisumu, Kenya on in 1-2 April 2021. The workshop brought together project partners from the three national genebanks of Kenya, Tanzania and Uganda, research partners such as CCAFS, Kenya Agricultural Research Organization (KALRO) and National Agricultural Research Organization (NARO), (Uganda); National Plant Genetic Resources Centre (Tanzania); government seed certification and regulatory services such as Kenya Plant Health Inspectorate Services (KEPHIS) and the Directorate of seed inspection and certification in Uganda; private sector actors such as Dashcrop Ltd Kenya, farmers' community-based organizations (CBOs) such as the Seed Savers Network (Kenya), community seed bank representatives from Lower Nyando Community Seed Bank (NYACOSEB) and Upper Nyando community seedbank (Kenya), and media representatives from Kenya. The participants met to review and discuss key policy issues underpinning the exchange of genetic resources of sorghum, finger millet and beans obtained through the Multilateral System (MLS) under the Benefit-Sharing Fund (BSF) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (hereafter 'Plant Treaty'), in relation to work undertaken on policies and institutions for climate change and research. This work was undertaken under the umbrella of the CGIAR Research Programs on Climate Change, Agriculture and Food Security (CCAFS) within two Bioversity International-led projects. The first of these projects aimed at promoting open-source seed systems for beans, finger millet and sorghum for climate change adaptation in Kenya, Tanzania and Uganda; the second to targeted the up-scaling of climate-smart and nutrition-sensitive seed value chains for food and nutrition security in Ethiopia and Uganda (see Background section for further project details).

The Workshop was designed provide a venue for country partners to explore policy options for issues such as the registration of farmers' varieties, release through breeding and direct commercialization using existing quality declared seed (QDS) systems, in accordance with the national laws of Kenya, Tanzania and Uganda. The three main objectives of the workshop were:

- Discussing the way forward on commercialization, direct use and/or further breeding and release of the selected varieties
- Providing updates on policy strides made by the three countries in strengthening farmers' seed systems
- Endorsing the Regional Seed Hub concept that, among other things, proposes policy-related work and harmonization of both seed and genetic resources policies.

Key issues related to the implementation of the MLS were discussed, specifically in relation to the dissemination and upscaling of varieties exchanged through the SMTA. Although the SMTA permits materials to be used solely for research purposes and breeding, farmers from Kenya, Tanzania and Uganda expressed an interest in scaling up the varieties for direct use in cultivation, as well as for commercialization, indicating the need for additional agreements to facilitate and the three countries in these exchanges.

The workshop provided an excellent platform for learning and exchange of partner experiences, especially related to policy issues linked to the exchange of planting materials and research conducted in both of the above-mentioned projects.

1. Background

Climate change poses a serious and ever-growing threat to the food and nutrition security of resource-poor farmers globally. In Kenya, Tanzania and Uganda, climate change has led to increased pests and diseases, low agricultural productivity, food insecurity and general loss of genetic diversity. As a result, farmers have a very narrow gene pool to depend on for food, nutrition and livelihood security. One of the Intergovernmental Panel for Climate Change (IPCC's) strategies for climate change adaptation is introducing new diversity through breeding and other interventions.

1.1 Promoting Open Source Seed Systems (OSSS) for beans, sorghum and finger millet for climate-change adaptation in Kenya, Tanzania and Uganda

To address these challenges, the Alliance of Bioversity International and CIAT (hereafter 'the Alliance') and its partners (see Acknowledgements) implemented two projects. The first, 'Promoting Open Source Seed Systems (OSSS) for beans, sorghum and finger millet for climate change adaptation in Kenya, Tanzania and Uganda' was funded by the Plant Treaty through its Benefit Sharing Fund (BSF) and implemented by the Alliance in partnership with the National Plant Genetic Resources Centre (NPGRC) Tanzania; National Agricultural Research Organization's Plant Genetic Resources Centre (NARO-PGRC) Uganda; Genetic Resources Research Institute (GeRRI) Kenya; Agricultural Research and Livestock Organization; Hivos International; and Sustainable Agriculture and Natural Resource Management Africa (SANREM-AFRICA). The OSSS project, which ended in October 2019, introduced and increased the availability and diversity of nutritious, climate-smart crop varieties—those better suited to new and ever-changing climatic conditions—of beans, finger millet and sorghum through testing, farmer participatory breeding and production of high-quality seeds in four sites in Kenya, Tanzania and Uganda. OSSS increased farmers' access to a wider range of locally-adapted varieties and established community seed banks (CSBs) for their conservation and access. Importantly, the project also created marketing channels to disseminate the most promising varieties through breeding programs or CSB platforms. The project's main focus was to:

- Identify seeds with climate-adaptation potential from the national genebanks of Kenya, Tanzania and Uganda using the MLS of the BSF of the Plant Treaty—and their exchange using SMTAs.
- Test and evaluate genetic diversity of the above exchanged materials for useful and desired traits for climate-change adaptation.
- Disseminate beans, millet and sorghum varieties for climate-change adaptation using citizen science approaches.
- Enhance communities' and farmers' capacity in the production of high-quality seeds through CSB platforms.
- Conserve diversity *in situ* through community seed banking.
- Influence an enabling policy environment for open-source seed systems.

1.2 Upscaling climate-smart and nutrition-sensitive seed value chains for food and nutrition security in Uganda and Ethiopia

Building on the progress and outcomes of the OSSS project, a second project titled 'Upscaling climate-smart and nutrition-sensitive seed value chains for food and nutrition security in Uganda and Ethiopia', funded by the Netherlands Organization for Scientific Research (NWO), was initiated in 2017 and ended in April 2021. The project aimed to improve farmers' adaptation to climate change and enhance food and nutrition security by increasing the availability of good quality, diverse and adapted seeds within local communities through the creation of innovative and gender-sensitive value chains. The Alliance implemented this project in collaboration with the KIT Royal Tropical Institute of the Netherlands, National Agricultural Research Organization's Plant Genetic Resources Centre (NARO-PGRC-Uganda), Bulindi Zonal Agricultural Research and Development Institute of the National Agricultural Research Organization (NARO-BUZARDI, Uganda), Participatory Ecological and Land Use Management (PELUM-Uganda) and Mekele University Ethiopia.

To address policy-related challenges arising from the exchange of genetic planting material between OSSS project countries Kenya, Tanzania and Uganda, the Alliance organized four workshops in 2016, 2018 and 2019 in collaboration with partners Hivos International, national genebanks, national agricultural research institutions, ministries of agriculture and seed certification bodies in Kenya, Tanzania and Uganda, together with civil organizations and farmers to discuss the legal and policy environment to improve integrated seed systems in the three countries.[1] In these workshops, participants considered the available seed policy options, including OSSS. Open source seed systems is a concept that **allows freedom of access and use of plant genetic material**, prohibits exclusive rights over those materials and applies to any subsequent derivatives of those materials (Otieno & Westphal, 2018). These workshops also led to a Policy Writeshop in 2018, aimed at synthesizing the main policy issues and identifying policy recommendations to improve ease of access to seeds through

[1] Open Source Seed Systems for Climate Change Adaptation in Kenya, Uganda and Tanzania: highlighting the importance of policy support. https://ccafs.cgiar.org/news/open-source-seed-systems-climate-change-adaptation-kenya-uganda-and-tanzania-highlighting-importance

Otieno, G.; Westphal, I. (2018) Building resilience through "Open Source Seed Systems" for climate change adaptation in Kenya, Uganda, and Tanzania: What are the options for policy? 8 p. https://cgspace.cgiar.org/bitstream/handle/10568/100157/Building_Otieno_2018.pdf

Recha, T., Vernooy, R., Halewood, M., Otieno, G. (2019) Resilient seed systems for climate change adaptation and sustainable livelihoods in the East Africa subregion. Report of the consultative workshop, 5-8 March 2019, Entebbe, Uganda. Bioversity International, Rome, Italy. https://core.ac.uk/download/pdf/200267142.pdf

Otieno, G.; Recha, T.; Vernooy, R.; Fadda, C.; Yosef, G.K.; Halewood, M. (2020) Report of a policy dialogue workshop on Open Source Seed Systems for Climate-Change Adaptation in East Africa. 19–22 November 2019, Entebbe, Uganda. Rome (Italy): Bioversity International. 36 p. ISBN: 978-92-9255-193-3 https://hdl.handle.net/10568/110900

Recha, T.; Muwanika, C.; De Jonge, B.; Mulumba, W.; Nankya, R.; Otieno, G.; (2019) Report of the International Workshop on Registration of Farmers' Varieties, 4–7 December 2018, Entebbe, Uganda. Rome (Italy): Bioversity International; Oxfam Novib 30 p. ISBN: 978-92-9255-123-0 https://cgspace.cgiar.org/handle/10568/101227

OSSS. The writeshop's main output was a regional policy brief titled 'Building resilience through "Open Source Seed Systems" for Climate Change Adaptation in Kenya, Uganda and Tanzania: What are the options for policy?' (available at: https://cgspace.cgiar.org/handle/10568/100157).

In 2019, the Alliance and Hivos International organized a workshop entitled 'Policy Dialogue workshop: Open Source Seed Systems for climate change adaptation'. Workshop participants explored how researchers and development projects wishing to access, evaluate materials from genebanks, then multiply and commercially release seeds of those materials, need to navigate and comply with a complex combination of the Plant Treaty's MLS of the BSF, national laws implementing the Nagoya Protocol, and national seed laws regulating the registration and/or release of plant varieties (and phytosanitary regulations when exchanging genetic materials and or seed across international borders). The Policy Dialogue workshop report sets out the issues that researchers/development projects need to consider and practical options for how to overcome policy-related challenges with a particular focus on the nexus between:

- having the right to access and use plant genetic resources for research under the Plant Treaty
- acquiring additional permissions to commercialize such materials (in the form received) from providers/provider countries, and
- meeting registration requirements under national seed laws to register/release those materials

The Policy Dialogue workshop also considered competent national authorities under these legal frameworks to promote mutually-supportive implementation/decision making, to create a harmonized policy environment that provides long-term support for exchanging, evaluating and using crop diversity for climate change adaptation and enhanced nutrition. In this context, participants considered the institutionalization of sub-regional seed hubs, which could: a) provide technical support for sub-regionally based projects exchanging, evaluating genetic resources and releasing crop varieties, and b) promote agreements between competent authorities and project partners, which proactively address and resolve policy bottlenecks and challenges, and secure agreement to take advantage of existing policies and to exercise discretion in implementation of those policies, in ways that are supportive of project goals.[2]

In the sections that follow, we explore the legal and policy environment in East Africa and how it directly and indirectly affects the outcomes of the two projects.

Section 1 provides a detailed summary of the projects, including key outcomes related to participatory varietal testing and selection, conservation through community seedbanks and policy.

[2] For more information, consider the report by Otieno, G.; Recha, T.; Vernooy, R.; Fadda, C.; Yosef, G.K.; Halewood, M. (2020) Report of a policy dialogue workshop on open source seed systems for climate change adaptation in East Africa. 19–22 November 2019, Entebbe, Uganda. Rome (Italy): Bioversity International. 36 p. https://cgspace.cgiar.org/handle/10568/110900

Section 2 highlights the importance of the policy workshop by pointing out the previous efforts and discussions held in the region. This section progressively explains what has happened and the current seed policy status in the East Africa region.

Section 3 presents the two projects in detail, showing the implementation process, the achievements and how the outcomes are directly being affected by the current policy environment. It also illustrates how the informal/farmer-led seed system can make an immense contribution to food security and which, therefore, creates the need for supportive policy environment.

Section 4 delves deep into seed policy issues in East Africa. This section explains country-level legal and policy environments for Kenya, Tanzania and Uganda. Some of key issues identified and discussed for all three countries include: (i) current status of the seed sector, (ii) existing opportunities to promote farmers' varieties, (iii) impacts of the existing policy, legal and regulatory frameworks on the informal seed system and the project's output, (iv) opportunities to strengthen alternative delivery and seed production systems for high-quality traditional seeds and open-pollinated varieties, and (v) promoting of public-private seeds platforms.

Section 5 outlines the opportunities and challenges to scale-up dissemination and production of selected and well-adapted farmers selected varieties from the two projects, under the existing policy environment highlighted in Section 4. This includes exploration of any provisions at national level on the use of genetic materials exchanged between national genebanks through SMTAs. It further looks at the limits in use of such genetic materials based on the national policy environment vis a vis international legal provision.

Section 6 gives a case of Ethiopia's seed system and the steps it has taken in addressing some of the challenges in Kenya, Tanzania and Uganda in line of breeding, registration and releasing of farmers varieties. It basically shows that it is an approach that can be practical.

Section 7 introduces the Regional Seed Hub concept which has been proposed to bring together all actors to deliberate, share and support efforts in establishing a strong seed system in East Africa. The draft Regional Seed Hub Brief, which sets out the dynamics of the hub, is attached as Appendix III.

Sections 8 and 9 include closing remarks, conclusions and recommendations.

2. Project Highlights

In this section, we provide an overview of the two project's highlights and one case study on the issues and challenges faced by Ethiopia, Kenya, Tanzania and Uganda, as presented and discussed at the Regional Policy Workshop.

2.1 OSSS Project highlights and related outputs and outcomes

By Gloria Otieno, Alliance of Bioversity International and CIAT

The project 'Promoting Open Source Seed Systems (OSSS) for climate change adaptation for beans, sorghum and finger millet in Kenya, Tanzania and Uganda'—OSSS for short—began in 2016 and ended in 2019. The project was funded by the Benefit-sharing Fund of the Plant Treaty and the European Union.

The project's objective was to improve adaptation to climate change and enhance the food and nutrition security of resource-poor farmers in Kenya, Tanzania and Uganda, through the availability, sustainable management and use of a wider range of quality crop agricultural biodiversity. The project concentrated on three crops, beans, finger millet and sorghum, considered to be major contributors to food security and showing strong resilience in the face of climate challenges farmers were facing in project sites. The main components of the project included: (i) exchange of germplasm from MLS between three national genebanks; (ii) testing and selection of germplasm that is suitable for climate adaptation and then dissemination of germplasm through seed businesses; (iii) conservation through community seed banking and (iv) policy issues related to access and benefit sharing, seed systems and conservation.

At the start of the project in 2016, we realized that the common climatic challenge shared by the four project sites of Nyando (Kenya), Hoima (Uganda) and Hombolo and Singida (Tanzania) was that the growing seasons had shortened, and farmers were faced with prolonged droughts and erratic rainfall. In Tanzania, for example, where there had once been one long season lasting 6–7 months, it had shortened to 4–5 months prompting the need for shorter-season varieties. The farmers had therefore abandoned four varieties and were only able to grow two varieties at the time the baseline survey was conducted in 2016. In Nyando Kenya, farmers had 13 available varieties of sorghum, but only four of them could be grown because the season had shortened, the drought had worsened, and the situation was exacerbated by perennial flooding problems. The project therefore aimed to identify and introduce varieties that would be suitable for these climatic challenges, taking into consideration farmers' desired traits such as early maturity, drought tolerance, pest and disease resistance and high yield. In Hoima (Uganda), there were two seasons, but both had shortened. More so, the second season was so short that they could no longer plant some maize varieties. Farmers had about three bean varieties they were growing at the outset of the project because other local varieties could not withstand the shorter rain season. The project selected a diversity of beans and finger millet varieties from the three national gene banks for farmers to evaluate and select the best performing under the existing climatic conditions. The project aimed to produce the following outputs:

- **Nutritious, climate-resistant varieties of beans, finger millet and sorghum** (sourced through the MLS and national genebanks, identified, introduced, tested and disseminated.
- **Value chains for climate-smart seed systems with equitable access by men and women** established; this approach ensured the gender dimension of the project.
- **Seed production units and seed quality assurance mechanisms** established through the value chains. The quality aspects are determined by the policy environment in the countries—for example, in Kenya farmers cannot produce QDS, but in Uganda farmers are allowed to and are guided in the production of QDS.
- **Community seed banks**, with supporting local seed networks, established.

- **Sharing and learning platforms** (at national and international levels) established and utilized to scaling-up and influence favourable policy changes.
- **Policy issues on Access and benefit sharing and seed systems elaborated.**

2.1.1 The research process adopted for the Open Source Seed Systems project

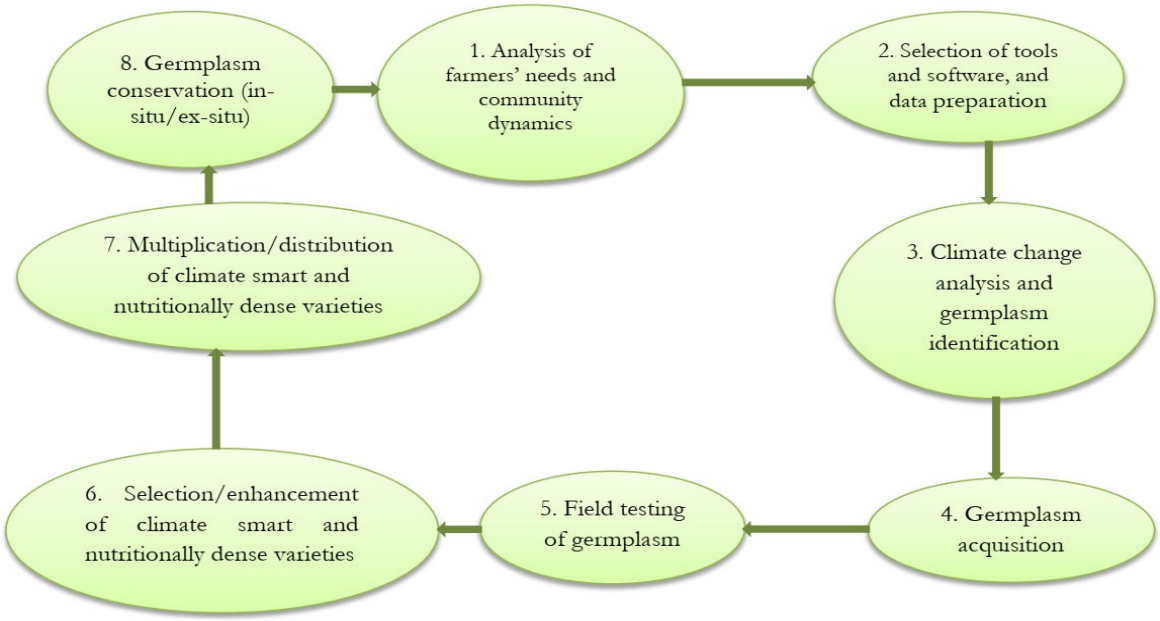


Figure 1: A schematic representation of the OSSS project's activities and life cycle

The project followed the research process outlined in Figure 1, which started with a baseline survey to identify the participating communities' challenges. Germplasm from the national genebanks of Kenya, Uganda and Tanzania was then identified by modelling Climate and GIS profiles of each accession. The selected accessions were then acquired using SMTAs, subsequently multiplied and later underwent field testing through farmer participatory varietal selection and also through crowdsourcing with farmers at four selected sites in the three countries. For the crowdsourcing trials, we engaged over 2000 farmers to conduct three cycles in Uganda, two cycles in Kenya and two cycles in Tanzania. After completion of the trials, the best-performing varieties are now being conserved *in situ* through community banks that are also working closely with the national genebanks.

2.1.2 Key project achievements

Table 1: A summary of key project achievements in Kenya, Tanzania and Uganda

Indicator	**Achievements/Outcomes**
Introduction of adapted diversity	A diversity of beans, finger millet and sorghum were introduced in the three countries. In Uganda, finger millet and beans were the most popular crops for climate-change adaptation; 7 bean and 7 finger millet varieties were prioritized in Uganda, 10 of sorghum in Tanzania and 10 of sorghum and 10 of finger millet in Kenya. These were selected from 739 accessions identified from the three national genebanks.
Establishment of Community Seed Banks	Another key achievement was the establishment and launch of two community seed banks. The Hoima community seed bank in Uganda is currently conserving 20 millet varieties and 32 bean varieties. Nyando community seed bank in Kenya is conserving 17 bean varieties, 15 millet varieties and 22 sorghum varieties. A second seed bank located in Upper Nyando, locally called KAPSOKALE Community Seed Bank, has been informally established through the initiative of about 15 members, who are producing and distributing seed among farmers. The seed bank is currently being hosted at one of the farmers' homes; however, in collaboration with the area chief, a piece of public land has been identified where the seedbank can be constructed. Remarkably, these farmers have been contributing money and hiring land in order to multiply their seeds. They have contributed money, rented land and independently multiplied seed, inspired by the project. Some farmers are also acting as independent seed custodians. One female farmer in lower Nyando has teamed up with a group of seven like-minded local women farmers who wanted to do more than just maintaining sorghum or finger millet seed. They also wanted to conserve and promote the production of beans and traditional leafy vegetables (TLVs) among other farmers, because finding these seeds locally was hard and sometimes very expensive. Their seed bank is currently conserving about 10 sorghum, 15 bean and 14 TLV varieties. Although TLVs were not our intervention crops in Nyando, the women farmers themselves decided that they would establish a community seed bank and incorporate TLV seeds. These are farmers' initiatives beyond what was launched by the project.
Capacity Development	• **1001 farmers** trained in participatory variety testing and selection and 2000 farmers participated in crowdsourced varietal testing and selection during four trial cycles. • About **700 farmers were trained** in community seed banking. • About **400 farmers were trained** on quality seed production. These are the farmers who expressed interest in forming and /or joining seed cooperatives and becoming seed producers. Hoima community seed bank farmers have already registered a seed cooperative with the intention of produce quality grade seed. Nyando community seed bank members have also registered their seed bank with an aim to produce seed. They have also been linked to Dashcrop Ltd—a female-

	headed flour making agribusiness—to enable them to not only produce seed but also sorghum and millet grain to be used as raw materials for making composite flour. • **200 farmers from Hoima** were trained in seed business management **(**in 2019). In September 2019, training on Gender Action Learning Systems was conducted and brought together **47 participants** (24 female and 23 male). The participants learned about the Gender Action Learning approach, as a transformative household approach for gender equality. The participants were trained on developing: vision journeys, a Gender/Family balance tree and empowerment leadership maps. • In Nyando, farmers were trained on various aspects of seed business management; because of social distancing issues, only **20 farmers** travelled to Kakamega for further training together with their Kakamega and Vihiga counties counterparts. • **Over 4000 farmers** have been exchanging seed and knowledge through attending seed fairs and outreach activities, which included exchange visits between farmers in Kenya, Tanzania and Uganda. These seed fairs play a key role in facilitating the exchange of genetic resources between farmers and knowledge sharing. • Additionally, researchers and breeders were trained on creating and adopting resilient seed systems, the last of which was conducted in Addis Ababa (Ethiopia) in September 2019[3]. • Since 2016, we have been conducting one policy workshop per year, so far reaching at least 150 policymakers in the region. In 2021, fewer participants will be invited to the annual policy workshop because of the issue of Covid 19. The annual policy workshop is dedicated to discussing key policy issues and sharing progress made within the three project countries, as well as looking for a ways to forge a path where issues have arisen.
Dissemination	Linkages with national breeding programs have been established. The institute of biotechnology and research of Jomo Kenyatta University of Agriculture and Technology is linked to the farmers in Nyando and has been working with those farmers on participatory varietal selection and testing. In Hoima, Bulindi Zonal Agricultural Research and Development Institute of Uganda's National Agricultural Research Organization has been working with farmers on participatory varietal selection of beans and finger millet. Some elite lines with good traits have been identified, for example a Striga-resistant sorghum variety in Nyando, and some very high-yielding beans and millet varieties. This information has been disseminated in the hope that breeding programs are able to adopt some of these varieties and improve them so that they improve farming in terms of drought resistance and yield.

[3] Kidane, Y.G., Recha, T., Halewood, M., Fadda, C., Mushita, A., Otieno, G. and Vernooy, R. (2019)
Resilient seed systems for climate change adaptation and sustainable livelihoods in the East Africa subregion: Report of training workshop, Addis Ababa Ethiopia, 17–21 September 2019. Bioversity International, Rome, Italy.
https://cgspace.cgiar.org/bitstream/handle/10568/107216/Kidane_Addis%20Training%20Report__Revised.pdf?sequence=4&isAllowed=y

	Information has also been disseminated through seed catalogues using various avenues such as CSBs and national breeding programmes in Kenya and Uganda. The catalogues were also sent to Tanzania where they were distributed to farmers in Hombolo and Singida. The seed catalogues are available at: https://cgspace.cgiar.org/handle/10568/111212 https://cgspace.cgiar.org/handle/10568/111207 https://cgspace.cgiar.org/handle/10568/111204
Learning Platforms	The Alliance is a member of Global Open Source Seed Systems Initiative, an online virtual group that discusses key issues related to seed systems, access to seed without intellectual property rights issues by farmers. There is a community seed bank platform in the region hosted by the Seed Savers Network in Kenya. The Seed Savers Network works with farmers in Vihiga County and provides a platform for seed banks to share knowledge on issues of seed sovereignty, access and benefit sharing and even policy issues that affect them in such a way that they are not able to produce QDS seeds. In Uganda, the National Plant Genetic Resource Organization is developing a seed bank platform, which has a database with information on all existing seedbanks in Uganda and the genetic resources they conserve This will provide a glimpse to policymakers, academic institutions and researchers on the use, adaptability and preference of varieties to inform better decision making. This database/platform is on its final stages of development.
Policy	We have organized yearly policy workshops. In Uganda, one of the key achievements is that there is a QDS guideline which was not available in March 2020 and farmers can now produce QDS. In Kenya we are contributing to the discussions of the draft legal notice on the implementation of the International treaty and also on issues to do with farmer seed systems and the quality assurance of farmer seed systems.

2.2 Results of participatory varietal testing and evaluation and scaling and dissemination of varieties

By Tobias Recha, Alliance of Bioversity International and CIAT

in this section presents the results of the of the activities related to selection and dissemination of germplasm through the Open Source Seed Systems (OSSS) project and the "Citizen's Science Approach to Climate-Smart and Nutrition-Sensitive Seed Value Chains for Food and Nutrition Security in Uganda and Ethiopia" (hereafter referred to as the Citizen Science project).

The aim of the OSSS project was to improve adaptation to climate change and enhance the food and nutrition security of resource-poor farmers in Kenya, Tanzania and Uganda, through the availability, sustainable management and use of a wider range of quality plant agricultural biodiversity. It aimed to:

i. Exchange the genetic materials between the national genebanks of Kenya, Tanzania and Uganda through SMTAs. These materials were further evaluated by farmers and breeders and the ones most promising were prioritized for further dissemination and scaling.
ii. Facilitate cooperation for research, breeding and training between national governments, genebanks, researchers, plant breeders, development agencies and farmers. The project targeted and engaged breeders and national genebanks to assess and appreciate how the exchanged materials can greatly contribute to alleviating food insufficiency and reduce the impact of climate change on food systems in the three countries. It therefore resulted in collaborations, capacity building in crowdsourcing methodologies and participatory varietal evaluation and selection, and climate profiling. This capacity building equipped researchers and plant breeders, national gene bank representatives and farmers with the additional skills to identify, produce and use quality seeds.
iii. Promote and encourage inclusion of materials and their information in the Treaty's MLS, based on the list of required crops under Annex 1. This approach enables easy access to information, use of information (passport data) and access to and use of this germplasm without restrictions related to intellectual property rights.
iv. Promote the integration of in-situ and ex-situ conservation into national system efforts; this includes promoting seed conservation at community level through establishing community seed banks and custodian farmers/farmer groups and linking these efforts to the national genebanks.

The "Citizen Scientists Approach to Climate-Smart and Nutrition-Sensitive Seed Value Chains for Food and Nutrition Security in Uganda and Ethiopia" project (hereafter referred to as the Citizen Science project), aimed to improve farmers' capacity to adapt to climate change and enhance food and nutrition security by increasing the availability of quality diverse and adapted seeds within local communities through scaling innovative seed production and value chains. It aimed to build upon and scale up most of OSSS project activities in Uganda. It also builds on the activities of the Seeds for Needs initiative—a crowdsourced seed selection and citizen science flagship initiative of Bioversity International to select the most climate-adapted seeds to meet farmers' needs—in Northern Ethiopia,

especially on crowdsourcing and participatory varietal evaluations and selections. Therefore, this project is contributing to:

i. Cooperation on research, breeding and training between national governments, genebanks, researchers, plant breeders, development agencies and farmers across the region.
ii. Strengthening regional and national seed policies in recognition of and strengthening informal seed systems, particularly in regard to registration and commercialization of farmers' varieties through the QDS systems.
iii. Exploration of policy options and strategies to ensure that the project can stock and directly use materials that were originally exchanged using SMTAs.
iv. Advocacy and establishment of regional hubs of experts to create/support a resilient seed system to facilitate collaborations in research, breeding and exchange of information and resources between experts, national genebanks and farmers

2.2.1 Project implementation process

Both the OSSS and Citizen Science projects followed the research process outlined in Figure 2. This schematic outline shows a summary of the seeds exchanged, the types of trials carried out by the farmers and researchers all the way through to the development and dissemination of the seed catalogues of the selected varieties.

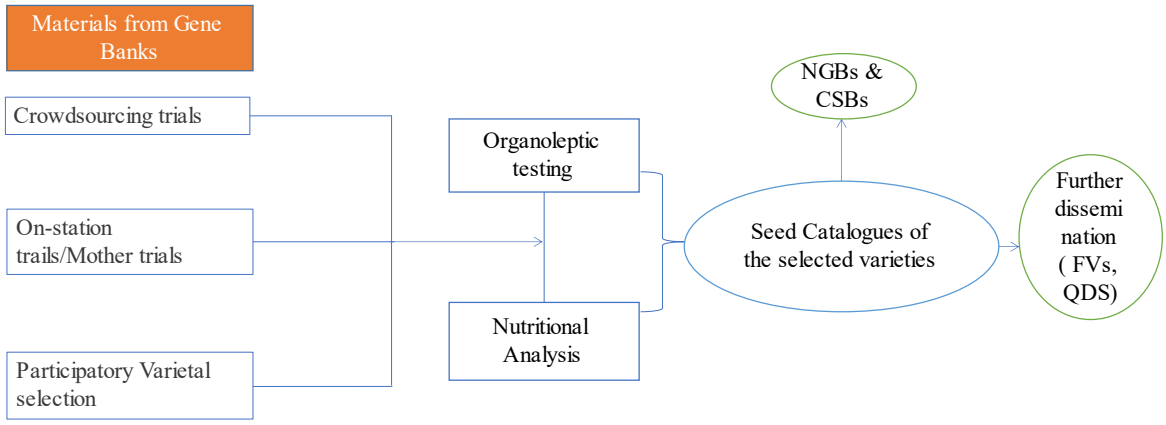


Figure 2: Schema of both project implementation processes

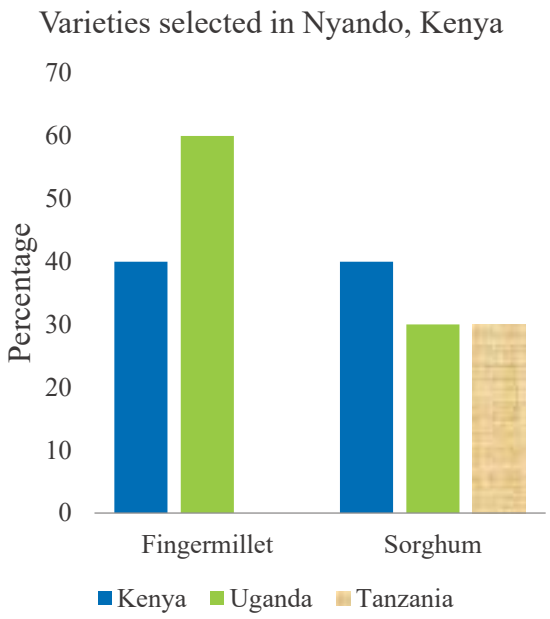
Under the OSSS project, 739 accessions were exchanged among the national genebanks of Kenya, Tanzania and Uganda. These materials underwent a series of multiplications to yield the right quantities needed for the three main trials: crowdsourcing trials, on-station/mother trials (for both characterization and participatory varietal selection) and participator varietal selection. Table 2 shows the quantities of planting materials received in each country for the intervention crops.

Table 2: Number of accessions exchanged between the national genebanks, multiplication and trials

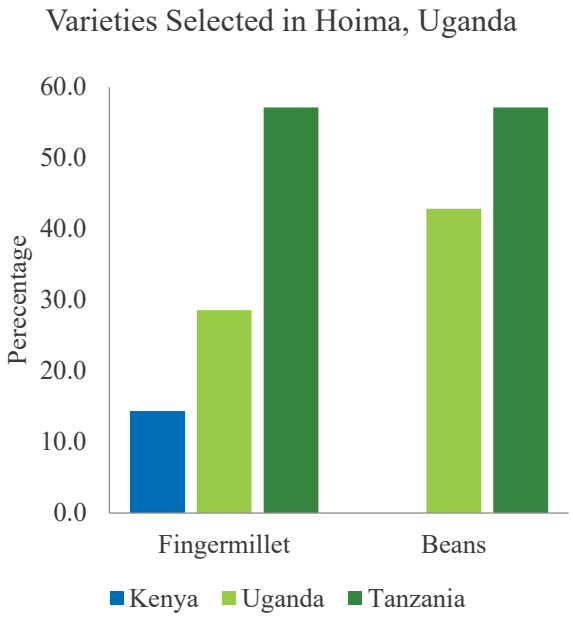
Country	Site	Crop	Accessions before multiplication	Accessions after multiplication	Best-performing accessions selected for crowdsourcing and on-station trials
Uganda	Hoima	Beans	99	50	34
		Millet	147	70	44
Tanzania	Dodoma and Singida	Beans	27	0	0
		Millet	62	61	0
		Sorghum	33	28	24
Kenya	Nyando	Beans	110	0	0
		Sorghum	193	180	48
		Millet	68	67	52

Some of the accessions did not perform well due to their susceptibility to pests, diseases and lack of sufficient moisture or exposure to too much rain and floods. The ones that survived and gave good yields were then distributed to about 2000 farmers in the three countries. These farmers prioritized the varieties that showed high adaptability and productivity, coupled with good taste and high likelihood of market demand. Some of the prioritized varieties are foreign germplasms exchanged through national genebanks.

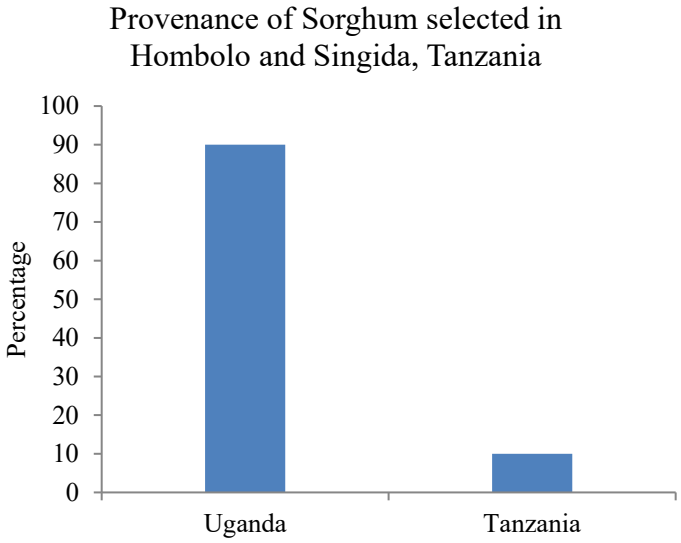
From Figure 3A, we see that 60 percent of the finger millet varieties selected by farmers in Nyando, Kenya is from Uganda and only 40 percent originates from Kenya. For Sorghum, 30 percent of accessions were from Uganda, 30 percent from Tanzania and 40 percent from Kenya. In Hoima, Uganda (Figure 3B), about 60 percent of prioritized beans came from Tanzania. The same trend was seen for finger millet, where almost 60 percent of selected germplasm originated from Tanzania, about 25 percent from Uganda itself and 15 percent from Kenya. For the case of Hombolo and Singida in Tanzania, farmers selected the 90 percent of the sorghum germplasm from Uganda, and only 10 percent prioritized varieties from Tanzania.



Graph 3A



Graph 3B



Graph 3C

Figure 3: Graphs 3A, 3B and 3C indicating the percentages of selected germplasm by farmers and their countries of origin

2.2.2 Dissemination of selected varieties

Farmers were able to successfully evaluate and prioritize certain varieties, which are currently being multiplied and planted by many farmers. Farmers, researchers and breeders will all benefit once these varieties, together with their agronomic and nutritional information, are disseminated across the region. Currently, the following options are being used for dissemination:

- Creating awareness of the selected/prioritized varieties through publishing of seed catalogues. These have been printed and shared with farmers and other interested parties, such as breeding programs. The catalogues provide information about where the farmers can ask for access to those materials, including the national genebanks that originally provided them for use in the project.
- Breeding with elite lines to release new improved varieties.
- Establishment of community seed banks, which provide an avenue for easy dissemination of the prioritized germplasm into the farming communities. The seed banks allow farmers to 'borrow' the selected accessions, returning seeds once the crops are harvested, and actively participate in national seed fairs to showcase their diversity, further allowing the spread of information and exchange of seeds.
- Value addition and creating sustainable value chains. Composite flour making companies like Dashcrop Ltd in Kenya have already developed interest in contracting the farmers who are growing some of the prioritized varieties. In Uganda, finger millet is used to make different products and some of the selected varieties are already being targeted for future use.

2.3 Formal and informal seed systems for climate change adaptation: Empirical evidence and success stories on the contribution of indigenous knowledge and local varieties to food and nutritional security for climate change adaptation

By John Recha, Climate Change, Agriculture and Food Security (CCAFS-East Africa)

Agriculture is key for food and nutrition security, natural resource management and economic development. It contributes significantly to gross domestic product (GDP) in East African countries; for example, up to 45 percent in Ethiopia. However, the region has an over-reliance on subsistence rain-fed agriculture with low productivity (10–40 percent achievable yield) and only 5 percent of area cultivated under irrigation. Production increase is often through increasing land under cultivation. Over 80 percent of farmers live in poverty, barely meeting their own food consumption needs; about 33 percent of the population are undernourished, which is estimated to rise to 320 million by 2050. East Africa (EA) exhibits spatial heterogeneity in climate, topography, agroecosystems, livelihoods and environmental challenges.

2.3.1 Emerging climate change-related challenges for agriculture in EA

East Africa is a climate hotspot where climate change poses grave threats to food and nutrition security and to human wellbeing. Temperature is likely to increase (3–6°C by late 21st century) due to

greenhouse gas (GHG) emissions including changes in frequency, intensity and timing of climate variabilities and extreme events like water stress, droughts, flooding, precipitation patterns, and heat waves. Climate variabilities and change are an additional source of risk for farmers and agricultural systems, for example:

- Shift in rainfall onset and cessation brings more uncertainty to farmers.
- Rising temperature causes yield reduction (5–20 percent), crop failure, quality, price along value chains.
- Exposure to emerging pests, diseases and parasites affects crop and livestock productivity.

These factors reduce farmers' resilience, their adaptive capacity and increase their vulnerability. In addition, agriculture is also the main source of GHG emissions in East Africa, 46 percent in Uganda and up to 86 percent in Tanzania. Effective adaptation and mitigation strategies are required to address the enormous challenges facing agriculture.

2.3.2 CCAFS goals and objectives

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is aligned with CGIAR's vision: A world free from poverty and environmental degradation, and seeks impact at three levels:

Figure 4: CCAFS' three priorities

CCAFS' overarching goal is to catalyze positive change towards climate-smart agriculture (CSA), food systems and landscapes, and playing a major role in bringing to scale practices, technologies and institutions that enable agriculture to meet the triple goals of food security, adaptation and mitigation. By promoting CSA, CCAFS-East Africa aims to address these persistent constraints and challenges through innovative technologies and practices, policies and enabling environments and conducive investment. Climate-smart agriculture ensures that there is: i) a sustainable increase in agricultural productivity and incomes, ii) production that adapts and builds resilience to climate change, iii) reduction/removal of GHG emissions where possible, and iv) enhance achievement of national food security and development goals (FAO, 2013[4]).

[4] FAO Climate-Smart Agriculture Source Book, 2013. http://www.fao.org/3/i3325e/i3325e.pdf

2.3.3 Climate-smart agriculture: Seed systems for food security

Farmers contribute to food security through crop genetic improvement, farmer selection, classical plant breeding and/or modern biotechnologies. A formal seed system is based on plant breeding and selection, resulting in different varieties, including hybrids, and promoting materials leading to formal variety release and maintenance. An informal seed system is basically what the formal system is not. An informal (local) system embraces most of the other ways in which farmers themselves produce, disseminate and access seed: directly from their own harvest, through exchange and barter among friends, neighbours and relatives, and through local grain markets.

Both formal and informal seed systems share important points of integration. These are the demand side, where farmers are accessing seeds from different sources, and the supply side, where there is an increasing number of breeding programmes that involve farmers in varietal selection.

2.3.4 Informal seed systems: Current policy framework challenge

The current policy framework is impacting farmers in the informal seed sector in East Africa. Policy and law focus on the formal seed system and do not support the environment for farmers' seed systems. Farmers have difficulty in registering farmers' varieties, as registering requires many steps, which are not feasible for smallholder farmer communities. Initiatives like open-source seed systems project provide the opportunity for informal seed systems to thrive, especially through community seed banks and linking them to international and national genebanks.

2.3.5 CSA examples: Indigenous vegetables' seed quality in Kenya

Research by Croft et al. (2017)[5] compared the seed quality of formal and informal seed varieties in Kenya (Box 1). The seed materials included amaranth (*Amaranthus* spp.) and nightshade (*Solanum* spp.) that had been collected from formal and informal sources. Seeds were also provided by the AVRDC (World Vegetable Center) in Arusha, Tanzania from landraces collected across East Africa.

[5] Croft, M.M., Marshall, M.I., Odendo, M., Ndinya, C., Ondego, N.N., Obura, P., and Hallett, S.G. 2017. Formal and informal seed systems in Kenya: Supporting indigenous vegetable seed quality. Journal of Development Studies. 54(4): 758–775.

Box 1. Comparison between formal and informal seed viability by Croft et al. (2017)

For Seed germination:
Twenty seeds from each accession were placed on moist filter paper in petri dishes and maintained in a germination chamber at 70 percent humidity and 25°C under constant light.
Three replicates were evaluated for each variety and the experiment was repeated twice at an interval of 2 months. Germinated seeds (defined as emergence of the radicle from the seed coat) were recorded and removed every day for a period of 14 days. Mean time to 50 percent radicle emergence was also calculated.

For Yield Comparison:
Seedlings from each variety were grown in soil to four weeks and transplanted into the field.
This experiment was conducted as a randomized complete block design with three blocks and four replicates for each variety within each block. Plants were harvested only once, six weeks after transplanting, and fresh weight was measured. Leaf area was measured by image analysis (Image J, National Institutes of Health) of digital photographs of excised leaves. The experiment was repeated twice.

This research was based on a household survey carried out across 95 villages in eight counties in western Kenya. The survey, on the status of African leafy vegetables (ALVs) market chains and their farming practices, was administered to 302 households. Training on production and marketing of ALVs had previously been carried out in each of these regions through farmer groups.

Seed quality plays a major role in germination rate and percentage. The results showed that the seed germination rate was 148 percent higher in informal seeds for amaranth and 190 percent higher in nightshade than in formally-sourced seed. This indicated that formal ALV seeds do not necessarily offer farmers benefits in terms of seed quality. In addition, more formal seed would need to be purchased in order to compensate for low germination rates, adding to the financial burden of purchasing formal seed varieties.

For yield comparison (Box 1), the results showed that the informal seed varieties had greater fresh weight and leaf area than formal seed varieties for amaranth but not nightshade. Yield of amaranths from informal seed varieties was 57 percent higher than formal seeds and had 42 percent greater leaf area. These differences were not significant for nightshade varieties, but it is clear that formal seeds of either species are not providing sufficient benefits in terms of yield to growers. This suggests that an investment in purchasing seeds would not pay off through better ALV sales.

Local Institutions should be used to advance informal seed systems. These institutions can help communities organize themselves through innovative partnerships, provide them with new knowledge and skills, and build capacity, especially in quality seed handling including QDS production. They can empower members to pool financial resources for savings and meet expenses related to seed production, assist in providing labour for farm operations and provide agro-advisory services for input acquisition.

3. Policy issues and challenges for Kenya, Tanzania and Uganda

3.1 Kenya's seed sector and regulations, opportunities for an informal seed system and commercialization of farmers' varieties — highlighting major strides in policy change

By David Ombalo Otieno, Ministry of Agriculture, Kenya

3.1.1 Introduction to an integrated seed system

Policymakers and practitioners recognize that both the formal and informal seed systems have considerable strengths that need to be leveraged systematically. Neither system alone has been able to scale up positive benefits for a good range of crops.

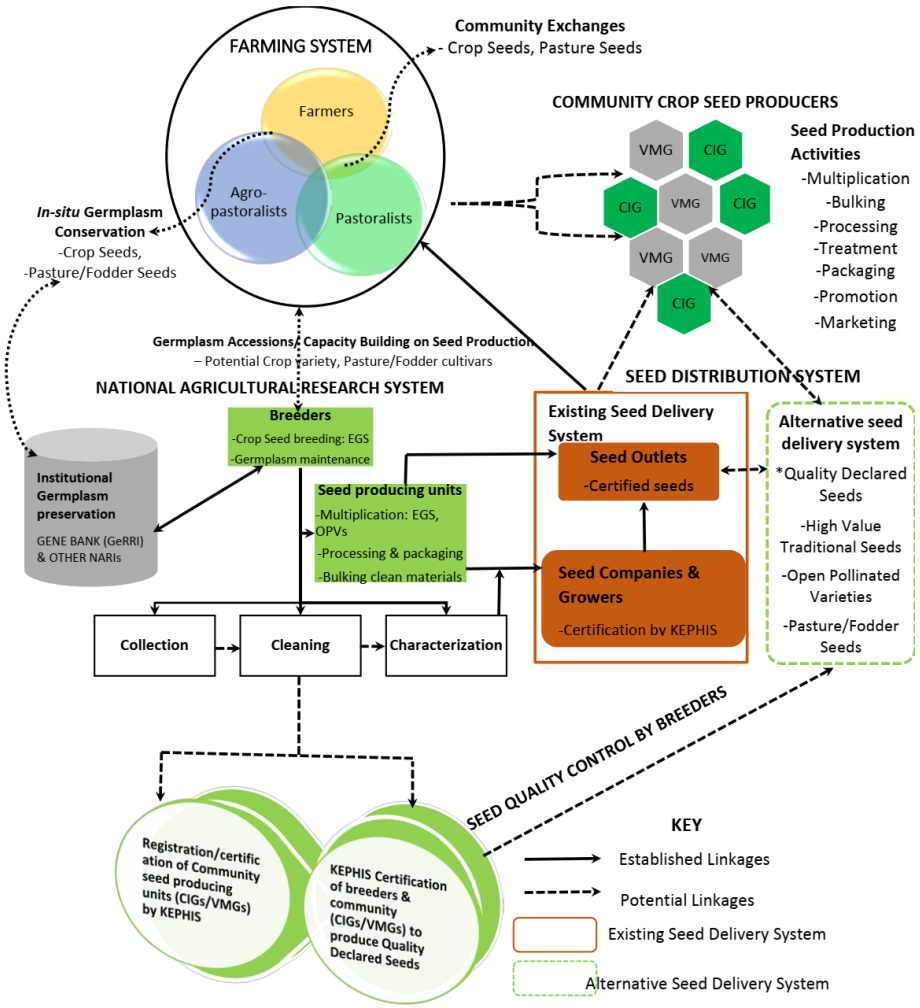


Figure 5: Integrated seed system in Kenya

The integrated seed system shown in Figure 5 shows how formal and informal systems work and interact in Kenya. The system essentially benefits from the input/flow of genetic

materials/germplasm. The formal seed system basically comprises three areas: (i) breeding, (ii) variety evaluation and release, and (iii) seed certification based on certain standards. Beyond this, improved varieties are prevented from circulating freely and easily in the seed system to incentivize breeders. The informal seed system, which in Figure 5 is referred to as an 'Alternative Seed Delivery System' (ASDS) is controlled in order to obtain seeds with an acceptable level of quality, including QDS. The Kenyan integrated seed system interactions need to be built upon so that each component of the system's potential can be exploited and assist in the delivery of quality seed to Kenyan farmers.

3.1.2 Scaling improved varieties and quality seed

Scaling the adoption of improved varieties and quality seed among smallholder farmers must include both formal and informal seed systems. In Kenya, there are certain crops that have done fairly well within the formal seed sector, a good example of which is maize. Maize has done fairly well in terms of high-yield, climate-tolerant varieties and Kenyan farmers and breeders will not want to erode these maize varieties, particularly when it comes to hybrid maize. The country should be able to gain in terms of yield and nutrition, even as it addresses the seed requirements in areas where the formal seed system has not been able to deliver in terms of seed requirements. The more formal channels of a seed system remain central to scaling. However, evidence shows that smallholder farmers source the majority of their seed from the informal system.

Kenya is known for having one of the best formal seed systems in sub-Saharan Africa, yet 65–70 percent of seed grown by smallholder farmers in the country is informal. To address this, Kenya has implemented a number of initiatives including creating ad hoc institutions. One such unit is the KALRO Seed Unit, established as a stop-gap to produce seed of open-pollinated varieties (OPVs) and high-value traditional crops not favoured by commercial seed companies. However, this has only partially addressed farmers' and growers' seed needs.

3.1.3 Policy, legal and regulatory framework

Kenya has the following seed sector policy/legal framework:

i. National Seed Policy, 2010
ii. Seed Law
    a. Seeds and Plant Varieties Act, Cap 326 and draft Legal notice for the review/revision of the Seeds and Plant Varieties Act, Cap 326, which is proposed to anchor the PGR laws implementing the Plant Treaty
iii. Seed Regulations
    a. Seeds and Plant Varieties (Seeds) Regulations, 2016
    b. Seeds and Plant Varieties (Plant Variety Evaluation and Release), 2016
    c. Seeds and Plant Varieties (Plant Breeders' Rights) Regulations, 1994
iv. Initiative and Programmes on Integrated Seed System

The objectives of the National Seed Policy of 2010 include:

- Provision of a sustainable financing system for research and development, germplasm conservation, extension, quality control and capacity building to fully exploit the potential of improved varieties and technologies for increased agricultural and forestry productivity
- Establishing an effective regulation, coordination, and management of all activities within the seed industry in order to tap into synergies and maximize resources for enhanced efficiency, including eradication of prevalence of adulterated seed.
- Building capacity and infrastructure within the seed industry to handle research and development, quality control, technology transfer and other emerging technologies such as genetically-modified organisms (GMOs), and information and communication technologies (ICTs).
- Create an enabling environment, through legal and policy reforms, for effective participation of both public and private sectors in the production of cost-effective and quality planting material.
- Harmonize regional seed policies and regulations to enhance cross-border trade in seed.
- Monitor seed supply situation in order to ensure adequate strategic seed reserves.

The Seeds and Plant Varieties Act, Cap326 was an Act of Parliament of 1972, which was revised in 2002, 2012 and recently in 2016. The purpose and objectives of this Act include:

- Establishing an index of plant variety names from which the National Variety lists are drawn
- Guiding the introduction of new varieties of plants
- Providing for measures to prevent injurious cross-pollination
- Provision for the testing and certification of seeds
- Conferring power for the regulation seed transactions in
- Controlling seed imports
- Providing the grant of proprietary rights to persons breeding or discovering and developing new varieties
- Establishing a national centre for plant genetic resources
- Establishing a Tribunal to hear appeals and other proceedings

3.1.4 Legal, regulatory, institutional and other programmes and initiatives to enhance integration

Kenya Climate Smart Agriculture Project (KCSAP) Seed Systems Manual

The Kenya Climate Smart Agriculture Project (KCSAP) has a subcomponent on Strengthening Climate-Smart Agricultural Research and Seed Systems, which also comprises

Building Competitive and Sustainable Seed Systems. The Seed Systems Manual has been developed as part to provide detailed guidance to the project implementing and executing agencies on the implementation of activities under "KCSAP Subcomponent on Building Competitive and Sustainable Seed Systems", the objectives of which are to:

i. Produce and maintain early generation seed and promote newly developed seed varieties
ii. Strengthen crop seed production systems
iii. Develop and strengthen alternative delivery systems for high value traditional seeds and OPVs
iv. Catalyze growth of competitive crop seed retail networks

This Seed Systems Manual systematically unpacks the What? How? Who? and When? and 'expected outputs' of the interventions to be undertake under the component. The subcomponent is financing crop, livestock and aquaculture breeding programmes, and the involvement of private sector interventions.

To achieve its objectives, four main intervention areas were identified as shown in Table 3.

Table 3: The Kenya Climate-Smart Agriculture Project; Building Competitive and Sustainable Seed Systems intervention areas

Intervention area	**Activities**
Production and maintenance of early-generation crop seeds and promoting newly-developed crop seed varieties	**Under the Formal Crop Seed System** Activity 1: Institutionalization of licensing and germplasm agreements Activity 2: Developing models for crop germplasm maintenance Activity 3: Developing a grant system to support early generation seeds (breeder and basic seeds) for high-value traditional crops (HVTCs) and OPVs **Under Informal Crop Seed System** Activity 1: Developing models for germplasm maintenance
Strengthening crop seed production systems	Activity 1: Undertaking market studies on improved crop seeds Activity 2: Identifying and strengthening community-based seed producing units Activity 3: Establishing a fellowship program to support training of crop seed producers Activity 4: Providing training in business development skills to owners of seed crop producing units Activity 5: Providing grants to crop seed production units for developing business plans
Developing and strengthening alternative delivery systems for high value traditional crop seeds and OPVs	Activity 1: Identification and formation of community seed producers: Activity 2: Capacity-building of seed production units: The existing training materials and modules Activity 3: Enhancing quality of HVTCs and OPVs Activity 4: Establishing and Supporting community-based storage, processing and distribution
Catalyzing growth of competitive crop seed retail networks, and rural communities, in the production and distribution of commercial seed	Activity 1: Assessing needs of crop input dealers Activity 2: Train, certify and geo-reference input dealers Activity 3: Strengthening linkages between input dealers and crop input wholesalers Activity 4: Establishing a revolving fund to support crop input dealers Activity 5: Providing institutional support to Seed Traders Association of Kenya (STAK) and Plant Breeders Association of Kenya (PBAK)

3.1.5 Challenges in seed production and distribution in Kenya and proposed interventions

In bid to address the gaps related to seed production and distribution in Kenya, a number of challenges and proposed interventions have been identified, as presented in Table 4.

Table 4: Producing and maintaining early-generation seed and promoting improved seed

Challenges	**Proposed Interventions**
Plant breeders have limited resources for breeding and maintaining early-generation seed especially, of OPVs and high-value traditional crops. Commercial seed companies have little interest in these crops and are not keen to support the promotion of many new and improved varieties whose market is not assured. Furthermore, there are no clear and firm arrangements on intellectual property rights (IPR)/royalties between breeders, parent institutions and seed companies. Thus, the need to bridge this gap.	• Institutionalization of licensing and germplasm agreements • Developing models for crop germplasm maintenance • Developing a grant system to support early-generation seeds (breeder and basic seeds) for HVTCs and OPVs
Crop seed, animal breeds and fingerling production systems are at different levels of development. The crop seed system appears to be more developed than the others. However, some commercial entities within the crop seed system are more advanced than others, which affects competition. Hence, the need for harmonization and increased support to the weaker entities.	• Undertake market studies on improved seeds and livestock and fish breeds • Identify and strengthen community-based seed and livestock germplasm production units • Establish a fellowship programme to support training • Provide training in business development skills • Provide grants to fingerling, crop seed and breeds production units for the developing business
High-value traditional crops and OPVs have for a long time been neglected. Yet, they constitute most of the essential food crops for nutrition security especially, of children and peoples living with certain disabilities, i.e. diabetes, HIV/Aids and cancer. However, commercial seed companies have shown little interest in these crops, either due to market uncertainties or limited economic returns from their sales.	• Identify common interest groups (CIGs)for high value traditional crops (HVTCs) seed production • Train the CIGs of the seed production unit on principles and practices of seed production • Register and certify groups • Support community-based storage, cleaning, packaging and selling/distribution systems • Provide grants to crop seed production units for developing business

3.1.6 Developing and strengthening alternative delivery systems for high-value traditional seeds and OPVs

Figure 6 represents a diagrammatic overview of the proposed system that Kenya wishes to adopt in the production of QDS. There are seed merchants, genebanks where OPVs and other genetic materials are held, and these are linked to community seed banks, which hold all manner of genetic resources, including varieties that developed that might no longer be of interest to the owners and yet remain available to the community. This interaction, at in-situ and ex-situ level, will ensure that all

these varieties remain available. Of course, they will be accessible to breeders, and seed merchants will choose those that have been developed so that there is basic certified class 1 and 2 seed. The community access these materials from the genebank and can produce first, second and third cycles of seed from the original, and then they can once again go back to obtain the original seed. In this way, it is possible to constantly maintain the quality seeds and replenish them, so that the quality is not eroded over many generations.

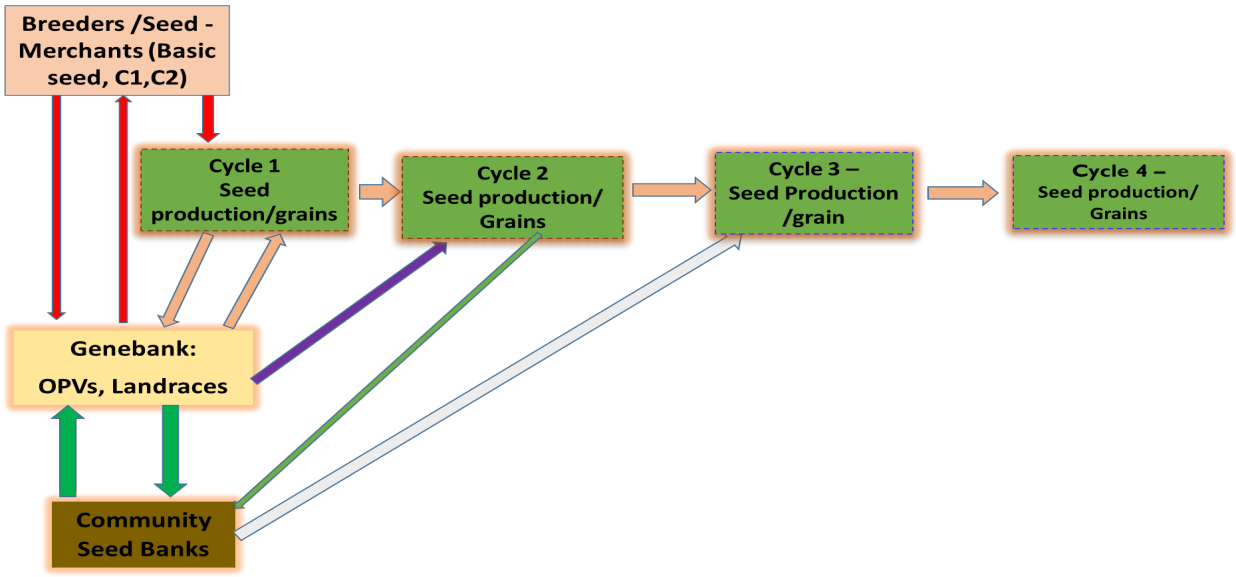


Figure 6: Diagrammatic overview of a possible Quality Declared Seed system model in Kenya

3.1.7 Catalyzing the growth of competitive seed retail networks

In order to catalyze growth and fair competitiveness in seed networks, a number of challenges need to be overcome. These and the proposed interventions to be adopted to overcome them are discussed in Table 5 below.

Table 5: Challenges affecting competitive seed market networks in Kenya and proposed interventions

Challenges	Proposed Interventions
The input retail networks in Kenya; commonly known as 'Agro Vets', supply most of the farm inputs including improved crop seed. The network dealers' professional background including level of training is not clear. However, farmers rely on the dealers for advice on suitability and quantities of the inputs, esp. seed varieties/types, fertilizer, livestock feeds & pesticide types/rates. Hence, need to identify their weakness and requirements	• Undertake a needs assessment of input dealers • Train, certify and geo-reference input dealers. • Support identified needs to strengthen linkages between input dealers and crop/livestock/aquaculture input wholesalers • Establish a credit guarantee scheme to support input dealers • Provide institutional support to Seed Traders Association of Kenya (STAK), Plant Breeders Association of Kenya (PBAK), Aqua-cultural Association of Kenya (AAK) and the Kenya Livestock Breeders Organization (KLBO). • Provide support to the development of a fisheries mobile information network platform.
Enabling a supportive policy and legal environment is crucial to the improvements envisaged in the seed systems. However, the current seed policy and legal framework remain out of step with the expected developments. Hence, need to review existing policy and legal framework, and to identify, develop and enact new and more appropriate seed policies, laws and regulations.	• Audit of the existing legal frameworks in the seed sector and a survey on quality of seeds breeds and species in the target counties will be made. • A stakeholder validation workshop will be held, to review and adopt the recommendations. • to advocate for relevant changes in the laws and legal frameworks to be consistent with the EAC harmonization protocols.

3.1.8 Policy legal and regulatory frameworks to support integrated seed systems

There are a number of seed sector policy/legal instruments under development. These include:

- Seed Industry Masterplan—this is a strategy document for the seed sector
- Seed Regulations
    a. Draft legal Notice on Seeds and Plant Varieties Act, Cap 326 (already reviewed to recognize a "Standard" Class of Seed and also reviewed to anchor PGR regulations that include the implementation of the Plant Treaty
    b. Draft Seed and Plant Varieties (Vegetatively Propagated Materials) Regulations
    c. Draft Seed and Plant Varieties (Conservation, Access and Benefits Sharing of Plant Genetic Resources)
    d. Draft Seed and Plant Varieties (Forest Trees) Regulations

3.1.9 Supporting a national public–private dialogue platforms on seed, breeds and fingerlings

For a very long time, different stakeholders have held divergent views on the seed sub-sector in Kenya specifically on hybrids versus farmers varieties. Policies are more oriented towards the formal seed sector which criminalizes the sale of seed from the informal sector and fail to recognize the informal sector's contribution to the seed sector which is currently 70 percent. The creation of national public–private dialogue (PPD) platforms is expected to offer a conducive discussion environment with the seed sub-sector stakeholders to achieve consensus on the way forward on many issues related to registration to include farmers' varieties. Relevant stakeholders need to be identified to form PPD platforms and also host and participate in workshops that address seed policy issues in Kenya.

3.2 Uganda's seed sector and regulations, and opportunities for an informal seed system and commercialization of farmers' varieties — highlighting new policy and regulatory developments

By Joyce Adokorach NARO Plant Genetic Resources Centre

3.2.1 Uganda's policy legal and regulatory framework

In Uganda's Second National Development Plan (2015/16 to 2019/2020), the country targeted maintaining all the genetic diversity of seeds and cultivated plants (farmed and domesticated) by 2020. However, this has been delayed but is in process.

In addition to the National Development Plan, the country also enacted a National Seed Policy Act of 2016. The Act has the following provisions:

> 3.1.2: Sustainably utilize and protect Uganda's national plant genetic resources; Government will ensure a viable and effective protection and exchange of germplasm for crop improvement.
>
> 3.2.2: Enhance production of quality seed within the informal seed system: Government will strengthen the capacity for production of quality seed for crops that have low profit margins for seed companies.
>
> 3.2.3: Strengthen seed distribution and marketing to enhance commercialization of quality seed: Government will promote an effective delivery mechanism for quality seeds to enhance uptake by smallholder farmers.
>
> 3.3.2: Quality control for Quality Declared Seed: Government will put in place appropriate seed quality standards and mechanism for regulation, production and sale of quality declared seed.

On the issue of access and benefit sharing, a memorandum of understanding (MoU) between three key institutions—National Environment Management Authority (NEMA), the National Agricultural Research organization (NARO) and Uganda National Council for Science and Technology (UNCST)—was signed to establish measures and procedures for harmonizing ABS laws under the

Nagoya Protocol and the Plant Treaty, and for strengthening institutional arrangements for their implementation. According to this memorandum, all requests for plant genetic resources related to agriculture are sent to NARO through the National Gene Bank, which hosts the focal person to the Plant Treaty. These requests are then reviewed by UNCST, which is the designated competent authority.

The Draft National PGRFA Policy is currently under review by stakeholders and will spell out how PGRFA are accessible and their shared benefits.

3.2.2 Legal and regulatory framework targets for/by 2022

- Draft PGRFA Policy (under review)
- Plant Variety Protection (PVP) Act (2014)
- ABS Regulations have been reviewed
- Plant and Seed Regulations provide for marketing of Traditional Varieties

The Draft PGRFA Policy has been in the making for quite some time and there are many lessons that have been learnt through its development, including:

- Understanding the existing legal and policy framework: its extent and limitations
- Understanding government aspirations and how stakeholders' efforts can contribute to shaping policy
- Mapping and understanding the needs and fears of the key stakeholders
- Understanding and analysing the strengths, weaknesses, opportunities and threats of stakeholders
- Creating awareness to bridge the perceived policy gaps with evidence
- Capacity building and re-tooling of technical personnel
- Creating alliances among stakeholders
- Identifying seed policy champions
- Rigorous and open engagements
- Wide-scale consultations

For some time, Uganda has needed to revise its legislation—mainly the Seed and Plant Act of 2006—to support the seed sector. That was followed by the Plant Variety Protection (PVP) Act of 2014 and, most recently, the National Seed Policy of 2018. Listing traditional varieties was a target for 2020. However, this provision is embedded in the National Seed Policy of 2018, but not in the PVP Act of 2014, which is the main Article. This means that the PVP Act of 2014 needs to be revised/emended so that it aligns with the National Seed Policy of 2018.

3.3 Tanzania's seed sector and regulations, opportunities for an informal seed system and commercialization of farmers' varieties—highlighting new policy developments

By William Chitula Hamisy, Tanzania Plant Genetic Resource Centre

Tanzania has an official seed certification body known as Tanzania Official Seed Certification (TOSCI), which is mandated with ensuring that seeds being produced in the country meet the required quality standards. The country has formal and informal seed systems. The formal seed system is only able to supply six percent of the seeds required by the country. This system targets very few crops that are considered to be of high value and profitable like maize and beans. The informal system accounts for 75–80 percent of the seeds being used in the country. The seeds used under informal systems are mainly farmers' varieties, with some improved varieties, which have been around and in the hands of farmers for quite some time. These varieties, after being used, saved and multiplied by farmers, also become part of the informal seed system.

The country recognizes and is using three types or categories of seed:

i. Improved varieties. These are bred and released by breeders. This category of seed is approved by TOSCI, the seed certification body, before they are multiplied and sold to farmers.

ii. Quality declared seeds. These are local varieties that have been certified and approved to be multiplied and sold in a specified region

iii. Farmers' varieties or landraces. Farmers are allowed to multiply, exchange and use these, but are not allowed to sell them as seeds.

3.3.1 Legal and policy frameworks

- ***National Agricultural Policy of 2013***. Aims to develop efficient, competitive and a qualitative agricultural industry for secure livelihoods and poverty reduction. Its focus is to transform agriculture from subsistence to commercial. This policy emphasizes varietal diversification and infrastructural development. Within this policy, there are initiatives to support germplasm and agroecosystem conservation, and to introduce genetically-suitable and preferred materials. This policy recognizes farmers as the largest contributors and the main source of seeds in the country.
- ***Seed Act of 2007***. The Act aimed to control and promote good quality agricultural seeds. The main focus of this Act was on ensuring that improved varieties, breeders' and quality declared seeds produced in Tanzania were of high quality. It also controlled importation, exportation, multiplication and sales of seeds in the country. This Act recognizes QDS and has stipulated the procedures that seeds undergo in order to be declared as QDS. Farmers' varieties have to undergo a similar procedure in order to qualify to be declared as QDS.
- ***Seed Act of 2017***. The 2007 Seed Act was amended in 2017, to set procedures for implementing the Plant Breeders' Act, which aims to protect the varieties breeders are developing.

On ABS, Tanzania is party to both the Plant Treaty and the Nagoya Protocol. Access to PGRFA is therefore in accordance with the Plant Treaty, whereby requests for PGRFA are made directly to the national genebank—which hosts the focal person—and the genebank releases the material under SMTA conditions.

4. Upscaling selected varieties: Options and challenges related to policy

By Gloria Otieno, Alliance of Bioversity International and CIAT

There are currently three possible pathways for the use and commercialization of varieties selected varieties (Figure 7):

i. Direct use of the best-performing varieties by farmers from and to the various seedbanks, i.e. through the seedbank 'model' of borrowing and returning seed. The seeds are then made available for use to more farmers within the same locality. This pathway also encourages conservation and ensures seed security for farmers.

ii. Breeding and development of new varieties. Selected elite lines can be further developed into 'new varieties' through participatory plant breeding (PPB). The varieties would be registered and released in the countries where they were developed.

iii. Direct commercialization of the varieties by farmers' groups or seed cooperatives through alternative quality assurance mechanisms such as QDS.

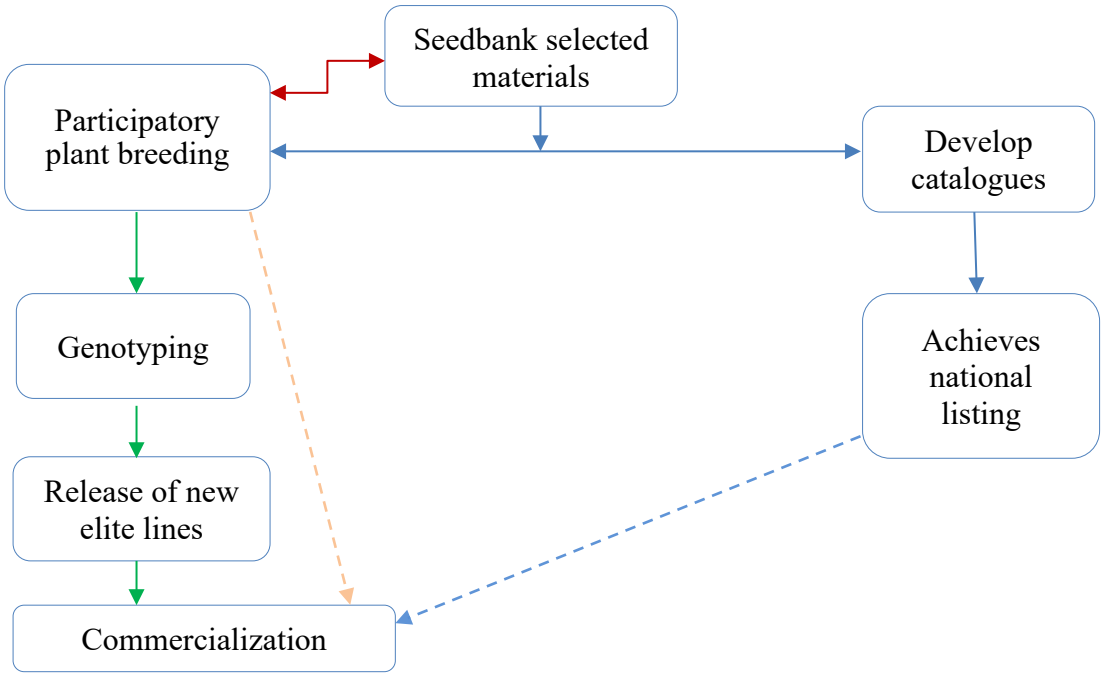


Figure 7: Available pathways for use of farmers' prioritized varieties

Legend: —Direct use of the best-performing varieties by farmers; —Breeding and development of new varieties; --- /--- Direct commercialization of the varieties)

Kenya, Tanzania and Uganda have different seed policy regimes that may either promote or hinder dissemination of selected varieties for the use and commercialization through these three main pathways. In this context, it is important to pause and consider the situation wherein materials received under the SMTA are found to be ready to scale-up for use in production in the form in which they were received under the SMTA, either for direct use in cultivation or for commercialization. We therefore need to address the following questions:

- How can we enable direct use of SMTA-sourced materials for cultivation by farmers? Can this be done through further discussions with the countries that provided the germplasm?
- How can we then commercialize the materials directly or as derivatives?
    - Registration is a mandatory pre-requisite for commercialization
    - Commercialization through alternative quality assurance mechanisms (e.g. QDS) since these are farmers' varieties
- In the event of commercialization, how can accruing benefits be shared back with original providers of the genetic resources?

According to Article 12.4 of the Plant Treaty, facilitated access to PGRFA in the Multilateral System shall be provided by contracting parties using the SMTA adopted by the Plant Treaty's Governing Body. Under Article 6.1 of the SMTA (see Section 7.1) recipients can use or conserve the materials transferred under the SMTA only for purposes of research, breeding and training for food and agriculture. Furthermore, if the recipient conserves the material, they agree to pass it on to others who request it using the SMTA.

4.1 SMTA and the Multilateral System of Access and Benefit Sharing

Article 6.1 of the SMTA states that the Recipient undertakes that the Material shall be used or conserved only for the purposes of research, breeding and training for food and agriculture. Such purposes shall not include chemical, pharmaceutical and/or other non-food/feed industrial uses. Article 6.2 states that the Recipient shall not claim any intellectual property or other rights that limit the facilitated access to the Material provided under this Agreement, or its genetic parts or components, in the form received from the Multilateral System. Under such provisions, what options remain open to us under the OSSS initiative?

4.2 SMTA for commercialization

The following are the provisions for commercialization of materials that are exchanged using SMTAs:

- **Article 6.7**. In the case that the Recipient commercializes a Product that is a Plant Genetic Resource for Food and Agriculture and that incorporates Material as referred to in Article 3 of this Agreement, and where such Product is not available without restriction to others for further research and breeding, the Recipient shall pay a fixed percentage of the Sales of the commercialized Product into the mechanism established by the Governing Body for this purpose, in accordance with Annex 2 to this Agreement.

- **Article 6.8**. In the case that the Recipient commercializes a Product that is a Plant Genetic Resource for Food and Agriculture and that incorporates Material as referred to in Article 3 of this Agreement and where that Product is available without restriction to others for further research and breeding, the Recipient is encouraged to make voluntary payments into the mechanism established by the Governing Body for this purpose in accordance with Annex 2 to this Agreement.

However, in our case, we are considering commercializing materials: (a) in the form in which they were received (or only altered very slightly) under the SMTA, (b) not incorporated into new varieties through breeding crossing. This use of the materials is not included in the scope of the SMTA and requires additional permissions from the countries that supplied the germplasm.

It may be, in fact, that other rules apply to those materials, depending on the laws in place in the countries from which and at the time they were obtained. It is therefore necessary to investigate if the materials are subject to such laws/restrictions and, where necessary, seek permission from the legal providers of those materials (and from whomever else may be involved under the national law). Of course, this process can be complex and time consuming and may ultimately lead to a refusal to grant use of the materials as desired (Otieno et al., 2020).

Variations of these questions were considered by the Ad Hoc Technical Advisory Committee on the Multilateral System and the Standard Material Transfer Agreement (TAC-MLS/SMTA). As its name suggests, this body was created by the Plant Treaty's Governing Body to consider legal issues associated with the daily operation of the MS and the use of the SMTA. In its published 'Opinion 10', the TAC-MLS/SMTA opined, among other things, that

> "PGRFA received under the SMTA can be made available to farmers for direct use for cultivation only if there is a separate express permission allowing for such distribution from the provider that included such material in the Multilateral System. No such permission would be required where germplasm is being restored to farmers that originally provided it. PGRFA distributed to farmers for direct use for cultivation should not be transferred with the SMTA."

In this case national genebanks and national governments that provided the PGRFA would need to be involved in further discussion to provide permissions or direct use or commercialization of such varieties.

4.3 Summary of the policy environment in Kenya, Tanzania and Uganda

In the context of the SMTA, as described above in sections 4.1 and 4.2 above, all subsequent use of materials derived from germplasm accessed from the MLS must comply with and pass on the legal terms and conditions related to uses and monetary benefit sharing.

Since the recipients of the germplasm in the three countries would like to use the materials directly for cultivation and/or commercialization they must seek permission from the providers to do so under additional conditions. These additional conditions may be subject to the national legal and regulatory

environment of the countries that provided the materials. It may be that other rules apply to those materials, depending on the laws in place in the countries from which they were obtained, at the time they were obtained. It is necessary to investigate if the materials are subject to such laws/restrictions and, if they are, seek permission from the legal providers of those materials (and from whomever else may be required under the national law).

A quick look at the national laws reveals that:

- None of the three countries' ABS policies spell out any exemptions for the direct use and cultivation of MLS materials. All the three countries follow the SMTA conditions for providing the materials; therefore for any use other than what is specified in the SMTA, additional requests must be made from the providers of the materials.
- On commercialization:
    - Varieties must first be registered in all the three countries before they can be commercialized, which means that the MLS materials must first go through a process of either breeding or farmer registration for them to be commercialized in any of the three countries.
    - Registration of farmers' varieties is not yet possible in the three countries; however, Uganda is currently working on the modalities for the registration of farmers' varieties.
    - Production of QDS is allowed in Tanzania and Uganda but not in Kenya. However, Kenya has introduced a standard class of seed that does not require stringent regulations for its production. In addition, a seed manual that recognizes farmers' varieties is being drafted in collaboration with KCSAP and other stakeholders.

Given the above-mentioned issue on ABS and on commercialization, it is imperative to facilitate the direct use and subsequent commercialization of the best-performing MLS materials exchanged using SMTAs between the three countries. This is not currently possible and may require additional permissions from the providers of the materials exchanged and is an avenue which is being further pursued.

On commercialization, an option discussed by the workshop participants is that the parties can enter into a regional arrangement whereby, if the varieties are released in one of the countries, say Uganda, they can still also be commercialized in the other two, e.g. Kenya and Tanzania. A good example of regional agreements is the COMESA Seed Trade Harmonization Regulations of 2014, which states that:

"Varieties that have been registered and released in one COMESA Member State (tier 2) are eligible for an expedited or "fast track" process, where only **one** season of DUS and VCU testing is required (confirmation test), along with DUS and VCU information from the original Member State."

It further states that:

"If a variety has already been registered and released in at least two COMESA Member States (tier 3), no additional testing is required, and an application can be made for immediate entry in the COMESA

Variety Catalogue, provided that the application contains the necessary DUS and VCU data." This may provide the flexibility needed to register and use the varieties within the project.

5. Policy developments in strengthening and promoting farmers' varieties in Ethiopia: breeding, registration and release

By Degene Mengistu and Mulugeta Tilahun, Alliance of Bioversity International and CIAT, Ethiopia

In Ethiopia, crop improvement (breeding) and seed provision (from the formal sector) is mainly done by public institutions. These are federal and regional research institutions, higher education bodies, federal and regional seed enterprises. Breeding is carried out for cereals, pulses, oil crops, fruits, vegetables and fibre crops. Table 6 summarizes the crops included in Ethiopia's breeding programme and Table 7 provides a glimpse of Ethiopia's breeding system strengths and weaknesses.

Table 6: Major commodities in Ethiopia's breeding programme

Cereals	Pulses	Oil crops	Fibre crops	Horticultural crops
Wheat	Faba bean	Sesame	Cotton	Vegetables
Barley	Field pea	Line seed		Fruits
Maize	Chickpea	Niger seed		Root and tubers
Sorghum	Haricot bean			
Tef	Lentil			
Finger millet	Mung bean			
Rice				

Table 7: Strengths and weaknesses of the Ethiopian breeding system

Ethiopian Breeding System	
Strengths	**Weaknesses**

• Decentralized breeding system (at federal and regional levels)
• Represent major agroecologies
• Under the public domain
• Financed and managed by public institutions
• Safeguards farmers from being exploited by private breeding and seed companies
• Has developed several varieties of target crops
• Ethiopia has developed competent and effective breeding programmes in the region. e.g. wheat breeding is the biggest in Africa
	• Mainly depends on introduced exotic materials
	• Undermines the use of diverse local genetic resources
	• Is less successful in marginal production areas:
	  o Lower adoption rate of developed varieties through the breeding system
	  o Low productivity in marginal areas and farmers unable to ensure food security

5.1 Participatory plant breeding and participatory varietal selection in Ethiopia

The introduction of participatory plant breeding (PPB) and participatory varietal selection (PVS) into Ethiopia over two decades ago has resulted in improved breeding efficiency in marginal environments.

Farmers were empowered to make decisions on which variety to promote and their participation was disaggregated by sex. Food productivity gradually increased in the marginal areas as the conventional, centralized breeding was gradually replaced by PPB.

PPB was used for the production of 373 landraces/farmers' varieties and 27 improved varieties of Durum wheat. At the phenotyping stage, many superior landraces were identified with yield advantage of up to 62 percent over the best improved variety. Top performing landraces/farmers' varieties were identified and distributed to farmers through crowdsourcing for further evaluation and selection.

Additional PPB, involving 31 farmers' varieties and 5 improved varieties, was carried out at four locations over two years. As a result, two farmers' varieties qualified for release and registration, e.g. Wehabit (4t/ha) and Rigeat (5t/ha). These varieties have broader adaptation potential and, in highly potential areas like Arsi and Bale, they can produce up to 9.6t/ha. The other selected farmers' varieties are now being utilized in breeding programmes.

5.2 Policy and legislative framework environments

Varieties released from farmers' varietal selection for a particular environment, seed multiplication and marketing face a major challenge in entering the commercialization stream through the formal seed system. National and regional seed enterprises are profit oriented and only selectively multiply seed, as the system has limited capacity to multiply and sell all released crop varieties.

The alternative or intermediate seed system works for seed producer cooperatives (SPCs). They multiply and sell improved varieties and QDS. Community seed banks have also been evolving into seed producers and marketers, besides maintaining seeds. CSBs are being used to multiply and disseminate released varieties. The Alliance project team based in Ethiopian is currently working with five CSBs and many SPCs, as they are good channels for variety dissemination.

Ethiopia's national seed and variety release policy has been revised (Seed Policy 2020—available in Amharic). The policy will support highly-productive, biotic- and abiotic- stress tolerant, quality crop varieties and that are liked by the end-user. To achieve these requirements, the new policy document recognizes:

- The use of local crop/animal diversity for crop improvement. This is lacking in the previous seed and variety development directives
- Variety development primarily to solve farmers' problems of productivity and adaptation to climate change.
- Variety release and registration policy is still biased towards distinctiveness, uniformity and stability (DUS) criteria.

Despite the 2020 Seed Policy recognizing the use of local crop and farmers' varieties in breeding programmes, it poses a limitation to the final breeding output to obey the laws of DUS, thereby:

- Limiting the release of non-uniform farmers' varieties, forcing them to undergo rigorous selection pressure to purify the heterogeneous varieties.

- Limiting the commercialization of farmers' varieties as a seed
- Not recognizing the importance of growing heterogeneous populations to buffer climate change-related stresses.

The previous seed and variety release policy did not recognize the utility of local crop varieties. It did not recommend the use of farmers' varieties in breeding programmes, neither did it recognize the breeders'/farmers' rights and other intellectual property rights.

Nonetheless, strides have been made. The current seed and variety release policy has embedded many improvements on these issues. This implies that the policymakers have been influenced by the impact of research and other participatory approaches. National dialogues on seed and breeding systems have been carried out to inform the current policy.

6. Proposing Regional Seed Hub

6.1 Policy developments in the region and introducing the Regional Seed Hub concept

By Gloria Otieno, Alliance of Bioversity International and CIAT

The 'Regional Seed Hub' (RSH) concept aims to bring together all researchers working on PPB in the region, including those who attended training on resilient seed systems in Ethiopia in 2019 and have already received training in resilient seed system methodologies. The target is to have a pool of experts dealing with inter-linked issues of genetic resources' mobilization, PPB, seed systems and seed policies. The RSH also aims to act as a knowledge and information exchange platform where methodologies and information on certain crop varieties will be shared and where the scaling of best practices—for example community seed banking and participatory plant breeding—will be promoted. The Hub will also act as a policy discussion platform aimed at identifying how to harmonize and drive progress on common regional policy advocacy issues, such as registration and commercialization of famers' varieties. This includes learning from other countries like Ethiopia where the Bioversity International *Seeds for Needs* initiative has been successfully ongoing for the past decade and has resulted in the registration and release of two local wheat varieties into the national seed register.

The RSH policy brief (see Appendix III for further details about the proposed functions and operationalization of the Hub) outlines an idea that is still being developed and consolidated, to be shared with various key stakeholders for backing and traction. The Regional Policy Workshop participants proposed a number of concepts for inclusion in the Regional Seed Hub and agreed on the following points:

- There are key projects in the region that the RSH concept could build upon. For example, an active sub-project in southern Africa—including the Southern Africa Development Community (SADC) region that includes Tanzania—that aims to harmonize and streamline policies on ABD for in-situ materials and crop wild relatives. Guidelines are being developed on how these materials can be accessed with minimal transaction costs or bureaucratic hurdles, prior-informed consent issues, MTAs etc. The SADC region has a regional genebank—SADC

Plant Genetic Resource Centre (SPGRC) and has already harmonized guidelines on ex-situ and in-situ conservation, on how collections of genetic resources can be put together in the SADC region.

- The Hub could be useful for collecting information on the availability of regional genetic resources and the modalities to access them. Additionally, and as a longer-term goal, participants suggested it could enable the building of a common regional seed/genebank for better conservation and access to germplasm, especially in the East African Region. However, participants agreed that the main aim of the Hub would be to principally to support extensive information sharing about regional genetic resources, including modalities of how these materials can be shared across the region.
- Looking at the regional seed system, most crop varieties are not well documented, and the region lacks a platform or portal where stakeholders and partners can log in and search for information about regional germplasm; for example, varieties to suit a particular need. There are no catalogues indicating varieties' specific qualities, like drought or disease tolerance. The Hub should definitely focus on addressing this gap.
- The Hub should work on harmonizing regional seed policies to lift restrictions on seed movements within the region in both the formal and informal sectors. For example, a regional platform for community seed banks would enhance the exchange of farmers' varieties across the RSH member countries.
- The Hub should include private sector actors, as they are one of the main players and influencers of seed systems. This will also introduce their perspective and enable harmonization processes. Bringing together all the parties will enhance the implementation process of the idea behind the Hub.
- The RSH should ideally include multi-stakeholder platforms at the country level in each of the RSH countries. The RSH should therefore draft documents that target key country-level actors to be the equivalent of focal points and who will be equipped to drive processes and ensure that issues agreed upon are followed up at country level. When country-level issues are discussed, one of the major stumbling blocks is often no or little follow-up action because the right country-level actors/stakeholders were not brought onboard.
- In the foreseeable future, there will be a need for more meetings around the seed hub idea, in order to speak with high-level actors and address the most important issues.
- Communication aspects should be given priority, especially with the media, to ensure that information generated by the RSH is disseminated broadly to general and that it correctly targets specific audiences.

The RSH idea was meant to be endorsed at the Workshop, but since the Plant Treaty focal persons (national genebank curators) were not physically present at the workshop, it was agreed that another meeting should be held with everyone present. The endorsement meeting should include high-level representatives of the Plant Treaty, including the regional focal persons, researchers and representatives of different regional seed systems programmes. Once endorsed, the RSH will be hosted by a pan-regional consortium of resilient seed-system stakeholders, to be agreed upon at the meeting.

7. Conclusions and recommendations

The Regional Policy Workshop objectives were fully achieved. The workshop provided an excellent opportunity for mutual learning of the three countries on what seed system efforts are being implemented, particularly concerning policy-related issues.

Discussions on the way forward for commercialization, direct use and/or further breeding and release of the selected varieties between the countries were fruitful. The workshop discussions highlighted key issues related to the implementation of the Plant Treaty's MLS of ABS, specifically in relation to the dissemination and upscaling of varieties that are exchanged through the MLS using the SMTA. Although the SMTA permits materials to be used only for research purposes and breeding, farmers from the three countries have expressed interest in scaling up the varieties for direct use in cultivation, as well as for commercialization. This will require additional agreements to be formulated between the three countries to facilitate and streamline these exchanges.

The Regional Seed Hub concept was fully endorsed by the participants, generating strong interest and confirming participants' full engagement in the initiative. This confirms the importance of engaging with the partners as the idea is further developed.

One main outcome of the workshop will be a high-level meeting, agreed upon by the participants, to further discuss a number of key issues arising from the workshop. Some of these issues and quick action points include:

- Promptly tackling the issue of direct use and commercialization of the materials that were exchanged during the project between the three countries through additional MTAs.
- Again, reviewing the policies at country level and mutually sharing further information on best practices borrowed from each other.
- Pursuing a review of policies to strengthen farmers' seed systems.
- Harmonizing policies at the regional level.
- Regional Seed Hub endorsement.

All the participants felt that future meetings should include representatives from SADC and EAC in order to tap into their experience, knowledge, good practices and lessons learned.

Appendix I: Policy Workshop Programme

Day 1: 1 April 2021

Time	Programme
09:00-09:20	Introduction of the participants
	Welcome and opening of the workshop Background and objectives of the workshop *Gloria Otieno and Suzanne Ngo-Eyok, Alliance of Bioversity International and CIAT*
Session 1: Setting the scene	
09:20-09:40	Project highlights and related outputs; and dissemination of seed catalogues *Gloria Otieno, Alliance of Bioversity International and CIAT*
09:40-10:10	Research process and selected varieties in the catalogues *Tobias Recha, Alliance of Bioversity International and CIAT*
10:10-10:40	Formal and informal seed systems for climate-change adaptation: Empirical evidence and success stories on the contribution of indigenous knowledge and local varieties to food and nutrition security for climate change adaptation *John Recha, Climate Change, Agriculture and Food Security (CCAFS-East Africa (Virtual)*
10:40-11:00	Coffee/Tea break
Session 2: Policy Issues and Challenges	
11:00-11:10	Kenya's seed sector and regulations, opportunities for informal seed systems and commercialization of farmers' varieties — highlighting major strides in policy change *David Ombalo & Desterio Nyamongo*
11:10-12:00	Uganda's seed sector and regulations, opportunities for informal seed systems and commercialization of farmers' varieties — highlighting new policy and regulatory developments *John Wasswa Mulumba – NARO Plant Genetic Resources Centre (Virtual)*
12:00-12:30	Tanzania's seed sector and regulations, opportunities for informal seed systems and commercialization of farmers' varieties — highlighting new policy developments *William Chitula Hamisy, Tanzania Plant Genetic Resource Centre (Virtual)*
12:30-13:00	Upscaling selected varieties: Options and challenges related to policy *Gloria Otieno, Alliance of Bioversity International and CIAT*
13:00-14:00	Lunch break
Session 3: Panel discussion	

14:00-15:30	Introduction to the MLS and ITPGRFA and SMTA provisions: how countries are implementing MLS and SMTA provisions *John Mulumba, NARO Plant Genetic Resource Center (Virtual)* *Desterio Nyamongo, KALRO, Genetic Resources and Research Institute* *William Chitula Hamisy, Tanzanian Plant Genetic Resources Centre (Virtual)*
15:30-16:00	Group discussions and contributions to the regional policy brief
16:00-16:30	Coffee/Tea Break
16:30-17:00	Recap and summary of the day and action points
	Closing of the day

Day 2: 2 April 2021

Time	**Programme**
Session 4: Contributions to a regional policy brief	
09:00-9:30:	Policy developments in strengthening and promoting farmers' varieties in Ethiopia: Farmers' varieties: breeding, registration and releases *Dejene Mengistu and Mulugeta Tilahun, Alliance of Bioversity International and CIAT, Ethiopia*
09:00-9:30:	Policy development in the region and introducing the seed hub concept *Gloria Otieno, Alliance of Bioversity International and CIAT*
09:30-10:00	Seed Hub Endorsement *ALL*
10:00 -10:30	Closing Remarks *Suzanne Ngo-Eyok and Gloria Otieno, Alliance of Bioversity International and CIAT*
10:30-11:00	**Coffee/Tea break**
11:00-13:00	Departure

Appendix II: List of Participants

No.	Title	Guest	Organization
1	Dr.	Desterio Nyamongo	Genetic Resources and Research Institute, Kenya
2	Mr.	David Ombalo	Ministry of Agriculture, Kenya
3	Dr.	Japheth Jamoza	Kenya Plant Health Inspectorate Services
4	Mr.	Dalmus Mitei	Seed Savers Network Kenya
5	Dr.	Gloria Otieno	Alliance of Bioversity International and CIAT, Uganda
6	Mr.	Tobias Recha	Alliance of Bioversity International and CIAT, Uganda
7	Mr.	Godwill Abiti	Alliance of Bioversity International and CIAT, Uganda
8	Dr.	Dejene Mengistu	Alliance of Bioversity International and CIAT, Ethiopia
9	Dr.	Mulugeta Tilahun	Alliance of Bioversity International and CIAT, Ethiopia
10	Dr.	Suzanne Ngo-Eyok	Alliance of Bioversity International and CIAT, Kenya
11	Ms	Caroline Alango	Dashcrop Ltd, Kenya
12	Ms	Joyce Adokorach	National Agricultural Research Organization of Uganda
13	Dr.	Ronald Kakeeto	National Agricultural Research Organization of Uganda
14	Dr.	John Waswa Mulumba	National Agricultural Research Organization of Uganda
15	Dr.	John Recha	CGIAR Program on Climate Change Agriculture and Food Security in East Africa
16	Mr.	Siraj Nyende	Ministry of Agricultural Animal Industry and Fisheries of Uganda
17	Ms	Helen Were	Nyando community seed bank
18	Mr.	Daniel Koech	Upper Nyando Community Seed Bank
19	Dr.	William Chitula Hamisy	Tanzania Plant Genetic Resource Centre
20	Ms	Evelyn Kugonza	Hoima Community seed bank, Uganda
21	Ms	Rachel Kibui	Nation Media Group of Kenya
22	Ms	Wanjiru Macharia	National Media Group of Kenya

Appendix III: Draft Regional Seed Hub Policy Brief

Seed Hubs for East and Southern Africa: mobilizing knowledge and resources for resilient seed systems

Research and Development for biologically-rich, climate-resilient seed systems

Farmers in Africa are facing unprecedented challenges to deal with changing and anomalous climates and related crop management problems caused by (new) biotic and abiotic stresses. With the exception of a few crops that are amenable to, and benefit from, substantial investment from the private and public sectors, current seed systems are not providing farmers with effective and timely access to and adequate supply of good quality seeds (or other reproductive materials) for important food security crops, fruits and vegetables. Poor seed access and availability are major obstacles to improve a country's seed and food security. Under supportive policy and socioeconomic conditions, a diversity of seed production and distribution practices makes up a resilient seed system. A resilient seed system contributes to greater food availability throughout the year, the production of more nutritious and healthy crops, income generation and a sustainable resource base. These outcomes together will contribute to greater resilience of food systems. Figure 1 represents a framework to analyze seed-food system components and interactions.

Figure 1. Framework for resilient seed systems for healthy food systems

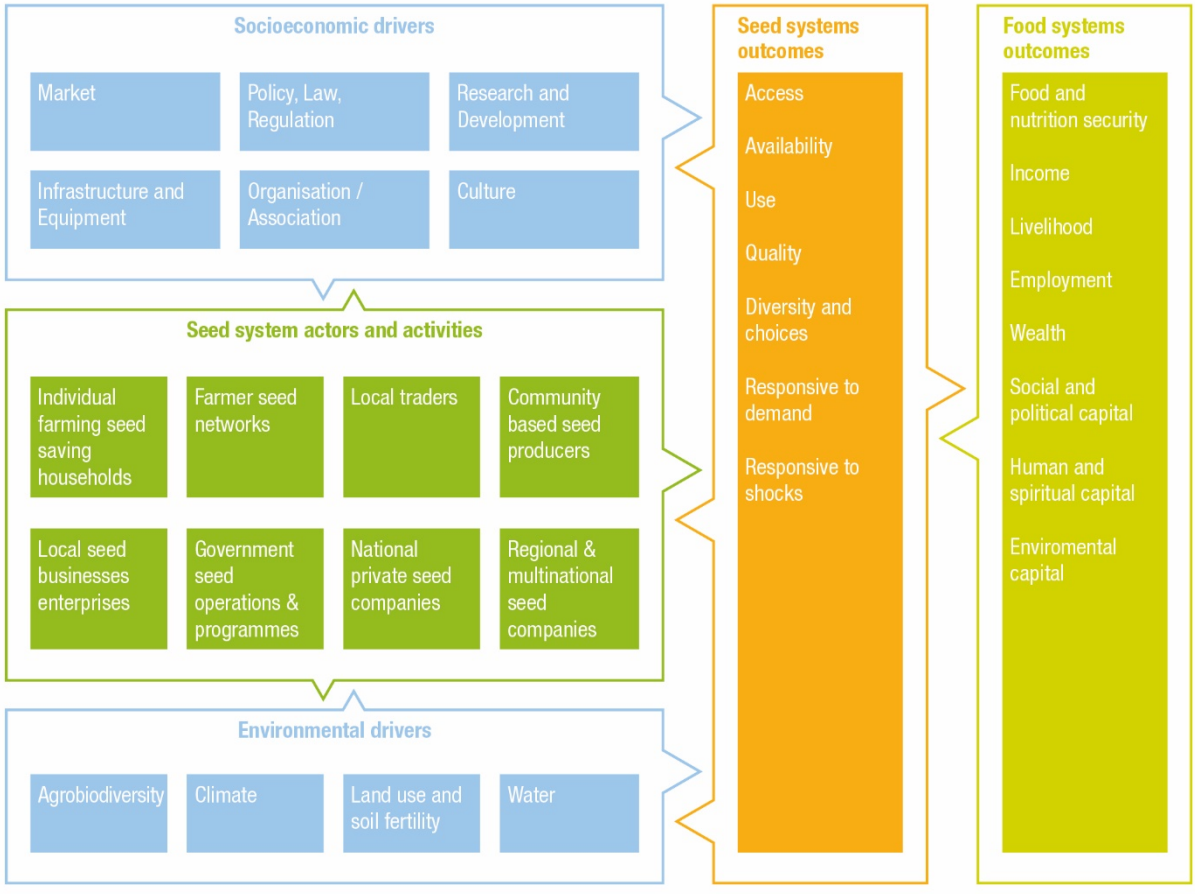


Figure 1. Framework for resilient seed systems to support healthy food systems

Source: Subedi, A. and Vernooy, R. 2019. Healthy Food Systems Require Resilient Seed Systems. In Bioversity International, Agrobiodiversity Index Report 2019: Risk and Resilience. Bioversity International, Rome, Italy, pp. 127-134. Available: https://hdl.handle.net/10568/100820

In recent years, there have been some scattered successful pilot efforts to provide solutions to improve underperforming seed systems.[6] Solutions include:

- Identification and testing of promising varieties for climate change adaptation in national and international genepools
- Joint scientist-farmer characterization, documentation and conservation of crop diversity, based on key functional traits
- Participatory variety selection using crowdsourcing, citizen science and Information Communication Technologies (ICT)
- Community protocols regarding access and benefit-sharing of genetic resources
- Establishment and support of multifunctional community seed banks and connecting them to national genebanks for country-wide systems of plant genetic resources conservation and sustainable use
- Revision or reform of national policies concerning plant genetic resources and seed
- Mutually-supportive implementation of international agreements concerning access and benefit-sharing of genetic resources
- Alternative variety registration systems and seed certification mechanisms
- Establishment and support of community-based seed enterprises

There is now an urgent need (aggravated by the negative impact of Covid-19 on seed systems) to scale-up these strategies through capacity and institutional strengthening from community to subregional levels. The scaling goal is to enhance the functioning of African seed systems and provide every African smallholder farmer access to a secure and diversified supply of quality seed (or other reproductive materials) suitable for local conditions. In practice, this means increasing the availability and use of genetic diversity by farmers, plant breeders, extension agencies and rural development planners, as part of their strategies to adapt to climate change and improve livelihoods. The strategic use of crop diversity can benefit from improved information provision about seeds and climate and better technical and financial support from formal sector agencies. Central to the scaling efforts is the engagement with multiple stakeholders including the private seed sector, civil society organizations, agriculture research and education organizations and local and national governmental and non-governmental organizations that are well-positioned to take up and further develop strategies, methods and tools and integrate them in their daily work.

Subregional Seed Hubs

While some of related research and development work in this area can take place entirely within a particular country's borders, efficient scaling strategies will require unprecedented levels of cooperation (and cost sharing) between countries. Climate changes will often impact in similar (if not identical) ways on rain fed cropping systems in contiguous agroecologies that are divided only be national borders. It makes sense in such cases for the countries concerned to work together. This can be done by pooling the genetic resources whose performance they want to evaluate in test sites across the areas concerned, sharing evaluation information, jointly supporting crop enhancement efforts (if more breeding is appropriate) and developing agronomic

[6] Examples are the Integrated Seed Sector Development programs in Ethiopia and Uganda, the Genetic Resources Policy Initiative in Rwanda and Uganda, and the Sowing Diversity=Harvesting Security project in Uganda and Zimbabwe. For more information: https://issdethiopia.org/; https://hdl.handle.net/10568/106023; https://issduganda.org/; https://www.sdhsprogram.org/.

training materials for extension agents and farmers concerned in both countries. Alternatively, it can also happen, given the migrating nature of climate changes, that parts of one country may be experiencing climatic conditions like those that were previously experienced in another country; with the result that crop varieties have evolved and coping mechanisms have been developed in the latter country that could help the former, and vice versa.

Given scarce resources for genetic resources evaluation networks and national breeding programs it makes sense for countries with common or complementary climate change and agricultural production challenges to pool their scarce resources in support of mutually satisfactory outcomes.

Not only the research and development activities, but also the exercise of public authorities' discretion in regulating uses of genetic resources needs to be coordinated in support of these activities. The upstream research and development activities involved in assembling, testing, improving genetic resources and the further downstream registration, release, multiplication and commercialization of new varieties are governed by a multitude of national laws and regulations. It makes sense for countries to agree, in advance, on how they will exercise their discretion under those laws in common ways, to support the research program and objectives. There is mounting evidence that applicable regulations (including access and benefit sharing regulations for implementing the CBD, Nagoya Protocol and the Plant Treaty; phytosanitary regulations; intellectual property, variety registration and release rules) are exponentially increasing costs of research and development in this area. Cooperation and pre-agreements on policy and legal questions between countries involved in the research and development activities is critically important.

Sub-regional seed support/service unit(s) could address these needs, constituting an essential component of scaling strategies to mainstream the availability and use of biological/genetic diversity in seed systems for climate change adaptation. The hubs will be demand driven and provide intelligence and technical backstopping to farming communities, national and international research programmes, development actors, seed companies and policy decision-makers, on resilient seed systems tools, methods, information sources, data management, policy design and compliance with applicable regulations and agreements. As far is known, such a kind of seed hub does not yet exist in the region.

The Hub's functions are:

- Facilitate the establishment of new links among interested seed system actors at national level and in the (sub)region(s) working on conservation and sustainable use of plant genetic resources (south-south collaboration), climate change adaptation and resilient seed systems, for example, between the national genebank and community seedbanks, between a private sector seed company and a public research institute or between a farmer seed enterprise and a seed service delivery enterprise.

- Support research through training in tools and methods and navigating/complying with applicable laws and policies identifying and accessing genetic resources with traits that are suitable for use under changing climatic conditions, from local, national, sub-regional and global sources.

- Support participatory crop evaluation activities across countries and seed quality trials within the countries, for example, on neglected and underutilized species.

- Develop and maintain a digital seed knowledge portal and support the use of digital tools for information management, information sharing, data collection and analysis, and communication.

- Support capacity development activities (sub-regional, national and institutional tailor made trainings) and curriculum development in collaboration with national and international partners.

- Develop harmonized principles/agreements endorsed by public authorities in the participating

countries to support subregionally coordinated research in compliance with international and national laws. Facilitate and support policy coordination, for example, through the development of agreements for germplasm exchange, data sharing, and dissemination of research outputs in compliance with applicable international laws (ITPGRFA, CBD/Nagoya Protocol, UPOV 1978 and 1991, regional seed harmonization agreements, IPPC).

- Provide forums for comparing experiences and lessons learned across the countries, and to use that information to develop policy briefs and submissions to national and international policy processes.

Coordination (management) of the seed hub

The Hubs will be managed by a small unit that operates through a combination of face-to-face and virtual interactions. The unit will be made up of specialists drawn from national research organizations, farmers organizations, development NGOs active in the subregions, with complementary disciplinary backgrounds, who may reside in their home countries, but operate as a "flying doctors" team (virtual doctors when there are COVID-related travel restrictions). During the start-up period, staff of the Alliance of Bioversity International and CIAT (drawing as necessary on other CGIAR Centers active in the subregions) and the Wageningen Centre for Development Innovation will provide technical support to the management team.

Sustainability of the seed hub

Initially the hubs will be supported through bilateral funding to the Climate Resilience Seed Systems initiative and co-funding from directly participating organizations in the subregion. The hub(s) can achieve sustainability through: renewed co-financing of staff positions by participating organizations, annual membership contributions; co-funding contributions; core support (this will require proposal development); embedding activities in ongoing initiatives; and payment for facilitation and support services.

Outlook

The Seed Hub(s) will contribute to very practical results that make seed systems more resilient, such as:

- Much faster and cheaper ways of gathering, compiling, analysing and sharing information about relevant (anticipated) climate changes and climate induced stresses, for example, through the use of climate analogues.

- More efficient ways to identify 'best-bet' germplasm and portfolios of diverse varieties that are potentially adapted to changing conditions.

- Novel ways to efficiently distribute these promising materials in sufficient quantities to large numbers of farmers for evaluation and selection.

- Innovative seed business models and innovative seed value-chain mechanisms to respond to the demand for crops and crop varieties and to offer work and income generation opportunities, for example, through young seed entrepreneurship.

- Strong collaborative, multi-stakeholder dialogue and learning, and exchange of knowledge, experiences and good practices.

- Empowerment of farmers and effective implementation of their rights, to make their voices, needs and interests heard in national and international decision-making processes related to the management of plant genetic resources, seed system development, agricultural production and livelihoods.

- More power and resources for provincial, district and municipal level public agencies to effectively work together with farmers, their organizations (such as community seedbanks) and the private sector to improve their seed systems.

- The effective implementation from community to sub-regional levels of international agreements and national policies and laws governing access to genetic resources and benefit-sharing, seed trade and intellectual property in ways that support climate-resilient seed systems.

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