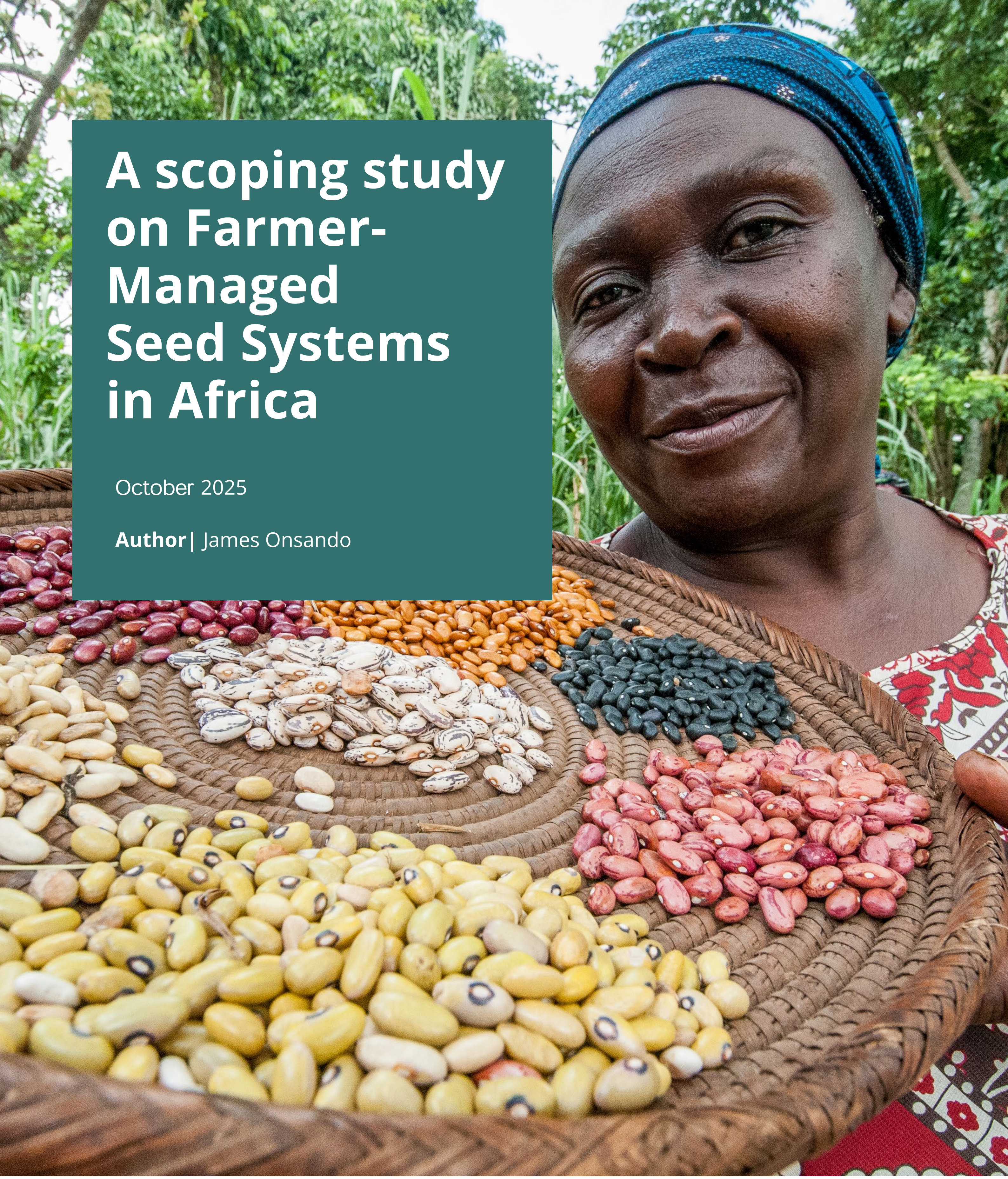
A scoping study on Farmer-Managed Seed Systems in Africa

October 2025

Author | James Onsando



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Scoping study on Farmer-Managed Seed Systems for increasing agricultural productivity, food and nutrition security and resilience

October 2025

James Onsando

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Acronyms

AFD	French Agency for Development
AFSA	Alliance for Food Sovereignty in Africa
AGRA	Alliance for a Green Revolution in Africa
AKIS	Agricultural Knowledge and Innovation System
ALF	Africa Leafy Vegetables
AMU/UMA	Arab Maghreb Union
ARIPO	African Regional Intellectual Property Organization
ASA	Agricultural Seed Agency
ASBP	African Seed and Biotechnology Programme
AU	African Union
AUC	African Union Commission
BMGF	Bill and Melinda Gates Foundation
CAADP	Comprehensive Africa Agriculture Development Programme
CABI	Centre for Agriculture and Biosciences International
CEN-SAD	Community of Sahel-Saharan States
CESSA	Centre of Excellence for Seed Systems in Africa
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
COASEV	West African Catalogue of Plant Species and Varieties
COMESA	Common Market for Eastern and Southern Africa
COP	Community of Practice
CSS	Commercial Seed Systems
CTDO	Community Technology Development Organization
CWR	Crop Wild Relatives
CIMMYT	International Maize and Wheat Improvement Centre
DARBE	Department of Rural Agriculture, Rural Development, Blue Economy and
DeSIRA	Development Smart Innovation through Research in Agriculture
EAC	East African Community
EC	European Commission
ECAS	Economic Community of Central African States

ECOWAS	Economic Community of West African States
EGS	Early Generation Seed
ESE	Ethiopian Seed Enterprise
EU	European Union
FAO	Food and Agriculture Organization
FAOLEX	Food and Agriculture Organization of the United Nations Database.
FAOSTART	FAO's database of agricultural statistics
FARA	Forum for Agricultural Research in Africa
FFS	Farmer Field Schools
FMS	Farmer Managed Seed
FMSS	Farmer Managed Seed Systems
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HOSG	Heads of State and Governments
IFAD	International Fund for Agricultural Development
IGAD	Intergovernmental Authority on Development
IPPC	International Plant Protection Convention
ISSA	Integrated Seed Systems Approach
ISSD	International Seed System Development
ISTA	International Seed Testing Association
KEPHIS	Kenya Plant Health Inspectorate Service
LIMICs	Low- and middle-income countries
MOU	Memorandum of Understanding
NGO	Non Government Organisation
OECD	Organization for Economic Co-operation and Development
OPV	Open Pollinated Varieties
PABRA	Pan-Africa Bean Research Alliance
PGRFA	Plant Genetic Resources for Food and Agriculture
PROMAC	Climate Smart Agriculture Programme for Small holder and Emerging Farmers in Mozambique
QDS	Quality Declared Seed
SADC	Southern African Development Community
SDHS	Sowing Diversity Equals Harvesting Security

SKI	Seed and Knowledge Initiative
STAK	Seed Trade Association of Kenya
TASAI	The African Seed Access Index
UN	United Nations
UNCLOS	United Nations Convention for Laws of the Sea
UNFCC	United Nations Framework Convention on Climate Change
UPOV	International Union for the Protection of New Varieties of Plants
US	United states of America
USAID	United States Agency for International Development
VCU	Value for Cultivation and Use
VPCs	Vegetatively propagated crops
VSBC	Village seed bank committees
VSBs	Village Seed Bank
WFP	World Food Programme
WHO	World Health Organization
WIPO	World Intellectual Property Organization

Executive summary

Farmer-managed seed systems (FMSS) represent a critical yet undervalued component of Africa's agricultural landscape, with smallholder farmers—predominantly women—supplying 80-90% of all seeds planted across sub-Saharan Africa through traditional practices of seed management, selection, multiplication, storage, and exchange. Unlike formal commercial seed systems (CSS) that focus primarily on cash crops and selected staples, FMSS encompass the culturally appropriate, biodiverse networks through which farmers produce and disseminate seeds of local food crops and landraces that typically receive minimal attention from commercial seed companies. This report addresses the urgent need for comprehensive evidence on FMSS status, opportunities, and challenges, providing a balanced assessment to inform policy and investment decisions that could strengthen these vital systems and contribute to improved food and nutrition security across the continent.

Reviewing FMSS functions and actors

The definition for FMSS used in this report is as follows:

> *"Farmer-Managed Seed Systems (FMSS) are community-based seed systems where farmers have control and rights over their seeds, using mainly local varieties, indigenous knowledge practices, and rules developed according to their customs as they adapt to their changing environment."*

FMSS are multifaceted systems defined by community-based control where farmers maintain rights over their seeds using local varieties, indigenous knowledge, and customary practices adapted to changing environments. These systems serve seven critical functions: facilitating social networks and seed exchange through trusted relationships and kinship systems; enhancing crop genetic diversity through in-situ conservation of landraces and wild relatives; providing affordable and accessible seed for diverse crop portfolios including minor crops neglected by commercial systems; building resilience to abiotic and biotic stresses through genetic heterogeneity and mixed cropping strategies; enabling local crop development through continuous farmer selection and adaptation; supporting seed and food sovereignty by maintaining farmer control over genetic resources; and ensuring intergenerational transfer of dynamic indigenous knowledge.

Women constitute the backbone of FMSS, serving as primary custodians despite limited decision-making authority, with expertise spanning the complete seed value chain from selection to utilization, while Africa's youthful demographic (70% under 30) represents an emerging force that combines traditional knowledge acquisition with technological adaptability. However, systemic constraints including gender inequalities in land access, credit, and extension services, combined with policy environments that may criminalize traditional seed practices, threaten to marginalize these critical actors and undermine the seed systems they have developed over generations.

Seed security: the indispensable contribution of FMSS

Despite FMSS providing 70-100% of seed for legumes and small grains across Africa, comprehensive data on seed volumes remains critically scarce, requiring triangulation of commercial seed data with stakeholder insights to fill information gaps. Case studies from Kenya and Zimbabwe demonstrate that while CSS dominate hybrid crops like maize (77% certified seed use), FMSS accounts for 72-98% of seed for traditional crops including sorghum, millet, and legumes, with similar patterns observed across fragile areas.

Seed exchange mechanisms within FMSS operate through complex social networks shaped by kinship systems, ethnolinguistic groups, and trusted relationships, encompassing distinct pathways from on-farm production and local borrowing to community seedbanks and farmer-based enterprises that blend traditional practices with entrepreneurial approaches.

Price differentials between commercial and FMSS seed vary significantly by crop and country, with FMSS seed typically 32-38% cheaper compared to certified seed across crop categories, though differences can reach 270-600% for hybrid maize. This makes FMSS the economically viable option for resource-constrained farmers to obtain seed.

Quality assessment in FMSS relies on farmer-developed visual, tactile, and innovative testing methods—including salt-based moisture detection and flotation techniques for rice—that emphasize traits valued by communities such as climate resilience, pest resistance, and organoleptic characteristics, validated through trust-based networks and seasonal performance rather than formal laboratory certification.

The critical data gaps in FMSS documentation underscore the urgent need for systematic data collection to support evidence-based policy development and resource allocation for these vital systems.

Challenges and opportunities in FMSS development

FMSS face multiple interconnected challenges that threaten their sustainability and effectiveness despite their proven resilience and contributions to food security. The primary challenge of agrobiodiversity loss and genetic erosion results from decades of hybrid seed promotion that has replaced local varieties with monocultures for certain staple crops, leading to varietal contamination and loss of valuable traits like storage pest resistance. Additional factors including land grabbing, climate change, conflicts, and shifting food preferences compound this genetic erosion.

Knowledge gaps surrounding African wild species and crop wild relatives limit farmers' ability to leverage these genetic resources. This is compounded by the absence of government frameworks for their conservation and the technical complexity of in-situ conservation methods that require genotyping and phenotyping expertise beyond typical farmer knowledge. Persistent misconceptions linking in-situ conservation with underdevelopment and poverty, combined with the complexity of evaluating genetic evolution progress in dynamic conservation systems, create barriers to recognition and support for FMSS approaches.

Legal uncertainties around ownership of crop genetic resources and farmers' rights remain unresolved despite international treaties like ITPGRFA and UNDROP, while the restrictive and localized nature of in-situ conservation limits its scalability compared to sector-wide agricultural modernization strategies.

However, FMSS present significant opportunities for agricultural development through complementarity with ex-situ conservation methods, which are increasingly recognized as synergistic rather than competing approaches. In-situ conservation provides unique value by maintaining living agroecosystems that generate new genetic resources, serving as backup to gene bank collections, and offering natural laboratories for agricultural research while delivering ecosystem services including pollination, soil conservation, and carbon sequestration.

Opportunities for improving local varieties through participatory plant breeding, exploitation of natural gene flow, and farmer-led selection processes demonstrate the innovation potential within FMSS, though these are constrained by high costs, taxonomic uncertainty, farmers' short-term perspectives, and limited technical knowledge for precise variety identification.

FMSS excel in seed production and quality assurance through indigenous methods including appearance-based assessments, quantitative trait selection, and functional attribute evaluation that prioritizes organoleptic qualities over laboratory measurements, though precision limitations and absence of formal isolation distance standards create quality assurance challenges.

Seed exchange within FMSS offers distinct advantages including enhanced affordability through gifting and barter mechanisms, local distribution networks that reduce transportation costs, and supply of crops neglected by commercial systems, particularly vegetatively propagated crops and indigenous vegetables.

However, FMSS face significant obstacles including inadequate government support, restrictive legislation favouring commercial breeders, competition from industrial seed backed by government promotion, and limited infrastructure in rural distribution networks.

The interactions between CSS and FMSS occur across multiple domains—gene conservation, crop development, commercialization, seed access, and legislation—creating both synergies and tensions, though emerging evidence suggests these systems can coexist complementarily when supported by appropriate policies that recognize their distinct but overlapping roles in ensuring farmers' seed security across diverse crops and agroecological contexts.

Strengthening seed systems: bridging CSS and FMSS support

Africa's agricultural transformation depends critically on robust seed systems, yet significant funding disparities exist between CSS and FMSS. Formal CSS receive predominant government funding and private sector investment, with governments creating enabling environments through policies and regulations while private entities fund the entire value chain. In contrast, FMSS rely mainly on support from NGOs, civil society organizations, and development partners, with minimal governmental backing despite serving as the primary seed source for most African farmers.

Several significant initiatives support formal CSS across Africa. AGRA's 15-year seed systems development program has facilitated the release of over 670 new crop varieties by 2018, focusing on improved policies, early generation seed supply, and expanded certified seed markets. The Pan-Africa Bean Research Alliance (PABRA) has reached 19.5 million farming households with quality improved varieties, dramatically reducing the time for new varieties to reach farmers. The African Union Commission coordinates continental-level seed sector development, mobilizing member states around international frameworks and conventions.

Despite limited government support, several initiatives champion FMSS. The "Seed is Life" campaign advocates for recognizing FMSS as cornerstones of food sovereignty and biodiversity. The African Seed and Biotechnology Program established an FMSS cluster in 2021, while CABI's Good Seed Initiative and the Seed and Knowledge Initiative work to strengthen farmer-led seed systems across the continent.

The Integrated Seed Sector Development (ISSD) framework represents a promising approach that acknowledges both formal and informal seed systems as complementary rather than competing.

However, funding remains critically inadequate—less than 0.5% of sustainable seed innovation investment focuses on FMSS, with only $2-6 million spent annually on FMSS programs globally. This stark underfunding undermines Africa's agricultural resilience and farmer autonomy. Successful models demonstrate viable scaling pathways, including community seed production systems, evolutionary plant breeding approaches, and market-based strengthening initiatives. Addressing this funding gap through national support mechanisms, simplified certification processes, and targeted microfinancing could significantly enhance food security while preserving agricultural biodiversity across the continent.

Indigenous knowledge integration: the foundation for FMSS strengthening

Enhancing FMSS requires a fundamental paradigm shift that recognizes these systems as sophisticated knowledge-based systems grounded in centuries of indigenous science rather than informal alternatives to commercial approaches. The integration of this indigenous knowledge into formal regulatory frameworks represents the critical pathway to unlocking FMSS potential while preserving cultural integrity and farmer sovereignty.

Indigenous knowledge within African FMSS demonstrates sophistication, operating on legitimate scientific principles that parallel commercial seed development processes. Case studies from Zambia, South Africa, and Kenya reveal complex variety selection methods incorporating organoleptic properties, stress tolerance, and cultural considerations. Farmers maintain genetic diversity through strategic selection from trait-associated populations while leveraging natural gene flow to enhance varietal resilience against environmental stresses. Traditional seed preservation employs natural methods like kitchen smoke for pest protection, ash-based treatments, and specialized storage containers.

The documentation and formal recognition of this indigenous knowledge requires systematic national surveys to capture farmers' seed management practices across variety selection, quality assurance, preservation, and exchange systems. Strategic enablers can accelerate government engagement, including positioning FMSS within environmental and climate agendas, biodiversity conservation frameworks, international human rights instruments like UNDROP, and continental policy alignment through the African Union's seed agenda.

Regulatory integration demands FMSS-friendly quality assurance frameworks through revised legal structures, ad hoc registration processes, or quality-focused certification systems. Farmer variety recognition requires modified registration criteria replacing "uniformity" with "consistency in expression" to accommodate heterogeneous materials typical of traditional varieties. This includes establishing appropriate variety release committees incorporating traditional leaders and farmer organizations, developing community-based ownership frameworks, and implementing less stringent certification guidelines like Quality Declared Seed protocols.

Success depends on genuine government commitment, comprehensive stakeholder engagement meaningfully including farmers, appropriate legal frameworks honouring traditional knowledge while meeting quality assurance needs, and sustained investment in documentation and institutional development. The ultimate objective is enhancing FMSS effectiveness and recognition while maintaining their essential character, creating a balanced approach that bridges traditional wisdom with contemporary regulatory requirements for more resilient and inclusive seed systems across Africa.

Seed policies and legislation: recognizing FMSS

Current seed policies and legislation across Africa systematically marginalize FMSS while prioritizing formal CSS. African seed policies create multiple obstacles for FMSS development through monopolistic plant genetic resource rights, insufficient recognition and support mechanisms, and harmonization with international conventions that tend to favour commercial interests over farmers' rights. The domestication of UPOV 1991 and similar frameworks provides strong breeder protections while potentially curtailing FMSS development, as farmer varieties often cannot meet formal registration criteria requiring distinctness, uniformity, and stability assessments. While some national policies acknowledge FMSS existence, most fail to provide concrete support. Only Mali, Uganda, and Zimbabwe explicitly recognize FMSS value within national seed sectors. Many countries prohibit trade in unregulated seed, while others allow local exchange within specific parameters. This creates an uneven playing field that gives formal systems comparative advantages at FMSS expense.

Supportive legislation requires addressing six critical criteria:

i. Provision of quality seed through recognition of indigenous quality markers;
ii. Freedom to exchange and sell seed within FMSS;
iii. Inclusion of farmer varieties in release systems using alternative criteria like "distinctness, consistency, and stability" rather than uniformity requirements;
iv. Implementation of user-friendly quality assurance systems such as Quality Declared Seed protocols;
v. FMSS-friendly registration requirements for seed production; and
vi. Meaningful farmer participation in relevant authorities and policymaking processes.

Regional Economic Communities are developing comprehensive seed harmonization frameworks, but with regional differences how they accommodate FMSS. The equivalence principle offers a pathway for sharing FMSS best practices across Africa by focusing on functional similarity rather than textual uniformity. However, implementation faces substantial challenges due to Africa's diversity in political systems, cultures, and regulatory approaches. Success requires systematic documentation of indigenous knowledge, comprehensive policy formulation and reform, stakeholder buy-in recognizing FMSS contributions, institutional development elevating FMSS within research and regulatory agencies, and creation of robust national seed associations advocating for balanced support between CSS and FMSS.

Leveraging complementarities: moving beyond the CSS-FMSS divide

The perceived divide between CSS and FMSS reflects fundamentally different philosophical approaches that have created artificial opposition where complementarity should exist. The future of African agriculture lies not in choosing between CSS and FMSS, but in recognizing and supporting both systems' unique contributions while fostering their complementarity. CSS offers productivity advantages and standardized quality assurance, while FMSS provides genetic diversity, cultural relevance, and food and nutrition security. The challenge for African governments is to develop policy frameworks that support both systems without compromising their fundamental characteristics.

CSS operates through comprehensive policies, legal frameworks, and standardized quality assurance mechanisms aligned with international protocols. The system sustains itself through commercial viability, offering higher productivity varieties and efficient delivery mechanisms through private companies and agro-dealers. Quality determination relies on certification processes based on OECD schemes and laboratory testing according to ISTA protocols, emphasizing compliance with standardized physical, physiological, genetic, and plant health attributes.

FMSS provides critical foundations for food and nutrition security through seed diversity that supports balanced diets and agroecological resilience. Local varieties represent ecologically resilient seeds adapted to changing climate conditions without requiring expensive purchases or external knowledge systems. FMSS maintains agricultural biodiversity, with 80% of the world's biodiversity sustained within indigenous territories by peoples who deeply value collective rights and community stewardship.

Smallholder farmers demonstrate sophisticated understanding of system complementarity by strategically accessing different crops through distinct channels, combining modern and local varieties. This pragmatic approach creates natural interaction points between CSS and FMSS that, if properly nurtured, could deliver better seed and food security outcomes.

Quality Declared Seed (QDS) protocols offer an excellent bridge between systems, providing nationally agreed, less stringent standards that align with FMSS needs without compromising their fundamental character. Tanzania's experience demonstrates government willingness to support QDS production, with five-fold increases between 2015-2019, while Uganda's ISSD program successfully coordinates QDS advancement.

Rather than integration of both systems that risks eroding FMSS essence, a dual approach recognizing two fundamentally distinct systems offers optimal development potential. This framework captures synergies from both systems—benefiting from CSS higher productivity and FMSS dietary diversity, utilizing wide gene pools for breeding programs, and enabling farmers to access both affordable local seeds and high-yielding commercial varieties.

Success requires systematic implementation across nine critical areas:

i. Data generation on FMSS;
ii. Documentation of indigenous knowledge;
iii. FMSS policy and legal framework development;
iv. Institutional arrangements and capacity building;
v. Human resource development in support of FMSS;
vi. FMSS-friendly regulatory procedures and standards;
vii. Research and development investments;
viii. International integration and recognition of FMSS; and
ix. Cross-border trade facilitation mechanisms for farmer varieties.

This comprehensive approach positions both systems to maximize their individual contributions while capturing complementary benefits for enhanced food and nutrition security across Africa.

Conclusions and recommendations

FMSS sustains agriculture in Africa, contributing not only to seed security and food and nutrition security, but also to genetic resource conservation and cultural inheritance. Till recently, interventions and policies have focussed primarily on CSS development and regulations. It is recommended to urgently recognize, protect and strengthen FMSS to leverage its important role in securing nutritious food and genetic resource to improve climate resilience.

The report presents thirteen interconnected recommendations addressing:

1. Comprehensive data generation covering continental seed percentages, pricing differentials, and qualitative management practices;
2. Systematic indigenous knowledge collection and documentation;
3. FMSS integration in seed policies with dedicated resource allocation;

4. Comprehensive legal frameworks protecting farmers' rights;
5. FMSS-friendly regulatory procedures spanning the entire value chain;
6. Substantial investment in agroecological research and extension services;
7. Seed diversity promotion through community seed banks and exchange mechanisms;
8. International agreement integration enforcing FMSS principles;
9. Institutional capacity creation for appropriate oversight;
10. Integrated seed systems approaches leveraging complementary strengths;
11. Multi-stakeholder collaboration frameworks;
12. Enhanced research and development investment;
13. Capacity building through FMSS curriculum development in educational institutions.

Success requires collaborative approaches involving governments, NGOs, research institutions, and farmer organizations, supported by adequate funding for research, capacity building, and infrastructure development. The ultimate goal is a dual seed system approach leveraging both CSS and FMSS to ensure food and nutrition security, genetic resource conservation, and sustainable agricultural development across Africa.

1. Introduction

Seed as foundation of food security

High-quality seed represents one of the most crucial inputs for crop production and, consequently, food security. The term seed system refers to the network of actors and activities involved in developing and managing crop varieties, as well as producing, distributing, and using seeds and other propagating materials of these varieties. An effective seed system should sustainably enable farmers to access quality seeds of their preferred varieties, at the right time and at prices that justify their investment. The farmer's central role in making choices is paramount, as they are the ultimate customers. Seeds offered must align with farmers' requirements, including not only agronomic traits but also organoleptic (taste and sensory) characteristics. When commercial seed systems fail to address these organoleptic qualities, resources must be directed toward improving farmers' own seeds, which have already undergone selection for both agronomic and organoleptic traits. This reality makes farmer-managed seed systems (FMSS) a vital complementary option for governments and farming communities.

The case of smallholder farmers in Africa who have managed, selected, enhanced, multiplied, stored, planted and exchanged seeds, using their own inter-generational knowledge, experiences and skills for centuries has been advanced. Today, many millions of smallholder farmers in sub-Saharan Africa, most of whom are women, still supply 80–90% of all the seeds planted in Africa (AFSA, 2018). These local seed varieties of hundreds of different food crops are available to farmers without needing to buy them or depend on other knowledge systems. This collection of activities is embodied in what are now being called farmer-managed seed systems (FMSS), which are culturally appropriate, practical, customary and inclusive. These systems produce biodiverse, ecologically resilient seeds that can adapt to the changing climate along with many other challenges. The seed systems underpin the diverse, localized agro-ecological food systems that feed more than 80% of the people in sub-Saharan Africa. To sustain these diverse food systems requires genetically biodiverse seeds that are selected by farmers each season to suit local ecosystems and can adapt through farmers' dynamic management to external threats such as climate change (AFSA, 2018)

Classification of seed systems

Different types of seed systems exist, but two main categories of seed systems are widely recognized (Louwaars and de Boef, 2012):

1. **Formal/Commercial Seed Systems (CSS)**: purposefully designed for commercial seed production, primarily for cash crops and selected staple food crops; these systems operate under professional management, laws, regulations, and standards.
2. **Informal/Farmer-Managed Seed Systems (FMSS)**: in these systems, farmers produce, disseminate, and access seeds of different crop varieties directly from their own harvests or through exchange and barter within their communities or neighbouring ones.

However, it should be noted that different countries and programs may define FMSS differently and recognize various subcategories within the informal seed system, as illustrated in Figure 1 below.

Figure 1: Sub-categories of farmer seed

The significance of FMSS

FMSS typically cover minor or local food crops and landraces—crops that generally do not present compelling business cases to attract investment from national, regional, or international seed companies. Thus, FMSS have so far received minimal support, as governments and the private sector have focused primarily on promoting the organized formal or commercial seed sector. This trend is gradually shifting as Western scientific approaches and traditional knowledge begin to integrate in transformative ways. Progressive leaders and pioneers in government and research institutions are demonstrating that alternative approaches are viable. Social movements, long silent in Africa, are emerging as advocacy voices alongside various NGOs that support farmers at different levels (Wynberg, 2024).

Emerging challenges such as climate change have prompted agricultural approaches with potential to enhance crop resilience against adverse weather conditions and related biotic factors. Participatory plant breeding projects across Africa, often connected to NGO-supported community seed banks, have demonstrated that local varieties possess substantial improvement potential. Promoting FMSS development could therefore serve as a crucial complementary strategy for strengthening food security. Several African countries have initiated policy and regulatory measures to support FMSS, as detailed in this report's section on policy initiatives across Africa.

FMSS data gap

While data on formal seed systems has become increasingly available over the past decade (through organizations such as TASAI, AGRA, and AUC), information on FMSS remains fragmented, limited, and less robust. Nevertheless, it is often documented that more than 75 percent of seeds planted by African smallholder farmers are accessed through FMSS. Most seed in Africa is still maintained, adapted, and shared directly by farmers in their fields, networks, and systems.

Recent research by Sperling et al. (2021), analyzing 10,209 transactions across Africa, revealed that 36 percent of seed for all crops came from farmers' own stocks, 16 percent came from social networks, and 30 percent was sourced from local markets, including local farmers themselves. In total, 82 percent of seed originated from these three sources. By contrast, only 2 percent came from agro-dealers and just over 6 percent from government sources, including input subsidy programs. These percentages vary by country and crop.

Furthermore, Africa's contribution of approximately 20 percent to the global commercial seed market does not account for FMSS. This underscores the urgent need to gather evidence on this critical aspect of seed systems. Updated information is equally essential regarding the opportunities and challenges of

FMSS, particularly concerning the potential for improving local crop varieties and producing high-quality seeds to enhance food security.

FMSS support and future directions

Although African Union Member States acknowledge the importance of FMSS, concrete support for activities such as community seed banking and local seed business development remains limited. Even where innovative practices have emerged—spearheaded by civil society and in some cases supported by governments in Ethiopia, Malawi, Mali, Nigeria, Uganda, Zambia, and Zimbabwe (Andersen, 2018; Andersen et al., 2022; Meixner Vásquez and Andersen, 2023; Vernooy et al., 2023a)—the examples are still developing.

This study is therefore critically important as a balanced view of the status and significance of FMSS as a key component within African seed systems is much needed. This report is based on a review of academic and grey literature, and informed by discussions with experts in seed systems in Africa. The findings will help stimulate growth and resilience in FMSS, ultimately contributing to improved food and nutrition security across the continent.

2. Understanding FMSS

2.1 Definitions and usage of FMSS

Definitions establish boundaries around concepts, systems, processes, and subjects. However, FMSS are inherently difficult to confine within rigid boundaries or definitions. Nevertheless, at an African Union-facilitated meeting in Lusaka (October 14-18, 2024), FMSS experts agreed upon the following definition:

> *"Farmer-Managed Seed Systems (FMSS) are community-based seed systems where farmers have control and rights over their seeds, using mainly local varieties, indigenous knowledge practices, and rules developed according to their customs as they adapt to their changing environment."*

FMSS encompasses several components, including—but not limited to—sociocultural practices, biological and ecological factors, and traditional knowledge systems. It is important to note that due to the diversity of stakeholders involved in FMSS, there exist various interpretations of this generic definition, each functionally driven and motivated by different perspectives, as highlighted in the following examples.

FMSS through a livelihood lens

FMSS represent systems of seed production where farmers serve as custodians of both the practice and the indigenous knowledge deployed to select, produce, and disseminate seed. In fact, farmers utilize these systems to support their family incomes and livelihoods. Farmers have demonstrated for a long time that real solutions to challenges facing the global food system do not lie in industrial agriculture, but rather in farmers' hands and in FMSS. The continued over-reliance on a limited selection of hybrid varieties, monoculture practices, and extensive use of agrochemicals—promoted by a handful of multinational corporations—poses significant threats to food biodiversity, traditional food cultures, and the livelihoods of smallholder farmers (Slow Kenya, 2022).

FMSS through a food sovereignty lens

FMSS operate under farmers' control and form the foundation of agricultural production across Africa, despite receiving minimal or no support from African governments. FMSS is often dismissed by policymakers as outdated practices that should be replaced by the so-called "formal" seed system, which promotes hybrid and GMO seeds supplied by commercial seed companies, agro-dealers, and agribusinesses (AFSA, 2024).

FMSS through a biodiversity and climate change lens

Within FMSS, smallholder farmers maintain high seed diversity across both crop species and their varieties. Communities continuously select and conserve seeds to suit their production conditions and meet their food preferences and cultural needs.

In these systems, farmers practice in-situ conservation of crop diversity, which is essential for feeding humanity. This diversity reduces risks from crop loss, since if one crop or variety fails, others can help meet household seed and food needs. Keeping seeds in farmers' hands and maintaining agricultural biodiversity are thus critical to food system resilience in the face of climate change (Seed Change, 2020).

For example, a study in Niger on pearl millet demonstrated that an early flowering allele at the PHYC locus increased in frequency between 1976 and 2003. This increase resulted from selection for earliness, clearly indicating that recurrent droughts lead to selection for earlier flowering in this major crop (Vigouroux et al., 2011).

FMSS through a crop genetic resources lens

From a genetic perspective, FMSS can be defined as farmer-controlled seed systems responsible for providing diverse crop gene pools that play significant roles in crop improvement and breeding. This variant of FMSS comprises the diversity of genetic material contained in traditional varieties, lines, or landraces on farmers' fields, crop wild relatives, and other wild species. This genetic diversity provides farmers and plant breeders with options to develop, through selection and breeding, new and more productive crops that are resistant to pests and diseases and adapted to changing environments (Kameswara Rao, 2013). In this system, natural gene flow serves as a significant lever ensuring continuous crop improvement supported by farmer selections.

Additionally, FMSS can be defined as systems through which farmers domesticate wild plants that make important contributions to local communities. Once domesticated, these wild plants undergo continuous improvement through natural gene flow and selection to enhance their resilience. These plants play significant roles in various agricultural systems as sources of wild foods and fuelwood, and they have important socioeconomic functions through their use in medicines, dyes, poisons, shelter, fibers, and religious and cultural ceremonies. Despite this value, little systematic knowledge has been gathered on the uses of wild plants and crop relatives, causing them to be overlooked in considerations of farming systems by extension workers, policymakers, and economists (Scoones et al., 1992).

FMSS through a gender lens

From a gender perspective, FMSS operate within rural communities where women are proven stewards and custodians of locally adapted seeds, responsible for their selection, diversification, and innovation. Food security crops such as small grains and traditional legumes, promoted via FMSS, are better suited to achieving food systems resilience and food and nutrition security in the face of climate change than commercially oriented cash crops, especially in marginal rainfed areas of medium to low rainfall.

In this context, FMSS ensure plant genetic conservation, biodiversity preservation, and utilization while valuing the expertise and knowledge of women smallholder farmers (Practical Action, 2022).

2.2 The different functions of FMSS

FMSS is at the core for seed acquisition, especially in Africa. Conclusions drawn from a uniquely comprehensive data set, 9660 observations across six countries (Malawi, Kenya, DR Congo, South Sudan and Zimbabwe) and covering 40 crops (Including groundnut, common bean, cowpea, pigeon pea, green gram, cassava, banana, sweet potato, Irish potato and others), show that farmers access 90% of their seed from informal systems with 51% of that deriving from local markets. Further, 55% of seed is paid for by cash, indicating that smallholders are already making important investments in this arena (McGuire and Sperling, 2016). This piece of work quantitatively highlights the importance of FMSS as the principle contributor (90%) to food security and nutrition to the six African countries covering over 40 crops. The specific roles are articulated in the sections below;

Social networks and seed exchange

Several studies have noted a correlation between biological agrobiodiversity and cultural diversity, linked to distinct knowledge systems and social networks that influence both culture and seed flow among farmers (Perales et al., 2005). Labeyrie et al. (2016) show in a study in Kenya that kinship systems that shape farmers' social interaction networks also shape their seed exchange networks. Social ties and networks provide important avenues for seed access for the rural poor and women in particular (AFSA, 2023a). Seed exchange mostly happens within trusted relationships, but knowledge on seed and local crops is typically transmitted 'vertically' (within one's socio-cultural group). However, seed also travels through marriage where the woman brings seed and associated knowledge into the in-law family (Leclerc and Coppens d'Eeckenbrugge, 2012; Labeyrie et al, 2016). Rules of filiation, inheritance and marriage influence the spatial distribution of people and their crop genetic resources (Leclerc and Coppens d'Eeckenbrugge).

Enhancement of crop genetic diversity

The FMSS play a significant role in the provision of crop genetic diversity. An important characteristic of smallholder farming is the need for crop genetic diversity as it serves multiples purpose of consumption, use and marketing. Furthermore it enables farmers to cope with variable and unpredictable environments (Almekinders and Louwaars, 2002). As a consequence, FMSS provide an opportunity of delivering a cost-effective approach to *in situ* conservation of crop genetic resources such as landraces and crop wild relatives. *In situ* conservation aims to maintain target species and the collective genotypes they represent under evolution. A major rationale for this view is based on the likelihood that continued exposure to changing selective forces will generate and favour new genetic variation and an increased likelihood that rare alleles that may be of value to future agriculture are maintained. On-farm *in situ* conservation can drive evolution at an even faster pace through measures that lead to repeated introduction of additional genetic variation, while simultaneously enforcing tough selection pressures through active management of less desirable characteristics (Bellon et al., 2017). FMSS thus constitutes a dynamic *in situ* conservation system in which evolution continues to exist. These gives FMSS an important role in the global management of Plant Genetic Resources for Food and Agriculture (PGRFA) (FAO, 1996).

However, farmers increasingly face strong incentives to abandon their FMSS practices and landraces and the processes that sustain them due to social, economic, environmental, and cultural changes (Bellon et al., 2017). This threat of genetic erosion through the replacement of local varieties by improved cultivars, is the highest for crops that garner little interest from breeders and seed companies (Pascual et al. 2011).

Provision of available and affordable seed

FMSS provide farmers with readily available seed, which is affordable, reliable and largely adapted to their own environments and climate. The formal CSS can only supply seed for a limited number of crops and in few countries, and as such it cannot meet smallholder farmers' need for crop diversity. FMSS remains the only source of planting material for local varieties and minor crops, including indigenous vegetables, smaller grains and root crops like yam and sweet potato (Almekinders and Louwaars, 2002).

Resilience to abiotic and biotic pressures

Genetic diversity is a key element in farmers' livelihood strategies in areas under high ecological, climate and economic stresses and risk. The use of diverse crop species and varieties enhances smallholder farmers' adaptability and resilience capacity to changing environmental and economic conditions (Sthapit et al., 2009). Under highly variable rainfall and fluctuating pest and disease pressures, genetically heterogeneous local varieties and mixed cropping are often more stable yielding than genetically uniform varieties and mono-cropping. For example, farmers in Niger deal with the unpredictability of rainfall and soil moisture by using mixtures of different millet types (Brouwer et al., 1993). Finally, fluctuating prices for agricultural inputs and products are an important source of socioeconomic variation and a reason for farmers to diversify crop production. The use of diverse species and varieties enhances their adaptability and resilience capacity to changing environmental and economic conditions. Genetic diversity is a key element in farmers' livelihood strategies particularly in areas under high ecological, climatic and economic stresses and risks (Pascual et al., 2011).

Local crop development

Continuous seed selection by farmers in combination with the environment creates selection pressure on populations of genotypes (Harlan, 1992). Over time, these processes result in landraces that have adapted to prevailing stresses such as low fertility and drought, principally because most adapted genotypes performed best in terms of survival and seed production for next generations. Farmer seed selection under local conditions thus results in landraces with yield stability in seasons with severe stresses, which is crucial for small-scale farmers in marginal environments where environmental variation and risks of crop production are high. Farmers practice a form of local crop development through on-farm seed selection and production, maintaining genetically heterogeneous varieties that are adapted to the local environmental conditions (Almekinders and Louwaars, 2002; Villa et al., 2005).

Seed and/or food sovereignty

Within the FMSS, the principle of seed sovereignty is fundamental, making the delivery of seed sovereignty therefore one of the roles of FMSS. Seed sovereignty as a concept is defined as "farmers' rights to save, breed and exchange seeds, to have access to diverse open source seeds which can be saved and which are not patented, genetically modified, owned or controlled by emerging seed giants. It is based on reclaiming seeds and biodiversity as commons and public good" (Shiva, 2012). Seed sovereignty serves as a key foundation to food sovereignty (Bezner Kerr, 2013; Adhikari, 2014), which asserts that people should be able to control the mechanisms and policies that shape their own food production, distribution, and consumption (Wittman et al., 2010). As emphasized by Kloppenburg (2014), "it is difficult to imagine any form of food sovereignty that does not include a necessary and concomitant dimension of what might be called seed sovereignty". Seed sovereignty also addresses some of the weaknesses inherent in the concept of seed security, defined as when farmers 'have sufficient access to quantities of available good quality seed and planting materials of preferred crop varieties at all times in both good and bad cropping seasons' (FAO, 2016).

Intergenerational transfer of indigenous knowledge to next generation

FMSS are informed and supported by indigenous knowledge. This knowledge is not documented and so it has to be passed on from generation to generation. It is important that this knowledge is not static but dynamic. The dynamism is informed by innovation that come from farmers' observations over time. So the generational transfer of knowledge is on both the historical knowledge plus the current farmer innovations. This role of FMSS is critical because the systems draw their legitimacy from the indigenous knowledge/science.

2.3 The role of women and youth in FMSS

Women and youth represent the backbone of African agriculture and form the foundation of Farmer-Managed Seed Systems (FMSS) across the continent. Their roles, while often undervalued and inadequately supported, are critical to seed security, agricultural biodiversity conservation, and household food security. Understanding their contributions and constraints is essential for developing effective policies and programs that strengthen FMSS.

Women as custodians of seed systems

Women constitute approximately 55% of Africa's agricultural labour force and serve as the predominant source of labour for agri-businesses and agro-industries (World Bank, 2019; FAO, 2018). In the context of seed systems, female farmers uniquely combine roles as seed custodians, small-scale food producers, and family caretakers, positioning them at the heart of FMSS operations. Despite possessing superior knowledge about seed quality and management, women often lack decision-making authority over seed selection, adoption, and use—powers typically retained by men (Brearley and Kramer, 2020). This gender dynamic creates a paradox where those with the greatest technical expertise have limited control over implementation decisions.

Women in Africa shoulder primary responsibility for most harvesting and post-harvest activities, making them natural leaders in seed management. Their expertise encompasses the complete seed value chain, including selection, cleaning, conditioning, preservation, sharing, and utilization of seeds (Amri and Kimaro, 2010). This specialized knowledge extends to critical decision-making about which varieties to plant, optimal planting timing, and seeding rates based on weather patterns and local conditions. Women possess particularly deep understanding of local plant species and bear primary responsibility for *in situ* conservation and on-farm agrobiodiversity management (AFSA, 2023a).

Women's focus on FMSS reflects both constraints and priorities. Limited by restricted decision-making power, land access, financial resources, and extension support, women prioritize crops and varieties that contribute to household wellbeing rather than commercial viability. Consequently, they rely on FMSS to access seed that is reliable, available, and affordable within their local environments and climatic conditions. As such, women serve as custodians of local seed varieties and indigenous agrobiodiversity, preserving genetic resources that are often undervalued by both themselves and society due to their limited commercial significance (AFSA, 2023a). This custodial role extends beyond simple preservation to active management and improvement of local varieties through selection and breeding practices developed over generations. However, this critical contribution remains largely invisible in formal agricultural development programs and policies, perpetuating the undervaluation of both women's knowledge and the genetic resources they maintain.

A significant gender divide thus characterizes African seed systems, with women predominantly operating within informal FMSS while men dominate formal CSS and associated benefits. This division is exemplified in Eastern and Southern Africa's maize seed sector, which remains heavily male-dominated (CIMMYT, 2019).

FMSS face increasing pressure from commercial agricultural development models that emphasize "improved" varieties, monoculture production, and chemical inputs. In countries like Tanzania, government embrace of "Green Revolution" approaches creates environments where traditional seed varieties may be classified as grain rather than seed, potentially criminalizing farmer seed trade (AFSA, 2023b). These policy orientations threaten to marginalize women's traditional roles and undermine the seed systems they have developed and maintained over generations.

Despite their central roles, women in FMSS thus face multiple systemic constraints that limit their effectiveness and recognition. Research consistently demonstrates that gender inequality correlates directly with food insecurity, with agricultural productivity gaps of up to 30% observed in countries like Nigeria and Malawi, primarily due to unequal access to inputs (CIMMYT, 2020). Key constraints for women in FMSS include:

- Limited decision-making authority over seed and crop choices;
- Restricted access to land, credit, and financial resources;
- Inadequate extension services tailored to women's needs and priorities;
- Legal frameworks that may criminalize traditional seed practices;
- Undervaluation of indigenous knowledge and local varieties.

Recent research on gender security and trading in FMSS demonstrates how access to specific seeds enables both women and men, including youth, to express themselves more effectively within their communities (AFSA, 2023a). This research examined gender-based preferences for crops and seed management practices, accessibility and availability of seeds, gender dynamics in entrepreneurship and trade, and the empowerment benefits of quality seed access. The findings reinforce the importance of supporting women's roles in seed systems as a pathway to broader empowerment and community development.

Youth as emerging actors in FMSS

Africa possesses the world's youngest population, with 70% of sub-Saharan Africa's population under 30 years of age (UN, 2024). The African youth thus form an important resource for agricultural productivity, which is fundamental for economic development in Africa (IFAD, 2014, Afande et al., 2015). This demographic profile represents an immense opportunity for seed sector development as well, including FMSS, particularly given that many young people reside in rural areas where agricultural activities predominate. Youth bring distinctive advantages to agricultural systems: they are generally more resilient, better educated, technology-savvy, and adapt more readily to change compared to older generations (Brooks et al., 2013). These characteristics position them as potentially transformative actors in modernizing and scaling FMSS while preserving their essential characteristics.

Although youth roles in FMSS receive limited documentation in existing literature, they are integral participants through their involvement in daily agricultural activities alongside women. African women systematically involve their children in FMSS operations as part of traditional knowledge transfer processes, making youth contributions significant despite their informal nature. This intergenerational learning system ensures continuity of traditional seed management practices while creating opportunities for innovation and adaptation. Young people learn seed selection, storage, and management techniques through hands-on participation, gradually assuming greater responsibilities as they mature.

Africa's youthful demographic profile represents a strategic asset for seed sector development that requires systematic cultivation and integration into continental development agendas. However, realizing this potential requires empowering new generations to innovate while preserving traditional knowledge systems.

Leveraging the role of women and youth in FMSS

Women and youth occupy critical positions within Africa's rural communities and serve as the primary drivers of FMSS. Their roles encompass not only technical seed management but also preservation of agricultural biodiversity, maintenance of food security, and intergenerational knowledge transfer. Recognizing and supporting these contributions is essential for FMSS development and, more broadly, for achieving sustainable agricultural development in Africa. The challenge lies in addressing systemic constraints while building on existing strengths to create more equitable and effective seed systems that serve all community members. The combination of women's deep traditional knowledge and youth's adaptability and technological literacy creates opportunities for FMSS evolution that maintains core principles while incorporating beneficial innovations. To leverage the opportunities of including women and youth in FMSS strengthening, there is a need for appropriate policies and capacity building to address gender inequalities in the agricultural sector in general, and in seed systems specifically.

3. Seed security in FMSS

While data on the seed volumes for various crop types (large cereals, selected small cereals (sorghums and millets), legumes, and selected roots and tubers) in CSS is increasingly available in the public domain, comparable data for FMSS remains notably scarce. A number of strategies have been deployed to estimate the proportion of total seed accessed through FMSS, such as use of known repositories of data including:

- FAOLEX: one of the world's largest online repositories of national laws, regulations and policies on food and agriculture;
- FAOSTAT: a platform providing access to data on agriculture and food for over 245 countries, including annual measurements of cropping areas, crop production and productivity;
- The African Seed Access Index (TASAI): an initiative that evaluates national enabling environments necessary for building vibrant formal seed sectors, based on indicators for various seed sector functions across selected crops.

These databases predominantly focus on CSS, creating data gaps for FMSS. To address this limitation, information on FMSS requires validation through triangulation methods, combining available commercial seed data with rational assumptions to fill these gaps (de Boef & Thijssen, 2023). This approach requires supplementing public domain data with intentionally seeking insights and perspectives from stakeholders operating in the national seed sectors who possess knowledge and appreciation of FMSS.

3.1 Seed volumes in CSS and FMSS

Studies on volumes of formal and informal seed are very limited. Even the few studies available in the public domain lack distinctions, as they often include intermediate categories that may qualify as both formal and informal at the same time. The data that is available mostly considers cereals and legumes only. This data suggests that seed obtained from FMSS for legumes and small grains range from 70% to 100% of the total seed used. Case studies from Kenya and Zimbabwe illustrate these limitations (see below), revealing evident gaps in the data. Where possible, these gaps have been addressed through rational assumptions and corresponding calculations.

Generally speaking, the data presented corroborates well with other studies which show that local seed channels are the main sources of seed for small grains and legumes, providing over 80% of the seed grow, with the exceptions of hybrid varieties of maize and rice.

Case study: seed volumes in Kenya

Kenya's seed system is dominated by the formal/commercial seed sector, with certified maize playing a major role in the market. However, there is also a vibrant informal sector, as many smallholder farmers continue to use home-saved seed, exchange seed with neighbours or purchase seed at local markets. The level of emergency or free seed sector is lower in Kenya compared to Uganda; however, a trend toward decentralization has resulted in county governments providing more free seed to farmers (Jason Sullivan, 2023). The informal seed sector accounts for 80-90% of all seed transactions, with home-saved seed being prevalent for self-pollinated crops (McGuire and Sperling, 2016). The main exceptions to this pattern of informality are maize and vegetable crops, which are largely hybrid. Despite the widespread and regular use of informal seed markets, neither the Kenya Plant Health Inspectorate Service (KEPHIS) nor the Seed Trade Association of Kenya (STAK) has shown interest in supporting investments in this area.

The Kenya Seed Sector Profile (USAID, 2023) shows that for maize and rice, farmers predominantly use certified seed from the commercial seed sector (77% of the seed used). For smaller grains like millet and sorghum, the majority of seed is accessed through FMSS (72% and 77% respectively). Seed of legumes is mostly accessed through FMSS (98%) with the exception of soybean. An earlier household survey in 2004 obtained similar results (see Annex 2).

Case study: seed volumes in Zimbabwe

In a recent study, Ncube et al. (2023) show that farmers obtain seeds of commonly grown crops, with the exception of maize, from local sources, accounting for at least 70% of the seed supply. These findings corroborate well with other studies which show that local seed channels are the main sources of seed for small grains and legumes, providing over 80% of the seed grown in Zimbabwe (McGuire and Sperling, 2016; Mazvimavi et al., 2017). Maize, being a staple crop, it was mostly sourced from government aid (subsidies), agro-input dealers and own seed. Sorghum was mostly sourced from own seed, seed aid (from NGOs) and social networks as the seed (open-pollinated) can easily be saved and re-used in the subsequent seasons. Besides maize, own sources provided both the highest diversity and highest quantities of seed across crops. The FMSS is in particular dominated by legume seed and smaller grains (see Appendix 2 for further details).

3.2 FMSS seed exchange mechanisms

The studies describing seed exchange networks have underlined their dependence on the social, economic, and political conditions of their farming. In a case study in Malawi (Mauss, 2002), many farmers interviewed had limited autonomy on how they coped with barriers to seed exchange/sourcing such as low income or a lack of saved seeds. Farmers indicated that on-farm seed saving was a preferred method for sourcing seeds, but that it was difficult to save consistently in a context of widespread food insecurity. This corroborates with earlier research findings that seed saving by smallholders was the seed sourcing/exchange method that mostly maintained crop genetic diversity on-farm and at community scale (Kloppenburg, 2010). Indeed, in most rural communities, individuals are not independent because they belong to social groups (which can be permanent or dynamic) with rules and norms that determine how they interact. A study in Central Kenya (Vanesse, 2016), revealed that kinship systems that shape farmers' social interaction networks also shape their seed exchange networks. In smallholder farming systems in the Mount Kenya region, seed exchanges are favoured within the residence groups and are strongly confined within ethnolinguistic groups. These homophile processes, involved in shaping seed exchange networks, are related to the kinship system because most seed exchanges occur among relatives. Patrilocality and ethnolinguistic endogamy, which are widespread social norms, contribute to channelling seed diffusion, and are thus involved in crop genetic diversity dynamics. This study profiles the importance of social processes in shaping crop diversity. It paves the way for improving crop models for diversity studies through a more realistic quantification of seed-mediated gene flows, taking into account farmers' relationships and the topology of their social networks. Similar findings are true for Ethiopia and Cameroon (McGuire, 2008; Wencélius and Garine, 2014).

The social institutions of FMSS emphasize sharing seed within families and communities; seed exchange in CSS on the other hand is based on cash economy. Though CSS provides an additional channel for farmers to access seed, making them less dependent on their social ties, there are also reports that the expansion of considering seed as part of an economic exchanges (as is the case in CSS), seed sharing arrangements are being supplanted, making it more difficult for cash-constrained farmers to access seed (Jones, 2017).

Before farmers exchange seed, they first select, produce and store the seed**.** The seed exchange benefits greatly from seed storage. In Benin, Burkina-Faso, Ghana, and Togo, farmers store seeds in various structures ranging from pots, sisal bags, plastic bags and other locally available containers. They protect the seed using a diversity of products including but not limited to pepper, ash, pesticides, and warm sand (Assogba et al., 2015; Loko et al., 2019). They have apparently developed their optimal seed storage conditions (temperature and relative humidity). Similar storage and seed protection mechanisms have been observed in Kenya, Mozambique, Uganda and Tanzania (Onsando, 2024. Unpublished data).

There are several positive examples of seed diffusion from farmer to farmer. In Rwanda, Sperling and Loevinsohn (1993) found that introduced bean varieties disseminated widely from one farmer to another, having been sold initially in small quantities in local markets. NGOs have been very active in setting up community seed schemes to multiply seed at the local level for distribution to farmers leveraging on the informal farmer-to-farmer seed diffusion after the initial injection of introduced seed. This seed diffusion or exchange is driven by the agronomic and consumer traits of the seed genetics, the existence of functioning farmer exchange systems that do not depend on links with the wider economy, and the willingness of key individuals to play a leading role in informal seed diffusion (Cromwell, 1990; Almekinders et al., 1994).

Local seed management systems including exchange vary greatly. In some communities seed exchanges are elaborate and sophisticated, linked with religious and cultural ceremonies, with specialised seed producers and selectors, and a high degree of farmer experimentation. In other communities it is simply a question of retention of seed, with multiple opportunities for improvement and use. Local seed supply and diffusion are mostly based on existing traditional channels of information and exchange within and between communities. A wide range of mechanisms exists to exchange and supply seed. Transactions involve cultural forms such as gifts, seed swaps, in-kind seed loans or exchange for labour (GIZ, 2000). The detailed mechanisms are articulated below.

On-farm seed production

The on-farm produced seed can be saved for the farmer's own use or given out to relatives, friends or neighbours as gifts. This mechanism of seed exchange is by far the most important seed source for agriculture in developing countries, and is still important in more industrialized agricultural countries as well.

In Ethiopia, for example, this mode of seed exchange constitutes 60 to 70 % of the seed transacted (GIZ, 2000). On-farm seed production tends to be particularly high in wheat, a self-pollinating crop of which the seed stores relatively well. This practice tends to be less common for crops like beans or groundnut, due to limitations of plant diseases and local storage facilities. In maize, a cross-pollinating crop, it depends very much on the availability and adoption of hybrid or improved open-pollinated varieties.

Seed borrowed or purchased locally

Borrowed seed is used where word goes round that farmer x has material with elite traits as charged by the community. This then attracts other farmers who might not have money but can access the seed in exchange of labour or grain of the same crop or a different crop. Community farmers who have money can buy seed from a community farmer or go to the local market to purchase the same seed with the claimed or well-known traits. In Ethiopia this mode of exchange constitutes 20 to 30 % of the seed transacted (GIZ, 2000).

Gene Banks and seed fairs

Local seed banks support and improve the farmers' access to a diversity of seeds. Seed fairs play a similar role, enabling farmers to find seeds that they may have lost through crop failure or otherwise. These activities contribute to the *in situ* maintenance of genetic diversity or community agrobiodiversity management by addressing seed security. Participatory crop improvement also contributes to the maintenance of genetic diversity, as well as to community or farmer management of agrobiodiversity. At the same time, these activities support rural and community development (GIZ, 2000).

Community seedbanks

Community seedbanks have been established in various countries, primarily as a strategy for combating seed insecurity in times of risk (drought, famine or war). Their key objective is to establish community institutions that contribute to local level seed security, taking responsibility for the seed supply. In this mechanism, conservation of genetic resources is achieved rather as a secondary than a primary output (GIZ, 2000).

Farmer-based seed production

This strategy is applied when public, private or non-governmental organizations involved in seed supply work with farmers in the production of certified and/or quality declared seed of a set of varieties identified by those organizations. The relationship between the 'formal' seed organization and farmers is defined by its contractual basis: farmers produce seeds according to compulsory 'formal' standards required for certification or quality assurance. The seed organization may work with individuals or small groups, not necessarily organized through community organizations. The Farmer-Based Seed Production and Marketing Scheme in Ethiopia as implemented by the Ethiopian Seed Enterprise (ESE) is a large-scale and prominent example of the strategy, unique in sub-Saharan Africa. Farmers receive training and when joining the scheme, they enter the business called seed production with seed becoming a commodity (GIZ, 2000).

Farmer or small-scale seed enterprises

These are organizations that operate independently from the formal sector institutions. They operate within an existing cooperative structure, or are established as new small-scale enterprises. What is critical is that they are established according to business principles. These enterprises work with a specific group of farmers in countries such as Uganda, Bangladesh and Nepal. This strategy is interesting as seed enterprises can be instrumental in the dissemination of varieties produced through participatory varietal selection and plant breeding. However, it is critical to this strategy that the organizations are established with groups of individual farmers, so that they are less embedded in community structures, with implications for their institutional sustainability (GIZ, 2000).

Community-based seed enterprises

This strategy involves a community-based system with an entrepreneurial approach to seed production. In the example of Ethiopia, the farmer groups work as seed production cooperatives. Such community enterprises work with a range of varieties and crops, including local varieties. They are embedded in existing community structures or institutions, and are also more inclusive, seeking to include farmer households from various socio-economic strata. Their community focus is important and hence the scale of operation is local with the main aim of contributing to local seed security, rather than being driven solely by economic objectives. It should be realised that even though enterprises established according to this strategy could be community-based, gradually they may develop with a key group of farmers into small-scale seed enterprises driven by business principles rather than local seed security (GIZ, 2000).

To support the seed exchanges/diffusion by local farmers and their communities a number of case studies are articulated below. The available case studies do not allow a generalization of the most prevalent sourcing channel at crop cluster level. This is particularly the case due to the distortions by commercial crops such as maize, rice, soybean etc. whose sourcing channel is largely agro-dealers and local shops. This will skew the picture in favour of local markets and agro-dealers for the cereals cluster when in fact small cereals (sorghums and millets) are sourced differently. For the small cereals (sorghums and millets) and legumes the case studies show an over 80% sourcing from famer-saved seed. The more current studies (see Appendix 3) indicate that local markets are gaining traction as one of the major channels of seed sources even for the small cereals, followed by farmer-saved seed. For vegetatively propagated crops, the farmer-saved seed through neighbours, relatives and friends is still the most used channel of seed sourcing by local farmers.

There is critical need for resources to be allocated for the collection of this type of data in order to provide a basis to support the policy discussions and direction.

Case study: seed exchange mechanisms in Ethiopia

Ethiopia is known for its oldest agricultural system, high levels of crop diversity and patchwork of micro agroecological zones. The rich agrobiodiversity serves both to buffer the global food supply against environmental change and pest and disease outbreaks, and to maintain the sustainability of traditional small-scale agricultural systems (Gepts, 2006). These diverse crops and varieties are created and maintained through seed exchange among farmers, and the scales and strengths of these pathways have enormous influence on agricultural biodiversity.

Case studies in Ethiopia (Appendix 3) show that farmers typically use blended approaches to access sorghum and maize seed, combing own seed stocks from previous harvests with seed provided by neighbours and/or local agricultural offices. Very few farmers relied on external or formal seed exchange mechanisms only (Getahun, 2011). Samberg et al. (2013) also found that the most prevalent mode of seed access was farmers' own saved seed for 55% of the households in Gamo Highlands, followed by local markets (20%), neighbours (14%) and public extension (11%).

Case study: seed exchange mechanisms in Kenya

While both the formal and informal seed systems exist in Kenya, evidence shows that vast majority of farmers rely on the informal seed system for seed and planting material for most agricultural commodities, and often continue to recycle seed that has been exhausted through generations of cultivation. Ayieko and Tschirley (2006) report that 99% of surveyed households used their own retained seed, in combination with informal and formal purchases. The authors estimate that 63% of all seed exchange mechanisms is farmers' retained seed, compared to 18% and 19% for formal and informal purchases respectively.

Case study: seed exchange mechanisms in fragile areas

The Seed System Security Assessments (SSSAs)[1] have been carried out in fragile areas affected by civil strife, displacement, political instability as well as natural disasters during the last 20 years. These assessments highlight the importance of FMSS in fragile areas for households to access seed for major food crops, even when seed aid is provided. Figure 4 shows that FMSS is the major source of seed for farmers in fragile areas in Africa; FMSS provides between 60% to 100% of seed sown in the various areas. Actual proportion differ depending on the area, crop variety and year. See appendix 3 for more detailed analysis. McGuire and Sperling (2016) confirm that over half of all seed (51% across crops) was obtained from local markets, indicating that this source was the most important for seed exchange in fragile areas. Own stocks or farmer-saved seed was next at 31%, followed by friend, neighbour, relative at 9%, NGO/UN at 6%, agro-dealer at 2% and Governments at 2%. The other sources were insignificant (see Annex 3).

McGuire and Sperling (2016) used the same data to analyse seed exchange mechanisms by crop clusters: cereals, legumes, and vegetatively-propagated crops (VPCs) to highlight trends by crop type. Maize was kept as a separate category given its importance across much of Africa and its prominence in seed sector development (Shi and Tao, 2014). The data indicates that the relative importance of seed sources varies markedly by crop cluster. Local markets are the driving seed source for legumes, providing almost 65% of the seed sown (see Appendix 3). Own stocks are especially central for the VPCs (e.g., providing nearly 80 % of sweet potatoes cuttings) as well as for dryland cereals (sorghum and millets). For these latter crops, small seeds and dry storage conditions present fewer challenges to self-storage than for legumes such as beans (Sperling and McGuire, 2010). Use of social networks was noted in greatest quantity (30%) for the VPCs, partly as the market option here is so limited. Agro-dealers are used as major source for cotton seed only (Malawi). Local markets supplied at least 5% of seed for 26 out of the 40 crops monitored, and over 10% of seed for 24 of these crops. While the total percentages vary considerably by crop, an important point is that local markets are routinely used for seed for a wide range of crops.

From an array of at least nine possible sourcing channels, only two presently supply important quantities of seed to smallholder farmers in fragile areas, being local markets and farmers' own stocks (Figure 2). Local markets additionally stand out in terms of their importance for accessing legume seed. Leveraging such markets could be key for helping farmers enhance family nutrition and improve soil fertility, two functions often associated with enhanced use of legumes. Local markets might also warrant greater attention due to the diversity of seed and planting material they put on offer. Having access to a range of planting options is a central feature for encouraging current farming system resilience and for responding to the future climate-change spurred variations (McGuire and Sperling, 2013).

[1] See www.seedsystem.org for more information (accessed on 18/4/2025)

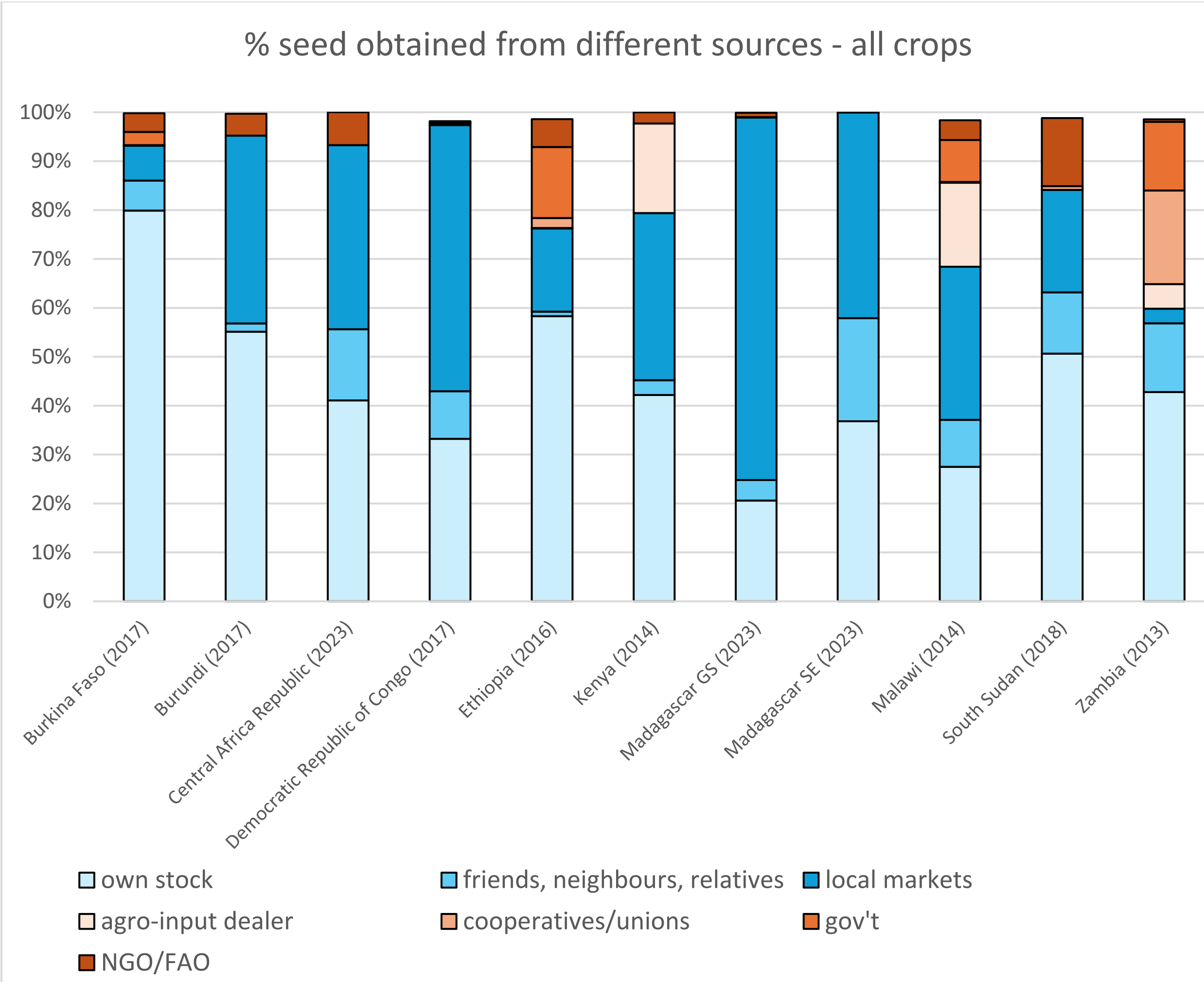

Figure 2. Seed exchange mechanisms in fragile areas (source: Seed System Security Assessments; www.seedsystem.org)

3.3 Price differences between CSS and FMSS

While the formal seed system markets are structured, farmers or farmer groups relying on FMSS source their seeds from a number of places, including own harvests, family, personal connections, and small local markets. In these transactions, both parties typically know one another. The buyer will often base the quality and validity of the sale on their relationship with the seller. The stronger the relationship between the individuals, the higher the likelihood of good seed. This has been referred to as "social certification." Another important distinction of informal seed systems is that they do not necessarily rely on cash; rather, seeds can be acquired through bartering. This is even compounded by the seed markets across the continent which are still fragmented (Gro Intelligence, 2015), making seed prices collection and documentation very difficult.

The seed price is a key consideration for resource-poor smallholder farmers who end up making a choice between purchasing seed from the formal or informal sources depending on the price differential. The greater the price difference between the two, the less likely that resource-poor farmers will purchase certified seed. Seed price differentials between the commercial seed sector and FMSS vary by crop, by country and by year, as shown by the data collected through TASAI (Annex 4). The highest price differences were found in Zimbabwe, and the lowest price differences in Ghana. The prices for certified seed from the commercial sector were generally higher than the estimated seed price for FMSS, as can be expected. The price differences tend to be higher for hybrid varieties. It should be noted that hybrid varieties are rarely sold in FMSS, and generally perform badly in comparison due to the special traits of hybrid varieties. Nevertheless, if price differences are very high, farmers may opt for cheaper OPV crops within FMSS, as investments in certified hybrid seed are high in comparison. This may be unattractive if there are many uncertainties regarding the return to such investments due to multiple external factors. However, in some cases the seed prices for OPV cereals and legumes were very similar for formal seed (commercial seed sector) and informal seed (FMSS) due to relatively high grain prices. In some exceptional cases, the price for informal seed was even higher than certified seed, as was the case in South Sudan in 2022. Though there is no clear evidence why this is the case, a potential explanation could be that huge volumes of seed aid distorts seed markets.

Despite the data collected by TASAI, which focuses on the commercial seed sector, it is very difficult to find comparative price data in the public domain for commercial certified seed and FMSS seed. Existing data is scanty with many gaps and it is mainly documented as formal and informal seed. Whereas FMSS are within the umbrella of informal seed, there is a distinct variation between the two as has been explained elsewhere in this report. To have complete data for the few crops available, some modifications based on assumptions were necessary (Annex 4). Available data indicates that FMSS seed is cheaper than commercial seed (except in South Sudan where seed markets are distorted due to humanitarian aid) but the differences are crop specific. For hybrid maize the differences are huge and they range from 270 to 600% (Annex 4). These differences are significantly lower when it comes to OPV maize and small grains. For legumes, the FMSS seed is cheaper than commercial seed but differences are typically smaller, with some exceptions (Annex 4).

There is critical need for resources to be spent in the collection of this data to support the policy discussions and direction.

Case study: African Leafy Vegetable (ALVs) seed prices in Kenya

In Kenya, African Leafy Vegetables (ALVs) can be purchased through both formal and informal systems, but growers also obtain informal seed through trade, barter, and gifts, making up a dynamic and complex system that varies from community to community (Abukutsa-Onyango, 2005). The need for high quality ALV seed has been growing with increasing market demand for fresh ALVs in urban markets (Mwangi & Kimathi, 2006) and high-yielding seed varieties can help to fill this gap. Though the seed supply may be sufficient to meet the needs of the current subsistence-level production, future seed systems will have to meet the demands of growing urban populations as well. This seed will have to be affordable to smallholder farmers while also meeting growers' expectations for quality in terms of germination and yield. In Kenya there is currently very little incentive for smallholder farmers to adopt formal seed. With few available varieties and low quality, farmers may be better off saving their own seeds or purchasing seed from their neighbours rather than participating in formal seed systems. Croft et al. (2017) evaluated the relative quality of formal and informal ALV seed and the findings show that informal seed systems have greater potential to address the need for high-quality germplasm. The study on the indigenous ALVs indicates that FMSS seed in this category is cheaper than formal seed, agreeing with most studies comparing formal and informal seed. In this case amaranth informal seed is 32% cheaper than formal seed while African nightshade is 29% cheaper compared to formal.

Case study: primary data on formal and informal seed prices in Kenya

In 2024, seed prices were collected from a number of agro-dealers selling seed of major crops from two major seed companies in Kenya. This was augmented by the author's knowledge of the seed prices in Kenya. A mean of two price sets from the two companies are tabulated in Table 1. The comparative informal seed data was collected from a number of farmers who sell FMSS seed. From this data the FMSS seed for cereals is about 37% cheaper than formal seed while for legumes it is 38% cheaper and for the indigenous vegetables the price is 34% cheaper. For the root and tuber crops in Kenya the formal market of these seed is at infancy stages. Most of the planting material in this category therefore is given by farmers within the community, in some cases for free.

Table 1: Formal and informal seed prices (KSH/kg) in Kenya

Crop Type	Formal Seed	Informal Seed	Price Ratio
Hybrid Maize	250	115	2.2 : 1
Rice	210	138	1.5 : 1
Sorghum	225	144	1.6 : 1
Finger Millet	205	161	1.3 : 1
Cereals	890	558	1.6 : 1
Beans	390	190	2.1 : 1
Groundnut	360	280	1.3 : 1
Cowpea	250	180	1.4 : 1
Legumes	1000	620	1.6 : 1
Amaranth	2075	1,411	1.5 : 1
Spider Plant	3000	2100	1.4 : 1
Black Night Shade	2540	1,600	1.6 : 1
Giant Night Shade	2310	1,417	1.6 : 1
Indigenous Vegetables	9925	6528	1.5 : 1
Sweet Potato Vines	Not available	Mostly free/gift	
Cassava Cuttings	Not available	Mostly free/gift	

Source: Author's data collection in Kenya, 2024

3.4 Seed quality

This section will benefit from a definition or understanding of the term quality seed in the context of FMSS. The CSS defines quality seed as seed that has been certified according to national regulations normally aligned to OECD seed schemes, and tested in the laboratory according to the International Seed Testing Association (ISTA) protocols and standards in order to deliver guaranteed seed quality according to the attributes in Figure 3 below.

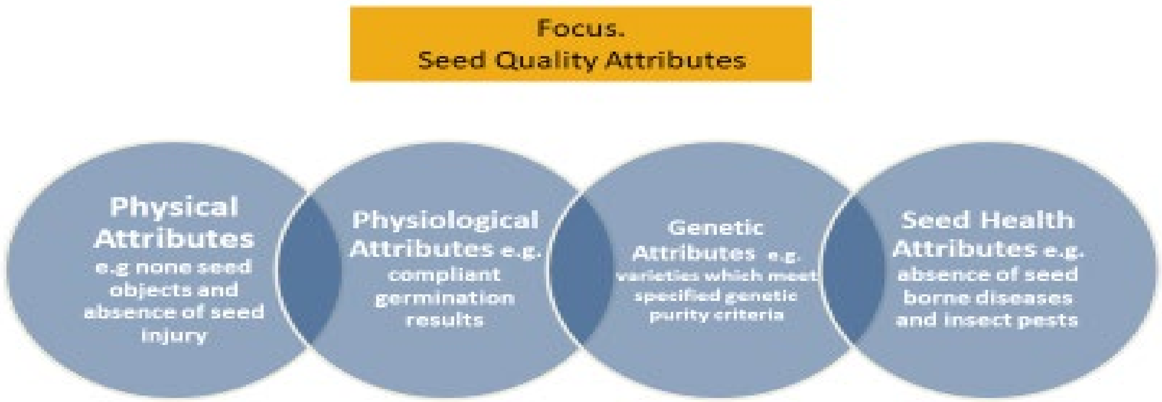

Figure 3: Formal seed quality attributes

In FMSS, quality seed is seed that has been selected over the years by farmers for resilience to climate shocks (droughts, wind/cyclones and floods), resistance to diseases and pests, and has consumer-preferred organoleptic traits. These quality attributes spread through community networks via word of mouth, based on trust rather than laboratory tests. This trust is validated through a full growing season demonstrating the promised traits. This trust-based system has worked in African communities for generations. However, it is important to note that since the knowledge is not documented, there is a risk of distortions of facts with time and the erosion of this local knowledge, particularly as national governments give more attention to the formal CSS.

In FMSS, seed selection skills are passed down from generation to generation, often from women seed savers to their daughters and granddaughters (AFSA/GRAIN, 2018). Farmers typically evaluate seed quality based on visual inspection and tactile assessment. They examine physical characteristics including width, length, weight, shape, surface texture, and colour, while also checking for damage from improper moisture exposure or insufficient sunlight. In the absence of technological moisture meters, farmers have developed their own techniques to assess seed moisture content. AFSA (2023b) describes some common methods used by farmers to test seed quality. One method involves cracking seeds with the front teeth—a properly dried seed resists cracking and produces a distinctive sharp sound, indicating moisture levels below the recommended 10-12%. Another traditional technique utilizes common household materials: farmers shake seeds with dry salt in a clean glass jar for several minutes; if salt adheres to the jar's sides, this signals excessive moisture content, while a clear jar surface confirms appropriate dryness for storage. Additionally, farmers inspect seeds for various contaminants, including weed seeds, off-type varieties, and foreign materials such as plastic, paper, or metal fragments—ensuring seed purity before planting or storage (AFSA, 2023b).

AFSA (2023b) reports that farmers in Tanzania employ a systematic quality control process for paddy rice seed. First, farmers designate a specific portion of their farm for seed production. Within this section, off-types are uprooted throughout the growing season to ensure that the remaining paddy is uniform. This section is then carefully harvested, threshed and winnowed. The seed is carefully dried in the sun over several days, but not left out overnight so as to avoid it from absorbing moisture from the air. Farmers store the dried seed in specific labelled bags in the house, separately from the paddy used for food or sold for income. Farmers use an ingenious floatation method to test the rice seed quality. Farmers add salt to a 20-litre bucket of clean water until a fresh chicken egg floats halfway above the surface to reach the right solution density. The solution is divided between two containers, and the stored seeds are immersed, stirred and allowed to settle. The good quality seeds sink to the bottom of the container, while inferior seeds float to the surface where they can be easily removed. Farmers continue the stirring, settling and skimming process until all low-quality seeds are removed. The remaining quality seeds are rinsed with clean water and dried for storage, or sown in the nursery ready for transplanting into the farms.

4. Challenges and opportunities of FMSS

4.1 Preservation of genetic resources and improvement of local varieties

Like all biological evolution, crop evolution involves two fundamental processes, the creation of diversity and selection (Harris, 1989). Crop evolution is distinguished by two types of selection, one natural and another artificial or conscious. These evolutionary processes must continue in order for agriculture, a living and evolving system, to remain viable. Therefore, an essential criterion of crop evolution is the availability of genetic diversity. Both farmers and scientists have relied on the store of genetic diversity present in crop plants that have been accumulated by hundreds of generations who have observed, selected, multiplied, traded, and kept variants of crop plants. The result is a legacy of genetic resources that, today, feeds billions of humans (IDRC & IPGRI, 1999).

Although farmers' rights were endorsed by FAO in 1989 with the recognition that farmers and rural communities have contributed greatly and continue to contribute to the creation, conservation, exchange and enhancement of genetic resources, and that they should be recognized and strengthened in their work (Nkhoma and Nangamba, 2021), the lack of proper positioning of famers and FMSS in Africa is still an outstanding issue. Because of the low profile and weak to lack of support of FMSS by African governments, the system is riddled with a number of challenges and opportunities in equal measure. The public policy, can for example support genetic resource conservation through:

- Community gene banks establishment;
- Cultural/social expressions of specific communities that goes or migrates with seeds (specific varieties).

The specific challenges are many as articulated below.

Loss of agrobiodiversity and genetic erosion

The strength of FMSS lies in its diversity of local seed varieties that they manage, ensuring food security (AFSA/GRAIN, 2018). Loss of genetic diversity in crops, especially maize, is noticeable generally throughout Zambia and indeed in many countries in Africa. The effect of years of promotion of hybrid seeds and other improved varieties that ignored the value of the diverse local varieties has resulted in the replacement of the local crop varieties with monocultures of maize. In fact, the problem is not only limited to replacement, but also varietal contamination. Local varieties of maize are already contaminated with hybrid varieties making them lose some of the original positive attributes such as pest resistance in storage, taste and even vigour (Teshome and Nkhoma, 2010). The other factors responsible for loss of agrobiodiversity and genetic erosion include land grabbing, climate change asserting unidirectional genetic shift pressure, conflicts and people displacements and general change in food preferences.

Lack of knowledge of African wild species and crop wild relatives

Farmers are not sufficiently aware of the presence and value of crop wild relatives. Crop wild relatives (CWR) are wild plant species that are genetically related to domesticated crops. Untended by humans/farmers, they continue to evolve in the wild, developing traits such as drought tolerance or pest resistance that farmers and breeders can cross with domesticated crops to produce new and robust varieties. They are important because they contain useful genetic diversity, some of which is not present in domesticated crops (Dwivedi et al., 2008). This is compounded by the fact that Governments have not properly positioned their long-term conservation, for deployment to farmers and breeders in breeding new, improved crops. CWR collectively constitute an enormous reservoir of genetic variation useful for plant breeding initiatives and are critical to meeting the challenge of global food security through enhanced agricultural production. There is an urgent need to conserve CWR both in the wild (*in situ*), on-farm and in gene banks (*ex situ*) to ensure that genetic diversity remains available for future generations[2].

Novel approaches needed for *in situ* conservation of crop wild relatives

While *in situ* conservation of crop wild relatives can draw on theories and methods developed for conserving many different species in their natural habitats, the on-farm/*in situ* conservation suffers because it requires specific and technical approaches. These approaches are typically beyond the knowledge of farmers, such as genotyping and phenotyping in order to identify the diversity of the wild relatives. These approaches allow the determination of the conservation value and the tracking of diversity to guarantee gene preservation. It is this diversity which arguably is the most important one for the future viability of agricultural evolution, as it has been in the past (IDRC & IPGRI, 1999).

A perceived linkage of in situ/on-farm conservation to underdevelopment and poverty

Historically *in situ* conservation was perceived as a potential alternative strategy for conserving crop germplasm, yet it was dismissed for several reasons. Early thinkers like Otto Frankel (1970; 1974; Frankel and Soulé, 1981) acknowledged the theoretical appeal of *in situ* conservation but dismissed it as impractical due to modernization pressures. They championed *ex situ* strategies as more secure, arguing that preserving crop genetic resources in seed banks offered better control. Main concerns were that genetic resources would be lost otherwise because of the assumptions that farmers might abandon local varieties due to economic shifts, cultural changes or biological risks and environmental changes. In the 1980s and 1990s, however, other scholars (IDRC & IPGRI, 1999; Maxted et al., 1997) re-evaluated *in situ* conservation, in particular on-farm conservation of crop landraces and CWR. Nevertheless, local crop varieties and *in situ* conservation are still associated with traditional agricultural practices, low production, underdevelopment and poverty. This is seemingly confirmed by the fact that agricultural development in many places, and at different times, occurred with the replacement of local crops by hybrid varieties during the Green Revolution. For example, the introduction of hybrid maize in in U.S agriculture between 1920 and 1950 replaced farmers' germplasm (Cochrane, 1993). Finally, crop scientists who promoted *ex situ* conservation were not interested in conservation alone but also in using genetic resources for crop improvement. As long as breeders' work is confined to experimental stations and laboratories, genetic resources that remain in farmers' fields are not directly useful for crop improvement unless the breeders deliberately purpose to carry out participatory breeding with farmers. The assumed underdevelopment and poverty tag on in situ conservation discourages elite conservationists and even farmers themselves.

The complexity of evaluation and quantification of the genetic evolution progress in the *in situ*/on-farm conservation system

The dynamic aspect of *in situ* conservation is one of its most difficult attributes for planning and evaluation. Rather than presenting an easily quantified and non-moving target, such as the number of alleles or genotypes in a collection, the *in situ* conservation concerns dynamic ecological relationships, knowledge, cultural practices, and environment, elements that are difficult to quantify and likely to change over time. The success of *in situ* conservation cannot be judged only by the number of alleles or

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[2] See: The importance of Crop Wild Relatives: Crop Wild Relatives (Bioversity International)

genotypes preserved. It might also be measured by the number of farmers within a target area or group who maintain local crop populations and manage those populations according to local criteria and practices. Alternatively, the success of *in situ* conservation might be measured by the use of local germplasm in breeding programs that result in new crops but do not replace the crop population of a region. Yet another measure might be the exchange and flow of farmer varieties within and among different communities. The lack of capacity of farmers to carry out evaluation and quantification of in situ genetic evolution, is a significant challenge in the conservation efforts by farmers.

Restrictive nature and impact of *in situ*/on-farm conservation of crop genetic resources

The nature of *in situ* conservation programs and projects is to conserve specific agroecological, cultural, and biological processes in specific localities so that the historic processes and ecological relationships of crop evolution remain viable therein. In other words*, in situ* conservation is not a sector-wide strategy for a nation's agriculture but one targeted to a few locations as it is mainly farmer driven. This then means that on-farm conservation is not meant as an alternative to agricultural modernization nor is it appropriate to all farmers. The challenge then is that the system does not render itself to a high degree of decentralization and exchange between scientists, government officials, and farmers for purposes of economies of scale and overall national crop productivity.

Ownership of local crop genetic resources and the issue of farmers' rights

The legal issues of the ownership of and compensation for genetic resources, local knowledge, and new plant varieties is a long way to go in Africa. A longstanding debate about "farmers' rights" contrasts the interests of industrial countries that use genetic resources against the interests of non-industrial countries that produce them. Industrial countries are concerned with access to genetic resources and with protecting intellectual property that they have recognized. Non-industrial countries are interested in sharing the financial and technological benefits derived from using genetic resources. Conflict between these two parties surrounds the granting of intellectual property rights (IPR), compensation for resources normally considered to be public goods, and the ownership of resources already collected. Because *in situ* conservation provides a pool of genetic resources for future collection, these conflicts will remain unresolved for long. The conflict can be further expounded by the analogy of crop genetic resources whereby the loss of genetic diversity, or genetic erosion, is analogous to the loss of topsoil from common pastures. In each of these examples, farmers receive little reward for producing socially beneficial goods or compensation for the costs of producing or maintaining those goods. Nevertheless, the issues of ownership of crop genetic resources and compensation to farmers for maintaining and providing crop genetic resources are widely discussed among donors, non-governmental organizations, conservation agencies, and governments. This is one of the reasons why there is a critical need for review of national policies and international treaties in order to address the issues of ownership and compensation/benefit sharing. It is important at this juncture to note that International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) ensures that farmers and plant breeders can access the raw genetic material needed to develop new crop varieties, including those with higher yields and those that are resilient to climate change (FAO, 2019). The United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas (UNDROP) also addresses itself to farmers' rights related to seed and genetic resources although it is not legally binding. African countries should leverage on these treaties in order to foster the African agenda of global and continental recognition of "farmers' rights", through the development of FMSS friendly protocols and standards to guarantee the award of farmers and/or communities' varietal rights.

The value of in situ/on-farm conservation of crop genetic resources

Promoting *in situ*/on-farm conservation of crop genetic resources*,* provides a number of opportunities such as enabling the key elements of crop genetic resources which cannot be stored off-site to be captured and stored, provision of agroecosystems to continue to generate new genetic resources, provision of the necessary backup to gene bank collections, provision of agroecosystems in centres of crop diversity/evolution and natural laboratories for agricultural research, and finally it makes it possible to fulfil the Convention on Biological Diversity recommendation on *in situ* conservation (IDRC & IPGRI, 1999).

Complementarity of *in situ* and *ex situ* conservation approaches

With more availability of data, there is now a shift in attitudes to the view that *in situ* and *ex situ* methods are no longer perceived as exclusive alternatives to each other. They are now seen as complementary approaches rather than as rivals. There is recognition that these methods address different aspects of genetic resources, and neither alone is sufficient to conserve the total range of genetic resources that exist. Altieri (1995), for example, has been criticizing the Green Revolution and associated crop breeding programs for causing genetic erosion and cultural loss. Instead, he is promoting agroecological practices to support the dynamic conservation of genetic resources by maintaining local cropping systems and farmer knowledge. Secondly, it is now evident that farmer-led agriculture and genetic diversity are not inexorably linked and that agricultural development is not incompatible with the on-farm maintenance of diversity. Thirdly, a variety of method are available to promote the maintenance of crop genetic resources by farmers (IDRC & IPGRI, 1999).

The complementarity of *in situ* and *ex situ* conservation is based on the recognition that crop genetic resources involve more than the alleles and genotypes of crop populations. Besides the genetic raw material of landraces, crop genetic resources also comprise related species, agroecological interrelationships, and human factors. Wild and weedy relatives of crops, as well as perennials and species with recalcitrant seeds, have been recognized as elements of crop genetic resources that cannot be contained in *ex situ* facilities. In addition, it is now recognized that ecological relationships such as gene flow between different populations and species, adaptation and selection to predation and disease, and human selection and management of diverse crop resources are components of a common crop evolutionary system that generate crop genetic resources. The broader ecological view of crop genetic resources, then, includes not only alleles and genotypes of diverse crop populations but also wild and weedy crop relatives, predators and diseases, and systems of agricultural knowledge and practice associated with genetic diversity (Altieri and Merrick 1987). While *ex situ* conservation is well suited to capture and store alleles and genotypes, it is not suited to the conservation of the other components of the agroecosystem that generate crop genetic resources. *In situ* conservation is specifically intended to maintain those components in living, viable agroecosystems. A critical difference between *ex situ* and *in situ* conservation is that the former is designed to maintain the genetic material in the state in which it was collected, to avoid loss or degeneration. In contrast, *in situ* conservation is meant to maintain a living and ever-changing system, thus allowing for both loss and addition of elements of the agroecosystem which is an important mechanism of genetic evolutionary resilience.

Further complementarity of *ex situ* conservation

Often gene bank collections fail to capture genetic diversity and new resources that are generated after the collection has occurred. Frankel et al. (1995) suggest that much diversity remains uncollected, as different sampling procedures are being used and documentation is poor in many collections. Though it is estimated that, based on the number of landraces collected, the majority of the local crop diversity has been captured in gene banks (Plucknett et al. 1987), such estimate are quickly rendered obsolete by continued crop evolution. Moreover, these estimates are derived from a consensus among scientists rather than from a thorough analysis of genes in the bank and genes in farmers' fields. Further to this, new resources become available because of continued mutations, recombination, gene flows between wild, weedy, and cultivated populations and somatic variations.

Risk of breakdown of *ex situ*/gene banks

Although all forms of conservation are vulnerable, *ex situ* approaches are particularly subject to numerous risk factors such as genetic drift within collections, loss of seed viability, equipment failure, security problems, and economic instability. Gene banks, like all human institutions, depend on volatile public and political support. Even large and prestigious institutions may suffer sudden reversals of fortune, endangering their collections. A number of observers point out that gene banks are usually inadequately funded, so that storage and regeneration facilities are limited, evaluation is partial, and equipment is obsolete or not adequately backed up. While the purpose of *in situ* conservation is not to preserve alleles and / or genotypes *per se*, regions where successful on-farm maintenance of genetic diversity occurs provide potential stores for re-collection of genetic resources (IDRC & IPGRI, 1999).

Diversity value

On-farm crop genetic diversity delivers not only agronomic value to the farmers, but also provides yield stability and harvest security, consumption values, and tolerance to risks such as pests and diseases, competition, and unfavourable environments (Clawson, 1985). The consumption values in this case are associated with special qualities that can be found in local crop varieties but not in non-local ones. These qualities include taste, cooking characteristics, or better storage. Taking maize land races as example, some studies (Bellon, 1996), have indicated that no single variety can satisfy the concerns of all the farmers in the village, resulting in the maintenance of a complex population of maize landraces, even though modern varieties and commercial inputs are available. Diversity in this regard delivers value to the extent that they are not to take on board by improved varieties.

Opportunity for crop improvement

Perhaps the most important strategy for increasing the value of local crop varieties is to use them as the basis for crop improvement programs, especially with the participation of farmers who will use the results. This approach is referred to as "Participatory Plant Breeding." Participatory plant breeding is defined as the formalized cooperation between farmers and plant breeders in such activities as identifying crop improvement needs and priorities, selecting varieties, and evaluating varieties (Eyzaguirre and Iwanaga 1996). The *in situ* conservation aspect of participatory plant breeding is to offer farmers a viable alternative to using exotic crops and varieties in their quest to increase production or income. Development of local varieties and populations through procedures such as mass selection may be especially suitable for marginal environments where conventional breeding has had limited success. Participatory plant breeding thus provides not only a context for *in situ* conservation but also one to work in environments where conventional crop improvement has been frustrated.

Provision of ecosystem services

In addition to the preservation of local genetic resources, FMSS also supports local agrobiodiversity that is essential for ecosystem services such as food and nutrition security, pollination, soil conservation, and a more robust carbon sink than you could have with a monoculture in the same landscapes (Bellon, 2004; FAO, 2010; IPBES, 2019; Jarvis et al. 2011).

4.2 Improvement of local varieties in FMSS

Farmers' crop management and constant seed selection, combined with environmental pressures, contribute to the continuous evolution of farmers' varieties and landraces, leading to the emergence of new or improved ecotypes and populations or local varieties with distinct characteristics (De Jonge et al., 2021). In recent decades, biologists, activists and policy makers have increasingly recognized the crucial contribution of farmers to the development and conservation of crop genetic diversity. Over successive generations of seed selection, vegetative propagation practices, germplasm exchange and cultivation across diverse environments, farmers exert selection pressures that contribute to the evolution of plant species (Halewood and Lapena, 2016). This continuous process of farmer-led selection and management highlights farmers not merely as users of agrobiodiversity but as its essential stewards and innovators. Indeed, farmers have even domesticated wild species and they are largely responsible for the extraordinary genetic diversity within species (intraspecific diversity) that exists today (Brush, 2004).

Within FMSS, farmers select and multiply seed of landraces and improved varieties that are typically adapted to local conditions. Seed distribution is largely based on local indigenous knowledge passed down over generations and regulated by informally established norms (De Jonge et al., 2021). However, there are some challenges to varietal improvement under the FMSS.

Cost of varietal improvement

Varietal development is capital intensive as it requires access to germplasm, field trials, physical equipment and the scientific expertise that is necessary to undertake an effective breeding programme. Moreover, varietal development is a long-term process. While this is true for commercial variety development, the same applies in the FMSS varietal development because even here, varietal/seed selection and confirmation of the desired traits is time consuming. For the farmers, this is compounded by low economies of scale which may deter private sector investment in varietal development or allow one firm to monopolize this activity especially in very small markets (Jaffee and Srivastava, 1994).

Taxonomic Uncertainty

Although it is acknowledged that farmers' varieties are often considered synonymous with traditional varieties or landraces, they are surrounded by legal and taxonomic uncertainty. These varieties are recognized by farmers through their phenotypic characteristics such as, growing habits, leaf pause, leaf venation and colour. Although these phenotypic characteristics work for farmers, they lack taxonomic precision and identity which can hold true nationally, regionally and even internationally. This in itself restricts the development of farmers' varieties/seed to very local jurisdictions with markets and sustainability implications.

Farmers' short-term vision

Varietal improvement whether by farmers or breeders is a long-term investment. By nature, however farmers are not prepared to bear potential risks from their involvement in long-term selection or research efforts. They work and cooperate if they can discern immediate benefits from the effort. There is a tendency for farmers not to become involved in projects that will only result in tangible benefits after several years. Their priorities are mainly related to day to day subsistence living. This has clear implications for the potential success of the farmer research activities.

Farmers' varietal development knowledge

Although the farmers' indigenous knowledge is deployed in varietal development, this knowledge is limited when it comes to genotyping varieties for identification. Unclear recognition of farmers' varieties which is sharp and dependable, weakens the farmers' varietal ownership, protection and rights concept. This weak varietal identity or identification is largely responsible for the lack of a clear mechanism to award incentives to farmers' varietal innovations. The lack of an indigenous mechanism to guarantee varietal stability is another weak area in varietal development by farmers. To mitigate against this, farmers select seeds continuously to ensure that the desired traits are not lost. This will frustrate the reward system of farmers for their developed varieties as the phenotypic traits which are relied and could shift with time. This situation could easily frustrate sustainable incentives given to farmers' varietal innovations (Regmi and Vickers, 2000).

Climate-smart traits

Because of directional evolution pressure, the local crop seeds develop resilience against abiotic and biotic factors such as drought tolerance and disease and pest tolerance respectively. In the past and even now, farmers had and still have a diversity of crops which could survive and still survive the droughts better. Crops like yams, cassava, sweet potatoes and some varieties of millet and sorghum could not fail just because of a few months of drought (Wanjama, 2019).

Opportunities of improving local varieties

The opportunities of farmers improving their local varieties are limited and poorly documented because the indigenous knowledge transmission from generation to generation is verbal. The key messages which matter are still with the respective communities. The farmers use the following opportunities to improve their varieties:

- Use of natural gene flow;
- Selection and multiplication of seed/varieties with the desired traits;
- Exploitation of environmental pressures which contribute to the continuous evolution of landraces, leading to the emergence of new ecotypes and populations with distinct characteristics (De Jonge et al. 2021).
- Deployment of mass selection or deliberate hybridization (Almekinders and Hardon, 2006; Smolders, 2006).

4.3 FMSS seed production and quality assurance

Seed quality assurance is among the most important parameters that farmers consider in crop production. This is because quality seed leads to good yields if other parameters are held constant. Poor quality seed with low germination potential affects the entire crop production value chain (AFSA, 2023a). African communities have different approaches of seed quality assurance but with very high convergence because the indigenous knowledge in this area is passed from community to community. Smallholder farmers in Tanzania for example, have developed a number seed assurance approaches which are an integrated part of crop production. However, the knowledge is uneven, diverse and not well documented (AFSA, 2023a). Interaction with African farmers clearly demonstrates that quality assurance, though not properly documented, is part and parcel of their practice of seed selection, processing including preservation and storage. Quality assurance in the FMSS is met by a number of challenges but mainly informed by weak precision in measurements of seed quality parameters. The specific challenges and opportunities are described in more detail below.

Farmers' methods to assess quality based on appearance and physical properties

In commercial seed production, seed quality parameters are determined in the laboratory and the standards are well developed which makes noncompliance very straightforward to detect due to the numerical values that are used. In FMSS, there is always a parallel approach or method which can only give an indication based on human judgment. Although this has delivered over the years, it is low on precision and objectivity. Nevertheless, these FMSS methods, such as cracking seed, deliver reasonable indications on the quality of seed.

Lack of isolation distance standards to ensure seed genetic purity

In the commercial seed systems, precise isolation distances are used to avoid gene flow contamination and hence maintain the genetic purity of the seed crop (for example, 200m for maize). Imprecision of isolation distance can easily allow the undesired pollen to fertilize the seed crop resulting into undesired maize and indeed any other crop ecotypes. Just like in commercial seed production, farmers isolate a seed crop from grain crop as the example of paddy rice in Tanzania shows. It may not be called isolation distance nor is the isolation distance specified but it is some sort of isolation all the same. It is important to point out that the concept of genetic purity through isolation distance does not deliver genetic purity as understood and delivered in the commercial seed system. This is because gene flow is one of the mechanisms the FMSS use to enhance variety/landraces resilience. Secondly because genetic purity through isolation distance cannot be achieved, farmers select seed for planting continuously to guarantee the desired traits are not lost.

Use of quantitative traits as selection criteria

A number of African communities use the cob size as a seed quality driver. In Tanzania and some parts of Kenya, farmers select maize plants with a big cob. A cob with 15 lines and above is considered suitable for seed. Selected maize cobs are dried and may be stored whole or shelled. When seeds are stripped off, they are treated with wood ash or powder from particular medicinal trees such as neem. Unshelled maize cobs are stored in cribs or above the fireplace where the smoke keeps the seeds dry and reduces insect and disease damage. Selection continues at the sowing stage when the selected cobs are re-examined. From the selected cobs, farmers remove five rows of grain from the top and five from the bottom. The top grains are removed because they are small in size and the bottom ones are removed because have irregular shapes. The remaining grains of the cob are used for seed.

Quantitative traits like cob size are influenced by many other factors which may not be genetically determined. For example, in a field with a fertility gradient, the plants on the more fertile ground within a field may be selected for genetic superiority and yet the superiority observed is merely due to soil nutrients. The other factor could be variability of disease pressure in a field which could result in smaller cobs of maize due to the disease pressure as opposed to genetic superiority. Other factors in the field that could influence quantitative characteristics could be moisture gradient, weed pressure gradient and soil pH gradient. It is important to note that even with these challenges farmers have improvised sampling methods to mitigate against this such as taking their selections randomly across the field (personal observation).

Seed crop growing architecture and disease pressure

A number of African communities use the seed crop plant architecture and vulnerability to disease infection levels. For example, in Tanzania and Kenya the seed selection for bean crop is based on plant growth habits and vulnerability to insect and disease attack. In this case, seed is selected based on yield potential and leafy characteristics. Farmers select against varieties/ecotypes that are bushy in nature as they compromise pod production. Farmers also consider the performance of plants in the field, and those that appear to be free of pests and diseases, for seed selection. Once beans are harvested and cleaned, they are stored in closed containers with wood ash or powder obtained from medicinal plants such as neem to prevent insect pests damage (AFSA, 2023b).

Although generally speaking, bushy growth habits are associated with poor pod and hence seed formation, it is also true that some viruses on beans manifest in bushy plant habits/symptoms, meaning that this is not always a genetic trait *per se.* Secondly, although farmers are able to know the symptoms of crop insect and disease attack, they are not always able to determine the specific insect or disease attack on the beans or indeed any other crop. With the well-developed science of insect pests and disease diagnosis, it is now possible to precisely determine the insect pest name, fungal, bacterial or viral names and hence deploy a relevant control method. This can be mitigated by FMSS-friendly policies such as deployment of various crop experts such as plant pathologists and entomologists to serve farmers accordingly within the FMSS space.

Seed functional attributes like organoleptic traits and cook-ability

In FMSS, the organoleptic properties of seed and hence grain occupies a very high profile in the determination of seed quality. This is one of the reasons why farmers' adoption of modern and high yielding maize varieties has been very poor resulting in very low varietal turnover, despite the higher yields**.** For example, factors that guide seed selection include taste, texture, aroma, processing and storage qualities. Most communities in Africa who consume maize as a stable food such as Kenya, Zambia, Tanzania, Malawi, Mozambique etc., select maize seed which confers sweet and aromatic flavour when roasted. The other functional attribute is grain that does not break easily upon milling and produces heavy flour that melds properly when cooked. For rice, seed selection is driven by grain which is aromatic and separates easily when cooked for Kenya but sticky for Tanzania. In both cases aroma or flavour is overriding. For bean farmers, the quality selection is for taste, speed of cooking coupled with sticky gravy without gas in the stomach when eaten (AFSA, 2023b).

4.4 Seed exchange in FMSS

By empowering farmers to cultivate diverse crops and preserve traditional knowledge, FMSS lays the foundation for a future where African food systems are not only sustainable but also deeply rooted in the traditions and values of local communities. The empowered farmers have the freedom to exchange or sell their seed deploying historical mechanisms developed over time such as gifting neighbours and friends, exchanging seed within the community on the barter trade basis and selling the seed *in situ* or at the market place. These modes of exchange come up with challenges and opportunities as articulated below.

Seed affordability and access

Because farmers in Africa can share, gift, barter and sell seed, this enhances seed affordability. This means that even the poorest community members can access seed. For example, in Uganda some smallholder farmers borrow seeds from their neighbours or get free seeds from friends and relatives through seed exchange (AFSA/GRAIN, 2018). This case study in Uganda shows that some communities have designated seed custodians, people in the community whose job is to save seed in order that others can source from them. These seed keepers, often prominent farmers, will sell, exchange or share the seed with smallholders when the planting season arrives. Seeds are exchanged mostly within the local community, but they may also be exchanged with farmers from other districts, increasing the number of local varieties available. Some seeds are maintained by elderly people who specialize in growing a particular variety, but in such cases quantities are small and they may not be able to supply the whole village. The Uganda case study also indicated that farmers feel very free to access seeds in their communities, with no laws hindering them from doing so.

Local seed markets and distribution

The FMSS seed exchange and sales happens within the community or neighbouring communities. This means that the famers can exchange or sell their seed, without incurring transportation costs. Secondly the farmers can access seed of their preferred agronomic and organoleptic traits. Thirdly farmers can access seed through social insurance mechanisms which include, gifting and barter trade resulting in a significantly higher access of seed even to the poorest households.

Commercial seed distribution networks and agro-dealer networks, on the other hand, are more developed where they are linked to urban and sub-urban areas. This is not the case in the rural areas where FMSS are domiciled, resulting in far less infrastructural development (roads and agro-dealerships). This scenario hampers the exchange, distribution networks and access of FMSS seed within and across communities.

Supply of crop seed that are not covered by the CSS

The FMSS fill a huge gap by providing seed of food security crops which because of a weak business case, are not taken up by the CSS. The FMSS therefore have improved the supply of seeds in the villages, targeting those that lack supply such as cassava cuttings, sweet potato vines, arrowroots and other local leafy vegetables. In Kenya for example, vegetatively propagated crops are under the custodianship of farmers as the seed suppliers who are entered into a database that helps in connecting supply to demand (Wanjama, 2019).

Lack of robust government support

Despite their crucial role for having been the primary custodians of seed and germplasm, providing reliable, affordable, and nutritious seeds, FMSS and their guardians, particularly women, face marginalization and lack official recognition and support. This marginalization undermines the resilience of traditional seed systems exchange, selling and exacerbates the challenges faced by smallholder farmers in accessing diverse and locally adapted seed varieties.

Legislation and regulatory frameworks

Changes in national and regional legislation aimed at harmonizing seed laws and introducing protections for commercial breeders at the expense of farmer breeders impacts the development and growth of FMSS negatively. These legislative changes effectively strip farmers of control over their seeds and prioritize the proliferation of multinational agri-food companies' plant varieties at the expense of farmer lines, land laces or ecotypes. This scenario tends to prioritize access of commercial seed over FMSS seed.

Productivity of farmer varieties/ecotypes

Because the farmer selection process is based on the crop/genetic diversity which is a product of natural pollen/gene flow, the hybrid vigour and hence crop yield is not comparable to that of the modern breeding technological advancements. Secondly the seed production quality levers, including genetic purity, seed health and physiological attributes are measured and determined by very precise approaches while in the FMSS, indigenous methods are used which are not as precise, resulting in comparatively lower yield potential. It is however important to note that although the modern varieties result in higher yields, the farmer-managed varieties provide higher dietary diversity with implications of diverse nutrition making the FMSS a complementary lever to the commercial seed sector.

Competition from industrial seed

Because of the government support and positioning of CSS, some seed categories such as the hybrid maize are more visible and accessible to farmers and could pose a comparative advantage of hybrid maize seed over OPVs and maize land races seed.

Lack of infrastructure in the distribution networks

Seed distribution networks and agro-dealer networks are more developed where they are linked to urban and sub-urban areas. This is not the case in the rural areas where FMSS are domiciled, resulting in far less infrastructural development (roads and agro-dealerships). This scenario hampers the exchange, distribution networks and access of FMSS seed within and across communities.

Though FMSS provide specific opportunities for seed access and affordability in rural areas, a number of potential opportunities are not available to farmers because Governments have not put deliberate efforts to promote and develop FMSS crops by buying and providing the seed to farmers for exchange/sale in order to improve seed security and livelihoods. Secondly, Governments have not extended support to SMEs to acquire FMSS seed as a business hence capacity to offer the seed for sale as community seed enterprises, frustrating sustainable seed access for farmers.

4.5 Interactions between CSS and FMSS and possible tensions

Informal and formal seed systems both converge at the farmer, where they share common markets for their seed, gene pool for selection or breeding, same governments, same physical infrastructural networks, common agro-dealers who supply farm inputs. Functionally, both systems contribute to seed, food, nutrition securities and farmer livelihoods**.** Because these systems share so much in common within the seed agroecosystem, then naturally they interact with each other. Depending on the country and the policy and legal environment, most of the interactions are positive and others negative. In summary the interactions between the two seed systems occur at the following intersections:

- Gene conservation;
- Crop development (in formal systems and in FMSS);
- Commercialisation of varieties (release, IPR);
- Seed access;
- Legislation & marketing.

The specific interactions which are positive as well as negative are articulated below.

Gene conservation

Most advocates for FMSS argue that governments unfairly prioritize formal seed systems over FMSS. However, these same governments often rely on farmers' *in situ* gene banks and conservation reservoirs to strengthen their *ex situ* gene banks. This relationship, as mentioned elsewhere in this report, helps mitigate vulnerabilities of *ex situ* methods, which face risks like genetic drift, loss of seed viability, equipment failures, outdated technology, security issues, and economic instability. Notably, these interactions between institutional gene banks and farmers' *in situ* conservation can create tension, particularly when farmers deposit their seeds but cannot later retrieve them.

Crop development and improvement

Plant breeders commonly employ participatory plant breeding and participatory variety selection to develop commercial varieties incorporating farmer-preferred traits. This represents a formalized collaboration between farmers and plant breeders in identifying crop improvement priorities, selecting varieties, and conducting evaluations (Eyzaguirre and Iwanaga, 1996). The approach creates varieties that connect formal and informal seed systems. For instance, National Agricultural Research Systems (NARS) utilize high-yielding landraces to develop new varieties. Additionally, varieties from formal seed systems may degenerate or experience gene flow from local landraces, resulting in new varieties. Though these gene flow products are novel varieties, breeders cannot claim ownership under UPOV protocols since they no longer match the original variety—a situation that can generate tension.

Seed access and usage of common markets

Recent research has revealed that local markets play a critical role in seed dissemination in Africa. According to a comprehensive study examining seed sources for 40 crops across six countries following disasters, approximately 51% of seeds from informal sources were obtained through local markets, while farmer-saved seeds accounted for 20% (McGuire and Sperling, 2016). This is not limited to local varieties only. In fact, small and public seed companies selling formal seed also the local market places. This interaction occasionally encourages farmers to experiment with formal seed varieties. It is however important to highlight that in food-insecure regions, governments and World Food Programme (WFP), distribute seeds from the formal seed system as they are prohibited from purchasing FMSS seed. Unfortunately, these formally-sourced seeds often lack adaptation to local growing conditions, resulting in large distributions of poorly-suited seed varieties. This structural issue frequently creates tension between formal and informal seed systems.

Seed commercialization and development of Early Generation Seed

Development of Early Generation Seed (EGS) forms part of the initial stages of commercializing seed. The national seed companies engaging in seed production of food security crops (sorghum, millet, cowpea, pigeon pea, groundnut etc.) use contact farmers for the multiplication of basic to commercial seed. This engagement is very interactive and often contractual. Small-scale seed companies sometimes sell formal seed to farmers through this mechanism resulting in a dual system of access to seed.

Seed commercialization and demonstration plots

An important component of varietal development and hence seed commercialization is the development of new varieties through demonstration plots on farmers' fields. This approach is used by seed companies to showcase their new varieties on farmer's fields for ease of adoption. This interaction is viewed by FMSS proponents as negative, i.e. the farmers are being used. But seed industry actors consider this a positive interaction, as farmers are given a choice to decide which variety they prefer to buy. Secondly, the technology and methodology of this approach are transferred to farmers, resulting in farmers' capacity enhancement.

Farmers grow seed from diverse sources

In nearly all African communities farmers will grow seed from both formal and informal sources. This is very common in Eastern and Southern Africa where hybrid and OPV maize is the major source of calories. But even in Western Africa, where cassava is quickly transitioning from informal to formal because of the processing cassava for starch option, farmers would access planting material from both formal and informal sources. For example, a maize variety survey in Kenya indicated that 80% of the maize growers planted both hybrid and local varieties, driven by various considerations such as cash availability, weather patterns, culinary preferences, and expected yields (Almekinders et al., 2021). The fact is therefore that farmers grow different crop varieties using seed from multiple sources. This situation results in some form of interaction between the formal and informal seed systems. Tensions can however arise when IPR on improved varieties can prevent farmers to recycle seed to improve seed in FMSS through natural gene flow.

Perceived or real tensions between formal and informal seed systems

The seed ecosystem has a wide range of literature and hence views on perceived or real tensions between formal and informal seed systems in Africa. Opinions range from either FMSS or nothing else to Governments have not created supportive policy and legal frameworks, to both systems can co-exist with each other drawing synergies to each other. In Africa both the FMSS and CSS can co-exist and synergize one another without any conflict and tension.

In recent years, accusations have been made that farmers' indigenous knowledge and traditional practices regarding seed production and usage have been 'violated' by multinational seed companies and governments (Wynberg, 2024; AFSA, 2024). Such accusations cause tension, distorting discussions on the complementarity between CSS and FMSS, and the need for government support and policies for FMSS. Though it is true that policy and legal frameworks tend to advantage the commercial seed sector, lack of government support to FMSS and documentation of the indigenous knowledge seem to be the major threats to FMSS.

A Zimbabwe seed security assessment found that in spite of the 2008 financial collapse and long drought, FMSS were sufficient to ensure food security (McGuire and Sperling, 2016). Ncube (2021, 2023), confirms this, showing that FMSS in Zimbabwe have displayed resilience over time despite a lack of policy support and political and environmental challenges. FMSS are the most reliable source in ensuring that seed availability. Contrary to commonly held views, Kusena et al. (2017), reveal that FMSS in Zimbabwe provide and circulate good-quality, fungal-free seed. The authors conclude that these seed systems are delivering food and nutritional security in sub-Saharan Africa and have the potential to provide solutions that are resilient to changing climates. This case study of Zimbabwe would resonate with many players in the seed sector. However, the claim of supply of fungal free seed, can be a source of debate and tension; plant pathologists would disagree with this conclusion, causing debate and possible tension between FMSS and CSS.

FMSS are crucial in the livelihoods of millions of farmers, as well as for long-term food system sustainability. Most African farmers source their seed from own harvest or exchanged or traded in social networks or informal markets (McGuire and Sperling, 2016), forming the backbone of the seed supply in many countries (Coomes et al., 2015, Ncube et al., 2023). The first principle for all seed system development efforts should therefore be to “do no harm” to FMSS, but instead build upon their strengths. Contrary to popular belief, this principle does not conflict with the development and introduction of new varieties through formal seed systems. While FMSS distribute local varieties (e.g., landraces), they also disperse new varieties originating from breeding programs. This principles does not necessarily conflict with programs and policies supporting formal seed system development, as farmers often use different channels for different crops, leveraging the advantages of each system. However, policies designed to promote formal seed systems can negatively impact FMSS if they prohibit traditional practices such as seed-saving and exchange. In recent years, integrated seed system development has gained recognition in national seed policies and regulations, ostensibly supporting coexistence between different seed systems. To transition from merely acknowledging this in policy documents to actual implementation in practice, both funding and political commitment are essential (Westengen et al., 2023).

In their recent review of seed systems, Westengen et al. (2023) conclude the following: “We document that a new agenda for seed system development is taking root around the world and in Africa, based on the view that formal and farmers’ seed systems are complementary. Because needs differ from crop to crop, farmer to farmer and between agroecological and food system contexts, a variety of pathways are needed to ensure farmers’ seed security.”

This new approach is informed by empirical research into farmers’ seed use, revealing that despite decades of large investment in formal seed system development, farmers in Africa largely rely on FMSS to source seeds for most of their crops. It is also informed by experiences of different seed system actors who approach farmers in alternative ways than merely as commercial end-users of technology.

5. Initiatives to strengthen seed systems

In Africa, public expenditure is one of the main tools enabling governments to alleviate poverty, fight hunger, and accelerate the transformation of agriculture. However, despite government pledges to invest more in agriculture, several areas of the sector remain underfunded, which holds back their development potential. This is especially true for sub-Saharan Africa despite the political commitment in the Maputo Declaration to allocate at least 10 percent of total public spending to agriculture (Pernechele et al., 2021).

Comparing the two systems, formal CSS receive predominant funding from governments, which primarily create enabling environments (through policies, laws, and regulations) that allow private sector participation to flourish. This approach facilitates the development and delivery of novel varieties of commercial crops and their seeds to farmers. NGOs and development partners typically concentrate their support on early generation seed development, while private sector entities fund the entire quality seed value chain to market commercially competitive varieties. In contrast, the informal FMSS relies mainly on support from NGOs, civil society organizations, and development partners, with significantly less governmental backing for both seed development and distribution.

A study of cereal seed systems—including maize, wheat, millet, sorghum, and rice—concluded that FMSS remain the primary source of seeds for farmers, despite farmers' crucial contributions receiving little recognition within national seed systems. The development of improved seeds is largely driven by actors in both the public and private sectors. However, private-sector involvement appears especially critical, as significant seed shortages tend to occur in contexts where private sector actors are absent (Odame et al., 2009).

5.1 Initiatives in support of formal CSS

There are also a number of initiatives which support formal/commercial seed systems in Africa. Incidentally these initiatives recognize and appreciate the value of the FMSS as well. The initiatives are many and they range from NGOs, Governments, Public Research Institutions, CGIARS, International Seed Conventions and Seed Companies. At times some of the initiatives take an extreme view even to the extent of being oblivious of the existence of other seed system initiatives but on the other hand others recognize the FMSS as a significant player in the seed sector space in Africa. The predominant support in this space is government and private sector. The initiatives are as articulated below.

AGRA's Seed Systems Development

AGRA has been promoting national seed systems over the past 15 years by investing in the creation of improved staple crop varieties, training African breeders, and promoting a seed industry as well as agro-dealer networks to make quality crop seed available to African farmers. AGRA's seed systems development approach has been focusing in particular on the following elements (AGRA, 2018):

1. Improved seed policies at national and regional levels;
2. Early Generation Seed supply
3. Expanding certified seed markets
4. Increased awareness among local farmers
5. Increased density and sustainability of agro-dealer networks

With support of the Bill and Melinda Gates Foundation (BMGF) and The Rockefeller Foundation, over 670 new crop varieties had been developed and released by 2018, and were available to private seed companies and other seed supply groups for multiplication and marketing to farmers. In addition, donors such as BMGF, the World Bank, and the United States Agency for International Development (USAID) have also funded international agricultural research centres (CGIAR) to develop additional new varieties, resulting in the release of novel varieties with special traits including drought tolerance and resistance to diseases, pests, flooding, and acidic soils. Some varieties have also been bio-fortified to supply vital nutritional elements such as iron, zinc, and vitamin A (AGRA, 2018).

The Centre of Excellence for Seed Systems in Africa[3] (CESSA) at AGRA, launched in 2021, is focusing on forming partnerships to address various challenges in the African seed systems. CESSA supports "governments, the private sector, and development partners to deliver modern, effective, and resilient seed systems to serve African farmers better. It will strengthen the seed value chain, particularly variety development and release, production and distribution of both early generation and certified seed, farmer awareness creation and participation, quality assurance, national planning, and inform policy and regulatory frameworks" (AGRA, 2025).

Example of government support: Kenya

An analysis of the evolution of seed policies and regulatory frameworks in Kenya since independence indeed exposes a continuous support for the formal seed sector while support given to the informal sector has merely been intended to transform it into formal. In reality, however, the formal and informal sectors appear to be made up of a plurality of seed systems, with the informal seed systems being the main source of seed for most crops. (Munyi and Jonge, 2015) analysed some of Kenya's policy shifts in order to explore how its new seed policy and legislative framework. This high profile of the Kenyan seed system has influenced many African governments' positions and seed policies, such as Malawi, Uganda, Rwanda, Mozambique, Zimbabwe etc.

CIAT's PABRA Bean Project

The development of impact-oriented seed systems is a strategic issue. Informal seed systems models are not delivering with the efficiency and effectiveness needed. For example, farmers often rely on seed distribution from their fellow farmers, which is just too slow for new varieties to have a major impact. In parallel, formal seed systems, tend to focus on a few profitable seed crops such as maize and vegetable seed, leaving legumes, including beans, largely by the wayside.

PABRA[4] has identified leverage points by which bean varieties can be moved at high volumes, across geographic zones, and with wide social reach. We must be doing something right: 19.5 million farming households accessed quality seed of improved and preferred varieties between 2003 and 2013. The approach has greatly contributed to reducing the time it takes for newly released varieties to reach farmer fields: from about five years in the past to immediate (PABRA, 2025).

The African Union Commission in Seed Sector Development

The African Union Commission (AUC) functions as an intergovernmental secretariat that coordinates the implementation of mandates and decisions from African Union Heads of States and Governments (HoSG).

[3] https://cessa.agra.org/

[4] https://www.pabra-africa.org/seeds-system/

Multiple HoSG Declarations have emphasized the crucial role of a robust seed sector in driving accelerated agricultural growth and transformation across Africa. Operating on the principle of subsidiarity, the AUC enhances development project delivery while acknowledging Regional Economic Communities (RECs) and Member States as the primary implementation bodies. The AUC leverages its convening authority to advocate for, inform, and align policies for consistency, while coordinating and mobilizing support for RECs and Member States in their seed sector development efforts. Through partner support mobilization and effective stakeholder engagement, the AUC creates, validates, and localizes frameworks and blueprints for crop and animal seed development and farmer access at continental level.

The AUC mobilizes Member States to build consensus on implementing international instruments and conventions related to seed sector development and modern biotechnology. These include international processes concerning access and benefit-sharing led by the UN's Food and Agriculture Organization (FAO), World Health Organization (WHO), United Nations Convention for the Law of the Sea (UNCLOS), and World Intellectual Property Organization (WIPO). Additionally, the AUC coordinates Member State participation in the International Plant Protection Convention (IPPC), the Convention on Biological Diversity and its Cartagena Protocol on Biosafety, along with other International Treaties, Global Biodiversity Frameworks, and coordination mechanisms under the United Nations Framework Convention on Climate Change (UNFCCC) (AUC, 2021).

Private Sector

While African governments focus on funding CSS in the areas of seed research, regulation, policies and legal frameworks formulation and implementation including institutional development and communication networks, the private sector focuses on breeding, variety development, seed production, harvesting, processing, packing and distribution through the agro-dealer networks or directly to farmers. The private sector role is product development and marketing with a profitability agenda. In other words, this support is through funding of their own businesses.

5.2 Initiatives in support of FMSS

There are strong concerns about the superficial or non-existent support African governments provide to Farmers' Managed Seed Systems (FMSS). This lack of support often results in the marginalization of FMSS custodians, particularly women, who have historically played a vital role as primary keepers of seeds and germplasm. Contributing factors include the lingering influence of colonial systems, the prioritization of commercial and corporate interests that value profit over the preservation of traditional knowledge and biodiversity, and legislative changes that harmonize seed laws to favour commercial breeders. These regulatory shifts further constrain seed and food sovereignty across Africa, promoting a preference for commercial breeders' varieties and facilitating the spread of plant varieties from multinational agri-food corporations. Such preferences undermine the diversity and resilience of African food systems and perpetuate farmers' dependence on external sources of seeds and agricultural inputs. Despite these concerns, there are a number of initiatives which support FMSS in Africa.

The "Seed is Life" Campaign

The "Seed is Life" campaign[5] seeks to galvanize widespread support and action for FMSS across Africa, advocating for their recognition and protection as the cornerstone of food sovereignty and biodiversity in the face of challenges posed by industrial agriculture and GMOs. For centuries, smallholder African farmers have been the backbone of the continent's agricultural success, nurturing a system that supports over 80% of the population with diverse, nutritious, and resilient crops. However, these traditional practices face increasing threats from industrial agriculture and multinational seed corporations, influenced by the legacies of colonization and commerce (AFSA, 2024). On the occasion of the "Seed is Life" campaign launch, AFSA issued a powerful statement and call to action, urging African policymakers to prioritize FMSS in their agricultural policies. This call for action demands the integration of FMSS into national frameworks, strengthening legal protections for smallholder farmers, investing in agroecological research, promoting seed diversity through banks and exchanges, and ensuring FMSS principles are upheld in international agreements.

The ASBP positioning on FMSS

The African Seed and Biotechnology Program (ASBP) established an FMSS cluster in 2021, who developed an FMSS action plan[6]. The FMSS action plan has been aligned with the 'Guidelines on Harmonization of Seed Policies and Regulatory Frameworks and Use of Biotechnology in Food and Agriculture in Africa' and approved by the ASBP.

CABI's Good Seed Initiative

CABI's five-year (2014 to 2019) strategic plan Good Seed Initiative advocated for the strengthening of seed systems in sub-Saharan Africa and South Asia. It builds on CABI's experience of supporting farmer-led, quality seed systems in Africa and Asia since 2002. The purpose of this seed strategy[7] was to improve the seed systems on which poor and smallholder farmers rely in sub-Saharan Africa and South Asia (CABI, 2014). More specifically, the initiative worked with partners in Tanzania to strengthen the seed system for Africa Indigenous Vegetables (AIVs) through promotion of farmer seed enterprises using two models – contract farming in Arusha and Quality Declared Seed (QDS) in Dodoma (Kansiime et al., 2021)

The Seed and Knowledge Initiative (SKI)

The Seed and Knowledge Initiative[8] (SKI) is a dynamic partnership of diverse southern African organisations committed to securing food sovereignty in the region. Their advocacy in support of FMSS is focused on conservation of the farmer's seed genetic diversity and seed sovereignty because the farmers' varieties are under increasing threat – most urgently by the accelerated drive for a Green Revolution for Africa. Loss of crop diversity reduces nutrition and not only undermines the ability of households to cope with external shocks, but also diminishes social cohesion, knowledge and leads to increased reliance on the cash economy and reduces the ecological resilience of farming systems (SKI, 2022).

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[5] https://afsafrica.org/seed-is-life/ ; https://afsafrica.org/seed-systems/

[6] https://eoai-africa.org/wp-content/uploads/2024/04/FMSS-Development-Cluster-Approved-Version-PDF.pdf

[7] https://www.cabi.org/projects/promoting-good-seed-in-east-africa/.

[8] https://www.seedandknowledge.org/

FAO - ITPGRFA

The first Report on the State of the World's Plant Genetic Resources for Food and Agriculture (FAO, 1997) highlights the important role of informal seed systems to the conservation and maintenance of plant genetic resources. The report recognizes that farmers may use different varieties for different purposes, making it very difficult for the formal seed sector to serve all their seed needs. Moreover, it notes that many farmers cannot afford to buy seed for each planting season and thus produce and maintain their own seed supplies. The report notes that this reservoir of genetic diversity on-farm is a basis upon which a conservation strategy can be built. *In situ* conservation an on-farm mechanism of the conservation crop genetic resources is also highlighted.

The objectives of the International Treaty on Plant Genetic Resources for Food and Agriculture[9] (ITPGRFA) are the conservation and sustainable use of all plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security. The Treaty recognizes the enormous contribution farmers have made to the ongoing development of the world's wealth of plant genetic resources. It calls for protecting the traditional knowledge of these farmers, increasing their participation in national decision-making processes and ensuring that they share in the benefits from the use of these resources.

Global collaboration for resilient food systems

The Global Collaboration for Resilient Food Systems[10] (CRFS) is a program of the McKnight Foundation that has funded agricultural research since the 1980s. The program invests in FMSS through various projects. For example, a 3-year project in Malawi (2022-2025) seeks to strengthen FMSS for improved seed quality and access of preferred crop varieties, in particular neglected and underutilizes species (NUS) in Malawi for use and sale by smallholder farmers. In West Africa, the Networking4Seed II (2022-2026) seeks to o enhance smallholder farmers' food and nutrition security through farmer research networks around seed production (cereals and legumes) and agroecology approaches. The project portfolio includes more initiatives in support of FMSS in western and southern Africa. Regional Communities of Practice are characterized by networking, learning and collective action, thus further contributing to improved research quality as well as lasting relationships and partnerships among stakeholders.

Integrated Seed Sector Development (ISSD)

As most players in the seed sector in Africa confine their knowledge, resources and effort on the dichotomy of formal and informal, there is every benefit to accrue from a realization of the emerging of the Integrated Seed Systems (ISSD) approach. The ISSD framework could be helpful in this regard, as it avoids heating up the political debate by acknowledging that diverse interests which exist and that activities driven by these diverging interests can lead to different types of useful contributions to seed system development. The framework could also be used to better understand the different priorities of the various interest groups/partners.

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[9] https://www.fao.org/plant-treaty/en/

[10] https://www.ccrp.org/

The Integrated Seed Sector Development in Africa programme[11] (ISSD Africa) is an international Community of Practice (CoP) working to alleviate the problem of farmers' limited access to quality seed by addressing complex continental challenges. Thus, it is an initiative of the Royal University of the Netherlands, with the financial support of the Bill and Melinda Gates Foundation, which aims to reconcile the different seed systems in the different countries of Africa, with the main objective to facilitate quality seed access to small producers.

As part of the seed transformation effort in Africa, ISSD recognizes the cardinal role seed plays in this, in regard to genetic and crop innovation in order to contribute to food security, nutrition, and climate change adaptation. Currently seed is broadly categorized as formal, intermediary, and informal as distinguished by the types of stakeholders involved, the activities they perform, and the interests they have.

It is clear that despite the efforts of African governments and their partners involved in the seed sector, there still remain bottlenecks for easy access to quality seeds by a large number of producers. ISSD Africa aims to be a catalyst for the various existing systems (integration of formal and informal seed systems) in order to achieve the objective of providing quality seed to farmers in the preferred crop varieties at the right time and at reasonable prices to small-scale farmers (Louwaars and de Boef, 2012).

ISSD Africa is guided by eight guiding principles which have been formulated to support the design of seed programs and policies:

- To promotion pluralism and develop programs on the diversity of seed systems;
- To work according to the structure of the seed value chains;
- To promote entrepreneurship and market orientation;
- To recognize the relevance of informal seed systems/FMSS;
- To facilitate interactions between informal and formal seed systems;
- To recognize the complementary roles of the public and private sectors;
- To support enabling and scalable policies for a dynamic sector;
- To promote evidence-based innovation in the seed sector.

All of the eight principles have a bearing to FMSS, so ISSD Africa can be useful in the clarification of some of the issues such as the complementarity between Formal and informal seed system. This is a strong point of discussion for civil society (activists) who see the formal seed system as a competitor of FMSS.

The following are examples of ISSD successes in regard to the FMSS development:

- For Uganda the examples include, the development of the Local Seed Business concept for QDS and other locally farmer produced seed, the community gene and seed banks;
- For the Sahel, the examples include the pre-order system to improve access to early generation seeds, the identification and training of farmers including the small holder seed producers and exchange visits between farmers in the Sahel and Uganda and Burundi.

5.3. Potential funding mechanisms for FMSS strengthening

Funding of FMSS will be meaningfully impactful if it meets the criteria of environmental, human/social, economic and productivity sustainability. Through this lens, innovations in sustainable seed systems involve a set of interrelated activities that bring seeds to the market that meet the following criteria:

[11] https://issdafrica.org/

improved productivity, improved resilience, improved input efficiency, reduced environmental footprint, improved nutrition goals, and improved affordability and income for farmers. It is estimated that less than 0.5% (<USD 50 million cumulatively between 2010-2019) of the innovation investment in sustainable seeds is focused on FMSS though the lack of data granularity prevents an accurate assessment. More investment in this area can drive substantial value for farmers in the Global South. Over the last decade only USD 2 to 6 million is spent annually on innovations for FMSS programs. This funding is driven largely by funders in the multilateral, bilateral, and philanthropic sectors. Multilateral and bilateral donors spent about 4% of their investment in sustainable innovations in FMSS whereas philanthropic players spent only about 1%. Almost no private sector spending is focused on FMSS (Dalberg, 2021). Although this report does not have direct mechanisms to influence government funding of FMSS, a proposal such as the enhancement of R&D funding as a proportion of the GDP from 0.4 to 1% per country, might improve funding of FMSS. Below, several initiatives are highlighted to inspire potential funding mechanisms for FMSS strengthening.

Leveraging agricultural biodiversity and farmers' knowledge to adapt crops to climate change

Evolutionary plant breeding is maintaining and increasing agricultural biodiversity, while reversing the tendency of modern plant breeding towards uniform varieties, in order to adapt to climate change. This approach was successfully implemented in Iran through the IFAD grant Using Agricultural Biodiversity and Farmers' Knowledge to Adapt Crops to Climate Change (US$200,000, 2010-2014). This grant was implemented by a consortium of national and international research organisations and a local NGO Cenesta. The initiative was also supported by the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) benefit-sharing fund. The goal of the grant project was to increase the resilience of poor and smallholder farmers to current and future climate change shocks by increasing the adaptation of important food and feed crops through the evolutionary participatory plant breeding (EPPB) strategy (El Khoury and Delve, 2018).

The Community Seed Production (CSP) Model

Community-based seed production (CSP) system increases farmers' access to diversified crop varieties in rural areas by bridging the gap between CSS and FMSS. The value of this system is more important in open-pollinated crop varieties of cereals, which have by and large been neglected so far despite them being crucial for food security of resource-poor farm communities (Khanal and Maharjan, 2015). CSP includes activities relating to smallholder seed enterprises, informal seed supply systems, and other local seed system development programs. There is a need for greater understanding of underlying issues in CSP and to explore ways to mainstream it within the overall agricultural development strategies (Ojiewo et al., 2015). Techno Serve, Catholic Relief Services and ICRISAT implemented a three-year project aimed to address constraints from production to market for pigeon pea, groundnut, and chickpea. More than 600 farmer groups were involved in the project as a conduit for seed production and training resulting in the supply of improved legumes to more than 17,000 farmers (Ojiewo, et al 2015).

Market-based approach to strengthening local seeds systems

The Girma project in Niger is a multi-sectoral development project (2018-2023) implemented by Catholic Relief Services and funded by USAID to the tune of USD 70 million. Though the project's focus was not on FMSS alone but it considered local farmers' seed. The project strengthened local seed production and distribution to improve poor farmers' access to seed. The project established partnership with a seed company (Ferme Semencière Amaté), trained seed multipliers, agro-dealers and farmers themselves and provided foundation seed and fertilizer. By 2021, 1500 farmers purchased 3.9 tons seed from 44 agro-dealers, well beyond the anticipated project target of 900 buyers (SCALE / ISSD Africa,2022).

Other funding options

Alternative options for public funding of FMSS are:

- Creation of national funds to promote farmer seeds and strengthen the technical capacities of local communities;
- Creation of national and compensation funds for the shortfall in cultivating local varieties compared to commercial varieties;
- Microcredits and microfinancing of farmers to finance their seed needs and equipment without resorting to conventional banking institutions which have not only stringent requirements but provide expensive loans for farmers to afford;
- Simplification of seed certification mechanisms for farmer seeds that would guarantee their quality while respecting local practices. This certification will give a certain value added to the seeds and therefore improve farmers' income and hence the economic sustainability of FMSS.

6. Strengthening FMSS through indigenous knowledge integration

The enhancement of FMSS requires a fundamental shift in approach, beginning with meaningful government support and recognition. The most critical intervention lies in integrating FMSS into seed policies, legal frameworks, and regulations—a foundational step that opens pathways for subsequent improvements. This support creates the necessary conditions for budgetary allocation toward human resource development, infrastructure enhancement, and institutional strengthening, all essential for sustainable FMSS advancement.

Central to this transformation is the recognition that FMSS are not merely informal alternatives to commercial seed systems, but sophisticated knowledge-based systems grounded in centuries of indigenous science. Understanding, documenting, and integrating this indigenous knowledge into formal regulatory frameworks represents the key to unlocking FMSS potential while preserving their cultural integrity and farmer sovereignty.

6.1 Indigenous knowledge in FMSS

The perception of indigenous knowledge systems as simple and static is rapidly changing. Many societies with seemingly basic technologies possess remarkably complex and sophisticated understanding of their natural resources. All knowledge systems are inherently dynamic, incorporating elements of continuity and change through conscious community efforts to identify problems and develop solutions via local experimentation, innovation, and evaluation of external technologies (Dorji et al., 2024; Warren, 1991).

Indigenous knowledge supporting African FMSS exists within every community with minimal inter-community variations. This knowledge system is founded on seed sovereignty principles—farmers' rights to save, breed, and exchange seeds, and to access diverse open-source seeds that can be preserved without being patented, genetically modified, owned, or controlled by corporate entities. It emphasizes reclaiming seeds and biodiversity for public benefit.

Despite literature demonstrating local farmers' valuable knowledge for agricultural interventions, this indigenous wisdom has been overlooked by some seed sector actors (Nyantakyi-Frimpong and Carlson, 2024). FMSS operate on indigenous "science"—legitimate knowledge systems that authenticate and validate these practices, maintaining legitimate variety/seed selection and quality assurance value chains within their operational parameters.

This section draws upon a case study of a community in Zambia (Nkhoma and Nangamba, 2021) to demonstrate that the FMSS indigenous knowledge actually parallels a commercial seed science variety development and seed production value chain. This case study is complimented by another study from the Zulu community in South Africa (Rachel Wynberg, 2024) and the author's Kenyan experience (Onsando, 2024, unpublished).

Variety / seed selection

In FMSS, variety selection encompasses broader aspects of agricultural production and livelihood diversity (Bebbington, 1999; Scoones, 2016; Hazell, 2019). This approach reflects farmers' multiple motivations beyond yield maximization, as many are only partially engaged in market economies, with cultural tradition maintenance and autonomy preservation also influencing choices (Mausch et al., 2018; Rosset and Barbosa, 2021).

Farmer variety selection incorporates diverse rationales: organoleptic properties, biotic and abiotic stress tolerance, maturity rates, and cultural considerations. In Western Kenya, diverse seed and variety uses reflect maize's varied livelihood roles, shaping motivations underlying choices regarding seeds, varieties, and agricultural technologies, resulting in varied preferences based on sociocultural and economic considerations (Almekinders et al., 2021).

Farmers practice conscious selection with local varieties and recycled seed through sophisticated methods: Selecting seed from maize harvest is done by selecting cobs that look healthy and do not show any insect attack. For maize seed, healthy cobs without insect damage are selected, with different cob sections serving specific purposes. The seed from the tip of the maize cob is used for early maturity, the middle part is used for medium maturity and the bottom is used for late maturity. When selecting pumpkin seed, this is based on the taste (sweetness) of the pumpkin and this is also applicable to roots and tubers where taste is complimented with high dry matter content. For groundnuts, farmers select the big nuts for planting while the small nuts are used for cooking. Farmers also use physical seed characteristics such as width, length, weight, shape, surface texture, colour, and moisture content by seed cracking sounds or a local technique using dry salt and a clean glass jar.

Seed preservation and storage

Traditional seed handling demonstrates sophisticated understanding of preservation principles. Seeds for subsequent planting seasons are often suspended in kitchens where smoke provides natural pest and disease protection. Crops like pumpkin and sorghum may be placed on rooftops or stored in calabashes with detergent powder for pest control. Bambara nuts are kept unshelled to prevent pest attacks, and shelled only at planting time.

Natural preservation methods include using ash from burnt maize cobs, particularly valued for its pest control efficacy, and ash from burned aloe or neem tree leaves, sometimes mixed with dried citrus peels. These are complemented by ash from local fragrant herbaceous plants selected for their proven effectiveness.

Storage employs various containers, with pottery containers preferred where available, though increasingly replaced by locally available alternatives like glass containers. While all farmers consider themselves seed custodians maintaining a diversity of seeds for household food security, certain individuals are recognized for maintaining exceptional seed diversity—critical guardians whose role ensures agricultural biodiversity preservation.

Genetic purity and varietal maintenance

Traditional approaches to genetic purity differ fundamentally from formal CSS. The Tanzania paddy rice example demonstrates how farmers identify and isolate seed rice from grain, removing off-types to ensure uniformity. However, absolute genetic purity is not the goal because natural gene flow is deliberately leveraged to enhance varietal resilience against biotic and abiotic factors.

Varietal maintenance by farmers is difficult to achieve due to the leveraging on natural gene flow to attain the varietal resilience. This means that every varietal material is not identical season to season. To mitigate against this, farmers continuously select seed from a population that is already associated with a pool of desired traits. The varietal variants whose genetics has significantly changed to the extent of changing the desired traits are dropped. The slow pace of genetic change in quantitative characters—

resulting from multiple gene involvement—allows farmers to maintain desired characteristics over extended periods.

Yield and quality

Traditional quality assessment incorporates multiple indicators. In Tanzania and Kenya, bean seed crop selection utilizes plant architecture as a productivity marker, as bushy varieties compromise pod production. Farmers consider field performance, selecting plants appearing pest and disease-free. For maize, cob size serves as a reliable yield/productivity indicator.

6.2 Recognition and documentation of indigenous knowledge

Documenting indigenous seed knowledge represents the critical first step toward providing FMSS with deserved recognition. This documentation strengthens food and nutrition security, supports FMSS development initiatives, and ensures knowledge accessibility for development practitioners within FMSS ecosystems. It increases successful development solution adoption likelihood, as solutions often fail when misaligned with local knowledge systems. Additionally, documenting indigenous technologies facilitates transfer across communities facing similar challenges in comparable agroecosystems globally (Warren, 1991).

National surveys

National surveys could systematically document farmers' indigenous seed management knowledge across African countries through comprehensive household interviews examining knowledge underlying variety and seed selection, quality assurance, preservation and storage methods, and exchange and marketing practices. Survey findings require systematic analysis to identify similarities and differences across communities. Common practices would be documented as standard approaches, while variations would be evaluated for effectiveness and reliability. Robust variations would be harmonized to develop comprehensive country-specific knowledge frameworks for quality seed value chains within FMSS. Such consolidated knowledge serves practical application and preservation for future generations. Given the dynamic and evolving nature of indigenous FMSS knowledge, regular updates based on emerging lessons and best practices from other regions are essential. Collected knowledge should undergo structured management processes including consolidation, packaging, and repository development for accessibility and long-term preservation.

Anchorage of FMSS knowledge in national policies and legislative instruments

Incorporating FMSS into public policies and legal frameworks offers multiple advantages: clarifying FMSS status as key players in Africa's food and nutrition security; creating opportunities for public sector technical and financial support; building formal links between FMSS and public research institutions through participatory selection processes; and strengthening farmers' rights protection (Coulibaly and Peschard, 2023). Legal anchoring facilitates FMSS documentation and operationalization. This foundation is crucial given FMSS alignment with genetic resources for food and agriculture (GRFA) policies, grounded in the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). However, while ITPGRFA provides essential framework, it does not fully protect and support FMSS operations independently (Coulibaly and Peschard, 2023), underscoring the need for comprehensive national-level protection measures.

Strategic enablers for government engagement

Most African governments have invested more heavily in infrastructural, technical, policy and legislative efforts and finances to support CSS rather than FMSS. While this imbalance has begun changing over the past decade, strategic enablers can accelerate government advocacy:

***Environmental and climate agendas**:* Given global warming concerns and UN Sustainable Development Goals emphasizing Climate Action, governments find it attractive to profile FMSS as climate action strategies. Recognizing FMSS as Climate Action implementation vehicles enhances attractiveness and positions national FMSS profiles favorably while highlighting indigenous knowledge as operational enablers.

***Biodiversity Conservation Framework**:* In 2021, AFSA proposed a legal framework for FMSS recognition and biodiversity protection as an alternative to current legal systems focusing on commercial systems and negatively impacting FMSS. This framework emerged from participatory processes involving farmers, their organizations, and civil society partners across African regions (AFSA, 2022), helping reposition FMSS and associated indigenous knowledge foundations.

***International Human Rights Framework**:* The UN Declaration on the Rights of Peasants and Other People Working in Rural Areas (UNDROP) holds particular relevance for Africa (Herpers et al., 2019). UN General Assembly adoption establishes that seed and food rights must take precedence over intellectual property and seed marketing laws. This aligns with broader UN sustainability frameworks, with the UN System Task Team explicitly acknowledging indigenous knowledge's importance for environmental sustainability, stating that "traditional and indigenous knowledge, adaptation and coping strategies can be major assets for local response strategies". This high-level endorsement provides powerful framework for influencing African governments to value and support FMSS, recognize women's custodianship in transmitting indigenous knowledge, and formally document FMSS practices (Peschard et al., 2023). Such assessment offers valuable opportunities to understand how indigenous peoples have responded to environmental and development challenges, and the role their knowledge systems play in maintaining biodiversity and building climate change resilience, ultimately enhancing agricultural productivity (Dorji et al., 2024; Muthee et al., 2019).

***Continental Policy Alignment**:* The African Union seed agenda operates through the African Seed and Biotechnology Platform (ASBP), where FMSS is recognized as a separate cluster receiving equal focus as other clusters. This AU-level policy direction can influence Member States to accelerate FMSS indigenous knowledge recognition and documentation.

Approaches to regulatory integration

Successful indigenous knowledge integration into regulations requires FMSS-friendly quality assurance frameworks. Three primary approaches exist:

***Revised legal frameworks**:* Legal frameworks are modified to relax standards and simplify procedures for registering traditional and farmers' varieties, though commercialization often faces geographical limitations. Benin's seed law includes provisions for farmers' variety registration on specialized registers, though implementation is lagging (Vodouhe and Halewood, 2016). The European Union's experience with landrace and amateur variety registration has enabled well-functioning systems introducing numerous conservation varieties (Santamaria and Signore, 2021).

Ad hoc registrations: Public organizations support traditional variety registration without changing existing laws, adopting different procedures without normative basis (De Jonge et al., 2021).

Quality-focused certification: Traditional varieties require no registration but undergo less stringent quality certification processes.

Seed regulations development

Seed regulations are grounded in national policies capturing stakeholder intentions through comprehensive participation including farmers, research institutes, certification agencies, seed companies, and policymakers. Appropriate legal frameworks and implementation regulations emerge from these policies (FAO, 2017).

The consultative nature of regulation development, typically requiring parliamentary approval, can be extremely slow. Therefore, stakeholders must follow FMSS seed value chain components within farmers' cultural contexts. The objective is developing FMSS-friendly regulations that accurately interpret and reflect farmers' understanding and practices rather than merging with CSS regulations.

6.3 Recognition of farmer varieties

Through seasonal selection criteria for environmentally adapted seeds, farmers exert selection pressure on genotype populations over successive growing seasons (Harlan, 1992). This produces landraces adapted to prevailing stresses, as most adapted genotypes survived and contributed seeds to subsequent generations, often yielding harvests during severe stress seasons. From plant breeding perspectives, farmers practice local crop development when producing and selecting seeds on-farm, maintaining genetically heterogeneous varieties and their environmental adaptations. While integration into existing Plant Variety Protection Regulations may not be feasible due to DUS and VCU criteria requirements, alternative regulatory sections could address crop development with different but enhanced criteria for increasing varietal/seed quality and productivity. Farmer varieties often possess attractive characteristics like harsh environmental condition adaptability and high nutritional values, yet availability remains limited to FMSS due to national seed laws creating market access obstacles (De Jonge et al., 2021).

De Jonge et al. (2021) describe a pilot of registration of farmer varieties in Zimbabwe which informs the recommendations for legislation of farmer varieties below.

Variety Release: Variety release committees should include stakeholders considering farmers' criteria beyond commercial value—taste, cookability, biotic and abiotic tolerance. Committees should include traditional community leaders, farmer-focused organizations, and national gene bank experts. Zimbabwe's approach proposes registered farmers' varieties be produced only in areas where they were successfully tested, with potential regional restrictions for varieties unsuited to specific locations or posing risks to other varieties, humans or the environment (De Jonge et al., 2021).

Variety Registration: Unlike DUS criteria for formal varieties, the framework proposes "verification of distinctness, consistency, and stability (DCS)" for farmer varieties, assessing distinct characteristics, consistent expression, and stability after several multiplications. Replacing 'uniformity' with 'consistency in expression' accommodates heterogeneous materials typical of farmer varieties (De Jonge et al., 2021). Farmer descriptors encompass phenotypic characteristics like leaf venation, coloration, stem color, taste, aroma, and mouth feel. Systematic documentation integrates farmers' indigenous knowledge into registration protocols through genuinely consultative processes demonstrating regulatory commitment to extracting and distilling farmers' knowledge.

Variety maintenance: Mechanisms must be identified for farmers' variety maintenance, guaranteeing parent stock quality. Zimbabwe assigns this responsibility to the Genetic Resources and Biotechnology Institute (GRBI) (De Jonge et al., 2021). Varietal Ownership/Plant Breeders' Rights

Varietal ownership and rights*:* Varietal ownership is complicated because farmers' varieties belong to communities, and customary African ownership concepts differ from formal intellectual property rights. Arbiters must be identified and educated in indigenous arbitration mechanisms, with Zimbabwe vesting dispute resolution in GRBI (De Jonge et al., 2021).

Seed certification: Once recognized, farmers' varieties follow less stringent guidelines like Quality Declared Seed (QDS), prescribed by regulatory agencies while ensuring farmer/community indigenous knowledge on quality assurance methods are fully documented and integrated into regulations.

6.4 Integration of indigenous knowledge into seed regulations

Indigenous seed knowledge integration into seed regulations supporting FMSS seed quality value chains is not only feasible but essential for sustainable agricultural development in Africa. When conducted consultatively, this integration generates multiple benefits: faster and cheaper variety releases, improved farmer incomes, and greater diversity of well-adapted market varieties.

However, this transformation requires patience and persistence. The process will be gradual due to the complex nature of regulation development in Africa and the extensive negotiations necessary to convince diverse seed stakeholders, some holding strong opinions on optimal FMSS development approaches.

Success depends on several critical factors: genuine government commitment to recognizing FMSS as legitimate and valuable systems; comprehensive stakeholder engagement that meaningfully includes farmers and their organizations; development of appropriate legal and regulatory frameworks that honour traditional knowledge while meeting modern quality assurance needs; and sustained investment in documentation, capacity building, and institutional development.

The proposed framework recognizes that meaningful FMSS improvement requires systematic integration of indigenous knowledge into formal regulatory structures while preserving the cultural integrity and sovereignty principles that define these systems. This approach offers a pathway toward strengthening Africa's food security through the wisdom of its farming communities, bridging traditional knowledge with contemporary regulatory needs to create more resilient and inclusive seed systems.

The ultimate goal is not to transform FMSS into commercial systems, but to enhance their effectiveness and recognition while maintaining their essential character. This balanced approach can unlock the full potential of farmer-managed seed systems as cornerstones of sustainable agricultural development and food security across Africa.

7. Seed policies and legislation in Africa

Most African countries have national seed policies and/or seed laws, with accompanying implementing instruments, including seed regulations, ministerial orders or decrees. These national seed policies and laws tend to focus on the formal CSS. Notable exceptions to this are Cape Verde, Democratic Republic of the Congo (DRC), Djibouti, Guinea Bissau and Mauritius which lack any seed law or regulations (Onsando, 2020).

There are strong concerns about the superficial or non-existent support African governments provide to FMSS. This lack of support systematically marginalizes FMSS custodians, particularly women, who have historically served as primary keepers of seeds and germplasm. The marginalization stems from multiple interconnected factors: the lingering influence of colonial systems, the prioritization of commercial and corporate interests that value profit over traditional knowledge and biodiversity preservation, and legislative changes that harmonize seed laws to favour commercial breeders. These regulatory shifts further constrain seed and food sovereignty across Africa by promoting commercial breeders' varieties and facilitating the expansion of multinational agri-food corporations. Such preferences undermine the diversity and resilience of African food systems while perpetuating farmers' dependence on external sources of seeds and agricultural inputs.

7.1 Negative impacts of national seed policies on FMSS

The Africa Centre of Biodiversity argues that current seed policies and laws across Africa and globally neither recognize nor support FMSS. Their primary objective is constructing and maintaining a commercial seed sector driven by multinational interests through coordinated multinational public, private, and philanthropic investments (Africa Centre of Biodiversity, 2015). The impacts and potentials of the national legislations and policies on FMSS are articulated below.

Monopolistic plant genetic resources rights

Many African countries are establishing exclusive and monopolistic rights over plant genetic resources for food and agriculture, along with associated knowledge about their use. This trend obstructs farmers' access to seeds and threatens FMSS. As a mitigating strategy, Bioversity International advocates for Open Source Seed Systems (OSSS)[12] to enhance diversity and resilience. The OSSS approach seeks to improve access to and availability of seed and genetic resources by ensuring freedom of use and exchange among farmers and breeders without restrictions on subsequent varieties and their derivatives (Otieno and Westphal, 2018). However, the implementation of open-source systems faces significant challenges. While public breeding programs could release materials as open source, such systems may disincentivize breeders and seed companies from developing elite genetics for high productivity and climate resilience, as this would interfere with royalties and market niches that companies exploit through novel varieties.

Insufficient support to lack of recognition, regulation and stimulation centred policies

A comprehensive review of seed policies and laws in Kenya, Tanzania, and Uganda revealed that the concrete, field-level impact of seed-related policies and laws on FMSS remains modest. Smallholder farmers are more significantly affected by low levels of recognition and support for their seed management practices than by restrictive policies and laws (Vernooy, 2016). Similar conclusions emerge

[12] Open Source Seed Initiative - Home of the OSSI Pledge

from South Africa, where seed-related policies fail to recognize FMSS as a contributor to food security, potentially depriving farmers of necessary government support and assistance. Formal recognition and support for FMSS could substantially improve smallholder farmers' access to quality seed and, consequently, their yields and productivity (Hlatshwayo et al., 2021).

A recent CGIAR review of seed policies and laws in 14 African countries (Benin, Burkina Faso, Ghana, Mali, Nigeria, Burundi, Kenya, Tanzania, Uganda, Malawi, Namibia, South Africa, Zambia, and Zimbabwe) found that while these policies acknowledge FMSS existence to some degree, most fail to provide concrete support. Only Mali, Uganda, and Zimbabwe explicitly express the value of FMSS as part of the national seed sector (Vernooy et al., 2023a). The review concludes that substantial work remains to promote and support diverse genetic resources for climate change adaptation through strengthening national and regional collaboration on integrated seed sector development, increased recognition of FMSS activities (including community seed banks and local seed businesses), alternative variety registration systems, farmers' rights regarding seeds, and recognition of women's roles in seed systems. Encouragingly, some countries—including Mali, Uganda, and Ethiopia—have revised their national policies to recognize FMSS, providing models for broader policy reform.

Seed autonomy among farmers

In most African countries including Kenya, Uganda, Tanzania, Rwanda, Mozambique, farmers operate independently throughout the FMSS value chain (Subedi and Vernooy, 2019). Despite high levels of seed autonomy, local seed systems face increasing stress. Traditional seed exchange relationships and collective local management of plant genetic resources have weakened due to intensification, commoditization and privatization. Agricultural production is becoming increasingly market-oriented, creating both benefits and costs depending on the local context. Large-scale rural-to-urban migration is transforming smallholder farming and contributing to the feminization of agriculture, increasing women's workload and responsibilities in many regions (Vernooy, 2016). These trends affect local seed production, selection, storage, distribution, and exchange practices, for example, through substituting local varieties with hybrids purchased from local markets or agro-dealers.

Seed law harmonization and domestication of international conventions

Many African national governments and regional organizations are working to align and domesticate rules and regulations from the International Union for the Protection of New Plant Varieties (UPOV 1991), which provides strong protection for breeders' rights. The African Regional Intellectual Property Organization (ARIPO) has developed a draft harmonized plant variety protection law, approved as UPOV 1991-compliant by the UPOV Council on April 11, 2014. However, the domestication of international conventions creates a complex landscape of farmers' rights recognition. While some treaties recognize farmers' rights in Africa—including UPOV (1978), Plant Treaty (2001), SADC Harmonised Seed Regulatory System (2013), ECOWAS-UEMOA-CILSS Seed Regulatory Framework (2014), Arusha Protocol on PVP (2015), SADC Protocol on PVP (2017), and AU Guidelines for harmonizing seed regulatory frameworks—others do not recognize farmers' rights, including UPOV (1991), WTO TRIPS Agreement (1995), COMESA Seed Harmonisation Regulations (2014), Annex X of the Bangui Agreement (2015), and Draft AfCFTA Protocol on Intellectual Property Rights (2022) (Munyi, 2022).

This policy direction, particularly for conventions that do not recognize farmers' rights, potentially curtails FMSS development in Africa. Under Article 15 of UPOV 1991, farmers may exchange and save seeds of their own crops for propagation on their holdings, particularly for crops with a history of seed saving. But farmer varieties often cannot meet UPOV criteria for registration, leading civil society organizations to voice concerns that such initiatives do not support FMSS (AFSA/GRAIN, 2015). Despite countries being members of the International Treaty on Plant Genetic Resources for Food and Agriculture, seed-related policies and laws in these nations do not explicitly reference farmers' rights as described in Article 9 (Vernooy et al., 2023a). Zimbabwe has made some progress on domesticating farmers' rights law, including reviewing biodiversity legislation and developing a farmers' rights policy and law.

Limited Farmer Participation in Policy Development

The extent of African farmer participation in seed policy formulation processes remains inadequate. Such participation is essential for ensuring that seed laws, policies, and programs are relevant, effective, FMSS-friendly, and sustainable. These policies should address farmers' rights to save, use, and exchange farm-saved seeds and harvests of both protected and indigenous varieties (Munyi, 2022). Despite women being key actors in FMSS, few effective women-centred initiatives exist in seed systems, with Mali being a notable exception (Vernooy et al., 2023a).

Recent policy developments

The African Seed and Biotechnology Platform (ASBP) Steering Group met in Nairobi in November 2024 and produced a draft FMSS policy framework. This milestone development recognizes that AU Member States have not yet developed FMSS policy either as standalone frameworks or as sections within existing seed policies. Critical importance lies in securing AU Member State buy-in to recognize FMSS and facilitate transboundary trade of FMSS varieties to enhance development and sustainability. However, the primary obstacle will be mitigating phytosanitary challenges as outlined in current national phytosanitary laws. Given the importance of expanded markets for FMSS varieties and opportunities for countries with less robust FMSS to receive varieties from those with stronger systems, creating alternative mechanisms to facilitate transboundary trade becomes vital.

7.2 Shaping national legislation and policies to support FMSS development

The extent to which policies and legislation support or undermine farmer participation in seed systems depends on six identified criteria:

1. Provision of quality seed
2. Freedom to exchange and sell seed within farmer-led seed systems
3. Inclusion of farmers' varieties in variety release systems
4. Inclusion of user-friendly quality assurance systems across the FMSS value chain
5. FMSS-friendly requirements for registration to produce seed
6. Inclusion of farmers in relevant authorities and policymaking

Provision of quality seed

Progressive seed laws should protect farmers by establishing legal obligations for sellers to guarantee seed quality through standardized inspection and testing procedures (FAO, 2015). They should create level playing fields by setting market rules for different seed suppliers (Louwaars, 2005) without being skewed toward seed and biotechnology industry demands or criminalizing farmers (La Via Campesina and GRAIN, 2015). Such laws should recognize that while formal seed quality and identity depend on labels and certificates, FMSS depends on trust established between farmers and seed sellers based on community trade (Herpers et al., 2019). However, governments and farmer communities can collaborate to develop seed quality markers that farmers have developed over time. Recognition and documentation of these markers as seed quality indicators through policies and legislative instruments would improve FMSS, inspiring farmers to deliberately enhance seed quality to improve crop productivity, food and nutrition security, and farmer livelihoods.

The freedom to exchange and sell seed within FMSS

The freedom to exchange and sell seed within FMSS represents a crucial pathway for shaping legislation to enhance farmer livelihoods through seed and grain sales, resulting in improved food and nutrition security. Recognition of both CSS and FMSS would impact their operational synergies as both systems contribute to food and nutrition security.

Current legislation varies significantly across Africa. Francophone countries show less concern with guaranteeing farmers' freedom to sell and exchange farm-saved seed, except for Senegal, Niger, and Burkina Faso. Many African countries prohibit trade in unregulated seed, including Algeria, Angola, Benin, Botswana, Burundi, Burkina Faso, Cameroon, Côte d'Ivoire, DRC, Egypt, Gabon, Ghana, Guinea, Kenya, Madagascar, Mali, Morocco, Mauritania, Mauritius, Rwanda, Sudan, Togo, and Tunisia. Conversely, legislation allows local sale and exchange within FMSS in Senegal, Niger, South Africa, Tanzania, Zimbabwe, Zambia, Malawi, Ethiopia, and South Sudan. Uganda and Nigeria permit exchange of farm-saved seed, while Eswatini's law remains silent on exchange legislation (Herpers et al., 2019).

Several examples demonstrate the typical policy ambiguity regarding seed exchange:

- **Zambia** promotes an integrated seed industry involving both formal CSS and FMSS, yet aims to protect "farmers from using insufficiently tested varieties" (National Seed Policy of Zambia, 1999)
- **Eswatini** takes government responsibility for supplying farmers' improved seed (Seed Policy of Swaziland, 1993)
- **Ghana** focuses on quality seed while positioning smallholder farmers as distributors of less-well-performing varieties (National Seed Policy of Ghana 2013)
- **Uganda** acknowledges low output of smallholder farmers and envisions turning them into commercial entities while recognizing FMSS value (Draft National Seed Policy of Uganda, 2014)
- **South Sudan, Mali, Benin, and Guinea** recognize important roles of landraces and local varieties in crop improvement, climate change adaptation, and pest/disease resistance, committing to preserving these varieties and allowing farmers to multiply and share seed (Herpers et al., 2019).
- **Tanzania and Malawi** allow only certified varieties for sale, although farmers exchange seed among themselves within their communities (Herpers et al., 2019).
- **Senegal, Burkina Faso, Niger, South Africa, Tanzania, Zimbabwe, Ethiopia, South Sudan, Malawi and Zambia** allow for the sale of seed produced by smallholder farmers under certain conditions or provisions (ISSD Africa, 2017).
- **Rwanda, Ghana, Kenya and Mauritius** restrict the sale and exchange of seed by farmers. There are no provisions to facilitate the practice of seed sale or exchange by farmers (Herpers et al., 2019).

The lukewarm support to no support gives the formal CSS comparative advantage at the expense of FMSS. This slows down growth of the FMSS and limits the opportunities to adequately position the FMSS to play their rightful role in the delivery of food and nutrition security and farmer livelihoods through sale of seed and grain as food.

Inclusion of farmers' varieties in variety release systems

Most national seed laws in Africa heavily favour formal CSS and consequently do not provide for inspection, certification, or registration of farmer varieties. In formal seed systems, variety recognition typically ties to legal ownership or documented origin, with implications for breeders' rights and access and benefit-sharing mechanisms.

Variety registration requires official release through formal testing and evaluation—often including Distinctness, Uniformity, and Stability (DUS) and Value for Cultivation and Use (VCU) assessments—by designated committees. These procedures are costly and time-consuming, making them largely inaccessible to smallholder farmers. Additionally, many farmer varieties, including landraces, exhibit significant genetic and phenotypic diversity that contributes to resilience and local adaptability but complicates assessment under formal testing standards.

Enabling inclusion of farmer varieties in national or regional variety catalogues requires fundamental restructuring of existing variety release and registration frameworks. Such reforms would make seed laws more supportive of FMSS and unlock benefits including stronger integration with formal CSS, improved crop diversity and productivity, enhanced food and nutrition security, and better farmer livelihoods.

Progress has begun in recognizing and registering farmer varieties using alternative criteria:

- **Mozambique** registers varieties passing only DUS tests in the 'National Variety List,' while varieties passing both DUS and VCU tests with proven agricultural use are recorded in the 'List of Recommended Varieties' (Decree no. 12/2003).
- **Kenya, Uganda, and Nigeria** have important exceptions for automatic variety registration of vegetables (Gisselquist et al., 2013).
- **Benin** maintains an actual list registering farmers' varieties (Herpers et al., 2019).
- **Niger, Malawi, and Uganda** commit to registering landraces under looser criteria, while **Burkina Faso, Mali, and Kenya** have provisions for preserving local varieties (Herpers et al., 2019).
- **Ghana** does not aim to register farmers' varieties but supports farmers in official variety release (Herpers et al., 2019).
- **Niger** restricts seed production to registered varieties following DUS and VCU testing but recognizes that traditional varieties belonging to farmer communities can be used freely, guaranteeing de facto ownership (National Seed Policy of Niger 2012)

Inclusion of quality assurance systems

National seed laws in Africa recognize five seed classes: breeder seed, basic (foundation) seed, certified seed, standard (emergency) seed, and quality declared seed. Legal recognition of these seed categories is based on the premise that the seed is produced according to prescribed standards using DUS and VCU principles, ensuring trustworthy quality regarding germination rate, disease freedom, and genetic and physical purity (Herpers et al., 2019).

Several countries include escape clauses allowing standard loosening during emergencies (Rwanda, Kenya, Tanzania, Tunisia) or seed shortages (Uganda). Zimbabwe offers 'standard grade' classes for crops other than eight commercially important crops, requiring only purity and germination tests for registration (Herpers et al., 2019).

The FAO introduced Quality Declared Seed (QDS) systems as alternative quality control schemes providing less stringent certification standards. This recognizes that many countries lack expertise, infrastructure, and funds to certify all seed lots, and not all producers can meet strict commercial seed enterprise requirements. QDS aims to provide seed standards for diverse crop species and agro-ecologies. The system was revised in 2003 to accommodate local varieties (FAO, 2006; Visser, 2017). This semi-regulated certification approach makes seed-producing farmers responsible for quality control, with government agents checking limited portions of seed lots and multiplication fields. Eight African countries mention QDS in either their acts or policies: Ethiopia, Ghana, South Sudan (draft policy), Tanzania, Uganda (draft policy), Mozambique, Malawi and Zambia (Herpers et al., 2019).

There are mixed experiences with the use of QDS though and the strengths and weaknesses of QDS need to be better understood (Visser, 2017). In Tanzania and Uganda, smallholders can produce and sell seed under QDS systems within local areas. However, delays between inspector sampling and farmer receipt of test results can prevent sales under QDS systems (CABI, 2014). The lack of inspections and seed testing services render the seed not true QDS, posing challenges in assuring seed quality, hampering seed producers' access to premium markets due to lack of branding and product differentiation (Kansiime et al., 2021).

The International Federation of Organic Agriculture Movements (IFOAM) has developed participatory guarantee systems as alternative certification based on food sovereignty, security, and safety principles appropriate to small farmers' realities. This system emphasizes flexibility, learning, transparency, trust-building, local market priority, long-term relationships, co-responsibility, decentralized decision-making, empowerment, capacity building, and gender sensitivity (Visser, 2017). Though this system is still little applied, it can offer insights and guidelines for seed quality assurance within FMSS.

Requirements for registration to produce seed

Seed laws generally regulate the production of certified seed of registered varieties. Seed producers must undergo evaluation processes resulting in permits, authorizations, or certificates. Regulations prescribe rigid standards for competencies, skills, and infrastructural requirements (Herpers et al., 2019) that most FMSS seed producers cannot meet. This necessitates policies and legislative alternative criteria for registering farmers as informal seed producers. Countries differ in required registration entities, with few providing exemptions for farmer seed enterprises (Herpers et al., 2019):

- **Ghana** supports breeder seed supply to FMSS for local cultivars or adapted research releases (National Seed Policy 2013)
- **Malawi** requires registration only for premises where seed is processed, distributed, and sold, not persons performing these actions, with draft law including farmers' communities (Seed Act 1996)
- **Mozambique** differentiates between formal producers requiring full registration for commercial goals and informal producers allowed to produce seed after local authorization

- **Nigeria** exempts registration requirements for persons growing and delivering seeds directly to others for their own farm use without monetary transactions (National Agricultural Seeds Decree 1992)
- **Uganda** aims to transform FMSS into regulated systems while crediting FMSS roles in biodiversity conservation, though the Seeds and Plant Act (2006) lacks supporting provisions
- **Zambia** encourages farmer participation in germplasm conservation and small seed enterprise establishment, with government-supported breeder seed supply to FMSS (National Seed Policy 1999)
- **Zimbabwe** allows farmers to sell seed directly to other farmers without registration
- **Ethiopia and Tanzania** provide for smallholder farmer registration as QDS producers

Inclusion of farmers in relevant authorities and policy making.

Farmer participation in seed policy making is not only democratic, but also part of farmers' rights under the Plant Treaty. Farmers' participation rights should include laws, policies and practices addressing seed release, registration, commercialization, access and benefit sharing, plant variety protection and trade laws at national levels (Munyi, 2022). Most African countries specify which members should be included in their authorities that advise ministers on seed-related issues. Farmers are often represented, alongside decision makers, researchers, specialists and private sector representatives. Algeria, Benin, Burkina Faso, Cameroon, Mali, Madagascar, Burundi, Morocco, Tunisia, Kenya, Ghana, Nigeria, Mozambique, South Africa, South Sudan, Swaziland and Uganda include farmers in the seed sector government committees. In Ghana, Malawi, Mozambique, Rwanda and Swaziland, farmers are also included in variety release and certification agencies. However, the national laws (with exception of Rwanda) do not distinguish between large commercial farmers and smallholder farmers, and farmer inclusion does not guarantee representation of all farming systems (Herpers et al., 2019).

7.3 Prospects for equivalence in promoting best practices of FMSS strengthening

The equivalence principle and mutual recognition

The equivalence principle serves as the foundation for mutual recognition between states by harmonizing legislation to establish inter-state trust. This approach enables countries to maintain sovereignty over their legal frameworks while ensuring that regulatory provisions achieve comparable outcomes across jurisdictions. Mutual recognition operates successfully within the European Union across a wide array of products and services. This principle facilitates the sharing of inter-state best practices and ensures market access for goods that fall outside or are only partially covered by harmonized legislation at EU level. Under this framework, any product lawfully sold in one EU member state can be marketed in another, and best practices developed in one country can be adopted by others. However, African Union member states remain far from implementing such comprehensive mutual recognition systems.

The equivalence principle is a precursor to mutual recognition. It focuses on functional similarity rather than textual uniformity. It allows sovereign countries to maintain responsibility for their legal and para-legal instruments while ensuring that regulatory provisions are sufficiently generic to achieve equivalent meanings across different national contexts. Rather than requiring identical legislative language, equivalence examines whether different legal frameworks produce similar regulatory outcomes and interpretations. This distinction is crucial: two legal documents may differ significantly in their specific wording yet achieve equivalent meaning and practical application. For African Union member states, the equivalence principle offers a pathway toward regulatory harmonization that respects national sovereignty while enabling effective cross-border cooperation and trade.

Regional harmonization efforts

Africa's remarkable diversity—spanning political systems, ecological zones, cultures, economies, infrastructure, human capacity, and seed governance frameworks—creates significant challenges for continental coordination. This complexity is amplified by the continent's 55 sovereign states, each functioning as independent administrative entities with distinct regulatory approaches. Consequently, benchmarking and sharing best practices in seed systems across the continent face large challenges. These challenges become even more pronounced for FMSS due to several compounding factors: the strong cultural foundations underlying farmer seed practices, diverse indigenous knowledge systems, limited documentation of traditional practices and associated systems, and the absence of supportive policies and legal frameworks specifically tailored to FMSS regulation, protocols, and standards.

To comprehend the difficulties in implementing the equivalence principle for sharing FMSS best practices across Africa, it is essential to first examine why seed regulation harmonization has proven challenging even for CSS. Though the focus of this report is on FMSS, the absence of continental policy and legal frameworks supporting FMSS means that harmonization efforts remain largely undocumented and uncoordinated. This situation underscores that harmonization serves as a necessary precursor to operationalizing the equivalence principle.

Throughout sub-Saharan Africa, regional harmonization offers great promise for market integration, achieving economies of scale, and creating value chain opportunities that improve livelihoods across sectors, including agriculture. Legal and regulatory reforms constitute critical components of this regional integration process. Africa's Regional Economic Communities (RECs) are developing increasingly comprehensive frameworks for seed sector development through standardized rules and regulations (Kuhlman, 2015; Munyi, 2022). The harmonization of seed regulations and other agricultural inputs has emerged as a priority focus area across Africa's regional economic communities, reflecting recognition of its potential to facilitate cross-border trade and technology transfer while maintaining appropriate quality and safety standards.

While each REC is taking steps to harmonize critical aspects of seed regulation (variety release, quality control, and sanitary and phytosanitary (SPS) measures), the degree of regional harmonization varies across the RECs. Most importantly, much more remains to be done before regional efforts can be fully implemented. The variability in implementation is due to:

- Institutional structures and capacities within the RECs are very different;
- Overlap between different regional initiatives;
- The degree to which national level action, including further change in the laws and regulations, are needed to implement regional seed harmonization efforts;
- Weak regulatory cooperation among countries within the RECs;
- Weak inter-country trust or “mutual recognition” within the regions.

The degree of harmonization varies across regions, as listed below:

- **Common Market for Eastern and Southern Africa (COMESA)** enacted its Seed Trade Harmonisation Regulations in 2014 to create a regional seed certification, variety release and a phytosanitary system. The majority of the 21 COMESA countries have adopted the regulations (Munyi, 2022). Seven countries have harmonized fully the COMESA harmonization regulations namely, Burundi, Kenya, Malawi, Rwanda, Uganda, Zambia and Zimbabwe (COMESA variety catalogue, 2021)[13].

- **Southern Africa Development Corporation (SADC)** established a Harmonised Seed Regulatory System in 2013, including a framework for registration of landraces, which is being implemented in 12 out of 16 Member States (Munyi, 2022). The SADC Member States are making efforts to domesticate the regional seed regulations but the levels of harmonization vary based on the specific technical areas concerned (FAO, 2020).
- **Economic Community of West African States (ECOWAS)** Member States have made strides to align different aspects of their legal frameworks with the ECOWAS harmonized seed regulatory framework, despite the differences in institutional capacities. Countries that have made most harmonization progress are Benin, Burkina Faso, Gambia, Nigeria and Senegal (Kuhlmann and Zhou, 2016). Under the ECOWAS regulations, varieties (including landraces and local varieties) registered in one country will be included in the West African Catalogue of Plant Species and Varieties (COAFEV) and may be introduced in any ECOWAS Member States.
- **East African Community (EAC)** has not yet passed centralized seed harmonization legislation as required under the EAC Treaty, though specific aspects have been adopted. The agreement on variety release and registration allows varieties registered in one country's catalogue to be made available in another country following one year of VCU testing with sufficient data from similar agro-ecological zones. This agreement has been adopted by Kenya, Uganda and Tanzania. By 2015 the EAC Elimination of Non-Tariff Barriers Act had been passed by Legislative Assembly and the Protocol on Sanitary and Phytosanitary Measures adopted by EAC Summit (Kuhlmann and Zhou, 2016).
- **Northern African countries** have not documented any seed policy harmonization efforts, possibly because the RECs in the northern part of Africa are at formative stages.

Mechanisms for Implementing FMSS Equivalence

Despite challenging feasibility prospects, several mechanisms can begin operationalizing the equivalence principle for FMSS:

- ***Documentation of FMSS indigenous knowledge*:** This involves field studies interviewing farmers and key informants on FMSS indigenous knowledge across communities, regions, and countries. Analysis would identify variability and common ground, consolidating enriched knowledge into documents forming first-level indigenous knowledge documentation. Through case study approaches, best practices would be identified country by country, forming bases for agreed-upon best practices informing inter-country benchmarking.
- ***Seed policy formulation and reform:*** Most African member states have not formulated FMSS policies and, by extension, laws and regulations. Where seed policies exist, they address only elements of FMSS value chains. The absence of FMSS policies and legal frameworks makes interstate best practice sharing extremely difficult, calling for urgent commencement of FMSS

[13] www.varietycatalogue.comesa.int

policy formulation and reform of existing frameworks to support FMSS through financial, human, and infrastructural support.

- ***Stakeholder buy-in:*** The seed sector encompasses diverse stakeholders with strong views supporting different aspects. Government funding and policy development in Africa skews toward CSS, frustrating FMSS development and interstate best practice sharing. African governments should deliberately recognize FMSS significant contributions to seed diversity, food, and nutrition security, positioning FMSS as key players in this space.
- ***Institutional development:*** Current seed regulatory and research institutions in Africa develop varieties for the CSS. Regulatory agencies and research institutions often devote over 50% of efforts to maize at the expense of other crops in countries like Kenya, Tanzania, Zambia, Zimbabwe, South Africa, Malawi, and Rwanda. To enhance FMSS development, it should be elevated to full-fledged departments or directorates in research and seed regulatory agencies, accessing human capital, budgets, and infrastructural support. R&D institutions' FMSS departments should focus on farmer-assisted breeding of landraces to enhance productivity.
- ***Creation of robust national seed associations and civil society:*** Governments need to recognize National Seed Associations and Seed Civil Societies at policy levels, empowering them to advocate for FMSS sectors alongside commercial seed components. Combined advocacy to governments should balance support for FMSS and CSS with evidence where possible, inclining governments toward supporting FMSS as integral parts of seed industries.

8. Leveraging complementarities of CSS and FMSS

8.1 Apparent divide between CSS and FMSS

Contemporary seed sector development approaches reflect fundamentally different philosophical approaches and paradigms that shape investment priorities and program design. Organizations like AGRA/PASS focus primarily on private sector seed business development, promoting commercial seed companies and formal input supply chains. In contrast, select NGOs and donors emphasize locally-driven initiatives centred on informal, farmer-based seed systems, including community-based seed production, seed banking, and seed village initiatives (GTZ, 2000).

The concept of seed quality reveals the philosophical tensions between formal CSS and FMSS. Within FMSS, quality seed represents varieties selected over generations for resilience against climate shocks, disease and pest resistance, and consumer-preferred characteristics. Quality determination in these systems relies on trust-based relationships and farmer evaluation of performance under local conditions. Formal seed systems, conversely, define quality through certification processes based on OECD seed schemes and laboratory testing according to International Seed Testing Association (ISTA) protocols. This approach emphasizes compliance with standardized physical, physiological, genetic, and plant health attributes.

Unfortunately, national seed policies and legislation focus on CSS but tend to ignore FMSS at best, or negatively impact them at worst. CSS proponents have positioned FMSS as inferior, having anti-development orientations and requiring replacement by CSS. Consequently, there is little public support for FMSS. Meaningful support and recognition should include acknowledgment of diverse farming systems, FMSS roles, community seed banks, local seed businesses, alternative variety registration systems, farmers' rights regarding seeds, and women's roles in agriculture and seed systems (Vernooy et al., 2023a). This meaningful support remains distant in many African countries.

8.2 The case for CSS

System structure and regulation

The formal CSS represents a deliberately constructed and regulated system involving a chain of activities leading to genetically improved products. This system operates through comprehensive policies, legal frameworks, protocols, and standards. Quality assurance begins with breeding and variety registration under defined parameters in national seed variety protection laws, regulations, and standards that most African countries align with UPOV, basing the entire process on Distinctness, Uniformity, and Stability (DUS) and Value for Cultivation and Use (VCU) tests.

After variety registration, the seed multiplication journey commences with breeders providing breeder's seed, which is multiplied to basic seed, then commercial seed ready for planting. Seed inspection begins when commercial seed is planted, conducted according to national seed inspection regulations and standards that most African countries align with OECD seed schemes. Seed harvesting, processing, protection, and labelling are also inspected by seed regulatory agencies according to relevant regulations and standards.

Quality assurance and testing

Seed testing represents the final stage determining whether seed is certified for sale. Testing is based on national regulations and methodologies that most African countries align with ISTA methods and standards. This standardization is particularly significant for building trust in results. Cross-boundary trust is enhanced when national laboratories achieve ISTA accreditation, granting them authority to issue orange conformity certificates—internationally recognized seed passports.

Critical seed quality tests include germination, seed purity, seed health, and seed moisture tests. Most African seed testing laboratories have capacity for these four tests, which inform seed physiological state, freedom from seed-borne pathogens, seed purity regarding weed seed status, and other physical contaminants.

Only after successful seed testing is a seed lot certified for market distribution. The CSS undergoes methodical and precise measurements of seed quality status through well-calibrated machines and equipment, fully supported by African government investments in:

- Policy, legal frameworks, regulations, and standards;
- Institutional development through Research and Regulatory Agencies;
- Technically competent human capital;
- Operational budgets;
- International collaboration through seed international conventions.

Unfortunately, this level of government commitment and support does not extend to FMSS and is sometimes completely lacking.

Commercial viability and development arguments

CSS sustains itself on commercial viability, which is a function of high volumes/productivity and desirable traits. CSS development advocates argue this approach more efficiently closes yield gaps regarding seed quality, yield potential, and increased efficiency of delivery mechanisms offered by private companies and agro-dealers. These actors favour 'Green Revolution' agricultural sector modernization, promoting formal seed systems development through the private sector as part of a development path involving increased productivity aimed at delivering affordable food to urban citizens and rural net consumers (Haug et al., 2023).

8.3 The case for FMSS

Role in food and nutrition security

Seed security forms the foundation of agricultural productivity and household nutrition across Africa. Defined as farmers' year-round certainty of obtaining timely access to adequate quantities of affordable, quality seed for their production needs (FAO, 1998), seed security encompasses four essential dimensions: availability, accessibility, timing, and equity. These elements directly determine agricultural outcomes and, consequently, household food and nutrition security.

The relationship between seed diversity and nutritional diversity is particularly crucial. Households require access to varied seed types to produce diverse crops that support adequate, balanced diets. This diversity is especially vital for Africa's predominantly rural populations, who have developed intimate knowledge of their farming environments over centuries. Smallholder farmers have accumulated numerous crop landraces through domestication, selection, and improvement. Diverse crop plants and varieties are characterized by farming systems meant to address different ecological, social, cultural, and economic needs.

The agroecological resilience of FMSS has been convincingly documented in literature, forming part of the rationale for supporting locally developed farmer varieties. Many small-scale agroecological farming practices promote seed diversity and should be nurtured and supported (Wynberg, 2024). Local seed varieties are available to farmers without requiring expensive seed purchases or dependence on external knowledge systems. Moreover, they represent ecologically resilient seeds that can adapt to changing climate and other challenges (Nyong et al., 2007; Niang et al., 2014).

Agricultural biodiversity and genetic diversity

While CSS brings diversity through new varieties and combinations, increasing registered varieties of selected crops through commercial activity, this perspective fails to consider impacts on:

- Farmer varieties or populations that remain unregistered
- Narrowing genetic diversity within crops as many modern varieties represent slight adaptations from common genetic bases
- Narrowing genetic diversity in related crops of neglected and underutilized species

These deficiencies result from narrow investment and promotion focus on relatively few crops and varieties, driven by profit motives within the CSS. Although farmers have developed and cultivated thousands of different and genetically unique populations, today only 150 plant species are widely cultivated, with just 12 providing three-quarters of the world's plant-based food. These 'mega crops' include rice, wheat, and maize, along with sorghum, millet, potatoes, and sweet potatoes (Fowler and Mooney, 1990; Bioversity International, 2017).

It is no accident that 80% of the world's biodiversity is sustained within indigenous territories (Sobrevila, 2008) by peoples who deeply value collective rights and community. Biodiversity and agrobiodiversity stewardship reflects the profound connection that local farmers have to their territories and intergenerational knowledge passed down to 'observe, adapt and incorporate traditional knowledge to ever changing ecosystems, and harmoniously reside within the biological diversity of Mother Earth' (FAO et al., 2021).

Arguments for diversification and nutrition

The arguments presented by Fowler and Mooney (1990) and FAO (2021) suggest that CSS promotes crop monoculture of just 12 widely cultivated crops at the expense of thousands of different and genetically unique populations developed and cultivated by farmers. In these views, CSS contributes to continued crop genetic diversity erosion of thousands of farmer-cultivated crops responsible for dietary diversity and nutrition implications.Some therefore call for greater emphasis on nutrition security (e.g., Nordin, 2024) to move away from overreliance on few staple crops and emphasize nutritionally rich foods and dietary diversity, consequently supporting a larger range of local crop varieties. Others argue that modern agriculture (supported by CSS) depends too heavily on synthetic agrochemicals, while local varieties (supported by FMSS) exhibit resilience against abiotic and biotic factors (Shattuck, 2021; Wynberg, 2024) and should therefore be supported.

Performance comparisons and evidence gaps

Although CSS proponents emphasize productivity and delivery modes, comparative data on modern varieties versus FMSS varieties or landraces remains very limited. Even with maize, a staple food in most African countries, such data remains scarce. A study in Ghana indicated that hybrid varieties' mean maize yields significantly outperformed local counterparts and local Open-Pollinated Varieties (OPVs). During a season with ample rainfall, the hybrid maize variety Adikanfo performed best at up to 5 tons per hectare while the most popular landrace Obaatanpa yielded 3.1 tons per hectare. Hybrid varieties' profitability was also higher despite higher costs. Notably, yields on farmers' fields were substantially lower than on demonstration plots, as farmers tend to invest less labour and agro-chemical inputs than recommended (Udry et al., 2018).

Improved varieties demonstrate productivity benefits compared to farmer varieties. African governments should leverage this comparative advantage to feed growing populations while recognizing FMSS critical roles. This necessitates government support for integrated seed systems approaches encompassing both CSS and FMSS.

8.3 Complementarity of CSS and FMSS

Opportunities for complementarities between CSS and FMSS

FMSS and CSS demonstrate important complementarity in strengths and weaknesses, offering multiple opportunities for improving both systems' effectiveness. Very few countries have included such approaches in their seed policies (Almekinders and Louwaars, 2002). FMSS functions as an integrated system parallel to formal CSS. While FMSS and CSS are poorly connected, their complementarity indicates that better interaction offers opportunities to improve seed system functioning for all parties.

Governments need to support FMSS at both policy and technical levels. In most cases, farmers need new, additional crop genetic diversity despite the relative wealth of diversity in their own systems. New emerging diseases create needs for resistant varieties, changing rainfall patterns may require earlier maturing varieties, reduced soil fertility and eliminated fertilizer subsidies require better low-input adaptation, and new production technologies or market opportunities demand different crops or variety characteristics. The need for higher productivity varieties is evident in practically all situations.

Farmer practices leveraging complementarities

The apparent divide between CSS and FMSS does not reflect farmer realities. In practice, farmers strategically navigate both formal and informal seed systems, accessing different crops through distinct channels—for example, obtaining maize from agro-dealers while sourcing groundnuts from local markets (Sperling and Cooper, 2004). For example, a Maize Variety Survey in Kenya indicated that 45% of maize growers combine modern and local varieties, 28% plant only modern varieties, and about 27% plant only the local variety called Nyaluo (Hebinck et al., 2015).

This pragmatic approach demonstrates farmers' sophisticated understanding of seed system complementarity. Farmers access seed from formal sources, particularly public and small seed companies, as well as from their own farms, communities and local markets. This situation creates interaction between CSS and FMSS. If well-nurtured, this interaction will deliver better seed and food security outcomes in Africa.

Emergence of integrated approaches

Recent initiatives have begun conceptualizing "integrated seed systems" that explicitly plan for formal-informal system integration (Louwaars and de Boef, 2012; Sperling et al., 2014). The Bill and Melinda Gates Foundation has championed this approach through Integrated Seed System Development (ISSD) programs (Louwaars et al., 2013). However, integration points remain largely ad hoc and localized rather than systematically managed at scale.

While integrated approaches represent progressive thinking, they cannot substitute for FMSS. Complete integration risks eroding the fundamental character and essence of FMSS, which derives from deep cultural connections, farmer identity, and seed sovereignty that have evolved over generations.

Quality Declared Seed as a bridge

The QDS approach could be an excellent starting point for recognizing and strengthening FMSS without changing its philosophy and character. QDS is subject to nationally agreed, less stringent protocols—exactly what FMSS critically needs without necessarily copying CSS protocols. Starting from QDS can attract African government attention and support while quickly developing alternative oversight/regulatory protocols and standards.

In Tanzania, the government has demonstrated willingness to support QDS production through enacting QDS Regulations in July 2020. The new regulations clarify previously grey areas and introduce fees for inspection, germination, and moisture tests. Beyond introducing regulations, the sector has demonstrated steady performance over the years. QDS production increased five-fold between 2015 and 2019. QDS farmers work closely with the Tanzania Agricultural Research Institute (TARI), the Agricultural Seed Agency (ASA), and district agricultural officers to ensure quality seed production (Waithaka et al., 2021).

In Uganda, the ISSD Uganda program actively plays coordinating agency roles to advance QDS production. In Tanzania, such agencies do not exist, making many activities less coordinated (Waithaka et al., 2021).

Policy recommendations for dual seed system support

From the foregoing policy exposition on CSS and FMSS, it is strongly recommended to advocate for seed systems approaches that support both CSS and FMSS, at policy and technical levels, without integrating them into one system or transitioning FMSS to CSS. Integrating both systems may dilute benefits that accrue from each system individually. Furthermore, African governments' limited regulatory capacity recommends that policy support should allow strengthening both systems to maximize benefit accumulation.

For African FMSS to grow, it requires progressive and supportive policy and legal framework environments. Currently, this policy and legal framework environment is confined to CSS. Even for CSS, support is not as progressive or supportive as required in some African countries. African government commitment to critically important FMSS at policy and legal framework levels is the only route through which governments can apportion budgetary support to FMSS through their parliaments.

Benefits of the dual approach

Even after dual policy support, the argument remains that CSS development alone is neither realistic nor desirable for most crops and cannot independently deliver food and nutrition security. When policies take the most advanced crops as references for investments and regulation, major problems arise due to differential speeds of seed system development between crops and target groups. This policy direction leads to the conclusion that current single approaches are counterproductive for balanced sustainable growth and development and should be abandoned in support of dual approaches while allowing sufficient interaction to maximize synergies from diverse seed systems.

This dual policy approach presents an alternative framework for seed system development based on recognizing two fundamentally distinct seed systems (CSS and FMSS), each with advantages and limitations. This framework includes a range of possible interaction methods. In practice, these different systems operate side by side to serve different types of farmers' needs for different crops.

Interaction between different seed systems provides important ways of combining scientific and indigenous / local knowledge and plant materials, leading to site-specific solutions for production limitations and market produce. However, the dual approach at national levels will pose oversight/regulatory challenges, particularly regarding FMSS, which currently lack foundational policies, legal frameworks, and regulations in most African member states.

Despite policy and legal challenges, the dual approach provides opportunities for numerous spinoff benefits:

- Capitalizing on synergies from both CSS and FMSS;
- Benefiting from CSS higher productivity and FMSS dietary diversity and nutrition value;
- Utilizing wide gene pools within in situ agro-biodiverse gene pools for breeders to enhance resilience to biotic and abiotic factors in CSS varieties;
- Enabling farmers to access affordable, high-quality farmer-managed seed locally while accessing high-yielding commercial varieties such as hybrid maize to enhance overall food and nutrition security.

8.4 A way forward

This roadmap-based way forward addresses the critical steps needed to strengthen both seed systems:

i. Data generation and documentation of knowledge on FMSS

Government policy formulations are based on technical information, gaps, and statistical data revealing the value of subjects under review. In this case, there is substantial lack of data and information on FMSS. There is need for generating and documenting FMSS data through joint efforts of seed government agencies, CGIARs, NGOs, civil society, and farmer organizations to assist governments in formulating supportive FMSS policies, legal frameworks, and future planning.

ii. Documentation and consolidation of indigenous knowledge on FMSS

FMSS is informed by indigenous knowledge available with local communities, sometimes community gene banks and national gene banks. However, to unlock this knowledge for national and continental policies on FMSS, joint effort is required to collect, consolidate and document the indigenous knowledge from different African communities to legitimize FMSS.

iii. FMSS policy and legal framework development

For governments to commit budgetary support to strengthen FMSS, there should be commitment at policy and legal framework levels. Policymakers should prioritize FMSS in seed policies and legal frameworks, ensuring they fill policy gaps and FMSS is recognized, supported, and promoted as viable alternative to CSS. This includes allocating resources for national gene banks, germplasm collection and characterization, research on farmer varieties, capacity building, and extension services that empower farmers to conserve, enhance, and exchange their local seeds.

iv. Institutional Arrangements and Capacity Building

Governments cannot support FMSS without oversight roles. It is therefore necessary for governments to create institutional arrangements and capacities to manage FMSS oversight. The most cost-effective strategy will be creating FMSS departments within existing government agencies dealing with seed: research institutions to input into breeding efforts, seed regulatory agencies for oversight, and mainstream Ministries of Agriculture to enhance focus on FMSS crops.

v. Human resource development

Currently, there is a lack of technical teams to support FMSS throughout entire seed value chains, necessitating production and introduction of FMSS curriculum in schools, colleges, and universities to develop technical human resources that are currently weak to lacking.

vi. Regulatory procedures and standards

Seed regulatory procedures and standards as currently constituted are aligned to CSS. It is therefore necessary for governments to develop less stringent and farmer-friendly regulatory procedures and standards along entire FMSS seed value chains (from seed selection to product packaging and marketing) to enhance FMSS development while protecting end users. Best local practices and farmer knowledge can inform procedures and standards that drive seed quality assurance forward.

vii. Research and development investments

Currently, R&D on FMSS is lacking. Governments should allocate funding to support entire FMSS seed value chains, including agroecological research and extension services that support ecologically sound and sustainable farming practices, biodiversity conservation, and climate resilience. This includes promoting participatory research methods that engage farmers in co-creating knowledge and adapting agricultural techniques to local contexts.

viii. International integration and recognition

To attract foreign funding to support FMSS, policymakers and implementers should enforce integration of FMSS principles into international agreements and initiatives, particularly regarding agricultural development, biodiversity conservation, and food and nutrition security. This includes promoting recognition of farmers' rights in international forums and programs, advocating for fair and equitable access to genetic resources and benefit sharing, and resisting efforts to privatize and commodify plant genetic resources.

ix. Cross-border trade facilitation

To make FMSS grow sustainably, governments should invest in regulatory approaches to support local and cross-border seed trade without going through phytosanitary requirements that have been developed certified seed within CSS but are prohibitive to FMSS. This will require governments to develop alternative FMSS-friendly mechanisms/approaches to regulate seed trade across borders.

9. Discussion, conclusion and recommendations

9.1 The critical role of FMSS in Africa

FMSS represent dynamic, evolving networks and practices that adapt to the changing circumstances and environments. For the purposes of this report, FMSS is defined as "*community-based seed systems where farmers have control and rights over their seeds, using mainly local varieties, indigenous knowledge practices, and rules developed according to their customs as they adapt to their changing environment.*"

The FMSS encompass interconnected social, cultural, biological, ecological and traditional components. While alternative definitions exist that emphasize farmer livelihoods, biodiversity conservation, agricultural production, and genetic resource management for breeding programs, this comprehensive definition captures the multifaceted nature of FMSS in the African context.

Contribution of FMSS to seed security

Despite significant challenges in data availability and consistency, available evidence demonstrates the fundamental importance of FMSS to African agriculture. Public domain data on informal seed volumes remains extremely limited, with frequent gaps and inconsistencies, particularly for roots, tubers, and vegetables compared to cereals and legumes. Current estimates indicate that FMSS provides between 60% and over 90% of seeds for legumes and small grains, depending on the specific crop, region, and year (Appendix 2). These findings align with established research (McGuire and Sperling, 2016; Mazvimavi et al., 2017) confirming that FMSS serves as the primary seed source for small grains and legumes, supplying over 80% of utilized seeds.

Farmers access seeds through diverse, context-specific channels that vary significantly by community and country. The primary distribution mechanisms include: on-farm saved seed (farmer's own production), neighbours and relatives, local markets, NGOs, government programs, agro-dealers, and contract growers. Seeds from FMSS are generally exchanged within communities and on local markets. Ranking the seed sourcing channels across crop clusters proves challenging due to distortions created by commercial crops such as maize, rice, and soybean, which rely heavily on agro-dealers, public distribution and local shops. For small cereals (sorghum and millets) and legumes, studies demonstrate that farmers source over 80% from farm-saved seed. Recent studies (Annex 2) indicate that local markets are gaining prominence as major seed sources for legumes, providing approximately 65% of sown seed. For vegetatively propagated crops (VPCs), farmer-saved seed obtained through social networks of neighbours, relatives, and friends remains the predominant sourcing channel, primarily due to limited market alternatives.

Comparative price analysis between CSS and FMSS reveals consistent cost advantages for FMSS, though comprehensive public domain data remains scarce. Available data, supplemented by logical assumptions where necessary (see Annex 2), indicates significant price differentials favouring FMSS across crop categories. For hybrid maize, price differences are substantial, ranging from 270% to 600% higher for certified seed, though performance differences must be considered alongside cost variations. Open-pollinated variety (OPV) maize and small cereals show more moderate differences of 11% to 60%. Legume seeds from FMSS cost 1% to 20% less than CSS alternatives, while indigenous vegetables show approximately 34% price advantages for FMSS (Annex 2). However, these findings underscore the critical need for systematic collection of seed volume and pricing data from both systems to inform evidence-based policy discussions.

The role of FMSS in genetic resources preservation

Farmers fulfil a critical and irreplaceable role in crop genetic resource preservation, often unconsciously contributing to conservation outcomes that formal *ex situ* gene banks cannot achieve. This farmer-managed conservation provides several unique and complementary functions that strengthen global genetic resource security. Unlike static gene bank collections that preserve genetic material in controlled states to prevent degradation, farmer-managed *in situ* conservation maintains dynamic, evolving systems. These living agroecosystems continuously generate new genetic resources through natural gene flow, accommodating both genetic loss and addition within the system. This evolutionary process creates genetic resilience impossible to replicate in controlled storage facilities, as crops adapt to changing environmental conditions and farmer selection pressures over time.

FMSS conservation provides modern plant breeding programs with access to diverse genetic pools containing traits developed through generations of farmer selection. These farmer-maintained varieties often possess unique characteristics adapted to specific local conditions, offering valuable genetic resources for developing varieties with enhanced resilience and performance. Furthermore, farmer-managed conservation serves as a crucial backup system, mitigating vulnerabilities inherent in *ex situ* gene bank storage. Gene banks face numerous risk factors including genetic drift within collections, seed viability loss, equipment failure, security breaches, economic instability, inadequate funding, and technological obsolescence—often without adequate backup systems. The distributed nature of farmer-managed conservation across multiple locations and communities provides natural redundancy against these institutional risks. These complementary conservation functions demonstrate that FMSS occupy an indispensable niche in global genetic resource preservation. Rather than competing with formal conservation systems, farmer-managed approaches provide essential services that enhance overall genetic security through their dynamic, adaptive, and distributed characteristics.

Despite the importance of *in situ* conservation of genetic resources, farmers face challenges in genetic resource preservation, primarily due to technical knowledge gaps in specialized scientific areas. Effective genetic resource conservation requires expertise that extends beyond traditional farming knowledge, encompassing both crop genetic resources and their wild relatives. The integration of wild relative gene pools into cultivated crops represents a critical mechanism for enhancing variety resilience against biotic and abiotic stresses. However, this process demands sophisticated understanding of both genetics and plant taxonomy—skills typically beyond farmers' knowledge base. Furthermore, successful genetic resource preservation depends on understanding gene diversity, uniqueness, and trait value assessment, requiring molecular biology and genotyping expertise that farmers do not possess. These technical requirements create substantial barriers to farmer-led conservation efforts using conventional scientific approaches.

Despite these technical limitations, the success of *in situ* conservation should not be measured solely by scientific metrics such as allele or genotype preservation. More relevant indicators include the number of farmers maintaining local crop populations within target areas, their adherence to traditional management practices that serve local needs, and the continued use of local germplasm in breeding programs that develop new varieties without displacing regional crop populations. Additional success measures encompass the exchange and flow of farmer varieties within and among communities, which maintains genetic diversity through traditional seed networks. Such community-based indicators can support farmers in effectively contributing to genetic resource preservation through their established practices, even without advanced technical training. Traditional conservation methods, community seed exchanges, and participatory approaches can complement scientific conservation efforts while building on farmers' existing knowledge and cultural practices.

9.2 Opportunities for strengthening FMSS

Current support for FMSS primarily originates from NGOs, civil society organizations, and limited government initiatives. Government support ranges from weak to medium, constrained by minimal policy and legal framework support. It is strongly recommended that African governments commit to FMSS at policy, legal framework, and regulatory levels, thereby dedicating necessary resources—human, infrastructural, institutional, and financial—to the FMSS sector.

Policy and legal framework requirements

The predominant inclination of seed policy and legislation across Africa is driven by commercial interests through coordinated multinational, public/private, and philanthropic investments. This policy environment requires reshaping to support FMSS through progressive seed laws and legislation that protect farmers by establishing legal obligations for sellers to guarantee seed quality through standardized inspection and testing procedures (FAO, 2015). These instruments should recognize that while formal seed quality and identity depend on labels and certificates, FMSS relies on trust established between farmers and seed sellers based on community trade relationships (Herpers et al., 2019). Recognition and documentation of these quality markers as levers of seed quality must occur at policy and legislative levels to support FMSS development.

Several critical policy and regulatory gaps have been identified:

1. **Indigenous knowledge documentation**: Commitment at policy level to document FMSS indigenous knowledge along the seed quality value chain, with actual documentation in seed regulations rather than laws to allow for frequent revisions and changes.
2. **Farmer variety registration**: Alternative seed certification criteria that account for FMSS seed quality criteria, and alternatives to Distinctness, Uniformity, and Stability (DUS) and Value for Cultivation and Use (VCU) testing that incorporate FMSS variety identification criteria.
3. **Seed producer registration**: Alternative criteria to register farmers as growers of informal seed, moving beyond current rigid requirements that exclude FMSS actors.
4. **Quality assurance frameworks**: Policy-level commitment to document FMSS seed quality levers with alignment to less stringent regulatory protocols, listing quality levers in regulations rather than laws.
5. **Seed exchange and trade freedom**: Recognition of farmers' freedom to exchange and sell seed within FMSS to enhance livelihoods through seed sales and grain as food, improving food and nutrition security.
6. **Institutional representation**: Inclusion of smallholder farmers and their organizations in seed authorities to ensure FMSS-supportive legislation and positive impacts.

In summary, a two-pronged response to policy shaping is recommended:

- Well-defined exemptions to accommodate FMSS operations within existing regulatory frameworks.
- Greater flexibility in regulations and standards to accommodate FMSS characteristics and operational requirements.

This dual approach would create space for FMSS development while maintaining necessary quality assurance and regulatory oversight appropriate to each system's characteristics and capabilities.

Recognition and documentation of indigenous African seed knowledge

For Africa to effectively recognize and document indigenous African knowledge underlying variety selection, maintenance, and seed handling practices until sowing in FMSS, conscious awareness of FMSS roles in food and nutrition security must be created. This awareness should highlight that FMSS are fundamentally based on indigenous knowledge, as recognition and documentation of unacknowledged systems remains impossible. Various case studies (Nkhoma and Nangamba, 2021; Wynberg, 2024) demonstrate that FMSS indigenous knowledge parallels scientific methods used in CSS for variety development and seed production. Recognition of FMSS in laws and public policies offers numerous advantages including status clarification, access to public sector technical and financial support, formal linkages between FMSS and public research through participatory selection, and stronger protection of farmers' rights (Coulibaly and Peschard, 2023).

Towards farmer-led oversight systems

Recognition and documentation of African indigenous seed knowledge requires progression toward farmer-led seed production oversight or regulation. While some FMSS proponents oppose regulating or overseeing FMSS production value chains, oversight mechanisms are designed to improve quality, efficiency, and productivity of oversighted processes.

Farmer varieties and seed production would benefit from appropriate oversight forms to enhance productivity and support Africa's food and nutrition security agenda. The strategy must involve oversight without jeopardizing farmers' cultural connection to seed and their seed sovereignty principles. The proposed approach must begin at policy level, with AU Member State policy commitments informed by both seed and social sciences inputs, requiring alignment across policy, legal frameworks, regulations, and standards levels. This approach must be anchored on the principle of simplification and relaxing stringent legal and regulatory instruments governing commercial seed systems.

Integration of indigenous seed knowledge into seed regulations to support FMSS seed quality value chains is feasible when conducted consultatively. This integration can generate benefits including faster and cheaper variety releases, improved farmer incomes, and increased diversity of well-adapted varieties in local markets. However, this process will be slow and gradual due to the nature of regulatory development in Africa and necessary negotiations to agree with diverse seed stakeholders on the way forward.

9.3 Conclusions

The evidence presented in this report demonstrates that FMSS represent a cornerstone of African agriculture, providing the majority of seeds for small grains, legumes and neglected and underutilized species, while serving as guardians of genetic diversity through dynamic *in situ* conservation. FMSS offer significant economic advantages to farmers through lower seed costs and maintain irreplaceable genetic resources that formal gene banks cannot preserve through static storage alone.

However, FMSS face substantial challenges stemming from policy environments oriented toward CSS, limited technical support, and inadequate recognition in legal frameworks. The current data gaps regarding FMSS operations, seed volumes, and economic impacts hinder evidence-based policy development and resource allocation.

The path forward requires comprehensive policy reforms that recognize FMSS as legitimate and valuable components of national seed systems, supported by appropriate regulatory frameworks that balance quality assurance with accessibility and cultural compatibility. Integration of indigenous knowledge systems with modern scientific approaches (including social sciences) offers opportunities for enhanced variety development and improved farmer livelihoods while maintaining genetic diversity and cultural connections to seeds.

Success in strengthening FMSS demands collaborative approaches involving governments, NGOs, research institutions, and farmer organizations, supported by adequate funding for research, capacity building, and infrastructure development. The ultimate goal is a dual seed system approach that leverages the strengths of both formal and farmer-managed systems to ensure food and nutrition security, genetic resource conservation, and sustainable agricultural development across Africa.

9.4 Recommendations

Recommendation 1: Comprehensive FMSS data generation and documentation

Establish coordinated data collection initiatives involving seed government agencies, CGIARs, NGOs, civil society, and farmer organizations to inform evidence-based FMSS policy formulation, legal framework development, and planning. Current FMSS data remains inadequate with significant gaps. Priority data collection should encompass:

- Continental seed percentages attributable to FMSS;
- Seed percentages attributable to FMSS for individual and clustered crops across cereals, legumes, roots and tubers, vegetables, fruits, and medicinal plants;
- Comprehensive pricing differentials between FMSS and CSS;
- Ratios of seed trading versus sharing (exchange, barter, gifts) within FMSS;
- Qualitative data on FMSS management, variety improvement, seed selection and storage, quality assurance mechanisms, and local regulation systems.

Recommendation 2: Indigenous knowledge collection and documentation

Systematically collect, consolidate, and document FMSS indigenous knowledge available within local communities, community gene banks, and national gene banks to legitimize FMSS practices. This knowledge base, covering the entire FMSS value chain, should be formally recognized and integrated into policy and regulatory frameworks.

Recommendation 3: FMSS integration in seed policies and legal frameworks

Policymakers should incorporate FMSS principles into national seed policies, addressing identified policy gaps while ensuring recognition, support, and promotion as viable alternatives to industrial seed systems. This integration should include dedicated resource allocation for national gene bank germplasm collection and characterization, research on farmer varieties, capacity building, and extension services that empower farmers to conserve, enhance, and exchange local seeds.

Recommendation 4: Comprehensive legal frameworks for farmers' rights protection

Governments should enact and enforce comprehensive laws safeguarding farmers' rights to save, use, exchange, and sell seeds. These legal frameworks must include provisions for recognizing customary seed systems, protection against biopiracy and seed monopolies, and mechanisms for community-based seed governance.

Recommendation 5: FMSS-friendly regulatory procedures and standards

Develop less stringent, FMSS-compatible regulatory procedures and standards spanning the entire FMSS value chain from selection to product packaging and marketing. These frameworks should enhance FMSS development while protecting end users, incorporating best local practices and farmer knowledge to inform procedures and standards.

Recommendation 6: Agroecological research and extension service investment

Governments should allocate substantial funding for agroecological research and extension services supporting ecologically sound and sustainable farming practices, biodiversity conservation, and climate resilience. This investment should promote participatory research methods engaging farmers in co-creating knowledge and adapting agricultural techniques to local contexts.

Recommendation 7: Seed diversity and resilience promotion

Governments should support the establishment of community seed banks and facilitate seed exchanges to promote conservation, exchange, and distribution of diverse and resilient seed varieties. These initiatives should be inclusive, participatory, and grounded in seed sovereignty principles, ensuring farmer access to diverse locally adapted seeds while establishing mechanisms for cross-border germplasm exchange between community, national, and international gene banks.

Recommendation 8: International agreement integration

Policymakers and implementers should enforce FMSS principle integration into international agreements and commitments related to agricultural development, biodiversity conservation, and food and nutrition security on the African continent. This includes promoting farmers' rights recognition in African forums, advocating for fair and equitable access to genetic resources and benefit sharing, and resisting efforts to privatize and commodify plant genetic resources.

Recommendation 9: Institutional capacity creation for FMSS oversight

Establish cost-effective institutional capacities to manage FMSS oversight, preserving and improving positive aspects while enhancing FMSS development. The most effective strategy involves creating FMSS departments within existing government agencies, such as research institutions to input into breeding efforts, seed regulatory agencies for oversight, and mainstream Ministries of Agriculture to enhance focus on FMSS crops.

Recommendation 10: Integrated Seed Systems approach implementation

Governments should operate CSS alongside FMSS, embracing Integrated Seed Systems approaches that leverage the complementary strengths of both systems to optimize agricultural productivity, genetic diversity conservation, and farmer livelihoods.

Recommendation 11: Multi-Stakeholder collaboration framework

Foster collaborative frameworks involving governments, NGOs, research institutions, seed companies, and farmers' organizations to create supportive environments for both CSS and FMSS prosperity. This collaboration should include knowledge exchange, fair market access for farmer-produced seeds, and advocacy for policies prioritizing long-term sustainability over short-term profit.

Recommendation 12: Enhanced Research and Development investment

Increase funding for FMSS research and development to enable improved seed selection and storage technique development and robust community seed bank creation. This investment should support innovation in farmer-led quality assurance systems and variety development processes.

Recommendation 13: FMSS capacity building and Education

Governments should commit at policy level to developing and introducing FMSS curriculum in schools, colleges, and universities to cultivate technical human resources supporting the entire FMSS value chain from seed selection to marketing. This educational investment ensures sustainable institutional knowledge and technical capacity for long-term FMSS development and support.

Annex 1. Scoping study Terms of Reference

The Terms of References listed the following questions to be addressed by the scoping study:

1. What is the role of farmer-managed seed systems within the wider context of seed systems to ensure access to quality seed?
    a. What definitions of FMSS are being used?
    b. What percentage of total seed used for the different food crops (cereals, roots, vegetables, selected minor crops) are accessed through FMSS in selected countries?
    c. What is the importance of FMSS in guaranteeing the access of women and youth to quality seed?
    d. What are the exchange mechanisms that exist for FMSS seeds (by%)?
    e. In cases where FMSS seed is sold, what is the price difference between FMSS seed and seed from the formal sector?
    f. What are the main challenges and opportunities regarding the preservation of genetic resources, improvement of local varieties, quality assurance and seed production, exchange and selling of seeds in FMSS?
    g. What are the positive and negative interactions between the formal and informal seed systems and what are the tensions (if any)?
    h. What initiatives exist in support of FMSS? How do these initiatives compare to the support of the formal seed sector?
    i. How do national legislation and policies affect the operations and potentials of FMSS?
2. What can be done to improve the FMSS?
    a. Which sustainable funding models can support the development of the FMSS in Africa?
    b. How should national legislation and policies be shaped to support the development of FMSS?
    c. In this context: What level of regulation (if any) by government agencies is necessary and why?
    d. What could be the constraints associated with regulating FMSS and possible solutions?
    e. Which mechanisms can be deployed to manage (silent) conflicts between the commercial seed sector and FMSS?
    f. Which policy instruments can be developed by governments in order to make FMSS synergistic to commercial seed systems with the objective of enhancing both food security and seed business?
3. How can Africa recognize and document indigenous African knowledge behind the selection and maintenance of varieties and seed handling until sowing in the FMSS?
    a. How can this knowledge be integrated in the regulation and development of FMSS in order to improve quality of farm-saved seed?
4. What are the prospects of observing equivalence in promoting best practices of strengthening FMSS nationally, regionally or continentally?

Annex 2. Seed volume data and calculations

USAID study on cereal and legume seed volumes

The Kenya Seed Sector Profile (USAID, 2023) shows that cereals constituted 19.2% of the total FMSS seed while the legumes' constituted 80.8% respectively. For the formal seed, however, the cereals had a significantly higher percentage at 97.8% while legumes had a paltry 2.2%. The high percentage of cereals was driven mainly by maize which truly constitutes a significantly higher component of the national formal seed system (Table 2). Root and tuber crops were not included in this study due to scanty data and their wet weight which will distort a comparison with dry seed.

Table 2. Volume of formal and informal cereals and legumes seed in Kenya

Crops	Certified/Formal (tons)	FMSS /Informal (tons)	% seed from informal
Maize	51,845	15,550	23%
Sorghum	707	1,839	72%
Millet	101	347	77%
Rice	340	100	23%
Cereals	*52,993*	*17,836*	*25%*
Pigeon Pea	120	2,188	95%
Soy bean	45	-	0%
Cowpea	155	2,604	94%
Beans	892	70,210	99%
Legumes	*1,167*	*75,002*	*98%*
Totals	***54,160***	***92,838***	***63%***
% Cereals of the certified or FMSS	97.8%	19.2%	
% Legumes of the certified or FMSS	2.2%	80.8%	

Source: Kenya Seed Sector Profile, USAID 2023

TAMPA 2 Household Survey 2004

Egerton University and Michigan State University collected household data in 2004 as part of the Tegemeo Agricultural Monitoring and Policy Analysis Project (TAMPA 2). The household data showed that most of the maize planted is hybrid (53%) while 47% is a combination of OPVs and local lines and land races. Most of the wheat seed comes from the commercial seed system and it is composed of purchased hybrid and retained hybrid (Table 2). Other crops that are important in the food security agenda of Kenya tend to be local varieties (e.g. sorghum, millet, beans and cowpeas) purchased from the FMSS. For example, about 98% of sorghum, 99% of millet are local varieties respectively. This trend holds true for legumes which posts a mean of 98% informal. This suggests that the importance of informal seed system in addressing seed and food security in the country is significant. In this second Kenyan study, the FMSS cereals constituted 51.4% of the total seed studied, while the legumes constituted 48.6% respectively. For seed from the formal sector, however, the cereals had a significantly higher percentage at 95.7% while legumes had a paltry 4.3%. The high percentage of cereals among the certified seed was mainly driven by maize which truly constitutes a significantly higher component of the national formal seed system (Table 3).

Table 3. Proportions of formal and informal seed crop (cereals and pulses)

Crops	Certified/Formal (tons)	Informal (tons)
Maize	53	14
Wheat	72	27
Oats*	39	14
Rice*	85	15
Sorghum	2	98
Millet	1	99
Total Cereals	252	267
% of Cereals out of the totals	97 %	40 %
Soybean	4	96
Groundnuts	1	99
Beans	1	99
Cowpeas	2	98
Total Legumes	8	392
% of Legumes out of the totals	3 %	60%
Totals of Cereals and Legumes	260	659

**Modifications on the basis of assumptions of 25:75 informal to formal ratio for commercial crops.*
Source: TAMPA 2 Household Survey, 2004
(https://tegemeo.egerton.ac.ke/images/_tegemeo_institute/downloads/data/2004-survey-documentation.pdf)

Seed access in eastern Zimbabwe

Ncube et al. (2023) conducted a study in Chimanimani district in Zimbabwe, involving commonly grown crops by farmers in the area including maize, sorghum, pearl millet, groundnuts, Bambara groundnut, cowpeas, beans, pumpkins, and yam (Table 4).

Table 4. Volume of formal and informal seed in Chimanimani District of Zimbabwe expressed as a % of the total

Crops	Formal & Informal (Kg)	Formal*	Informal*
Maize***	3850	3580	270
Sorghum	470	141	329
Pearl Millet	89	27	62
Finger Millet	91	28	63
Totals Cereals	**4500**	**3776**	**724**
Groundnut	313	94	219
Bambra groundnut	208	62	146
Cowpeas	142	43	99
Beans	857	257	600
Totals Legumes	**1520**	**456**	**1064**
Pumpkin**	9	0	9
Yam**	1545	0	1545
% Cereals	**75% out of 6020**	**89% out of 4232**	**40% out of 1788**

*Except for maize, the rest of the seed is informal at about 70%
** Pumpkin and yam at 100% informal
** Pumpkin and yam not computed due to their wet weight
***Maize at 7% informal

The study considered seeds of these crops from mostly government-provided assistance and agro-input dealers and local sources (own seed, social networks, and local markets). The results revealed that, with the exception of maize, local sources dominated, accounting for at least 70% of the seed supply. Local sources were thus essential in supplying both the bulk and diversity of seed crops needed by these farming households (Ncube et al, 2023). Maize, being a staple crop, it was mostly sourced from government aid (subsidies), agro-input dealers and own seed. Sorghum was mostly sourced from own seed, seed aid (from NGOs) and social networks as the seed (open-pollinated) can easily be saved and re-used in the subsequent seasons. Besides maize, own sources provided both the highest diversity and highest quantities of seed across crops. Considering the two categories (cereals and legumes), legumes dominate the informal seed accessible to farmers at 60% while cereals are at 40%.

Annex 3. Seed exchange mechanisms

Household survey in East Hararghe Zone, Ethiopia

Getahun (2011) studied seed exchange mechanisms among 200 households in Ethiopia. According to this survey, farmers' own saved seed from previous harvests was used by 43% and 22% of households for sorghum and maize respectively (Table 5). Few households relied on solely external sources for maize and sorghum seed. It is more common for households to obtain seed from multiple sources; for example own seed in combination with seed supplied by the agricultural office (21% of households for sorghum seed, 30% of households for maize seed), or own seed in combination with neighbours' seed (17% of households for sorghum seed, and 18% of households for maize seed). These findings highlight the central importance of FMSS, while demonstrating how they are often complemented by both community networks and formal agricultural institutions.

Table 5. Seed Exchange strategies in Ethiopia

Seed Exchange Type	Sorghum (n)	% Exchange	Maize (n)	% Exchange
Own/Saved Seed	86	43	44	22
Neighbours/Relatives	4	2	4	2
Local Market	3	1.5	3	1.5
Agricultural Office	2	1	12	6
NGOs	1	0.5	12	6
Own + Neighbours	34	17	35	17.5
Own + Agric. Office	41	20.5	68	30.4
Own + Local Market	7	3.5	4	2
Own + Neighbour + Market	12	6	5	2.5
Neighbour +Market +Agric. Office	4	2	5	2.5
Neighbour + Agric. Office	4	2	2	1
Local Market + Agric. Office	1	0.5	1	0.5
Total	200	100	200	100

Source: Getahun, 2011

Household survey in Gamo Highlands, Ethiopia

The southern highlands of Ethiopia are home to some of the planet's oldest agricultural systems, dating back to 10,000 years (Brandt et al. 1997), and are considered a global centre of crop diversity (Vavilov and Chester 1951). The highland landscape is made up of a patchwork of small, diverse subsistence farms, grasslands, and forests where the lines between 'human' and 'natural' are indistinct, and the actions of farmers are a driving force in the distribution of biodiversity. Crop diversity serves both to buffer the global food supply against environmental change and pest and disease outbreaks, and to maintain the sustainability of traditional small-scale agricultural systems (Gepts 2006). These diverse crops and varieties are created and maintained through seed exchange among farmers, and the scales and strengths of these pathways have enormous influence on agricultural biodiversity. Samberg et al. (2013) conducted a household survey (n=235) in 12 communities in the Gamo Highlands, Ethiopia (Table 6). The results show that farmers own saved seed is by far the most prevalent mode of accessing seed (55% of households) followed by local markets (20% of households), neighbours (14% of households) and public extension (11% of households).

Table 6. Farmer responses regarding seed exchange practices in the Gamo Highlands, Ethiopia.

Seed Exchange Type	Number of farmers (N=235)	Exchange %
Own / saved seed	129	55
Neighbours	33	14
Government extension	27	11
Markets	46	20
Total	235	100

Source: Modified from Samberg et al., 2013

Tegemeo Rural Household Data, Kenya

Ayieko and Tschirley (2006) report findings from the Tegemeo household survey in Kenya (Table 7). These findings indicate that the FMSS is an important source of seed for farmers. Farmer-saved seed is by far the most important source of seed for all crops except maize and rice. Seeds for maize and rice are predominantly purchased from the formal seed sector. Only a small proportion of the seed of the other crops is purchased from the formal seed sector. Other seed exchange mechanisms play a very minor role. Ayieko and Tschirley (2006) also report that 99% of the households used their own retained seed, in combination with informal and formal purchases. The authors estimate that 63% of all seed exchange mechanisms is farmers' retained seed, compared to 18% and 19% for formal and informal purchases respectively.

Table 7. FMSS Proportions Exchange Mechanisms expressed as a Percentage

Crops	Own / saved seed	Community seed	National companies	International companies	Government	Donors/ NGOs
Maize	32	2	55	5	5	1
Millet	90	3	3	0	0	4
Sorghum	87	0	9	0	2	2
Rice	15	0	85	0	0	0
Cereals (Mean %)	56	1	38	1	2	2
Soy-bean	99	1	0	0	0	o
Beans	80	0	5	0	0	0
Groundnut	80	3	10	0	0	7
Pigeon-pea	80	0	10	0	0	10
Cow-pea	75	8	12	0	0	5
Legume (Mean %)	83	2	7	0	0	4
Cassava	93	2	5	0	0	0
Sweet Potato	96	3	1	0	0	0
Roots & Tubers (Mean %)	95	3	3	0	0	0

Source: Ayieko & Tschirley, 2006

Seed System Security Assessments in fragile areas

The Seed System Security Assessments (SSSAs)[14] have been carried out in fragile areas due to civil strife, displacement, political instability as well as natural disasters during the last 20 years. These assessments highlight the importance of FMSS in fragile areas for households to access seed for major food crops, even

[14] See www.seedsystem.org for more information (accessed on 18/4/2025)

when seed aid is provided. FMSS is the major source of seed for farmers in fragile areas in Africa; FMSS provides between 60% to 100% of seed sown in the various areas. Actual proportion differ depending on the area, crop variety and year.

For maize seed (Figure 4), farmers rely heavily on FMSS with the exception of Ethiopia and Zambia, where the government is providing maize seed to farmers in fragile areas. In Kenya, on the other hand, agrodealers play a relatively large role in providing maize seed to farmers.

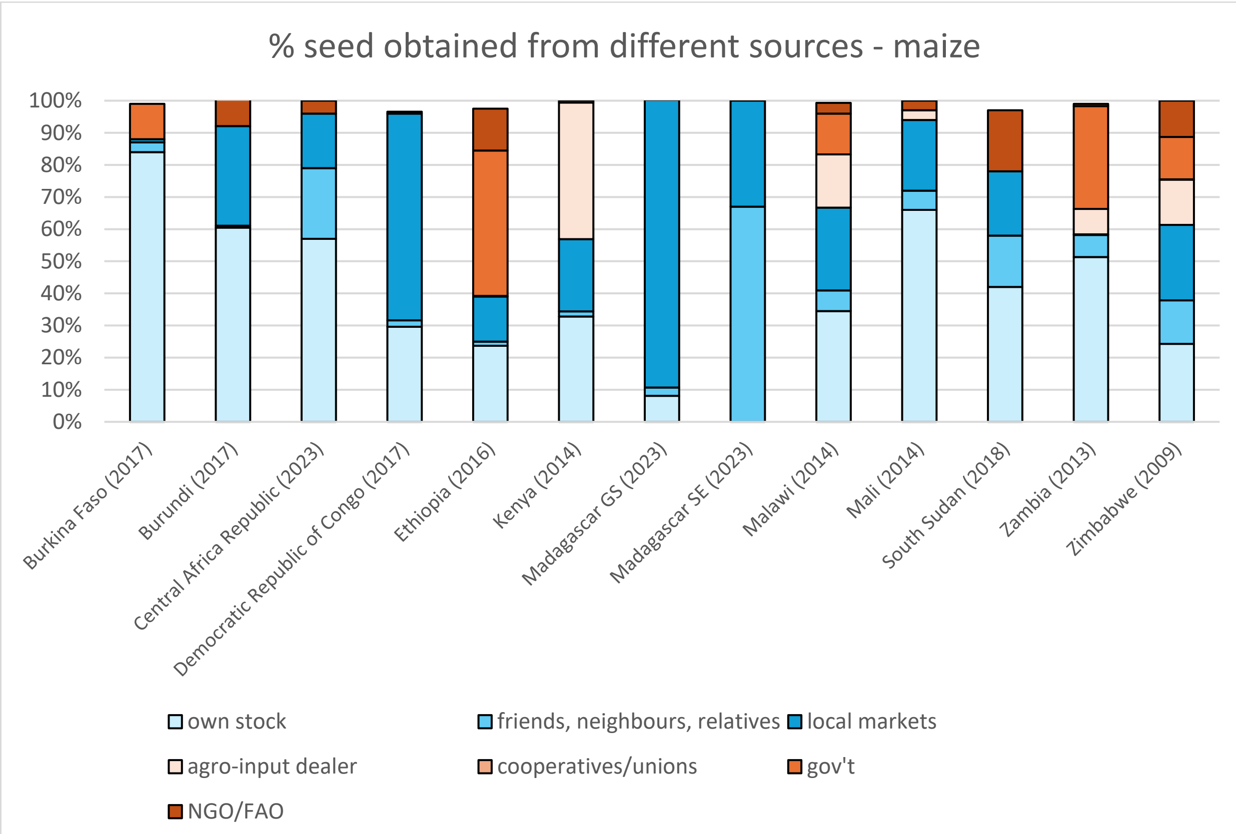

Figure 4. Maize seed exchange mechanisms in fragile areas (source: Seed System Security Assessments; www.seedsystem.org)

Sorghum is often cultivated in drought-prone areas. It was indeed distributed as seed aid in Madagascar (Grand Sud), and in Kenya, South Sudan and Zimbabwe to a lesser extent (Figure 5). FMSS remains the major source for sorghum seed in most fragile areas though.

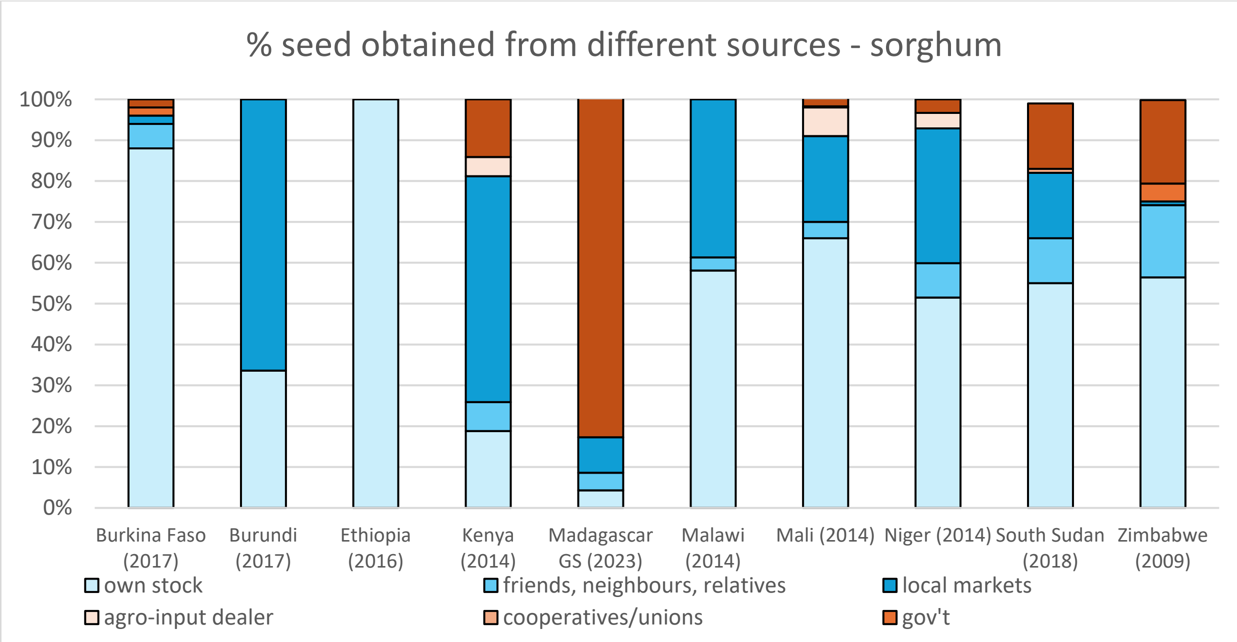

Figure 5. Sorghum seed exchange mechanisms in fragile areas (source: Seed System Security Assessments; www.seedsystem.org)

FMSS is important for farmers in fragile areas to access seed of cowpea (or pigeon pea or chickpea), in particular the local markets (Figure 6). The though the formal seed system is also used to access cowpea seed, this is small in comparison to FMSS. The same holds true for groundnut (Figure 7).

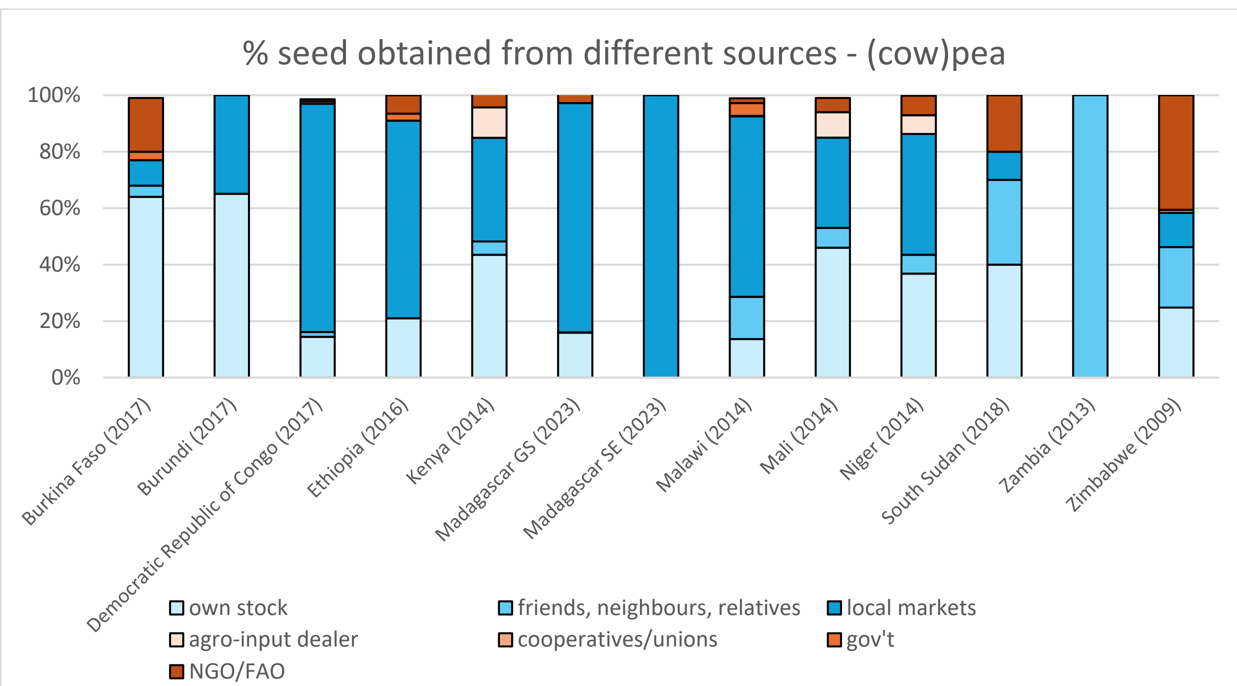

Figure 6. Pea seed exchange mechanisms in fragile areas (source: Seed System Security Assessments; www.seedsystem.org)

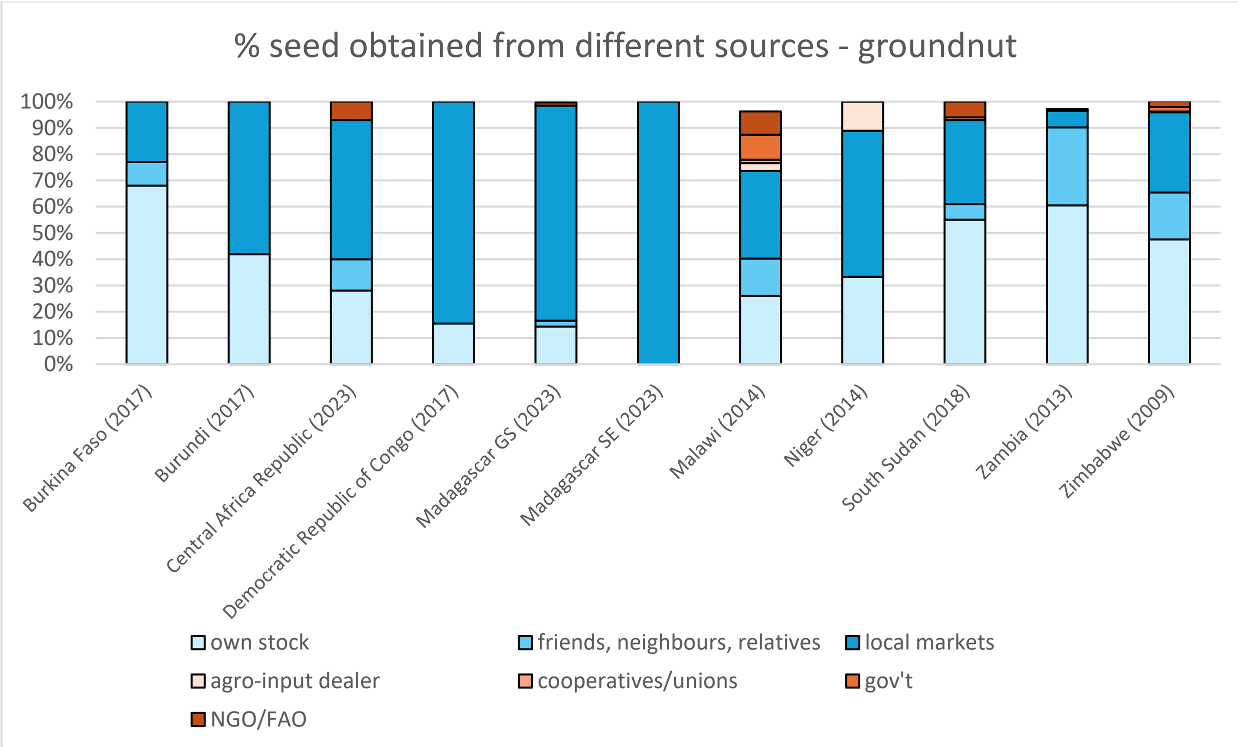

Figure 7. Groundnut seed exchange mechanisms in fragile areas (source: Seed System Security Assessments; www.seedsystem.org)

McGuire and Sperling (2016) analyzed 9660 observations obtained through the Seed System Security Assessments. The results show that over half of all seed (51% across crops) was obtained from local markets, indicating that this source was the most important for seed exchange. The local market was also the dominant seed source in Kenya, Malawi and DRC. For South Sudan and Zimbabwe however, market access was constrained during the assessment periods. The own stocks/ farmer saved seed was next at 31% followed by friend, neighbour, relative at 8.6%, NGO/UN at 5.7%, agro-dealer at 2.4% and Governments at 1.6%. The other sources were insignificant (Table 8).

Table 9 is using the same data (McGuire & Sperling, 2016) for Malawi, Kenya, DRC, Haiti, South Sudan and Zimbabwe but expressed on clusters of crops basis. The crops have been clustered as cereals, legumes, and vegetatively-propagated crops (VPCs) to highlight trends by crop type. Maize was kept as a separate category given its importance across much of Africa and its prominence in seed sector development (Shi and Tao 2014). The data indicates that the relative importance of seed sources varies markedly by crop cluster. Local markets are the driving seed source for legumes, providing almost 65% of the seed sown (Table 8). For all major legumes, local markets supplied from 49.5 to 81.3 % of all crop-specific seed sown (with the ranges indicating green gram and common bean market use, respectively).

Own stocks are especially central for the VPCs (e.g., providing nearly 80 % of sweet potatoes cuttings) as well as for dryland cereals (sorghum and millets). For these latter crops, small seeds and dry storage conditions present fewer challenges to self-storage than for legumes such as beans (Sperling and McGuire 2010). Use of social networks was noted in greatest quantity (30%) for the VPCs, partly as the market option here is so limited. As agro-dealer use was very modest, this channel is better understood through examining use by specific crop (Table 9). If cotton were removed from the 'other' crop category, agro-dealer use falls to 2.1 % for this cluster. Of note, is the near absence of agro-dealer use as a seed source for the full clusters of legumes and VPC crops, that is <1 % of the total seed sourced (Table 9). This is an important gap area for clusters of crop types key for basic nutrition and calorie provision. Maize seed is given separate focus as this crop is an engine for public and private seed sector investment, at least in much of Africa (Langyintuo et al. 2010).

***Table 8**. The sources supplying seed in most recent season, as a % of total seed supplied in each site*

	Malawi	Kenya	DRC/Katanga	Haiti	S Sudan	Zimbabwe	All sites
Own stock	28.3	36.2	35.0	17.4	42.2	45.2	31.1
Friend, neighbour, relative	7.8	5.7	16.9	3.3	12.1	21.9	8.6
Local market	32.0	40.1	44.6	73.0	34.3	9.9	50.9
Agro-dealer	17.5	11.6	0.4	1.5	0.2	5.8	2.4
CBSG	0.1	0.0	0.1	0.8	0.2	0.3	0.5
Government	8.9	5.1	0.0	0.4	0.6	11.5	1.6
NGO / UN	4.2	0.9	3.1	3.3	10.4	4.8	5.7
Contract growers	0.5	0.1	0.0	0.0	0.0	0.5	0.1
Other	0.7	0.3	0.0	0.2	0.0	0.0	0.1
Total %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total kg	4529	5267	7689	42842	33536	4789	98652

Source: McGuire and Sperling, 2016.

***Table 9**. The sources of supplying seed on crop basis as a % of total seed supplied in each site**

	Own stock	Friend, neighbour, relative	Local market	Agro-dealer	CBSG	Gov''t	NGO / UN	Contract growers	Other	Total (kg) - all sources
Maize	30.3	9.5	41.9	6.1	0.2	4.8	6.4	0.1	0.0	22,894
Other cereals	40.0	12.1	37.9	2.2	0.8	0.9	6.0	0.0	0.0	15,995
Sorghum	51.2	12.1	28.3	0.2	0.1	1.1	7.1	0.1	0.0	9,836
Millets	44.6	21.1	18.7	0.7	0.0	2.4	12.4	0.0	0.1	1,470
Rice	15.1	9.3	64.3	6.9	2.5	0.0	1.9	0.0	0.1	4,690
Legumes	24.2	4.0	64.4	0.6	0.5	0.6	5.5	0.0	0.2	50,670
Groundnut	34.8	6.4	51.7	0.1	0.3	0.2	6.6	0.0	0.1	23,994
Common bean	10.4	0.9	81.3	0.8	0.9	0.4	5.1	0.0	0.2	20,779
Cowpea	26.7	4.4	56.6	2.4	0.5	4.4	5.0	0.0	0.0	1,938
Pigeon pea	30.1	5.5	61.4	0.4	0.2	1.4	0.6	0.0	0.3	2,010
Green gram	37.1	2.2	49.5	2.9	0.0	4.6	1.6	0.0	0.5	1,597
VPCs	47.3	29.9	18.3	0.1	0.5	0.4	3.2	0.0	0.4	7,442
Cassava	52.9	32.4	9.5	0.0	0.3	0.5	4.3	0.0	0.1	4,951
Banana	16.0	26.0	54.7	0.4	0.8	0.0	0.6	0.0	1.6	1,408
Sweet potato	79.2	14.6	3.5	0.0	0.0	0.0	2.7	0.0	0.0	610
Irish potato	38.8	36.7	22.0	0.0	2.0	0.0	0.1	0.0	0.4	433
Others	22.9	9.1	33.5	22.3	0.0	1.4	8.7	1.5	0.7	1,642

**More minor legumes and VPCs are not displayed, but are included in totals. For the legumes: chickpea, Bambara nut, velvet bean, lima bean for the VPCs: yams and taro. Others' include 17 crops, mostly horticultural crops sowed in small quantities, with a few in more appreciable amounts: sesame, cotton, okra, pumpkin*

Source: McGuire and Sperling, 2016

Agro-dealer networks supplied appreciable quantities only for maize and rice at least at 5 %, pumpkin at 27 %, mustard leaves (15.6 %) and cotton (76.4 %). Cotton is the only crop within the entire samples where dealer supply exceeded local market supply. It is a unique case where specific commercial enterprises provided seed to out-growers. Legume seed, in contrast, was only very occasionally sourced from agro-dealers for example cowpea and green-gram reached levels of 2.4 and 2.9 % of total seed sown respectively for each crop. Common bean, groundnut and pigeon pea fell below 1 % of supply from agro-dealer networks (Table 9).

Local markets supplied at least 5 % of seed for 26 out of the 40 crops monitored, and over 10 % of seed for 24 of these crops. While the total percentages vary considerably by crop, an important point is that local markets are routinely used for seed for a wide range of crops (Table 9).

Annex 4. Seed prices

Seed prices for cereals and legumes in Burkina Faso

Mabaya et al. (2022a) report seed price data in Burkina Faso in the years 2017, 2019 and 2021 but for formal seed and grain. The prices reported in this study were obtained from the averages of indicative cereal prices and one legume in different regions of the country. The seed prices were calculated from the average prices provided by the interviewed enterprises. The grain price has been adjusted by 30% for selection, processing, preservation, and storage to estimate the FMSS seed price.

The price differentials vary by crop and by year. Hybrid maize shows the highest price ratio, but this is generally not available in the FMSS because of the poor performance. The second highest price ratio can be found for sorghum. For the other crops, the price ratio vary due to fluctuating prices. In particular the grain price shows a substantial increase in 2021, lowering the price differential between formal and informal seed in 2021 (Table 10).

***Table 10*. Seed prices (XOF/kg) for cereals and legumes in Burkina Faso**

	2017			2019			2021		
Crop Type	**Formal seed**	**Informal seed***	**Price ratio**	**Formal seed**	**Informal seed***	**Price ratio**	**Formal seed**	**Informal seed***	**Price ratio**
Maize (hybrid)	1,500	198	**7.6 : 1**	1,365	202	**6.8 : 1**	1,591	442	**3.6 : 1**
Maize (OPV)	500	198	**2.5 : 1**	485	202	**2.4 : 1**	491	442	**1.1 : 1**
Rice	500	514	**1.0 : 1**	550	215	**2.6 : 1**	509	422	**1.2 : 1**
Sorghum	700	217	**3.2 : 1**	756	208	**3.6 : 1**	762	520	**1.5 : 1**
Soybean	1,100	514	**2.1 : 1**	1,060	507	**2.1 : 1**	1,309	1040	**1.3 : 1**

Source: Mabaya et al., 2022a

**For informal / FMSS seed, the grain prices were adjusted upwards by 30% due to the costs of selection, processing and storage of the seed, which is not necessary for grain.*

Seed prices for cereals and legumes in Ghana

Mabaya et al. (2022b) collected information on seed prices for cereals (maize, rice) and legumes (soya bean, cowpea) in Ghana for the TASAI index (Table 11). The seed price for hybrid maize seed was significantly higher than seed from FMSS. In 2019, FMSS seed was cheaper than seed from the commercial seed sector, with the exception of rice due to a higher grain price. For OPV maize seed and for all the other crops, the prices for seed from the formal seed sector or FMSS were almost similar in 2021. This is mainly because farmers buy open-pollinated varieties once every three years. During the second and third year, they recycle the seed which means that the formality of the OPV maize, cowpea, rice and soybean is only for one season. It is important to note that these prices are dynamic because they are influenced by a number of factors including the price disparity between formal and informal seed, prices of farm inputs, and the socio-economic status of the farmers. This data indicates that there is no price advantage of buying FMSS seed except for hybrid maize.

Table 11. Seed prices (GH₵/kg) for cereals and legumes in Ghana

	2017			2019			2021		
Crop Type	**Formal seed**	**Informal seed***	**Price ratio**	**Formal seed**	**Informal seed***	**Price ratio**	**Formal seed**	**Informal seed***	**Price ratio**
Maize (hybrid)	8.54	-		18.00	1.83	**9.8 : 1**	18.00	6.5	**2.8 : 1**
Maize (OPV)	5.82	-		4.20	1.83	**2.3 : 1**	6.00	6.5	**1.0 : 1**
Rice	3.88	-		3.80	5.15	**0.7 : 1**	6.00	6.5	**1.0 : 1**
Soya bean	7.00	-		4.60	3.20	**1.4 : 1**	8.00	9.1	**0.9 : 1**
Cowpea	8.15	-		7.00	5.20	**1.3 : 1**	10.00	10.4	**1.0 : 1**

**For informal / FMSS seed, the grain prices were adjusted upwards by 30% due to the costs of selection, processing and storage of the seed, which is not necessary for grain.*

Source: Mabaya et al., 2022b

Seed prices for cereals and legumes in Kenya

Mburu et al. (2022) report seed prices for cereals and legumes for the TASAI Index for the years 2017, 2019 and 2021 (Table 12). The price differentials are high for maize (OPV) and sorghum, where seed from FMSS is substantially cheaper than formal seed from the commercial seed sector. The same holds true for bean and cowpea seed, where seed from the FMSS is still 20% to 50% cheaper.

Table 12. Seed prices (KSH/kg) for cereals and legumes in Kenya

	2017			2019			2021		
Crop Type	**Formal seed**	**Informal seed***	**Price ratio**	**Formal seed**	**Informal seed***	**Price ratio**	**Formal seed**	**Informal seed***	**Price ratio**
Maize (hybrid)	201	27	**7.4 : 1**	210	49	**4.3 : 1**	210	91	**2.3 : 1**
Maize (OPV)	181	27	**6.7 : 1**	192	49	**3.9 : 1**	188	91	**2.1 : 1**
Bean	191	98	**1.9 : 1**	225	125	**1.8 : 1**	246	208	**1.2 : 1**
Cowpea	161	104	**1.5 : 1**	168	86	**2.0 : 1**	202	111	**1.8 : 1**
Sorghum	171	52	**3.3 : 1**	175	64	**2.7 : 1**	209	59	**3.5 : 1**

**For informal / FMSS seed, the grain prices were adjusted upwards by 30% due to the costs of selection, processing and storage of the seed, which is not necessary for grain.*

Source: Mburu et al., 2022

In Kenya, the price ratio between formal and informal seed is estimated at 1.6 on average. Formal seed for maize and beans is twice the price for FMSS seed for these two crops. Though price differences for other crops are smaller, they are still substantial (Table 13).

Table 13. Formal and informal seed prices (KSH/kg) in Kenya, 2024

Crop Type	Formal Seed	Informal Seed	Price Ratio
Hybrid Maize	250	115	2.2 : 1
Rice	210	138	1.5 : 1
Sorghum	225	144	1.6 : 1
Finger Millet	205	161	1.3 : 1
Cereals	890	558	1.6 : 1
Beans	390	190	2.1 : 1
Groundnut	360	280	1.3 : 1
Cowpea	250	180	1.4 : 1
Legumes	1000	620	1.6 : 1
Amaranth	2075	1,411	1.5 : 1
Spider Plant	3000	2100	1.4 : 1
Black Night Shade	2540	1,600	1.6 : 1
Giant Night Shade	2310	1,417	1.6 : 1
Indigenous Vegetables	9925	6528	1.5 : 1
Sweet Potato Vines	Not available	Mostly free/gift	
Cassava Cuttings	Not available	Mostly free/gift	

Source: Onsando 2024, unpublished

Seed prices for cereals and legumes in Malawi

Mabaya et al. (2023a) report the seed prices for cereals (maize) and legumes (bean, groundnut, soya bean) for the years 2016, 2019 and 2021 (Table 14). The FMSS seed for maize but also for legumes (in particular in 2019) is substantial cheaper than formal seed from the commercial seed sector. Formal seed seems relatively expensive in Malawi.

Table 14. Seed prices (MKW/kg) for cereals and legumes in Malawi

	2016			2019			2021		
Crop Type	Formal seed	Informal seed*	Price ratio	Formal seed	Informal seed*	Price ratio	Formal seed	Informal seed*	Price ratio
Maize (hybrid)	900	281	**3.2 : 1**	1,489	195	**7.6 : 1**	1,180	195	**6.1 : 1**
Maize (OPV)	875	281	**3.1 : 1**	1,189	195	**6.1 : 1**	929	195	**4.8 : 1**
Bean	1,060	921	**1.2 : 1**	2,050	546	**3.8 : 1**	1,433	663	**2.2 : 1**
Groundnut	1,097	754	**1.5 : 1**	1,873	585	**3.2 : 1**	1,718	624	**1.8 : 1**
Soya bean	800	572	**1.4 : 1**	1,061	364	**2.9 : 1**	1,059	416	**2.5 : 1**

**For informal / FMSS seed, the grain prices were adjusted upwards by 30% due to the costs of selection, processing and storage of the seed, which is not necessary for grain.*

Source: Mabaya et al., 2023a

Seed prices for cereals and legumes in Mali

Mabaya et al. (2022c) report the seed prices for cereals (maize, rice, sorghum) and legumes (cowpea) for the years 2018 and 2020 in Mali (Table 15). As expected, the prices for hybrid seed from the commercial seed sector are three to six times more expensive than FMSS seed (generally OPV) for the same crops. This price difference underlines the high investment a farmer makes when purchasing certified hybrid seed. For OPV seed, the price differentials are smaller, varying between 1.3:1 and 3.3:1 depending on the crop and the year.

Table 15. Seed prices (XOF/kg) for cereals and legumes in Mali

Crop Type	2018			2020		
	Formal seed	Informal seed*	Price ratio	Formal seed	Informal seed*	Price ratio
Maize (hybrid)	1,500	260	**5.8 : 1**	2,185	364	**6.0 : 1**
Maize (OPV)	650	260	**2.5 : 1**	896	364	**2.5 : 1**
Rice (hybrid)	1,500	520	**2.9 : 1**	-	582	
Rice (OPV)	650	520	**1.3 : 1**	840	582	**1.4 : 1**
Sorghum (hybrid)	1,500	293	**5.1 : 1**	-	291	
Sorghum (OPV)	650	293	**2.2 : 1**	952	291	**3.3 : 1**
Cowpea	1,350	650	**2.1 : 1**	1,625	1,092	**1.5 : 1**

**For informal / FMSS seed, the grain prices were adjusted upwards by 30% due to the costs of selection, processing and storage of the seed, which is not necessary for grain.*

Source: Mabaya et al., 2022c

Seed prices for cereals and legumes in Mozambique

Mabaya et al. (2022d) report the seed prices for cereals (maize, rice) and legumes (cowpea, soya bean) for the years 2016 and 2020 in Mozambique (Table 16). Seed prices in the commercial seed sector are higher than estimated FMSS seed prices, though it varies by year and crop. In 2016, for example, the seed prices for cowpea and soya bean were similar in both sectors.

Table 16. Seed prices (USD/kg) for cereals and legumes in Mozambique

Crop Type	2016			2020		
	Formal seed	Informal seed*	Price ratio	Formal seed	Informal seed*	Price ratio
Maize (hybrid)	1.9	0.5	**3.7 : 1**	2.7	0.7	**4.2 : 1**
Maize (OPV)	1.5	0.5	**2.9 : 1**	1.5	0.7	**2.3 : 1**
Rice	0.7	0.3	**2.9 : 1**	1.6	1.2	**1.4 : 1**
Cowpea	1.3	1.2	**1.1 : 1**	1.8	1.4	**1.3 : 1**
Soya bean	1.1	0.9	**1.2 : 1**	1.8	0.7	**2.8 : 1**

**For informal / FMSS seed, the grain prices were adjusted upwards by 30% due to the costs of selection, processing and storage of the seed, which is not necessary for grain.*

Source: Mabaya et al., 2022d

Seed prices for cereals and legumes in Nigeria

In this survey of TASAI, Mabaya et al. (2023b) report the seed prices for major cereals (maize, rice, sorghum) and the legume soybean for the years 2017, 2019 and 2021. Seed prices vary between the years, for formal seed (from the commercial seed sector) as well as inform seed (from FMSS). Generally, formal seed is at least twice the price of FMSS seed, though in 2021 these price differences were less pronounced (Table 17).

***Table 17**. Seed prices (NGN ₦/kg) for cereals and legumes in Nigeria*

	2017			2019			2021		
Crop Type	**Formal seed**	**Informal seed***	**Price ratio**	**Formal seed**	**Informal seed***	**Price ratio**	**Formal seed**	**Informal seed***	**Price ratio**
Maize (hybrid)	325	85	**3.8 : 1**	560	183	**3.1 : 1**	628	254	**2.5 : 1**
Maize (OPV)	375	85	**4.4 : 1**	495	183	**2.7 : 1**	398	254	**1.6 : 1**
Rice	400	156	**2.6 : 1**	519	183	**2.8 : 1**	455	203	**2.2 : 1**
Sorghum	400	78	**5.1 : 1**	417	173	**2.4 : 1**	417	298	**1.4 : 1**
Soybean	350	156	**2.2 : 1**	434	217	**2.0 : 1**	438	435	**1.0 : 1**

**For informal / FMSS seed, the grain prices were adjusted upwards by 30% due to the costs of selection, processing and storage of the seed, which is not necessary for grain.*

Source: Mabaya et al., 2023b

Seed prices for cereals and legumes in South Sudan

Mabaya et al. (2023c) report the seed prices for cereals (maize, sorghum) and legumes (cowpea, groundnut) for the year 2022 only in South Sudan (Table 18). Of the four crops, the prices for hybrid maize seed and cowpea seed were the highest, followed by sorghum, groundnut, and OPV maize. When it comes to price variation, hybrid maize is 2.9 times more expensive than informal/FMSS seed; this is followed by sorghum which is 1.7 times while OPV maize is 1.4 more expensive than the FMSS seed. In this survey however groundnut and cowpea informal seed is more expensive than formal seed. This result, which is contrary to the knowledge of seed experts, could be attributable to huge volumes of seed aid which is transacted in South Sudan. Such huge volumes of free seed, could easily distort the seed prices in the country. The authors themselves caution for an interpretation of this result as the sampling was limited to a few areas.

***Table 18**. Seed prices (SSP/kg) for cereals and legumes in South Sudan*

	2022		
Crop Type	**Formal seed**	**Informal seed***	**Price ratio**
Maize (hybrid)	1550	650	2.4 : 1
Maize (OPV)	936	650	1.4 : 1
Sorghum	1320	780	1.7 : 1
Cowpea	2088	2400	0.9 : 1
Groundnut	1307	1600	0.8 : 1

**For informal / FMSS seed, the grain prices were adjusted upwards by 30% due to the costs of selection, processing and storage of the seed, which is not necessary for grain.*

Source: Mabaya et al., 2023c

Seed prices for cereals and legumes in Uganda

Mabaya et al. (2023d) report the seed prices for cereals (maize, millet, sorghum) and legumes (bean) for 2019 and 2021 in Uganda (Table 19). Formal seed for hybrid maize and sorghum is two to three times more expensive than FMSS seed. For millet, on the other hand, the seed prices are similar. The price differential vary by year and by crop.

Table 19. Seed prices (UGX/kg) for cereals and legumes in Uganda

Crop Type	2019			2021		
	Formal seed	Informal seed*	Price ratio	Formal seed	Informal seed*	Price ratio
Maize (hybrid)	6,020	2,106	**2.9 : 1**	5,883	1,866	**3.2 : 1**
Maize (OPV)	2,810	2,106	**1.3 : 1**	2,410	1,866	**1.3 : 1**
Bean	4,835	4,108	**2.9 : 1**	5,083	3,374	**1.5 : 1**
Millet	4,333	2,259	**1.2 : 1**	4,000	3,552	**1.1 : 1**
Sorghum	3,500	1,079	**3.2 : 1**	3,375	1,676	**2.0 : 1**

For informal / FMSS seed, the grain prices were adjusted upwards by 30% due to the costs of selection, processing and storage of the seed, which is not necessary for grain.

Source: Mabaya et al., 2023d

Seed prices for cereals and legumes in Zimbabwe

Mabaya et al. (2022e) report the seed prices for cereals (maize, rice) and legumes (bean, cowpea, soya bean) for 2016 and 2021 in Zimbabwe (Table 20). Formal hybrid maize is six to seven times more expensive than informal maize seed sold in FMSS. This is a huge price difference for farmers. Legumes, in particular cowpea and soya bean, also show high price differences between formal and informal seed. Certified seed sold in the commercial seed sector is thus a huge investment for farmers, compared to the estimated seed prices that can be purchased within FMSS.

Table 20. Seed prices (USD/kg) for cereals and legumes in Zimbabwe

Crop Type	2016			2021		
	Formal seed	Informal seed*	Price ratio	Formal seed	Informal seed*	Price ratio
Maize (Hybrid)	2.80	0.39	**7.2 : 1**	2.90	0.43	**6.7 : 1**
Maize (OPV)	1.40	0.39	**3.6 : 1**	1.60	0.43	**3.7 : 1**
Bean	2.80	1.61	**1.7 : 1**	3.00	1.61	**1.9 : 1**
Rice	1.60	0.78	**2.1 : 1**	1.60	0.64	**2.5 : 1**
Cowpea	2.60	0.39	**6.7 : 1**	2.54	0.51	**5.0 : 1**
Soya bean	1.60	0.26	**6.2 : 1**	1.64	0.51	**3.2 : 1**

For informal / FMSS seed, the grain prices were adjusted upwards by 30% due to the costs of selection, processing and storage of the seed, which is not necessary for grain.

Source: Mabaya et al., 2022e

Annex 5. Expert opinions on FMSS

Eleven internationally recognized experts in farmer-managed seed systems in Africa were asked to respond to common statements on FMSS. Though this is not a robust scientific method to analyse the status of FMSS, the responses give an indication of agreements and disagreements among key experts regarding common assumptions and hypotheses related to FMSS.

Experts' opinions on common FMSS assumptions and hypotheses

Eleven experts were asked to indicate whether they agreed or disagreed with common FMSS assumptions and hypotheses (Figure 8). A small majority of the experts agree that FMSS have a major productivity challenge and therefore they cannot exclusively feed Africans with a population of 1.48 billion and a potential to double by 2050.

The experts generally agree that a decline of FMSS varieties at the expense of fewer commercial varieties (maize, rice, sunflower, soybean) has negatively impacted agrobiodiversity leading to limited crop genetic diversity and hence a reduction in sustainable solutions to food and nutrition security through creation of dietary diversity.

The experts agree that FMSS are necessary to preserve genetic diversity and resilience for breeding of high yielding and organoleptically robust commercial and non-commercial varieties. Most experts agree that African have not supported FMSS sufficiently to preserve the genetic diversity and resilience.

The majority of the experts agree that a lack of supportive policies on FMSS has eroded farmers' indigenous seed knowledge and experience developed over the years. This is even compounded further by the fact that this knowledge is largely undocumented as it is normally passed verbally from one generation to another with a possibility of distortions of information/content as it is being passed on.

A small majority of the experts agree that it is not possible for African Regulatory Agencies to cope with the regulation of FMSS given current capacities. This hypothesis remains debated.

A small majority of the experts disagreed that regulation of FMSS is not necessary as the system has the requisite indigenous knowledge and the resilience to run by itself. This hypothesis remains debated.

Most experts agree that numerous crop species in the world, and specifically in Africa, are underutilized or overlooked by mainstream research and development initiatives. Yet, farmers save diverse varieties for their own use as they exploit the diversity of seeds and other local resources for home consumption, medicinal purposes, income generation, landscape management and so on.

Most experts agree that most of the agricultural crops and varieties have been conserved *in situ* as a result of farmers' efforts and could have been lost if farmers did not cultivate, save or exchange seeds.

The experts agree and disagree in equal measure that the African food supply rests essentially on the biological diversity developed and nurtured by indigenous communities and the farming communities located in the centres of origin and diversity of crops and wild relatives' genetic resources. This hypothesis remains debated.

The experts agree that agrobiodiversity, which characterizes FMSS, which is a valuable asset for scientific and technological advancements in crop production.

The experts agree that the formal CSS can co-exist with FMSS and draw synergies from each other in case of progressive seed policies and legal frameworks for the benefit of the seed sector in Africa.

Most experts disagree that there is enough conflict or strong disagreements between the proponents of the CSS and FMSS to adversely affect the growth of both even as they share common gene pool for breeding.

A small majority of the experts disagrees that FMSS deal in grain for seed and so the quality has significant challenges compared with formal seed. This assumption remains debated.

Figure 8. Expert responses to common FMSS assumptions and hypotheses

Experts' opinions on required regulation for FMSS

There is an ongoing debate what level of regulation is appropriate for FMSS, and who should be responsible for its governance. The experts also have varying opinions on the topic, though the majority thinks some form of regulation is desirable (Figure 9). The experts agreed that the capacity of seed regulatory agencies as constituted does not cope with the regulation of even commercial seed alone (Figure 10). Given these existing capacity constraints, extending regulatory oversight to cover FMSS presents even greater challenges, necessitating the deployment of alternative regulatory strategies.

The experts endorsed several alternative approaches, including Quality Declared Seed (QDS) systems, Integrated Seed Systems, and agricultural extension-based regulatory models implemented through targeted training and authorization programs. However, these same experts expressed skepticism about the robustness of community-based regulatory approaches, both in their current form and even after capacity building initiatives (Figure 9). Regardless these expert opinions, it is worth exploring the inclusion of farmer communities into FMSS governance. Once their capacity has been strengthened by regulatory agencies, they can effectively self-regulate local FMSS under a framework of periodic random oversight checks. This approach could provide a practical solution to the capacity constraints while maintaining appropriate quality standards. Indeed, the experts also support QDS-type of regulation and inclusions of farmer groups into FMSS governance because this is a cost-effective approach (Figure 10).

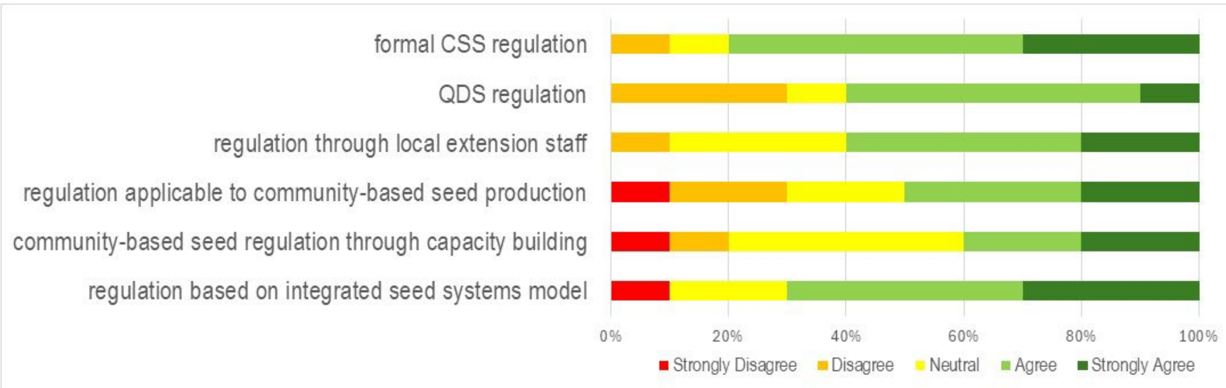

Figure 9. Expert opinions on the required level of regulation for FMSS

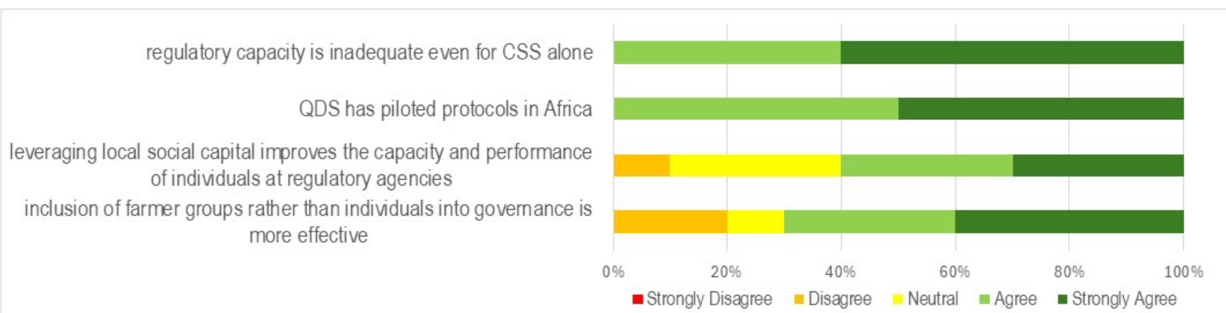

Figure 10. Expert arguments for required level of regulation for FMSS

Experts' opinions on constraints to regulating FMSS

The experts agreed that the key constraints impacting the regulation of the FMSS include (Figure 11):

- capacity in terms of number of management teams, inspectors, vehicles, offices and laboratories which would have to be enhanced significantly to cope and this will be very expensive for most African governments,
- lack of crop-specific regulations, protocols and standards for the FMSS
- lack of alternative methods of varietal identity different from the Distinctiveness, Uniformity and Stability (DUS)

- changing the farmer mind-set which would require significant education, resources, capacity building, demonstrating the benefits to influence the necessary paradigm shift.

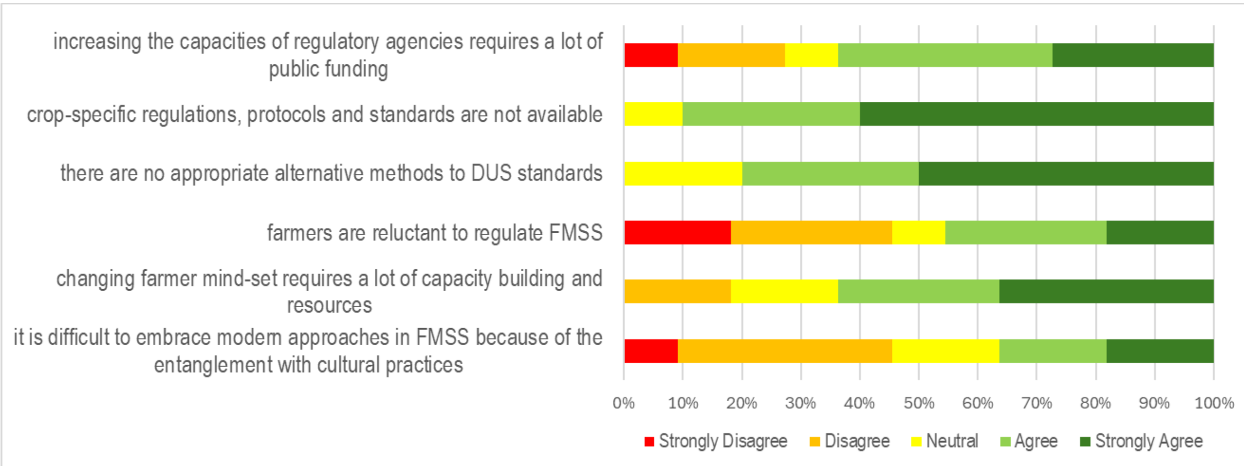

Figure 11. Expert opinions on constraints to regulating FMSS

Expert opinions on promotion of FMSS

Experts were asked which of the strategies below would contribute to African governments recognizing FMSS and documenting related indigenous knowledge. The experts generally agreed to the strategies, but note that these are not exclusive; other strategies may be needed as well.

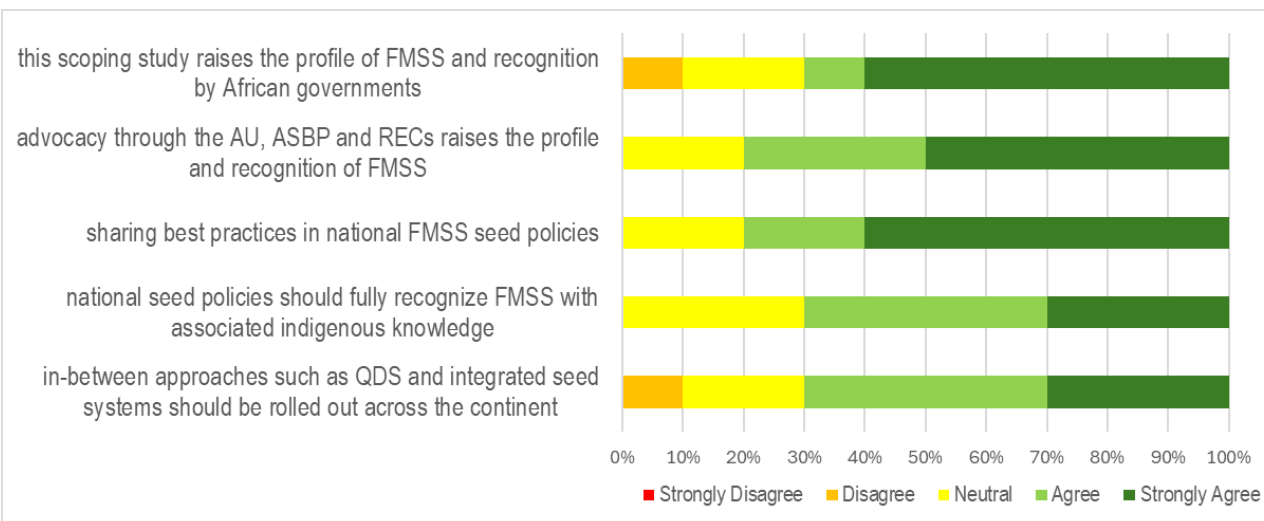

Figure 12. Expert opinions on strategies to promote recognition of FMSS with African governments

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Contact

Website:
www.desiralift.org

LinkedIn:
www.linkedin.com/company/desira-lift

Address:
Wageningen Centre for Development Innovation
P.O. Box 88
6700 AB Wageningen
The Netherlands

Email:
info@desiralift.org

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