

Harnessing Innovation and Data for Last-mile Seed Delivery

Africa Regional Meeting on Seed Systems

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Workshop REPORT

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Executive Summary

Impact-driven strategies for dryland crop seed systems are essential to improve access to quality seeds of new and improved varieties with desired traits. CIMMYT's Dryland Crops Program (DCP), through its complementary projects including AVISA, focuses on enhancing dryland crops' breeding and seed delivery systems. Under seed systems, the aim is to address the current low adoption of improved varieties of dryland crops such as sorghum, pearl millet, finger millet, groundnut pigeon pea, and chickpea. Low adoption and impact have been attributed to several concerns, including limited product information, inadequate access to early-generation seed (EGS), and a need for more awareness about the business potential offered by these crops. To overcome these challenges, there is a need for robust systems that enhance data access on varietal superiority and seed demand. The program also emphasizes gender equity by supporting women and youth in seed entrepreneurship and ensuring equal access to seed technologies. The workshop, therefore, sought to align efforts, share expertise, and establish strong partnerships among stakeholders involved in the dryland crops seed systems to enhance collaboration through data-driven decision-making, varietal inventory analysis, and innovative seed delivery models.

An assessment of publicly bred varieties released over the last decade in Eastern and Southern Africa (ESA) and West and Central Africa (WCA) regions revealed significant insights. In ESA, **181** varieties were released, with Ethiopia leading at **68** varieties, while countries like Zambia and Zimbabwe had fewer releases. In WCA, **145** varieties were released, with Burkina Faso and Mali standing out. To enhance variety availability, seed delivery models emphasize shortening the release-commercialization time-lag, substantial seed distribution, knowledge transfer, and value chain connections are crucial. Popular varieties were evaluated in different countries, highlighting areas for improvement like enhancing palatability and nutritional attributes.

A discussion on impact pathways delineated several challenges, including workflow inefficiencies, misaligned data collection methods, limited market understanding, and resource constraints. An impact-oriented approach focusing on farmers' constraints aims to deliver genetic solutions to improve productivity, food security, and nutrition. Strategies like inclusive seed systems and evidence-supported scaling models were proposed to drive an effective adoption of improved crop varieties.

Quality and regular data are also needed to assess and track seed systems performance indicators such as Weighted Average Varietal Age (WAVA) and Seed Replacement Rate (SRR) to expand understanding of varietal turnover challenges and the need to address institutional, technical, environmental, and socio-economic barriers to the efficient adoption of new crop varieties.

Participants engaged in describing *scalable* seed delivery models for dryland crop seeds in their respective countries, aiming to bring sustainable change on a broad scale by ensuring widespread benefits and positive outcomes beyond immediate contexts. The Scaling Scan methodology guided participants through three steps: a) constructing a scaling ambition, b) assessing scaling ingredients, and c) identifying challenges and opportunities. Various seed delivery models were discussed, such as the Adopted Villages model in Nigeria, the Youth and Women Quality Centers model in Tanzania, the Digital Seed Pre-order system in Rwanda utilizing innovative technology for efficient seed distribution, the Pre-secured Seed Market Option model in Uganda targeting existing markets for secure seed sales, the Traveling Weekly Market Days model in Chad bringing seeds directly to remote farmers, the Large-Scale Demonstrations initiative in Ethiopia introducing "shelved" varieties to farmers directly, and the Bundled Technologies approach in Kenya integrating seeds with farming technologies to optimize agricultural practices comprehensively. These models address challenges and enhance seed delivery efficiency within diverse agricultural landscapes.

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Introduction

Despite the resilience of dryland crops to climate change, the use of improved seeds for these crops is still very low. The main reasons often cited include limited product information, inadequate and timely access to seed, both early generation and commercial seed and the need for more knowledge regarding the business opportunity these present. CIMMYT's dryland crops program (DCP) seeks to overcome these constraints by establishing robust systems that enable collaboration across countries, support national agricultural research systems, increase data access on varietal superiority and seed demand, and improve the availability of EGS. The program seeks to also develop and support inclusive models to seed entrepreneurship and ensuring equal access to seed and other yield-enhancing technologies, envisaging strong gender and social inclusion outcomes.

In transitioning into CGIAR programming, CIMMYT's DCP through the AVISA transitional plan project with one of its primary outcome four (PO4) seeking to improve access to quality seeds of improved varieties. The *focus investments* include strengthening successful pathways and validating innovative approaches for creating awareness among resource-poor farmers of improved DLCs and reaping benefits from new varieties. Specifically, the PO4 aims to i) ensure seed supply approaches respond to demand signals, ii) reach the difficult to reach farmers, iii) enhance quality seed access and improve the adoption and production of new varieties at scale. Further the work is enriched in a key instrument for success known as the Africa Dryland Crops Improvement Network ([ADCIN](#)). This initiative enables a structured partnership approach with NARES and SMEs to advance the development of dryland crops. Thus, a common understanding between implementing partners is critical in meeting project objectives and outcomes.

To this end, a workshop was organized to share CIMMYT's vision for strengthening dryland crop seed systems in Africa. The event aimed to foster collaboration among partners, gather valuable input, and outline strategies for mutual learning and improvement. This would catalyze aligning efforts, sharing expertise, and establishing strong partnerships to address the unique challenges faced in various countries. Meeting participants comprised of persons responsible for carrying out seed systems activities within the framework of the implementation of the AVISA project at the research institutions in target countries (Country crop seed system lead) and some focal persons. Participants were drawn from Burkina Faso, Ghana, Nigeria, Chad, Cameroon, Togo, Niger, and Mali in West and Central Africa, and Tanzania, Kenya, Malawi, Mozambique, South Sudan, Uganda, and Ethiopia in Eastern and Southern Africa. Other non-NARS partners were the Centre for Behavior Change and Communication (CBCC), Syngenta Foundation for Sustainable Agriculture (SFSA), and New Markets Lab (NML).

The objectives of the meeting entailed:

- a) Analyse the inventory of varieties released in the past decade and devise strategies to enhance the visibility and utilization of 'on-the-shelf' varieties.
- b) Collaboratively identify crucial data points and project data requirements, choose appropriate data collection tools, and establish a comprehensive plan for data collection and support.
- c) Evaluate and select innovative seed delivery models suitable for pilot implementation across diverse countries.

This workshop aimed to outline a comprehensive approach to enhancing collaboration within the DLC seed systems, focusing on data-driven decision-making, varietal inventory analysis, innovative seed delivery, partner engagement, and immediate needs assessment. These objectives laid the foundation for a robust and sustainable partnership network that will contribute significantly to the success of seed systems for DLCs.

Exploring Dryland Crop Varieties in WCA and ESA Regions: Popular Varieties, Characteristics, and Traits Across 15 Countries

An assessment of publicly bred varieties released in the last ten years in nine Eastern and Southern Africa Countries showed that between 2013 and 2023, 81 varieties were released in the region comprising Sorghum (62), Finger millet (39), Pigeon pea (18), Groundnut (41), Chickpea (21) (Table 2). The varieties are at various stages of commercialization, with half in an emerging and expanding stage (at least 50 MT of seed produced per year). Ethiopia had the highest number of these varieties (68); on the contrary, countries in Southern Africa, especially Zambia and Zimbabwe, had less than ten released in the last ten years in these countries (Table 1, Figure 1).

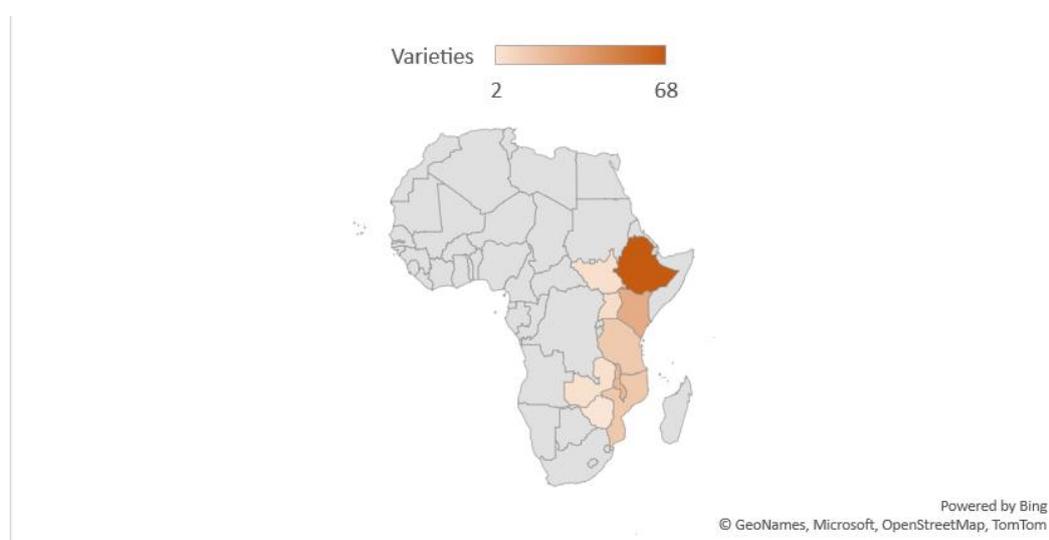


Figure 1. Varieties released post-2013 for 5 DLCs in Eastern and Southern Africa

Table 1. Varieties for the 5 AVISA crops released between 2013 and 2023 in 9 ESA partner countries.

Country	Sorghum	Finger millet	Pigeon pea	Groundnut	Chickpea	Total
Ethiopia	26	15	3	11	13	68
Kenya	4	14	3	3	5	29
Malawi	3	3	4	10	3	23
Mozambique	11	1	0	4	0	16
South Sudan	2	0	0	3	0	5
Tanzania	10	1	4	8	0	23
Uganda	4	5	0	2	0	11
Zimbabwe	2	0	0	0	0	2
Zambia	0	0	4	0	0	4
Total	62	39	18	41	21	181

In the West and Central Africa region, comprising eight countries, a total of 145 varieties were released for three key crops: groundnut, sorghum, and pearl millet (Table 2, Figure 2). Burkina Faso and Mali stood out with

the highest numbers of released varieties, 49 and 37, respectively, mainly due to significant releases of sorghum and groundnut varieties. Notably, pearl millet had the least number of released varieties, indicating a comparatively lower focus and investment in this crop.

Table 2. Varieties for the 5 AVISA crops released between 2013 and 2023 in 7 WCA partner countries.

Country	Groundnut	Pearl millet	Sorghum	total
Burkina Faso	7	5	37	49
Cameroon	Not assessed	Not assessed	0	0
Chad	Not assessed	Not assessed	0	0
Ghana	8	5	4	17
Mali	18	3	16	37
Niger	4	6	3	13
Nigeria	5	4	10	19
Togo	5	1	4	10
Total	47	24	74	145

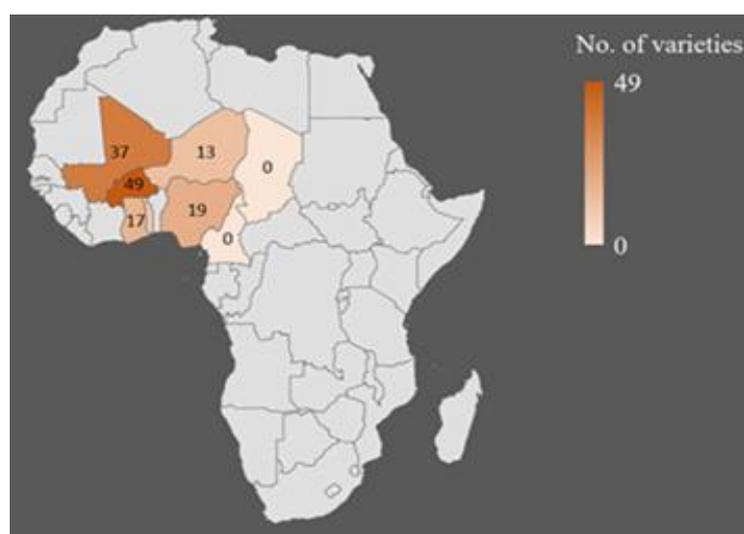


Figure 2. Varieties released between 2013 to 2023 for 3 DLCs in 8 countries of WCA

To enhance the availability of diverse varieties, it is crucial to identify seed delivery models with specific characteristics. These features include minimizing the time between release and commercialization, delivering a substantial amount of seed to communities, facilitating inclusive knowledge transfer, and connecting different actors in the value chain effectively.

Over the past decade, 181 varieties were released in the ESA region and 145 in the WCA region. Countries have evaluated the most popular varieties, outlining their strengths and weaknesses (refer to Annex 2). Among popular varieties of pearl millet in Nigeria, undesirable traits include short panicles and slender stalks, an opportunity for improvement. For groundnuts, for instance, popular varieties in Malawi are still deficient in nutritional attributes such as high oleic, iron and zinc, and flavor. Sorghum varieties that are grown in Tanzania need to be enhanced in terms of palatability, low tannin content, and tolerance to Striga weed. The pigeon pea varieties grown in Kenya could be improved on pod and grain size, which were reported as desired but missing traits in most popular varieties.

Pathways to Impact for Dryland Crops

Several limitations hinder the substantial impact of scaling improved varieties for dryland crops, including dysfunctional links within scientific workflow processes, misaligned data collection and analysis methods on on-farm variety performance, inadequate scaling strategies, limited market understanding during new variety releases, and resource constraints.

An impact approach is proposed which entails obtaining deeper insights into farmers' production and dietary constraints, focusing mainly on addressing one critical constraint at baseline resources. This approach is tailored for resource-poor farmers facing low input use and challenging environments, aiming to resolve productivity, food security, and nutrition issues. These include low soil fertility, variable climates, geographic and market isolation, and limited diet diversity. The primary emphasis lies in delivering genetic and complementary solutions to alleviate these constraints, encouraging farmers to adopt newer varieties that reduce production costs while enhancing yields and nutrition. The motivation for adoption stems from farmers witnessing the resolution of their problems, subsequently driving demand for these varieties. This demand, in turn, fuels efforts to develop efficient and scalable seed delivery models, ultimately aiming to provide suitable varieties that meet farmers' needs consistently, affordably, and profitably.

Five novel approaches underscore this impact-oriented methodology.

1. An impact orientation approach involves **identifying solutions to farmers' problems** in collaboration with farmers, communities, and researchers.
2. Bundled approaches emphasize **complementing superior crop breeding with other technologies**.
3. Evidence-supported scaling promotes **interventions proven through rigorous analysis or pilots**.
4. Subsidiarity ensures that **farmers and their communities remain at the operational level**.
5. **Inclusive seed systems focus** on linking formal, semi-formal, and informal systems in a complementary fashion rather than a competitive one.

In addition to these approaches, strategies related to process, organizational capacities, technology, and institutional/market innovations play a crucial role. The proposal suggests establishing sentinel sites, investment analysis for impactful projects, time-sensitive workflows for impact co-creation, and implementing twin-track breeding programs. Moreover, it emphasizes the importance of economic analyses preceding significant R&D investments, selecting varieties with economic advantages at baseline input conditions, and tactical suggestions for awareness creation, seed delivery, and business analytics.

The tactical and operational suggestions involve periodic seed marshal plans¹ to stimulate farmer awareness and demand, employing mobile delivery systems to deliver seed directly to farmers in remote or underserved areas, and borrowing logistical principles from large-scale humanitarian distribution to operate efficiently under challenging environments. These operations, designed as time-limited initiatives, must be implemented through local businesses and farmer organizations, necessitating regional and global solidarity.

¹ A "seed marshal plan" is a strategic, large-scale initiative aimed at ensuring the rapid production, multiplication, and distribution of new seed varieties to accelerate their entry into the market.

Weighted Average Varietal Age (WAVA) and Seed Replacement Rate (SRR)

Weighted Average Varietal Age (WAVA) and Seed Replacement Rate (SRR) are key indicators essential for understanding varietal turnover. Varietal turnover reflects how quickly farmers adopt new varieties, maximizing the benefits of genetic advancements in plant breeding. WAVA, a measure of this turnover, gauges the age of currently used varieties, revealing insights into seed quality and adoption trends. It is a yardstick to measure genetic gains and can be assessed at various levels—farm fields, districts, or regions—over multiple seasons or years.

However, persistent constraints hamper the swift replacement of varieties, impeding progress in the formal seed sector. Institutional, technical, environmental, and socio-economic barriers hinder the upscaling of varietal replacement rates. These constraints encompass issues like delayed release processes, narrow genetic diversity, and inadequate participation of the private seed sector, impacting the efficient adoption of new, high-yielding varieties.

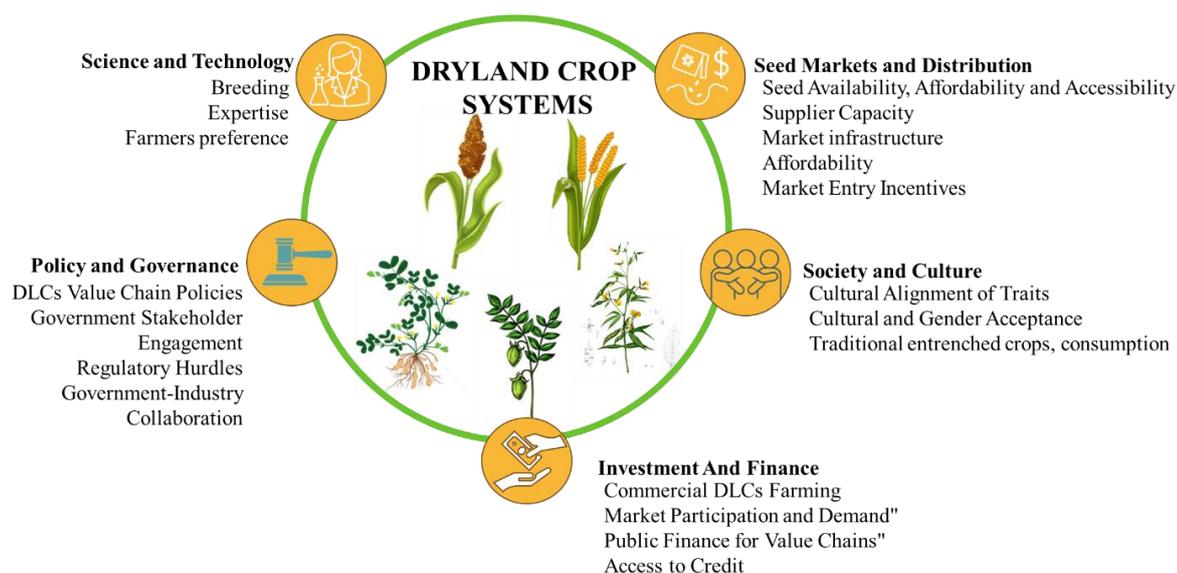
Technical challenges highlighted in these measurements included the slow induction of released varieties into seed chains and the preference for local varieties over modern ones. Environmental concerns, like declining natural resources and poor performance of modern varieties in less favourable conditions, also hinder rapid varietal turnover. Additionally, socio-economic factors such as risk aversion, input availability, and asymmetrical adoption patterns across regions further complicate efficient varietal turnover.

WAVA and SRR serve as critical indicators for the adoption of efficiency and diffusion processes within farmers' fields. However, addressing the persistent constraints outlined is pivotal to accelerating varietal turnover and ensuring the efficient adoption of high-yielding and resilient crop varieties in agriculture.

System Scan of Dryland Crop Seed System

A system scan of dryland crops in 15 countries was conducted during the workshop. Recognizing the complexity of change, participants were prompted to analyze the challenges in their countries within the context of dryland systems. This analysis involved responding to various prompted questions, rating the challenges on a scale of 1 to 5 (with 5 indicating high severity), and providing additional justifications. Once the systemic difficulties were identified, the group engaged in collective discussions. Subsequently, participants were tasked with conferring with their fellow country representatives or colleagues from CIMMYT to devise plausible solutions to the previously outlined challenges collaboratively. The systems scan is conceptualized by the following categories shown in Figure 3. 20 questions were recorded as crucial phrases in the figure.

Figure 3. System scan ingredients



Source: CIMMYT

Scan ingredient 1: Science and technology.

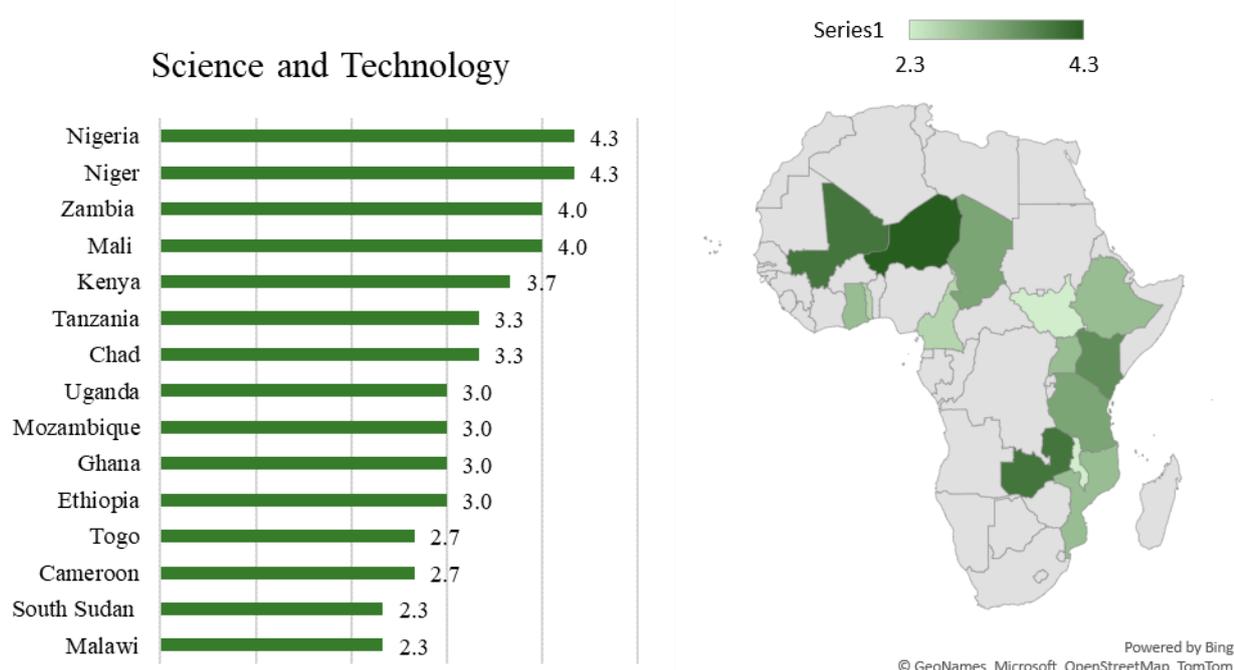
In this section, we addressed three key questions regarding the research and development landscape for dryland crop varieties, such as research infrastructure, seed production support, and variety alignment to consumer (farmer) preference and agroecological conditions. The average score in the scan ingredient of science and technology is shown in

Figure 4 with the highest average scores, they were shaded darker.

Some countries have severe challenges in science and technology where the existing; the most common challenges are as follows:

- **Lack of Adequate Research Facilities:** This extends to outdated or insufficient irrigation systems, limited seed storage facilities, and a lack of essential infrastructure like greenhouses and laboratories. These deficiencies significantly impede the breeding research and the EGS production process. It is imperative, however, to conduct further research to determine the specific facilities needed and their respective specifications. The absence of local research stations and facilities hinders the development of varieties tailored to local agro-ecological conditions. As such, market segmentation has been inadequately executed in most African countries; consequently, the current varieties may not appeal to everyone.
- **Insufficient Personnel:** A recurring issue is the shortage of qualified personnel, including breeders, pathologists, entomologists, social scientists, and technicians, hampering the effective functioning of breeding programs.

Figure 4. Science and Technology score



Source: data from workshop participants

- **Limited Funding Resources:** Inadequate funding resources impede the proper selection and advancement of dryland crop varieties.
- **Limited Awareness among Farmers:** Most countries face the issue of limited awareness among farmers regarding the importance of using improved seeds. The dominance of a few varieties in the formal seed system indicates insufficient awareness about new traits or a disconnect between released varieties and actual farmer needs.

Participants offered the following recommendations to address their challenges and expressed their requirements and current resources.

- **Enhance University Programs:** Establish degree programs in specific areas and specializations that are lacking; offer short—and long-term training opportunities for technicians; and develop the capacity of existing staff through advanced training programs and on-the-job training.
- **Training for Seed Producers:** Comprehensive training should be provided for farmers and community seed producers in areas such as seed field management, post-harvest handling, and seed business management.
- **Farmer and Consumer Preferences:** Farmers' and consumers' preferences are integrated into the definition of breeding ideotypes. This underscores the crucial need to align breeding goals with the specific requirements and preferences of end-users, particularly pertinent in countries with low consumption of dryland crops.
- **Infrastructure Development:** Overcoming the deficit in infrastructure for a variety of development requires targeted efforts. Countries must invest in essential facilities, including drought screening,

genotyping and phenotyping labs, small irrigation facilities, well-equipped seed testing labs, seed conservation rooms, pathogen and disease testing facilities, cold seed storage, and seed conditioning facilities. Additionally, prioritizing mechanization is vital for improving efficiency in the seed development process. However, given the diverse resources and capacities across countries, a comprehensive survey should be conducted to precisely identify the existing resources and facilities, clearly assessing the gap that needs to be addressed.

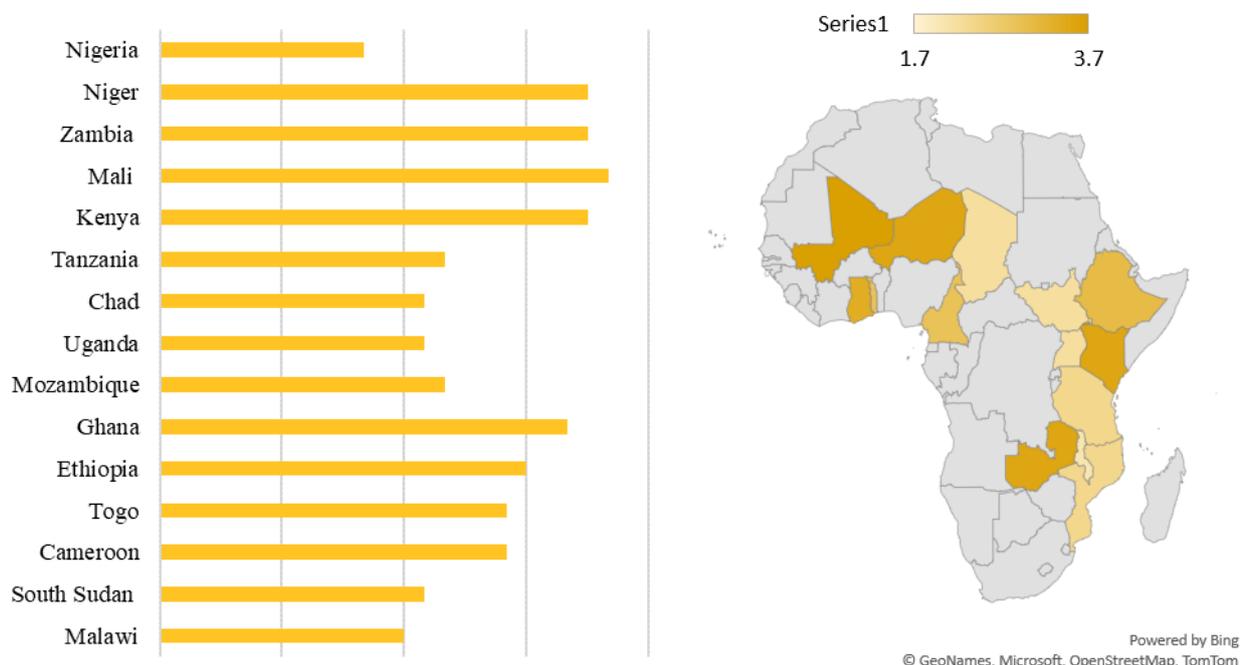
- **Interdisciplinary Approach:** An interdisciplinary approach in the variety development process ensures that new varieties align with consumer demand, underscoring the need for collaboration across different scientific disciplines.
- **Private Sector Engagement:** Countries should actively promote and encourage partnerships to stimulate private sector involvement in seed production activities. This entails installing research infrastructure that supports private sector participation and fostering collaboration between the public and private sectors.

Scan ingredient 2: Seed markets and distribution.

In this component, we addressed six critical questions regarding the availability and accessibility of improved dryland crop varieties in local markets. The average score in the scan ingredient of seed markets and distribution is shown in

Figure 5. With the highest average scores shaded darker color.

Figure 5. Seed markets and distribution score



Source: data from workshop participants

Challenges mentioned by countries with low scores include:

- **Varietal Awareness and Demand:** Most African countries face challenges in introducing improved varieties to the market due to a pervasive lack of awareness. Variable demand awareness and limited

market intelligence contribute to uncertainties in predicting and meeting the demand for specific varieties, creating hurdles for a streamlined market presence.

- **Financial and Infrastructural Constraints:** A common challenge across African countries is the over-reliance on National Agricultural Research Systems (NARS) to carry out various tasks within a limited budget. Inadequate financial and infrastructural capacity is a barrier for seed companies and producers, affecting their ability to produce the required quantities of seeds and impacting accessibility for farmers. Farmers, on the other hand, have financial constraints and a lack of purchasing power, which create significant obstacles to the affordability and adoption of improved varieties. These challenges are compounded by low income from farming, reliance on saved seeds, and limited access to credit facilities, contributing to the difficulty of embracing superior seed varieties.
- **Seed availability and Access:** The geographical distribution of seed producers poses a challenge as most are not based in remote areas, limiting accessibility for farmers in these regions.
- **Reaching the disadvantaged farmers:** Insufficient data on equitable access for women and youth persists despite initiatives like Direct Seed Marketing in Ethiopia. This lack of information hampers efforts to ensure fair access to improved varieties.
- **Seed Pricing Challenges:** The liberalized seed market introduces variable seed prices among producers, lacking consideration for the affordability levels of smallholder farmers. Additionally, the perception of high seed prices, particularly for certain crops, hinders farmer adoption, impacting the overall success of improved seed programs.
- **Erratic Sales:** Challenges in predicting sales projections, especially for open-pollinated varieties (OPVs), introduce unpredictability into seed companies' market entry planning. This uncertainty can hinder strategic decision-making and resource allocation.
- **Information Gaps:** The absence or lack of operational seed market information systems in countries creates challenges in making informed market decisions. Limited market infrastructure, including poor rural connectivity, inadequate networks, and deficiencies in transportation, processing, and storage facilities, further exacerbates these information gaps, affecting the efficient dissemination of improved seeds.

Participants offered the following recommendations to address their challenges and expressed their requirements and current resources.

- **Production Enhancement:** Enhance funding for Early Generation Seeds (EGS) and certified seeds. Encourage the growth of seed producer organizations into companies, particularly in countries lacking formal seed companies like Chad.
- **Seed Accessibility and Distribution:** Promote decentralization of seed producer operations to rural areas, addressing last-mile delivery challenges in countries like Chad. Establish seed marketing information centers and hotlines and train seed system actors for improved seed forecasting, as recommended by Ghana and Mali.
- **Collaboration and Partnerships:** Foster collaboration in seed systems, emphasizing strengthened partnerships with seed producers and stakeholders along the value chain. This includes initiatives for information exchange, awareness creation, and engagement with media channels, as demonstrated in Mozambique and Malawi.
- **Infrastructure Improvement:** Advocate for establishing an efficient market information system in South Sudan to support the dryland crop markets.

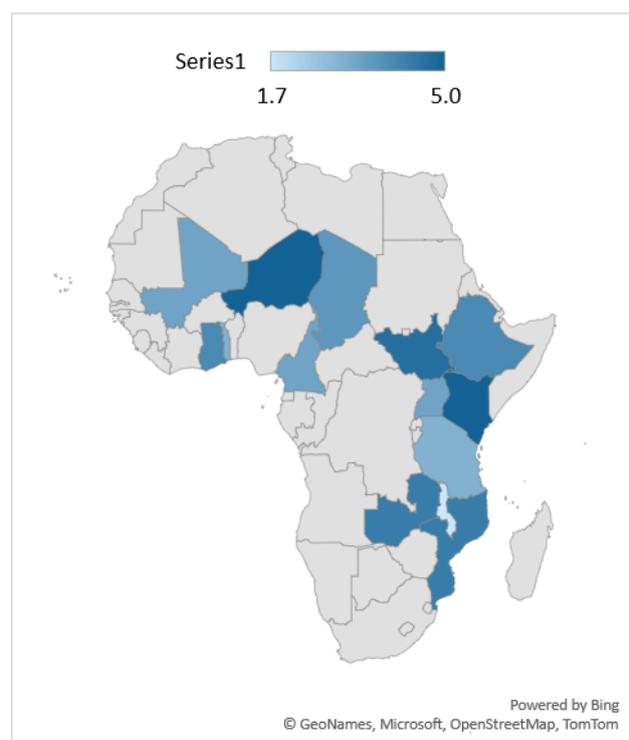
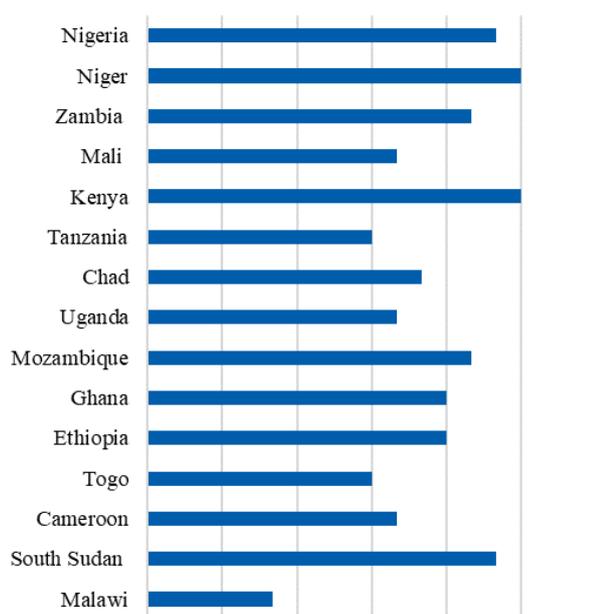
- **Capacity Building and Advocacy:** Advocate for seed subsidies and credit facilities in Uganda to address the seed cost for smallholder farmers. Involve gender and youth in sorghum and groundnut seed distribution systems in Togo. Facilitate the formation of seed supply centers in areas where they are non-existent, as suggested in Zambia.
- **Technology Integration and Knowledge Transfer:** Digitize information on commercialized varieties and their potential traits in Tanzania to enhance demand forecasting and pre-booking systems. Provide technical assistance and de-risking programs to demonstrate best practices in seed production, as suggested by the Syngenta Foundation.
- **Coordination and Planning:** Enhance linkage coordination between different partners at the local level using maps to create an optimal material flow, as proposed by the Syngenta Foundation. Assist in making sales forecasts and subsequent production plans to address the lack of seed sales forecasting and planning, as highlighted by the Syngenta Foundation.
- **Demonstrating Return on Investment and Business Case: Develop return on investment (ROI) models for specific seed producers to ensure profitability in producing specific seed varieties; feasibility studies or general business plans could also** be made so that investors have information.
- **Knowledge Transfer and Instruction:** As the Syngenta Foundation recommends, provide knowledge on developing production instructions, including questions to ask and trial methodologies to gather information.

Scan ingredient 3: Society and Culture

In this section, we addressed three key questions regarding the varieties of customary beliefs, social forms, cultural norms, local practices, and gender issues in the country's contexts. Additionally, we explored the presence of DLCs and specific varieties that are traditionally entrenched and consumed in each country. The average score in the scan ingredient of science and technology is shown in

Figure 5. With the highest average scores shaded in dark color.

Figure 6. Society and Culture score



Source: data from workshop participants

Many of the participants in this section needed help answering specific questions, primarily about customary beliefs and social norms and their relation to seed uptake. Furthermore, most countries indicated the absence of gender-related issues, emphasizing the traditional nature of dryland crop farming. For instance, in Uganda, it is customary to give groundnut seeds to brides for roasting for the men, and finger millet is used in marriage and child naming ceremonies. Participants from different countries also highlighted that dryland crops are widely incorporated into traditional dishes in local markets.

The following suggestions have been made for potential solutions to the challenges expressed.

Tailoring Varieties to Local Needs and Addressing Cultural Preferences: In Chad, participants recommended a targeted approach to breeding varieties based on the specific needs of different regions, aiming to overcome the rejection of certain sorghum varieties. Suggestions focused on addressing cultural preferences and tailoring varieties to local needs.

Involvement of Various Disciplines and Encouraging Adoption of Improved Practices: Participants emphasized including socio-economic scientists from the beginning to address societal, cultural, and environmental settings. Encouraging participatory farmer varietal selection and considering societal needs in technology development were also suggested.

Overcoming Gender-Based Challenges and Improving Extension Services: Capacity building in gender aspects and more effectively engaging extension workers in information dissemination and refresher training was suggested.

Diversifying Seed Production and Encouraging Adoption of Improved Practices: This will necessitate diversifying seed production to cover a range of aspects of youth and women within societies. Raising awareness about the benefits of improved varieties was also suggested to encourage farmers to patronize quality seeds. Both recommendations focus on diversifying seed production and encouraging improved practices among different demographic groups.

Scan ingredient 4: Policy and Governance.

In this section, we delved into four critical questions aimed at regarding finance. This was an inquiry on the existence of specific supportive policies, the engagement of governments with critical stakeholders in policy implementation, the presence of regulatory hurdles hindering DLC commercialization, and the collaboration between government agencies and various organizations to improve seed accessibility and availability for enhanced DLC varieties. The average score in the scan ingredient of science and technology is shown in

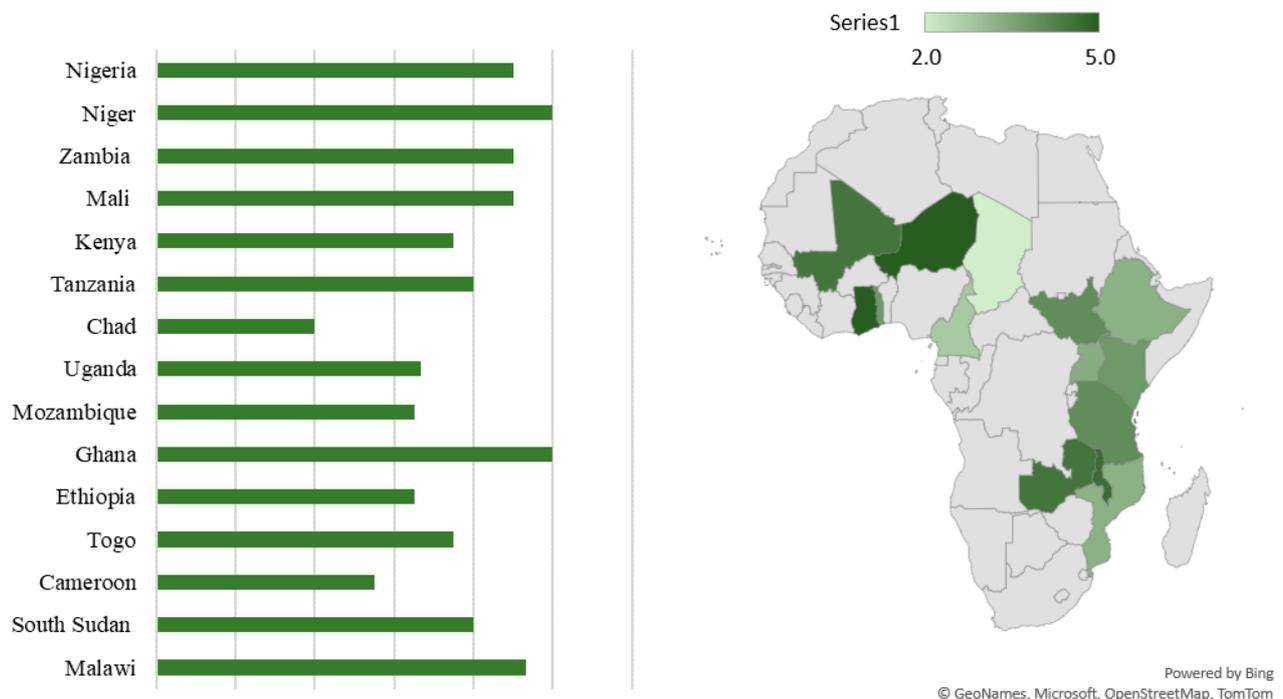
Figure 5, with the highest average scores shaded in a darker color.

Challenges in Low-Scoring Countries:

- **Lack of Focused Policies:** Some low-scoring countries, like Ethiopia and South Sudan, lack dedicated policies for DLCs, leaving a regulatory gap and inadequate support for these crops.
- **Limited Prioritization by governments:** DLCs are not a priority for local and national governments, resulting in sporadic engagement and limited stakeholder interaction, often initiated by development partners.
- **Regulatory and Bureaucratic Hurdles:** Insufficient regulatory framework and bureaucratic processes can hinder DLC production, causing delays in certification, commercialization, and distribution. The lack of quality control services, including human and financial resources, further complicates the situation.

- **Resource Limitations:** Insufficient infrastructure and resources in these countries hinder effective collaboration with seed organizations and international partners, affecting the accessibility of improved seed varieties.

Figure 7. Policy and Governance score



Source: data from workshop participants

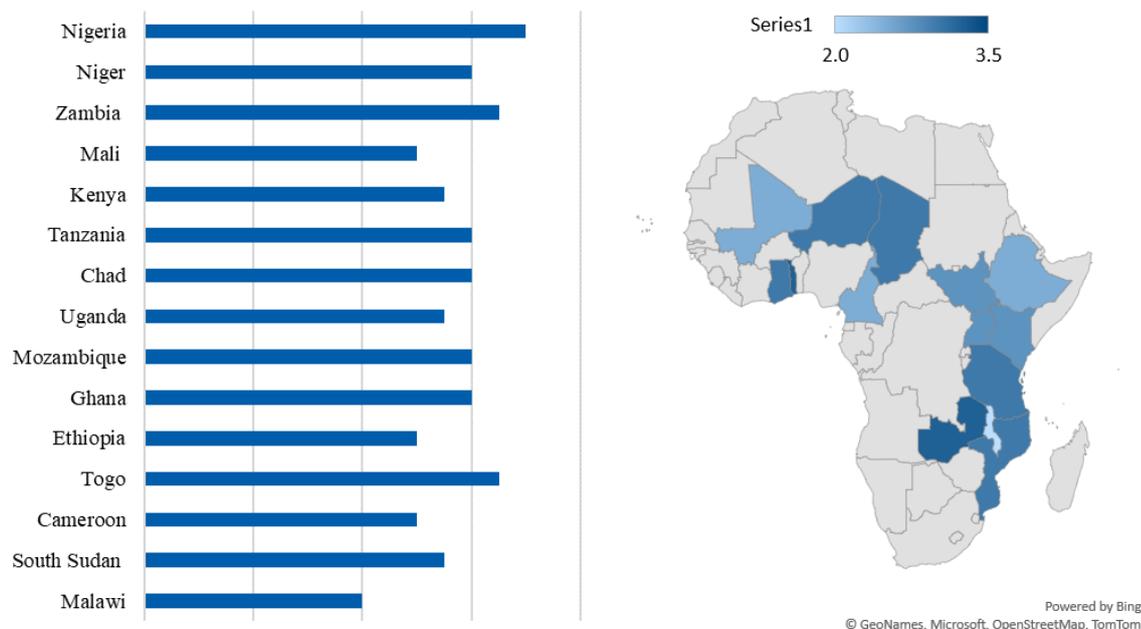
The solutions recommended by participants are summarized below:

- **Coexistence of Formal and Informal Seed Systems and Improving Policy Awareness and Implementation:** The coexistence of formal and informal seed systems will require implementing adopted seed policies and regulations that recognize inclusive seed systems and advocating for policies that promote a conducive business environment.
- **Creating a Safe Environment for Seed Production and Certification:** Nigeria and South Sudan both emphasize creating a safe environment for seed production, which includes managing the over-regulation of seed and increasing government support for certification and subsidies.
- **Improving Traceability of Plant Breeders' Rights:** Some regulations, such as those governing Plant Breeders' Rights and varietal release processes, need to be updated and strengthened to better protect breeders' innovations and ensure timely release and adoption of improved varieties.
- **Lobbying for Policy Revision and Accelerating Policy Implementation:** Participants emphasized reviewing and revising unfavourable laws/policies in the seed sector while building actors' capacity in interpreting and implementing guidelines. Zambia addresses the slow implementation of policies, suggesting regular publication of policy briefs, involvement of policymakers and experts, and the development of an implementation plan.

Scan ingredient 5: Investment and Finance.

In this section, we addressed four key questions regarding the economic aspects of DLCs and their value chains. We explored whether most DLC farmers engage in commercial production, the level of market participation, and consumer demand. Additionally, we assessed the sufficiency of public finances and the accessibility of favorable credit conditions for seed value chain actors in the DLC sector.

Figure 8. Investment and Finance score



Source: data from workshop participants

Common Challenges in Low-Scored Countries:

- **Limited Capital:** Many farmers lack sufficient capital for transition into commercial production, which hampers their participation in DLC markets.
- **Predominantly Subsistence Farming:** Some regions primarily focus on subsistence farming instead of engaging in commercial endeavours, limiting the growth of DLC markets.
- **Inconsistent Surplus Production:** Due to various factors, farmers may not consistently generate surpluses for commercial sales, hindering their market involvement.
- **Limited Government Financial Support:** Low-scoring countries commonly experience challenges due to inadequate government financial support for developing DLC seed and grain value chains.
- **Overdependency on External Funding:** These countries heavily rely on external funding, such as donor projects, for DLC development, which can be unsustainable and hinder long-term planning.

Participants offered the following recommendations to address their challenges and expressed their requirements and current resources.

- **Financial Awareness, Access, and Support for Farmers and Seed Producers:** Chad and Nigeria address financial awareness and access challenges for farmers and seed producers. Chad suggests financial training and developing finance mobilization strategies, while Nigeria emphasizes providing accessible credit facilities and promoting the formation of farmer cooperatives.

- **Planning, Investment Alignment, and Support for Seed Entrepreneurs:** Mozambique and Togo focus on planning and investment alignment challenges. Mozambique suggests planning production with seed companies and providing financial support for small agricultural entrepreneurial initiatives. Togo recommends increasing the budget for research and variety release, assisting seed production actors in accessing long-term credit.
- **Financial Constraints in Research and Development:** Ghana emphasizes financial support for seed entrepreneurs and agricultural research and development investments. Zambia addresses the creditworthiness of processing companies and farmers, emphasizing financial literacy lessons and the development of financing strategies.
- **Creating an Enabling Environment for Investment:** Participants emphasized creating an environment that attracts investors to seed production and distribution. Tanzania highlights the challenge of high interest rates charged by financial institutions for seed companies and community seed producers.
- **Demand Creation, Value Proposition, and Innovation:** Demand creation was emphasized; for instance, the Community Agribusiness (CAB) approach was supported by SFSA to create value and link it to supply capacity and effort.

Scaling scan of seed delivery models most suitable for Dryland Crops

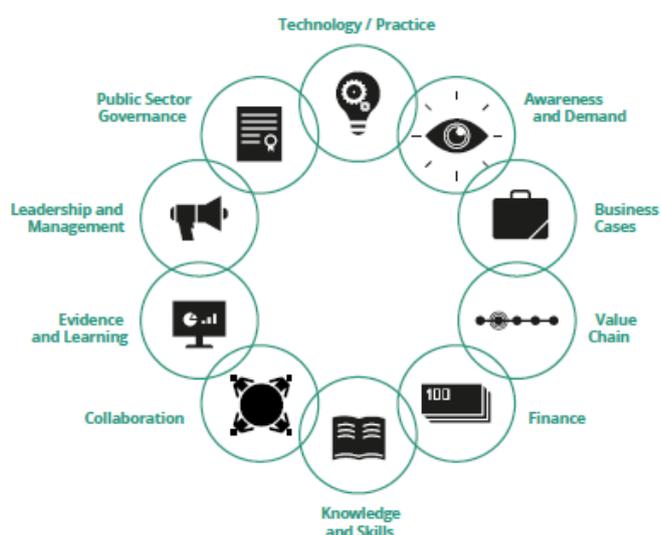
In the workshop, participants engaged in a valuable exercise that prompted them to contemplate the development of the most scalable seed delivery model for dryland crop seeds in their respective countries.

As a transformative process, scaling seeks to bring about sustainable change on a broad scale. This entails ensuring widespread benefits from new technology and extending the positive outcomes beyond the immediate project context, ultimately contributing to the enhancement of communities. Recognizing the complexity of scaling endeavors, it is essential to acknowledge that there is no one-size-fits-all recipe or blueprint. However, the Scaling Scan provides a structured approach to guide scaling initiatives and emphasize key considerations for scaling teams.

The Scaling Scan methodology is designed to systematically navigate the intricacies of scaling, tailoring approaches to specific contexts. Participants are led through three distinct steps:

- i. Constructing a Scaling Ambition, which provides a clear vision of the intended impact, identifies the stakeholders involved, and articulates the initiative's significance.
- ii. Assessing the scaling ingredients and evaluating the extent of attention given to ten critical scaling ingredients. Participants responded to targeted questions for each ingredient, assigning a score from 1 to 5 to indicate their level of confidence in achieving the scaling ambition. The ten scaling ingredients that collectively contribute to the success of the scaling process are presented in Figure 7.

Figure 9. Scaling scan ingredients



Source: CIMMYT, the scaling scan team

- iii. Identify and address challenges and opportunities through systematically identifying and addressing challenges throughout the scaling process.

By engaging in this 3-step structured approach, participants gained insights into the intricacies of scaling and are equipped to make informed decisions that contribute to their projects' sustainable and impactful expansion.

Following the Scaling Scan exercise, participants were tasked with organizing themselves into groups based on the specific seed delivery model they had chosen and conceptualizing the various elements of their chosen seed delivery model by creating a graphical representation.

Overview of scaling scan

Participants identified community-led, cooperative-based, or market-access seed delivery models as the *most scalable*. These included a community-based seed system suggested by Mozambique, the Youth and Women Quality Center by Tanzania, and a Cooperative model highlighted by South Sudan. Market access models included common interest groups in Kenya and farmer hub models by SFSA. For these models, the scaling ingredients with the lowest scores were Technology/practice, Knowledge and skills, Evidence and learning, and public sector governance (Table 3).

Table 3. Summary of the Scaling Scan

Team	Seed delivery model	3	4	5	6	7	8	9	10	11	12	Average
Mozambique	Community-based seed system	3.0	4.0	3.7	3.5	3.7	3.0	4.0	4.0	4.0	3.5	3.6
Tanzania	Youth and women's quality centers	3.0	3.0	4.0	4.0	2.7	3.5	2.5	3.0	3.0	3.5	3.2
Kenya	Bundled seed with grain off-taker / processors	1.0	3.0	3.3	3.0	3.0	3.0	4.0	3.7	3.0	3.5	3.1
Kenya	Tricot method with common interest groups & school agricultural activities (clubs)/ field schools	3.3	2.0	3.3	3.0	2.3	2.5	4.0	2.0	4.0	2.0	2.9
South Sudan	Community and cooperative-based model	3.3	3.5	2.7	2.5	3.3	2.0	2.0	1.7	4.0	2.5	2.8
Kenya	Youth and Women Quality Centres	3.0	1.0	2.3	3.0	2.7	3.5	4.0	3.0	3.0	1.0	2.7
SFSA	Farmers hub models	2.3	3.0	1.7	3.0	1.7	3.0	3.0	2.3	4.0	1.0	2.5
Ethiopia	Linking large-scale demonstrations with seed certification schemes to make seeds available for the local and national market	0.7	3.0	3.0	3.5	2.3	0.0	3.5	2.3	4.0	2.0	2.4
Cameroon	Seed fairs	2.5	3.0	1.7	2.5	2.7	3.0	1.0	1.0	3.0	3.5	2.4
Uganda	Pre-Secured Market Option Seed Delivery Model	3.5	1.0	2.3	3.0	3.0	3.0	2.0	1.7	0.0	2.5	2.2
Niger	Community-based seed production	2.0	2.0	2.3	1.5	1.7	3.5	3.5	3.3	0.0	2.0	2.2
Nigeria	Community seed production system	1.5	1.5	1.0	0.0	3.3	3.0	1.5	3.7	3.0	3.0	2.2
Ghana	Out-growers partnered to produce EGS of Groundnut	0.8	0.0	3.0	1.5	3.0	3.0	3.0	3.3	0.0	3.0	2.1
Nigeria	Adopted villages	1.0	1.5	3.3	4.0	1.3	1.5	4.0	1.0	2.0	1.0	2.1
Zambia	Integrated Approach: Linking Seed Growers, NARs Breeding Program, and Seed Companies for Sustainable Grain Production	1.5	3.0	1.0	0.0	4.0	1.5	3.0	3.0	0.0	3.0	2.0
Malawi	Linking NARS seed unit with seed companies	2.2	3.0	1.7	0.5	3.0	1.0	3.0	0.7	3.0	1.0	1.9
Togo	Community-based seed production	1.5	1.5	2.0	1.5	3.0	1.5	1.5	1.0	0.0	1.5	1.5
Chad	traveling weekly market days	0.7	3.0	1.7	0.0	4.0	0.5	1.0	2.0	1.0	0.5	1.4
NML	It is similar to the Smart Nkungire System (SNS) in Rwanda, but it is not based on a subsidy program.	0.5	1.5	2.7	0.0	2.7	0.0	0.0	1.0	4.0	0.0	1.2
Mali	Seed shops within farmers' areas	0.5	0.0	1.0	0.0	1.0	0.0	0.0	2.3	0.0	0.0	0.5
Average		2.5	2.8	2.9	3.1	2.7	2.6	3.1	2.6	3.6	2.5	

Note: Column 3 is technology/practice; Column 4 is awareness and demand; Column 5 is business cases; Column 6 is value chain; Column 7 is finance; Column 8 is knowledge and skills; Column 9 is collaboration; Column 10 is evidence and learning (based on data); Column 11 is leadership and management; Column 12 is public sector governance.

Seed delivery model concepts

a) Adopted villages - Nigeria.

The Adopted Villages model, initiated by the Nigerian Research Council, introduces a systematic approach to seed adoption. It involves the selection of specific villages or schools where the basic seed is provided, monitored, and certified for use within that community. This localized strategy allows close monitoring of the seed's performance and adoption rates within a controlled environment. Once thriving, the model then replicates this success by moving on to the next village or school. This iterative approach is a tested and controlled environment to gauge the adaptability and effectiveness of new seed varieties. However, scaling this model might pose challenges related to resources and replicability across diverse regions within Nigeria.

Collaboration is a critical element of this model, focusing on selecting 200-300 farmers within each village to foster cooperative efforts. The Adopted Villages model, currently operational in Nigeria, follows a systematic approach to seed adoption. Specific villages or schools are chosen, and essential seeds are provided, monitored, and certified for sale. This localized strategy enables close monitoring of seed performance and adoption rates in a controlled environment. Successes in one village are then replicated in the next, creating a tested and controlled environment to assess the adaptability and effectiveness of new seed varieties.

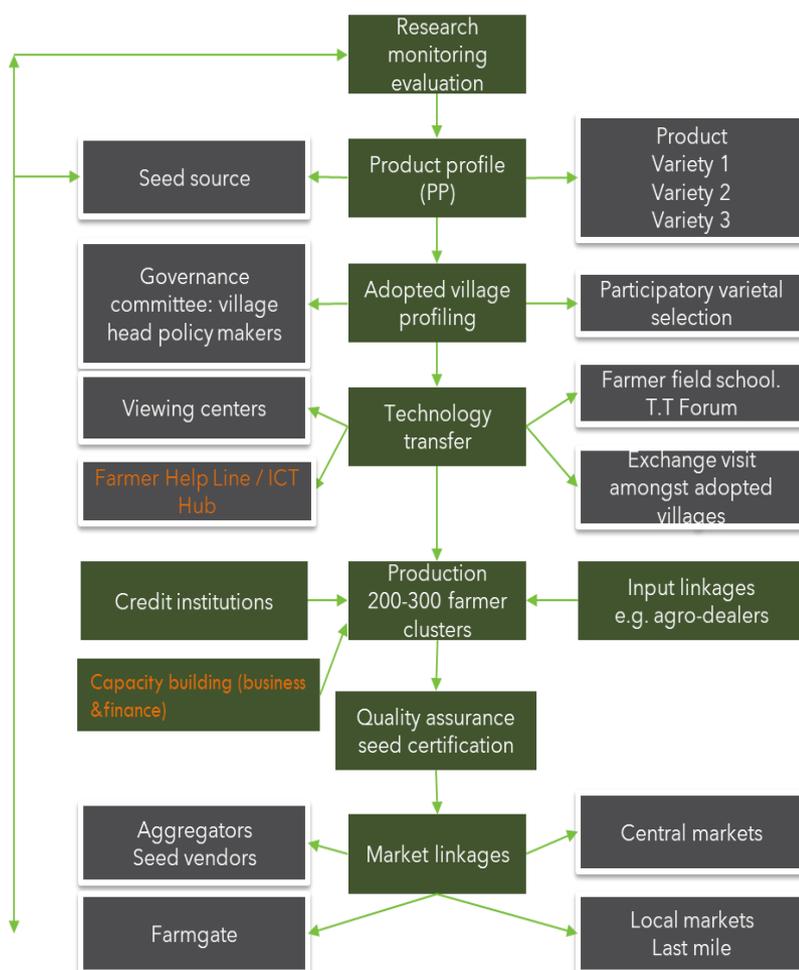


Figure 10. Scalable seed delivery model: Modified Adopted village - a case from Nigeria and Mali
Source: workshop participants

Monitoring and evaluation by the National Agricultural Research System (NARS) are complemented by governance through a committee involving the village head, NARS, and policymakers. Technologically, each village has viewing centers that encourage technology transfer, with farmer field schools operating within these centers. Partners are facilitated to exchange visits with other adopter villages, fostering knowledge exchange.

In terms of production, the model connects adopter villages to input providers and credit institutions like FCMB bank for soft loans, with training facilities provided to enhance skills. The seed production process involves inspection by the National Seed Council, followed by certification. The certified seed is then processed and linked to specific markets. Villages establish their brand name, which is distinct from NARS, and supply remote communities during market days. Sales also occur at farm gates and local markets, emphasizing the importance of harvesting and processing seeds when they are ready.

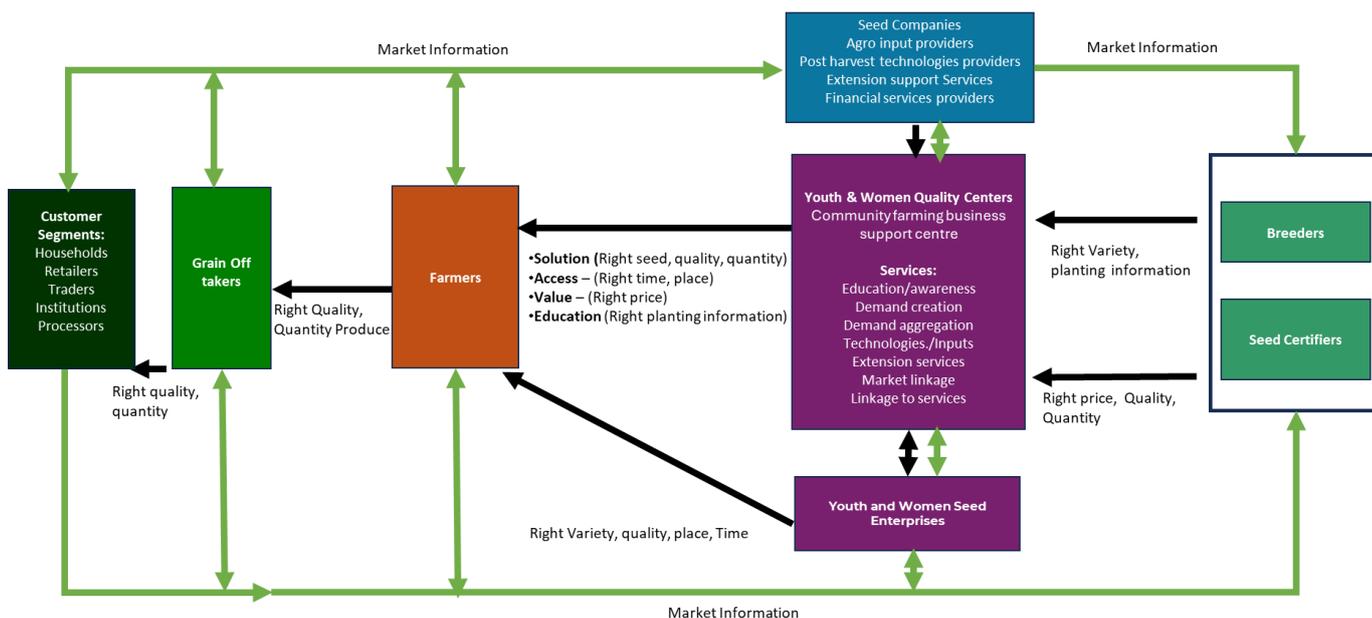
This seed delivery model offers advantages in terms of monitoring, awareness creation, and evidence-based learning. Its scalability is a key feature, allowing for a phased approach—starting with a few adopted villages and expanding to others over 2-3 years. Currently, this model is successfully implemented for SUPER SOSAT, demonstrating positive uptake and impact. This model has now been successfully implanted in a smart agriculture context as well. It was, however, noted that finance knowledge and skills are hindering the scalability of this seed delivery model. They suggest linking communities to affordable credit sources, training, and digitalization of data.

b) Youth and Women Quality Centers- Tanzania, Kenya, conceptualized by the Centre for Behaviour Change and Communication

The Youth and Women Quality Centers (YQWC) is a community-based seed production and delivery model currently in application in Tanzania, where YWQC plays the role of extension, seed producer and seller, grain seller, and, if possible, in the future, agro-input dealers. The model works well since the government provides resource centers (physical structures) for the YWQCs operations, and linkage with NARS provides the startup foundation seed for free. Crucially, the center also plays a pivotal role in the collection of grain, streamlining the process and ensuring a more efficient market linkage for the harvested produce. Beyond being a distribution point, the space serves as a platform for practical demonstrations, enabling farmers to witness and learn about innovative agricultural practices and technologies. This approach not only enhances access to inputs but also fosters knowledge dissemination and adoption of improved agricultural methods, contributing significantly to the overall growth of the farming community.

Given that DLCs are typically regarded as a women's crop and face challenges in accessing the formal seed market, a more effective strategy involves mobilizing women and youth. The current implementation faces challenges in diverse areas, including financial literacy, business skills, effective agronomic practices, seed production management, communication, behavior change, and establishing connections and collaborations between input providers and YWQC. Participants believed that the specific seed delivery model presented a compelling business case, with a significant demand for YWQC development in Tanzania. Participants from Kenya expressed keen interest in the model and engaged in discussions about its potential implementation in Kenya. The YWQC concept is currently undergoing a pilot phase in Kenya, focusing on finger millet. While the context will vary, CBCC aims to apply some of the lessons learned from its implementation in Tanzania.

Figure 11. Scalable seed delivery model: Youth and Women Quality Centers - a case from Tanzania



Source: CBCC

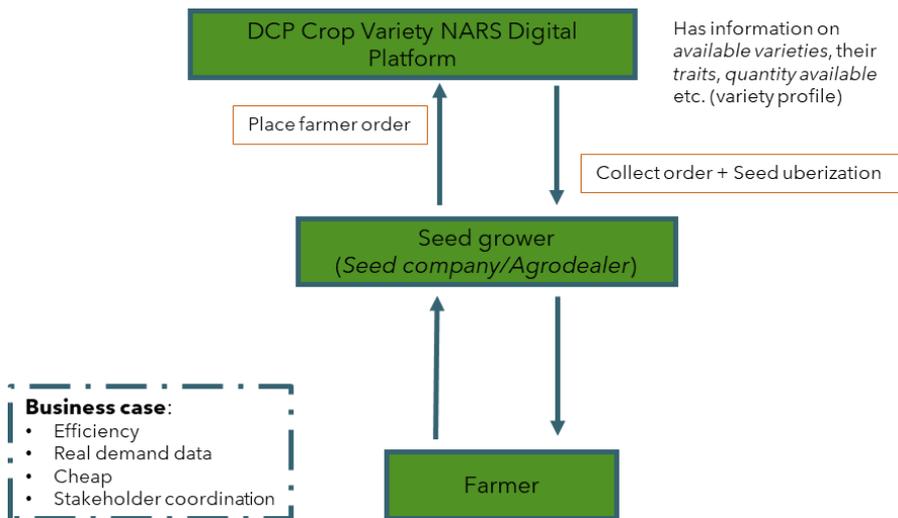
c) Digital Seed Pre-order system- Rwanda

This is an innovative digital platform-based approach to seed tracking and distribution, specifically implemented in a Rwandan context. This model utilizes smart technology and digital platforms to monitor seed producers, track seed quantities, and categorize seed classes. By leveraging digital infrastructure, the model streamlines the ordering process through agro-dealers, ensuring more efficient and precise seed delivery to farmers. Additionally, this approach fosters stakeholder collaboration, as it brings together producers, distributors, and government entities on a unified platform.

Moreover, through the integration of technology and the establishment of a seamless digital interface, this model aims to improve monitoring, coordination, and demand fulfillment within the seed supply chain in Rwanda, potentially serving as a blueprint for similar initiatives in other regions. In Rwanda, this system has demonstrated success, accelerated by subsidies, with farmers adopting it swiftly. Farmers place orders through USSD (Unstructured Supplementary Service Data).

Identified challenges in this model include the initial supply of seeds, ensuring it aligns with demand, providing sufficient information to stakeholders about the business case of this seed delivery model to facilitate adoption, securing access to finance for seed producers beyond their capital, assessing the acceptability of financial risks (such as market and regulatory uncertainty, seed production, and price volatility) for value chain actors and financial institutions/investors involved in this seed delivery model. Additionally, the model's success hinges on whether there is leadership with a formal or informal mandate that is recognized and respected by all stakeholders. Participants suggested a crucial need for access to sustainable financial inputs.

Figure 12. Scalable seed delivery model: Digital Seed Pre-order system - a case from Rwanda

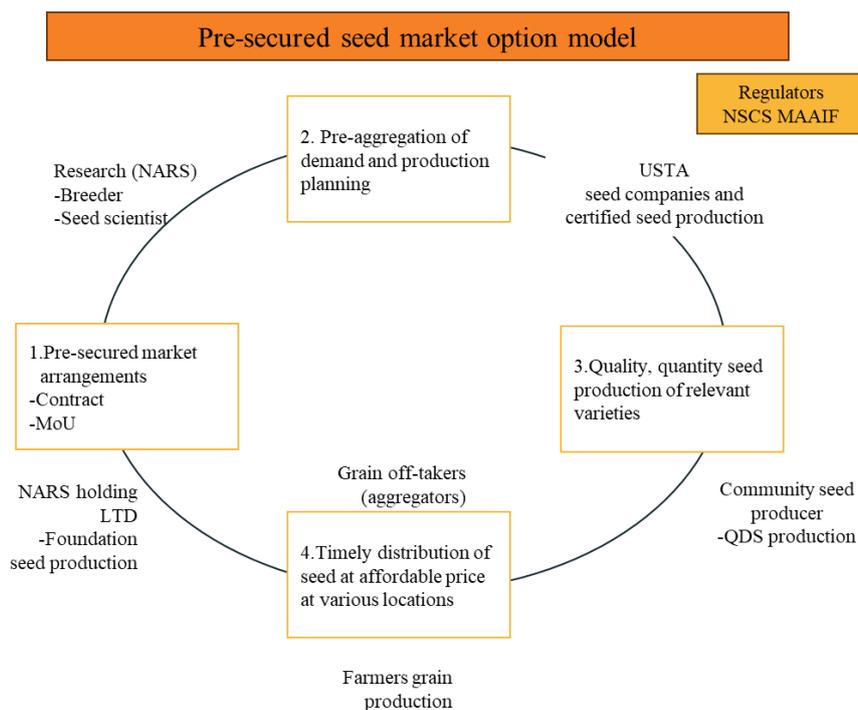


Source: workshop participants

d) Pre-secured seed market option model- Uganda

Similar to the above seed delivery model, Ugandan participants used a pre-secured seed market option model. Uganda's Pre-secured Market Option emphasizes a strategy where off-takers are already familiar with the specific seeds they require. This model involves contract farming for Early Generation Seeds (EGS) and is geared towards targeting existing markets. It aligns production with predetermined market demand, and this approach seeks to ensure a more secure market for the seeds that are produced, reducing uncertainties for both farmers and buyers. However, despite its potential, a significant challenge remains in securing adequate financing for the implementation of this model. Overcoming this obstacle is crucial for the successful execution of the Pre-secured Market Option and realizing its potential in enhancing seed delivery within Uganda's agricultural landscape.

Figure 13. Scalable seed delivery model: Pre-secured seed market option model - a case from Uganda

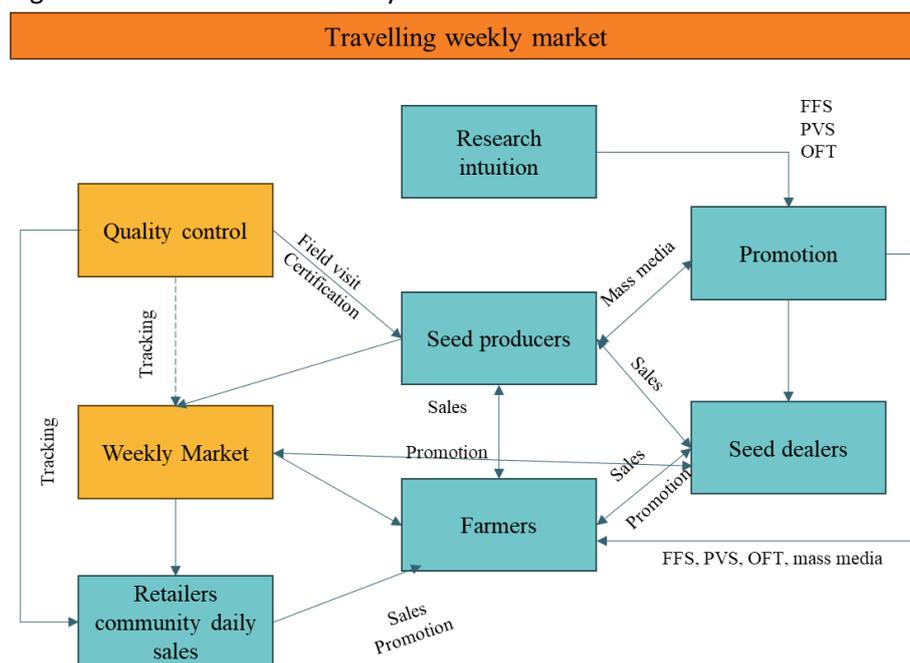


Source: workshop participants

e) *Mobile seed vans - Chad*

In Chad, the mobile seed vans (traveling to Weekly Market Days) model addresses the challenge of reaching remote areas typically underserved by seed companies primarily located in urban centers. This innovative approach focuses on bringing seed access directly to farmers in rural and remote regions. By organizing periodic market events in these areas, the model aims to facilitate the distribution and accessibility of seeds to farmers who might otherwise face significant challenges in acquiring them. This strategy not only tackles the geographical disparity in seed distribution but also recognizes the importance of catering to farmers in these marginalized regions. However, a potential limitation could lie in logistical complexities and the need for sustained efforts to ensure the continued provision of quality seeds to these remote areas.

Figure 14. Scalable seed delivery model: Mobile seed vans



Source: workshop participants

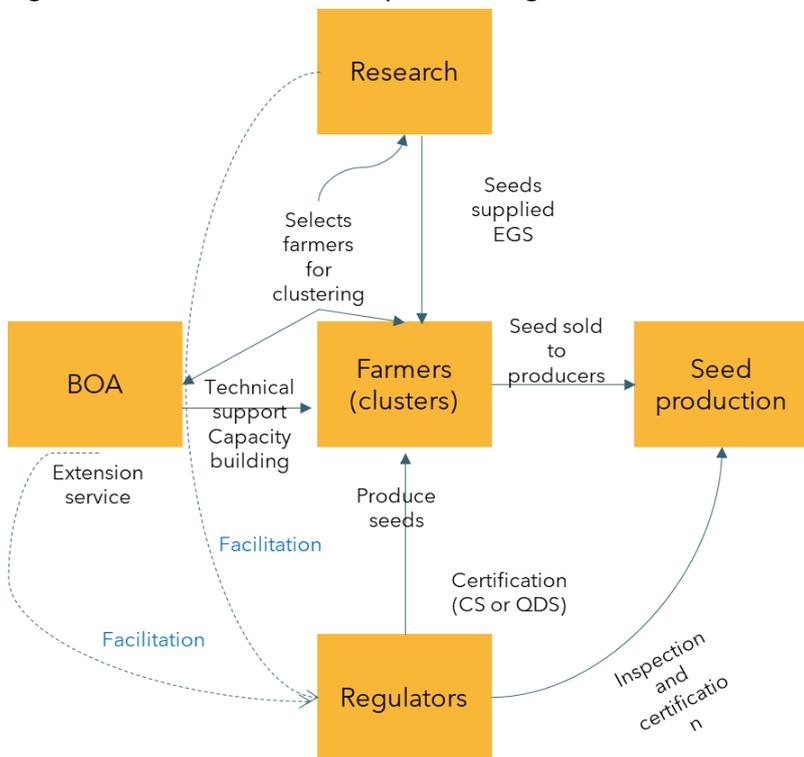
f) *Large Scale Demonstrations- Ethiopia.*

The Large-Scale Demonstrations (LSDs) initiative represents a proactive strategy to introduce shelved varieties to farmers directly. Clustering farmers into groups and providing them with the necessary seed, this approach aims to bridge the gap between available seed varieties and their actual on-farm adoption. Using this model in Ethiopia, LSD fields that are grown with basic seed are linked with the formal seed production system by facilitating field inspection and certification and bringing commercial seed producers on board. Seed producers process the seed from LSDs and market the certified seed. The approach's direct engagement with farmers and provision of seed tailored to their needs stand as robust efforts to encourage the adoption of improved seed varieties at the grassroots level.

The Ethiopian participant emphasized the need for intensive technical support and collaboration with seed certification agencies for the successful implementation of this model. Public financing is considered a crucial requirement for piloting and transforming farmers engaged in Large-scale Demonstration Schemes into

cooperatives. To address these challenges, suggested solutions include the establishment of an Innovation Platform to facilitate and sustain the initiative in terms of leadership and management. Additionally, it is proposed to create a revolving seed fund to ensure adequate financial support for the piloting phase. Further, the clustered farmers can be grouped into a cooperative and can consistently be used as outgrowers for the seeds of new varieties.

Figure 15. Scalable seed delivery model: large scale demonstrations – a case from Ethiopia

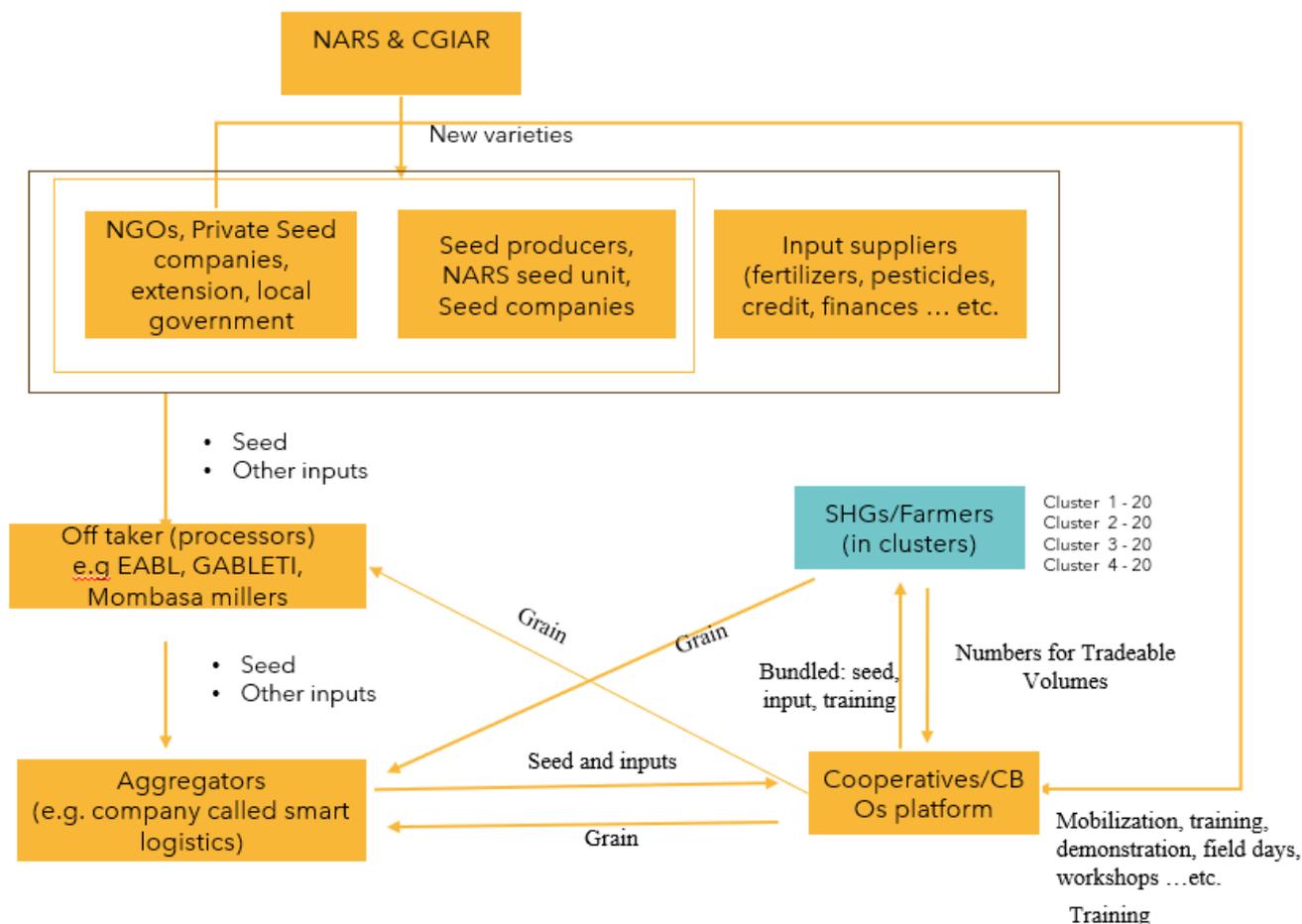


Source: workshop participants

g) Bundled Technologies (Nyota Bean Example)- Kenya

The Bundled Technologies approach in Kenya represents a holistic strategy aimed at catalyzing seed demand by integrating seed supply with complementary farming technologies. This model focuses on combining seeds with other essential agricultural inputs, such as fertilizers, alongside providing comprehensive agricultural information. By bundling these elements together, farmers are not only provided with improved seed varieties but also equipped with the necessary tools and knowledge to optimize their farming practices. This integrated approach seeks to address multiple facets of farming challenges, including soil fertility and crop productivity, ultimately enhancing the overall efficiency and sustainability of agricultural production. The bundling of technologies not only promotes the adoption of improved seeds but also reinforces their effectiveness within the broader agricultural ecosystem.

Figure 16. Scalable seed delivery model: Bundled Technologies – a case from Kenya



Source: workshop participants

Conclusion

This workshop brought together partners across Africa to foster collaboration, analyze varietal inventories, improve data collection, and evaluate innovative seed delivery models to enhance adoption and seed system efficiency. This will be enhanced through sustainable partnerships that address the unique challenges of dryland crop seed systems across diverse regions.

Impact-driven strategies for dryland crop seed systems are vital to improve access to quality seeds of new, improved varieties, addressing low adoption rates caused by inadequate product information and limited access to EGS and commercial seed. In the last 10 years close to 230 varieties of dryland crop cereals and legumes have been released. To improve the availability of these diverse varieties, it's essential to implement inclusive seed delivery models that shorten release-to-commercialization time, enhance seed production, and strengthen grain-seed value chain connections. Tracking seed system performance using metrics like Weighted Average Varietal Age (WAVA) ensures targeted solutions to institutional, technical, and socio-economic challenges in adopting new crop varieties.

Scaling improved dryland crop varieties faces challenges such as misaligned data collection, resource limitations, and weak market understanding, hindering substantial impact. An impact-driven approach is proposed that embodies 5 strategies: collaborative problem-solving, bundled technologies, evidence-supported scaling, subsidiarity, and inclusive seed systems.

A system scan of dryland crop seed systems across 15 countries revealed key challenges in science and technology, seed markets, society and culture, policy, and investment. Participants rated these challenges on a scale of 1 to 5, with science and technology averaging 3.3, seed markets 2.7, society and culture 3.35, policy and governance 3.5, and investment and finance 2.75. The analysis highlighted gaps in research infrastructure, market accessibility, and financing, while also considering the influence of cultural norms and policy support. Collaborative discussions focused on developing practical solutions to address these systemic challenges, aiming to strengthen dryland crop seed systems and enhance accessibility to improved varieties.

The Scaling Scan exercise explored scalable seed delivery models for dryland crops, guiding participants through a structured process of defining scaling ambitions, evaluating key scaling ingredients, and addressing challenges. Models such as community-led, cooperative-based, and market access systems were identified as most scalable, with varying levels of confidence across key ingredients like technology, knowledge, and public sector governance. Examples of delivery models included Nigeria's Adopted Villages, Tanzania's Youth and Women Quality Centers, Uganda's Pre-secured Seed Market, and Chad's Mobile Seed Vans. These models, while promising, face challenges related to finance, skills, and logistics, highlighting the need for collaboration, financial support, and innovative approaches to scale seed delivery systems effectively.

Annexes

Annex 1: Inventory of top varieties grown in 12 countries in ESA and WCA for selected dryland crops

Top Pearl millet varieties under production in Nigeria and their characteristics

Variety name	Year of approval/release	Desired traits (positive traits) in the variety	Unwanted characters (negative characters) in the variety	Desired but missing characteristics in this variety
LCIC-MV3 (Super SOSAT)	2011	High yield, good grain filling, medium panicle	Medium maturity	Earliness
LCIC-MV4 (PEO 5684-Jirani)	2013	Earliness, High yield	Short panicles, slender stems	Medium-Long panicles
LCIC-MV5 (Chakti)	2023	High micronutrient dense (Iron & Zinc), High yield, Earliness, High tolerability	Short panicles, slender stalks	Medium-long panicles, Stout stalks
LCIC-MV6 (ICMP1970115-Yelwa)	2023	Earliness, High yield	Short panicles, slender stalks	Stout stalks

Top Sorghum varieties under production in Ghana and their characteristics

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	Unwanted characters (negative characters) in the variety	Desired but missing characteristics in this variety
Kapaala	1996	High grain yield, very good for local dishes (Tuo zaafi & Koko), good malting and brewing qualities	Compact panicle (head)	Resistance to grain mold and bird damage
Dorado	1996	High grain yield, very good for local dishes (Tuo zaafi and porridge (Koko)), and good malting and brewing qualities.	Compact panicle (head)	Resistance to grain mold and bird damage
AtokpleChi	2022	This is a dual-purpose variety (High grain yield and biomass/ fodder). It is suitable for Tuo-zaafi and porridge (koko).	-	Resistance to grain mold and bird damage
AdSARGHUM 1	2022	High grain yield and good malting and brewing qualities. Also suitable for Tuo-zaafi	-	Resistance to grain mold and bird damage

AdSARGHUM 2	2022	High grain yield and good malting and brewing qualities. It is also suitable for Tuo-Salafi porridge (Koko).	-	Resistance to grain mold and bird damage
AdSARGHUM 3	2022	Early maturing and High grain yield, good malting, and brewing qualities.	-	Resistance to grain mold and bird damage

Top Pigeonpea varieties under production in Mozambique and their characteristics

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	Unwanted characters (negative characters) in the variety	Desired but missing characteristics in this variety
ICEAP 000554	2011	High yield 3 t/ha; Medium duration with large and cream-coloured seeds for both green and dry grain market	Susceptible to pod borer	Tolerance to pod borer
ICEAP000557	2011	Yield 3ton/ha; Medium duration, cream-colored grain for both green and dry grain market; tolerance to <i>Fusarium</i> wilt	Susceptible to pod borer	Tolerance to pod borer
ICEAP 00020	2011	Yield 2ton/ha.	Susceptible to pod borer and termites, long-duration	Tolerance to pod borer
ICEAP 00040	2011	Yield 2ton/ha.	Susceptible to pod borer and termites, long-duration	Tolerance to pod borer

Top Groundnut varieties under production in Mali and their characteristics

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	Unwanted characters (negative characters) in the variety	Desired but missing characteristics in this variety
Nafatiama tiga (ICIAR 19 BT)	2015	Early, rosette tolerance, high pod, and haulm yields	Small pods and not easy to shell.	Drought tolerance
Wassaba tiga	2018	High pods and haulm yields, large-seeded; tolerance to drought	No dormancy	ELS tolerance
Sago tiga	2018	Large seeded, high pod and haulm yields, stay green		ELS tolerance
Faso dèmè tiga	2022	High oil content, large-seeded, dual-purpose		Rosette tolerance

Benkadi tiga	2018	Large seeded, high yields, stay green	pod and haulm	ELS tolerance
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Top Sorghum varieties under production in Tanzania and their characteristics

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	Unwanted characters (negative characters) in the variety	Desired but missing characteristics in this variety
Macia	1999	High yield, early maturing, short, suitable for brewing and food	Susceptible to striga infestation and bird attack	Striga tolerance/resistance
Tegemeo	1983	High-yielding, early maturing, suitable for brewing and food	Susceptible to striga infestation and bird attack	Striga tolerance/resistance
Wahi	2002	Early maturing, large-seeded, suitable for brewing and food	Striga tolerance, Low yielding	High yielding
TARISOR 1	2021	High yielding, resistance to Striga, early maturing, suitable for brewing and food	Tall and low digestibility	plant height (short) and palatability
TARISOR 2	2021	High yielding, resistance to Striga, early maturing, suitable for brewing and food	High number of tillers	palatability

Top Sorghum varieties under production in South Sudan and their characteristics

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	Unwanted characters (negative characters) in the variety	Desired but missing characteristics in this variety
Seso 3	2018	High yield and tolerant to drought	undesirable red color	Lighter color
Macia	2012	Large head size, high yield, good eating quality.	susceptible to birds' attack and waterlogging	Tolerance to heat stress,
AGRAC116	2016	Large seed and high yielding, palatability	high rate of rotting in rainfall areas	Tolerance to high rainfall
AGRAC 216	2016	high yield, palatability	-	Palatability
Yeipa 1	2019	Large seed size and desirable color, high yield	Does not perform well in heavy/clay soils	

Top pigeon pea varieties under production in Kenya and their characteristics

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	Unwanted characters (negative characters) in the variety	Desired but missing characteristics in this variety
KARI Mbaazi 2	1995	Large pods and grain size, high yield,	Late maturing-one harvest per year	Shorten duration
KAT 60/8	1998	High yield, medium duration, hence two harvests/year	Small grain and pod size, susceptible to pests	Large pod and grain size
KARI Mbaazi 1	1998	Early maturing (3 months)	Small grain and pod size, susceptible to pests	Large pod and grain size
Mituki	2018	Medium duration, large pod, and grain size		
Peacock	2011	Medium duration	low grain yield	Large pod and grain size
ICEAP 00936/Karai	2011	Large pod and grain size	Late maturing-one harvest per year	Maturity duration
Egerton Mbaazi 1	2012	Medium duration	Medium grain and pod size	Large pod and grain size
Egerton Mbaazi 3	2019	Medium duration	Medium grain and pod size	Large pod and grain size
Egerton Mbaazi 4	2019	Medium duration	Medium grain and pod size	Large pod and grain size

Top groundnut varieties under production in Malawi and their characteristics

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	Unwanted characters (negative characters) in the variety	Desired but missing characteristics in this variety
CG 9	2014	Rosette resistance, high yield	seed color changes	Flavor, high oleic content, high iron and zinc
CG 11	2014	Rosette resistance, high yield	-	Flavor, high oleic content, high iron and zinc
CG 13	2014	Drought tolerance, high yield, early maturing	Seed size is not uniform	Flavor, high oleic content, high iron and zinc
CG 14	2014	Drought tolerance, high yield, early maturing	-	Flavor, high oleic content, high iron and zinc
CG 15	2020	Drought tolerance, high yield, early maturing	-	Flavor, high oleic content, high iron and zinc

Top sorghum varieties under production in Uganda and their characteristics

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	<u>Unwanted</u> characters (negative characters) in the variety	Desired but missing characteristics in this variety
SESO 1	2011	Tolerant to drought, good malting qualities, Early maturity	Susceptible to bird damage	Bird damage avoidance
SESO 3	2011	Drought tolerant, Low tannin suitable for bread/food, Early maturing	Susceptible to sorghum midge, smut	Resistance to smuts
NAROSORG 1	2017	Medium maturity, excellent for brewing	Susceptible to bird damage	Bird damage avoidance
NAROSORG 2	2017	Excellent for brewing, Less smut contamination, least affected by birds, high threshing %	Susceptible to sorghum midge, shoot fly damage	Tolerance to Sorghum midge damage
NAROSORG 4	2017	Suitable for food, least affected by birds	Some degree of smut contamination	Tolerance to smuts

Top pearl millet varieties grown in Niger and their characteristics.

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	<u>Unwanted</u> characters (negative characters) in the variety	Desired but missing characteristics in this variety
HKP	1980	Resistance to mildew and ergot	Susceptible to charcoal, downy mildew, and head ear miner, late maturing	Earliness, resistance to charcoal, downy mildew, and head ear miner
SASAT-C88	2010	Resistant to ergot, tolerant to lodging and drought.	Susceptible to stem borer and striga	Tolerance to stem borer and resistance to striga
Chakti	2016	Good grain filling, compactness, earliness, rich in Fe and Zn	The head is very short	Long head

Top sorghum varieties grown in Chad and their characteristics.

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	Unwanted characters (negative characters) in the variety	Desired but missing characteristics in this variety
IRAT 204	1980	Medium cycle. Resistant to grain mold and drought tolerant, good forage quality.	Striga, Susceptible to elongated smut, midge, bugs, and sooty blotch	Resistance to diseases and insects
S-35	1986	Short cycle, drought tolerant. Fairly good insect resistance. Good forage quality	Average sensitivity to elongated charcoal and less sensitivity to covered charcoal	Resistance to diseases

Zouaye	2004	Medium cycle. Moderately tolerant to drought and good tolerance to Striga.	Undesirable grain color (for some parts of the country)	White grains
Kolmon rouge	1993	Tolerant to grain mold, hardy, and resistant to charcoal.	Late maturity, sensitive to Striga and flooding, grain color (for some parts of the country)	Early maturity, White grains Resistance/tolerance to striga and flooding
K3R	1995	Coal resistance and grain mold tolerance	Late maturity, sensitive to Striga and flooding	Early maturity, White grains Resistance/tolerance to striga and flooding

Top groundnut varieties grown in Togo and their characteristics.

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	<u>Unwanted</u> characters (negative characters) in the variety	Desired but missing characteristics in this variety
ICIAR	2013	Earliness & yield	LLS susceptible, small seed size	LLS resistance and large seed size
SH470P SH	2021	Earliness & yield	LLS susceptible, small seed size	LLS resistance and large seed size
AMI-ZI	2022	Oil production & LLS tolerance	–	Earliness
RAFEET	2021	Oil production & yield	Drought susceptible	Drought Tolerance
Iciar	2021	Oil production & yield	Small seed size	Earliness and large seed size

Top sorghum varieties grown in Cameroon and their characteristics.

Variety name	Year of approval /release	Desired traits (positive traits) in the variety	<u>Unwanted</u> characters (negative characters) in the variety	Desired but missing characteristics in this variety
CS-54	1992	Tolerant to <i>Striga hermonthica</i> , to drought and lodging. Maturity: 90-95 days	Susceptible to grain mold and bird damage	Resistance to bird damage
S-35	1965	Tolerant to <i>Striga hermonthica</i> , to drought and lodging. Maturity: 90-95 days, good malting quality	Susceptible to grain mold and bird damage	Resistance to bird damage
Zouaye	2004	Tolerant to <i>Striga hermonthica</i> , to drought and lodging. Maturity: 90 days, Good for local beer	Susceptible to foliar diseases, The red color of the grains	Resistance to foliar diseases

Damougari	1998	It tolerates <i>Striga hermonthica</i> , drought, lodging, and grain mold. It matures in 95-100 days and does well with residual moisture and the white color of grains.	Susceptible to foliar diseases (anthracnose)	Resistance to foliar diseases
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Annex 2: List of participants

Entry	Region	Country	Name	Institution	Crop (s)
1	ESA	Ethiopia	Karta Kaske	EIAR	Chickpea, Finger millet, Sorghum
2	ESA	Kenya	David R. Karanja	KALRO	All crops
3	ESA	Kenya	Arnold Njaimwe	KALRO	All crops
4	ESA	Kenya	Benard Masila	KALRO	All crops
5	ESA	Kenya	Teresa Otin	KALRO	All crops
6	ESA	Malawi	Esnart Yohane	DARS	Pigeonpea
7	ESA	Mozambique	Faife Divage	IIAM	Pigeonpea
8	ESA	South Sudan	Innocent Kitara	MAFS	Sorghum
9	ESA	Tanzania	Alex Gerald	TARI	Groundnut
10	ESA	Tanzania	Eliud Kongola	TARI	sorghum, finger millet, pearl millet
11	ESA	Uganda	Paul Anguria	NARO	All-country SS focal person
12	ESA	Uganda	Hellen Opie	NARO	All crops
13	ESA	Zambia	Lloyd Mbulwe	ZARI	Sorghum, finger millet, pearl millet
16	WCA	Cameroon	Hortense épse Tontsa	IRAD	Sorghum
17	WCA	Chad	Mahamat Alhabib	ITRAD	Millet
18	WCA	Mali	Ibrahima Zan Doumbia	IER	Millet
19	WCA	Mali	Dramane Sako	IER	Groundnut
20	WCA	Niger	Abdou Bio Yérima	INRAN	Millet, Sorghum, Groundnut
21	WCA	Nigeria	Zakari Turaki	Lake Chad Research Institute	Millet
22	WCA	Nigeria	Mohammad Ahmad Yahaya	Ahmadu Bello University, Zaria	Sorghum
25	WCA	Togo	Koudjoukabalo Adjelem Palanga	ITRA	Millet, Sorghum
26	All	Netherlands	Nathalie Vignaux	SFSA	Multi-crop
27	ESA	Kenya	Catherine Lengewa	CBCC	Multi-crop
28	ESA	Kenya	Noel Templer	CIMMYT	Multi-crop
29	ESA	Kenya	Lilian Gichuru	CIMMYT	Multi-crop
30	WCA	Senegal	Doris Puozaa	CIMMYT	Multi-crop
31	ESA	Kenya	Marion Aluoch	CIMMYT	Multi-crop
32	ESA	Kenya	Geoffrey Muricho	CIMMYT	Multi-crop
33	ESA	Kenya	Chris Ojiewo	CIMMYT	Multi-crop

34	ESA	Kenya	Risper Gekanana	CIMMYT	Multi-crop
35	WCA	Ghana	Abdul Rashid Issah	CSIR-SARI	Groundnut
36	WCA	Ghana	Peter Anabire Asungre	CSIR-SARI	Millet
37	All	Uganda	Adron Naggayi Nalinya	NML	Multi-crop
38	ESA	Tanzania	Florian Ndyamukama	CBCC	Multi-crop
39	ESA	Kenya	Rachael Kisilu	KALRO	Sorghum and pearl millet
40	ESA	Kenya	Rael Karimi	KALRO	Legumes
41	ESA	Kenya	Chrispus Oduori	KALRO	Finger millets
42	ESA	Kenya	Paswel Marenya	CIMMYT	Multi-crop
43	ESA	Kenya	Davaatseren Narmandakh	CIMMYT	Multi-crop
44	ESA	Kenya	Leonard Kirui	CIMMYT	Multi-crop
45	ESA	Zambia	Jonathan Odhong	CIMMYT	Multi-crop
46	ESA	Ethiopia	Makda Wondwossen	CIMMYT	Multi-crop
47	ESA	Kenya	Pauline Muindi	CIMMYT	Multi-crop
48	ESA	Kenya	Pieter RUTSAERT	CIMMYT	Multi-crop
49	ESA	Kenya	Mercy Mbugua	CIMMYT	Multi-crop