Seed Systems Assessment Tool (SeedSAT)

Country Assessment Results – Ethiopia

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Acronyms and Abbreviations

A2Si	Access to Seed Index
AGRA	Alliance for Green Revolution
AOSS	agricultural one-stop shop
ATA	Agricultural Transformation Agency
BMGF	Bill & Melinda Gates Foundation
BPAT	Breeding Program Assessment Tool
COMESA	Common Market for Eastern and Southern Africa
CRM	customer relationship management
CSP&D	commercial seed production and distribution
DSM	Direct Seed Marketer
DUS	distinctness, uniformity, and stability
EABC	Ethiopian Agricultural Businesses Corporation
EBA	Enabling the Business of Agriculture
EGS	early generation seed
EIAR	Ethiopian Institute of Agricultural Research
EiB	Excellence in Breeding
ESA	Ethiopian Seed Association
FCU	farmer cooperative union
FGD	focus group discussions
GDP	gross domestic product
GPS	global positioning system
GTP	Growth and Transformation Program
ha	hectare
ICT	information and communications technology
IFPRI	International Food Policy Research Institute
IPPC	International Plant Protection Convention
ISSD	The Integrated Seed Sector Development Programme
ISTA	International Seed Testing Association
IT	information technology
kg	kilograms
MERCI	Modernizing Ethiopian Research on Crop Improvement

MIRA	Micro Reform for African Agribusiness
MOA	Ministry of Agriculture
MOU	memorandum of understanding
MT	metric tons
NARS	national agricultural research systems
NPC	national planning and coordination
NPT	national performance trial
NSA	National Seed Authority
NSAG	National Seed Advisory Group
NVRC	National Variety Release Committee
OECD	Organisation for Economic Co-operation and Development
OSE	Oromia Seed Enterprise
PBR	plant breeders' rights
PC	plot component
PLR	policy, legal, and regulatory
PVP	plant variety protection
QA	quality assurance
QC	quality control
R&D	research and development
RBOA	Regional Bureau of Agriculture
SeedSAT	Seed Systems Assessment Tool
SMS	short message service
SNNPR	Southern Nations, Nationalities, and Peoples' Region
SPS	sanitary and phytosanitary
TASAI	The African Seed Access Index
UQ	University of Queensland
VCU	value for cultivation and use

Executive Summary

The Seed Systems Assessment Tool (SeedSAT) is a new assessment tool under **beta development** envisioned by the Bill & Melinda Gates Foundation (BMGF) to collaboratively undertake in-depth country seed system analysis with governments and other stakeholders leading to **investments that increase the delivery and use of improved varieties of seed.** SeedSAT is intended to **build on, not duplicate,** the foundational knowledge, experience, and work in a particular country. Adding to that is the great body of work that is conducted by existing assessments, such as The African Seed Access Index (TASAI), World Bank's Enabling the Business of Agriculture (EBA), Breeding Program Assessment Tool (BPAT), and Access to Seed Index (A2Si), among others. Combined, this work outlines innovative pathways for seed system transformation and maturation.

The assessment is broken down into six thematic areas representing the interconnected stages of a seed system: 1) policy, legal, and regulatory (PLR) framework; 2) national seed quality assurance (QA); 3) national planning and coordination (NPC); 4) national agricultural research systems (NARS); 5) early generation seed (EGS) production and distribution; and 6) commercial seed production and distribution (CSP&D). The tool design and beta assessment were conducted by international and host-country subject matter experts relevant to each thematic area. The beta methodology was created in unison among thematic area experts, so that results of the assessment for the area are guided by a vision, strategic objective, and indicator questions, and results in a set of bottlenecks and recommended interventions; however, the way each thematic area adapted the indicators and questions and the method for gathering the evidence was unique. The beta version of the tool was tested in Ethiopia from 2019 to 2021 using four focus crops: **maize, sorghum, wheat, and tef**.

Assessment findings. Ethiopia has embarked on an intensive, agriculture-led structural adjustment since 1993 with major gains in improving production, food security, and the contribution of agriculture to the gross domestic product (GDP). These gains have come from intensification efforts made during the Growth and Transformation Program (GTP) I and II as smallholders and commercial farmers expanded to nearly their practical limits after peaking in 2012, with the annual increase in cultivated land area slowing by 2017 as farms pushed into marginal areas.[1] Major investments in the agricultural sector have included design and implementation efforts led by the Agricultural Transformation Agency (ATA) and the Ministry of Agriculture (MOA) with national, development partners, and private sector funding. However, the benefits from these activities still fall short of their objectives. Overall gains in yields still fall below GTP targets for staple food crops[2] that were set to generate benefits with revenue that would sustain and broaden the supply, effective use, and impact of productivity-enhancing inputs. At a very high level, farmers are not accessing new, market-driven varieties of seed (with the exception of hybrid maize) and there is not equitable competition in the system.

Ethiopia and its partners have made substantial investments in crop research and development (R&D) to produce new varieties; built and restructured national and regional parastatal seed companies and seed-producing cooperatives; adapted programs to address the needs of the country's formal, intermediate, and informal seed system components; and have done extensive experimentation in restructuring channels to aggregate formal seed sector ordering and distribution. However, the weight of public sector ownership and interests in most of the seed value chain for most crops, the difficulty in prioritizing and sustaining operations and maintenance funding in public institutions, decentralized regulatory policies and structures that are fraying, and a declining ability to supply the contracted quantity and quality of EGS threatens the seed system and reduces the impact of investments. As the need for quality seed of improved crop

[1] FAO. 2020. Ten years of the Ethiopian ATA. An FAO evaluation of the Agency's impact on agricultural growth and poverty reduction. Rome. https://doi.org/10.4060/cb2422e.

[2] FGRE/The Federal Democratic Republic of Ethiopia. 2018. GTP II Midterm Review Report. Addis Ababa, National Planning Commission.

varieties grows, and as the competition for public resources increases, these pressures will increase, along with the long-standing issues of the quality and timeliness of certified seed sold to farmers.

This assessment found the following drivers of change to be important to resolving bottlenecks in the public sector and finding a pathway to rebalance public and private investment in the seed system:

- An imbalance between public and private sector investment.
- A need for improvement of the business enabling environment, including dealing with issues in growing regionalism, insufficient public funding, and incomplete and inadequate PLR reforms.
- A need for improvement of the national QA program as a priority, followed by improvements in NARS programs and the need to incentivize and catalyze investment and make system planning and coordination changes in the EGS and CSP&D systems.
- A need to improve coordination that permeates all system components.

Conclusion. The seed system needs a more liberal market economy if Ethiopia is going to obtain greater returns from its successful investment in the food crop transformation effort. Ethiopia has succeeded in achieving remarkable results with a public sector approach, but there is some erosion of capacity and resilience in key regulatory institutions like QA, research institutions that are underfunded and have difficulty responding to demand for EGS in ways that appear to have knock-on effects throughout the seed value chain. These capacities can be restored with greater public funding and more coordinated effort among stakeholders, and if there is additional effort put into identifying and prioritizing investments that focus on delivering greater access and choice of quality seeds of improved crop varieties.

There is already substantial experimentation done by the ATA in partnership with the MOA that has shown strong returns. This assessment suggests that it is also time to experiment further with changes in incentives and the competitive landscape for national public enterprises and cooperatives. Cooperatives are on the path to professionalization of management. Public seed companies are gradually experimenting with more market-like practices, but are still dominated by supply side management. Policy and regulatory changes could help to further incent public companies to operate more on a private sector basis, but the challenge is how to get there since they are so large and can control market access, flows, and prices. Ethiopia has shown that they can restructure to provide operating space for new export-oriented private investment, for example, the rapid expansion of greenhouse flower production that became the country's largest horticultural export, or the fast transformation with foreign investment in textiles and clothing. Ensuring that national seed supply is treated as a strategic commodity is key to the food security and income agenda. Currently, there is not the political will to radically restructure public seed companies and cooperatives, but the recommendations from this assessment can be used to improve their efficiency and effectiveness.

Introduction

SeedSAT evolves from an initiative by BMGF to improve its engagement with government institutions that can either enable or constrict seed sector growth and maturation to scale the availability of quality seed of improved crop varieties to smallholder farmers. In 2019, an internal review of independent seed sector assessments and score cards, along with consultations with development partners and seed sector specialists, concluded that while certain gaps and deficiencies can be identified through independent assessments, and scorecards conducted by third parties help compare agricultural systems progress over time, key public institutions are often ill-equipped to translate scorecard recommendations into actionable implementation plans. The experience of BPAT,[3] which works with research institutions to collaboratively self-assess, and develop reform breeding programs, led to the concept to develop a similar methodology to do a collaborative deep assessment of the current seed system state, and potentially to improve the effectiveness of public institutions and their ability to catalyze improvements in seed sector performance. SeedSAT is intended to integrate this deep-level knowledge among the relevant BMGF and Alliance for Green Revolution (AGRA) teams, to better advocate with governments to improve their own performance, and to inform the development of future seed system investments to help them do so.

The effort included the design of the assessment tools and collaborative work with the AGRA headquarters and country teams in Ethiopia and Nigeria to test and refine the beta version of SeedSAT by performing the systems assessments. This "learning by doing" was intended to refine the tool, standardize the survey and in-country engagement models, and develop a digitized toolkit that could be used to conduct assessments across the remaining AGRA/BMGF countries.

Ethiopia was selected because of its large population of small farmers, and the distinction of having a seed system dominated by the public sector, intensively investing in agricultural transformation, including major efforts to restructure portions of its seed system. Ethiopia was also on the verge of passing its new Seed Policy in 2020 and advancing its Draft Seed Proclamation, which would open the country to a greater private sector role in the development, supply, and distribution of quality seed of improved varieties.

SeedSAT Beta Version

SeedSAT is a new assessment tool under **beta development** to collaboratively undertake in-depth country seed system analysis with governments and other stakeholders leading to **investments that increase the delivery and use of improved varieties of seed.** SeedSAT is intended to **build on, not duplicate,** the foundational knowledge, experience, and work in a particular country. Adding to that is the great body of work that is conducted by existing assessments, such as TASAI, World Bank's EBA, BPAT, and A2Si, among others. Combined, this work outlines innovative pathways for seed system transformation and maturation.

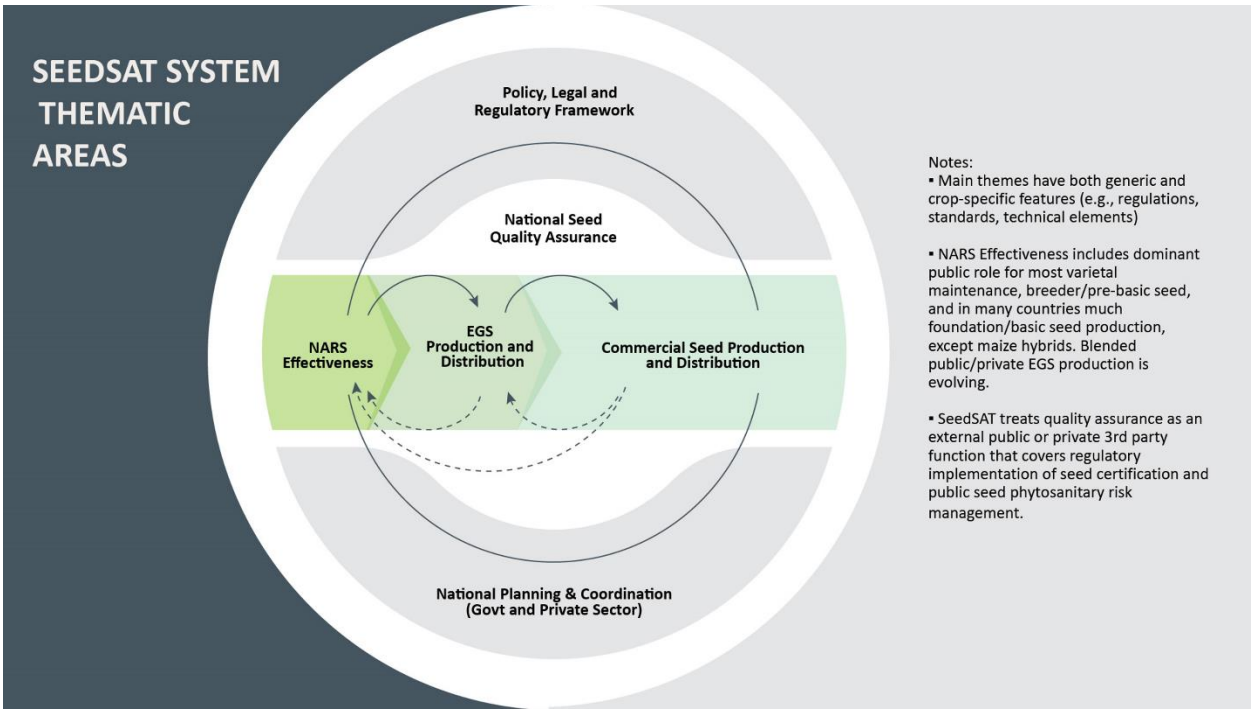
SeedSAT focuses on six "thematic areas" that make up the seed system:

1. PLR framework.
2. National seed QA.
3. NPC.
4. NARS.
5. EGS production and distribution.
6. CSP&D.

Figure 1 displays a simplistic relational view of these thematic areas within the system.

[3] See https://plantbreedingassessment.org.

Figure 1: SeedSAT Thematic Areas



What SeedSAT IS. SeedSAT incorporates a **system lens,** meaning it does not just assess one particular issue or event on its own, but it assesses those events and issues holistically as they relate to the overall structures, patterns, and relationships within the seed system and how those interactions affect the overall performance of the system. It leverages and aggregates existing information and utilizes **experts** who guide the process. SeedSAT relies heavily on **collaboration** with country-level stakeholders and is therefore a qualitative and interactive process with those stakeholders. It **triangulates** information from all types of stakeholders, both public and private, to ensure that we are getting a clear view of all perspectives. SeedSAT considers each country's **unique seed system maturity stage** and is therefore meant to be **flexible** to **adapt** to the specific context of each country. The basis of comparison for SeedSAT is the vision of a healthy seed system, but within the context of each country's unique development stage and stated goals. SeedSAT is both a **guide** for how to conduct a seed systems assessment and a toolkit of templates, which includes some **digitized elements** to facilitate efficient information gathering, analysis, and making conclusions about the relative health of the seed system. The final output of SeedSAT, which adds value, is that it collaboratively identifies and facilitates agreement on the root causes of issues presented, to subsequently inform the design of proposed interventions and investments, and to **prioritize** and add high-level **cost estimates** to those proposed interventions that can be used by public, private, and donor investors in the seed system.

What SeedSAT IS NOT. SeedSAT is not a standardized, turnkey, fully digitized tool, because it does not automatically generate results once information is gathered and entered. Rather, it requires rigorous expertise to customize the elements of the tool that are then used to evaluate results and make recommendations that are unique to each country context. Because the assessment is unique to each country, the results are not comparable to other countries and the tool is not intended to provide a ranking. While there may be scores generated for specific objectives under each thematic area, there will not be an overall dashboard of aggregated scores. And, finally, the results of the assessments are not public. Reports and findings are considered proprietary to host-country institutions, AGRA, BMGF, and select respondents (such as for EGS and commercial entities).

Beta version and country testing. This handover report describes the **beta (or exploratory)** version of SeedSAT, which was developed between **November 2019 and March 2021.** After an initial landscaping and design period, the beta version of the tool was developed and modified through a staged process in close collaboration with representatives from two countries based on their advanced work in seed systems improvements to date: **Ethiopia and Nigeria.** Throughout the beta time period, the SeedSAT team gathered information for the assessment and also on assessment design, taking into account feedback from country representatives on the assessment process and format. Elements of the beta tool were digitized, tested, and adapted throughout the beta period. However, the assessment is intended to be as interactive with representatives as possible, with only a few pre-established surveys and document requests digitized. Final reports and assessments will be available online based on secured, granted access. Finally, the beta version is intended to inform future versions of the tool that will include improvements based on feedback from AGRA, BMGF, host-country stakeholders, and thematic area exports throughout the process. It is intended that future versions will be rolled out to additional countries in Africa where AGRA has a presence.

SeedSAT beta team. The SeedSAT beta version was guided by a consortium of expert partners:

- DAI—NPC, project management, and technical guidance.
- New Markets Lab for Policy—PLR framework.
- Agri Experience—national seed QA.
- Dr. Yilma Kebede—NARS.
- Context Global Development—EGS and CSP&D.
- AGRA—co-designer, tester, and primary conduit within each beta country.
- BMGF—provider of funding and overall technical guidance.

Vision of a health seed system. The overall vision of a healthy seed system is one in which farmers grow modern varieties of crops that have product profiles that are responsive to market and consumer demands that are also adapted to their environments to ensure resilient and high yields. It is also a system that includes:

- A regular supply of domestically bred and imported crop varieties at a pace that matches market demand and that gives farmers choices.
- Healthy competition among public and private producers at the various stages of seed production to supply the market that are accountable for quality standards.
- An appropriate blend of public and private engagement AND investment to ensure that early stage and food security crops that are not yet profitable are not neglected.
- Seed subsidies (if used) are used carefully to temporarily bridge new market development and market failures for short periods of time.

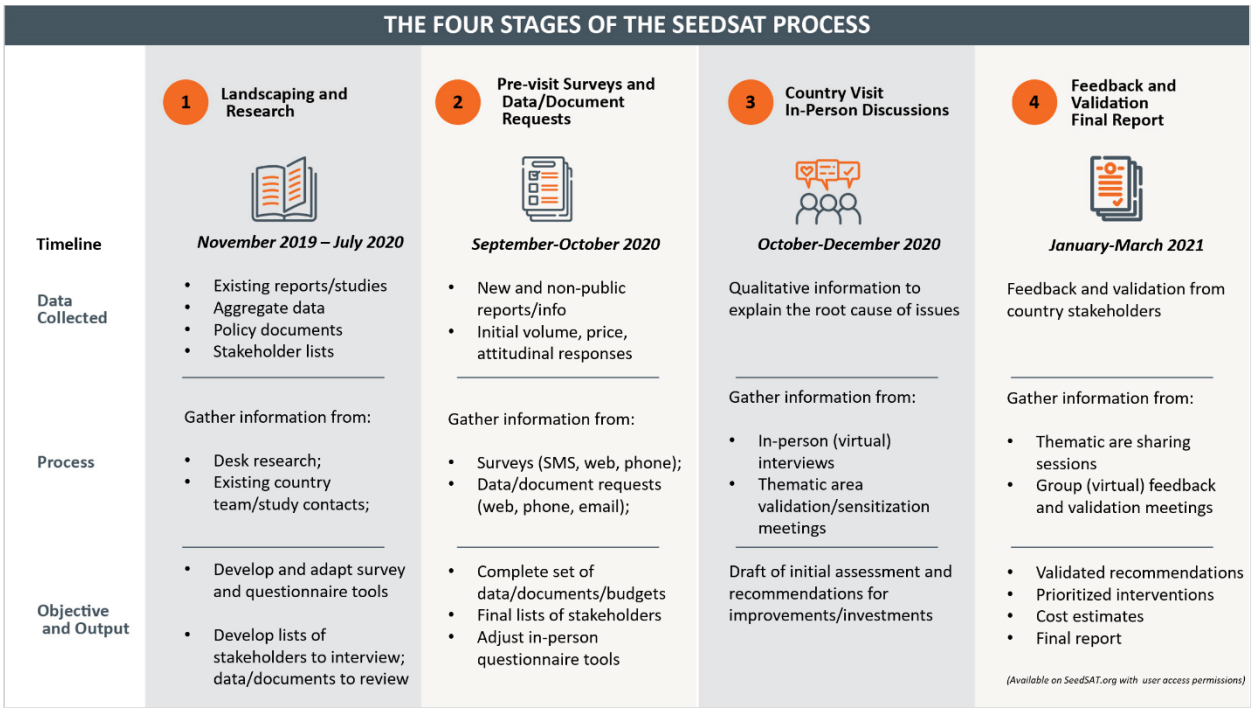
Each thematic area has developed a vision that incorporates elements that are necessary to obtain the overall vision (highlighted in the Assessment Results section below).

Focus crop selection. For beta testing, the experts chose four focus crops—**maize, sorghum, wheat, and tef.** These cereal crops are identified as strategic in Ethiopia's GTP and align with the SeedSAT intent to assess crops that are grown by many smallholder farmers.

Stages of assessment. The assessment was conducted over four stages (see Figure 2). The beta version included additional time to design the process and toolkit of templates, which included some digitized elements; however, there were significant delays due to travel limitations and restrictions on in-person meetings during the COVID-19 pandemic (March 2020–February 2021). Most of the surveys, interviews, and meetings were conducted virtually with expert teams located in various time zones in the USA and Africa, which limited the times of day that these activities could occur. Additionally, there was political

and social unrest in Ethiopia that resulted in restricted access to the internet for participants and restricted travel and access to lab facilities, which further delayed assessment activities.

Figure 2: SeedSAT Four Stages



Scoring. SeedSAT, by design, is not intended to develop aggregated scores by strategic area or for a particular country or selection of crops. The use of aggregate scores at those levels may overly simplify and average unique positive and negative results within a given thematic area, and opportunities and constraints might therefore be missed or neglected. The TASAI and EBA indices provide aggregated scores, while SeedSAT provides the "deep dive" to discover the root causes behind those scores. Experts did, however, use scoring represented by varying Likert scales (-2 to 2; 0 to 3; or 1 to 4) to help the assessor determine the overall health of an objective or indicator question, but these scores are not intended to be aggregated. Regarding the varying scales used, in some cases this was due to the expert's determination of the best way to rate the performance given the distinct and nuanced aspects of that area; while in other cases, the experts were adapting to analysis and scoring that had already been done, such as for the ratings and rankings presented for CSP&D. For PLR, there are only scores for a small subset of indicator questions and for EGS and CSP&D there are no overall scores and only colors on some areas, such as the overall capacity of the seed production and distribution system. While the scores in each thematic are not meant to be aggregated, the reader should instead attribute the associated colors with the assessed health of the system in the following ways:

- **Red:** very insufficient, unsatisfactory, non-compliant, non-existent.
- **Orange:** insufficient, unsatisfactory, somewhat compliant.
- **Yellow:** moderately sufficient, satisfactory, compliant.
- **Green:** sufficient, good, compliant, implemented well.

The scores and colors for the strategic objectives and indicator questions can be found in the assessment details provided in Annex II.

High-level costing. Cost estimates for the recommended interventions are high-level based on the expert's experience and knowledge of implementing similar activities; there are not detailed budgets or

line items with units, rates, and quantities that support them. Each thematic area provides information on what the estimate covers and what it does not cover. In some cases, specific steps or elements of what will make up the cost are provided. More detailed cost estimates will have to be determined by the investor and will be based on decisions that must be made between the investor and the beneficiary (e.g., specifications of equipment, number of staff to be trained, etc.). In the case of EGS and CSP&D interventions, cost estimates have not been provided by the experts. Costing details can be found in Annex III.

Implementation during COVID-19. Due to COVID-related travel restrictions in 2020 and 2021, it was not possible for the international expert assessment team to visit the country in person, and it is important to understand that this presented a considerable challenge in studying and assessing each thematic area. All efforts were made to overcome this challenge by conducting interviews and workshops virtually and by utilizing local perspectives and experience, but it is possible that the lack of first-hand observation and in-person discussions has resulted in errors and omissions. The subsequent in-person validation process was therefore an important step in finalizing assessment results and prioritizing recommended interventions.

Assessment confidentiality. SeedSAT reports are intended for use by BMGF and AGRA to distribute to host-country stakeholders at their discretion. The SeedSAT team followed strict confidentiality protocols with interviewed stakeholders and used a "Chatham House rules" approach. Quotes contained in the assessment results are non-attribution and **the contents of this assessment are considered confidential and not for broad distribution.**

Ethiopia Assessment Results

SeedSAT is a tool that guides experts and host-country stakeholders and institutions through a rigorous, interactive, and iterative process to arrive at assessments that are customized to the specific context of the host country. This section describes the overall approach the experts took while designing and implementing the tool, high-level assessment bottlenecks identified, and expert-recommended interventions. In addition, this section describes the results of the SeedSAT validation workshop held in Addis Ababa on March 3, 2021, which include participation by public, private, and development partner stakeholders, in person and virtually. The workshop included facilitated breakout discussion sessions aimed to first validate the findings—in other words, to determine if the bottlenecks and interventions were accurate, and if they were, identify any that were missing; and then to prioritize the interventions based on level of impact (high, medium, low) to the system and relative ease of implementation (high, medium, low).

SEED SYSTEM ASSESSMENT SUMMARY

Ethiopia has embarked on an intensive, agriculture-led structural adjustment since 1993, with major gains in improving production, food security, and the contribution of agriculture to the GDP. The focus on agriculture through two cycles of the national GTP I and II has supported high rates of economic growth, and an expansion of agricultural added value from $6.65 billion in 2000 to about $20.4 billion in 2019.[4] Overall, cereals crop productivity doubled in Ethiopia over the past decade, increasing from 1,116.3 kilograms (kg)/hectare (ha) in 2000 to 2,538.2 kg/ha in 2017 for maize, wheat, barley, and tef, according to recent FAO evaluation.[5] These gains have come from intensification efforts made during GTP I and II as smallholders and commercial farmers expanded to nearly their practical limits after peaking in 2012, with the annual increase in cultivated land area slowing by 2017 as farms pushed into marginal areas.[6]

[4] FAO. 2020. Ten years of the Ethiopian ATA. An FAO evaluation of the Agency's impact on agricultural growth and poverty reduction. Rome. https://doi.org/10.4060/cb2422e .

[5] Ibid.

[6] Ibid.

Major investments in the agricultural sector have included design and implementation efforts led by the ATA and MOA with national, development partner, and private sector funding. These initiatives have tested, scaled, and improved the targeted supply, distribution, and use of seed, fertilizer, agrochemicals, mechanization, crop management practices, agricultural extension and advisory services, crop production and marketing clusters, and financial innovations with positive results, such as decreasing the cost of food crops, reducing hunger and poverty, and increasing private investment in downstream processing, transportation, and other services.[7] However, the benefits from these activities still fall short of their objectives. Overall gains in yields still fall below GTP targets for staple food crops[8] that were set to generate benefits with revenue that would sustain and broaden the supply, effective use, and impact of productivity-enhancing inputs.

Crop production starts with seed and its productivity potential when it arrives at the farm for planting. Ethiopia and its partners have made substantial investments in crop R&D to produce new varieties, built and restructured national and regional parastatal seed companies and seed-producing cooperatives, adapted programs to address the needs of the country's formal, intermediate, and informal seed system components, and have done extensive experimentation in restructuring channels to aggregate formal seed sector ordering and distribution. However, the weight of public sector ownership and interests in most of the seed value chain for most crops, the difficulty in prioritizing and sustaining operations and maintenance funding in public institutions, decentralized regulatory policies and structures that are fraying, and a declining ability to supply the contracted quantity and quality of EGS threatens the seed system and reduces the impact of investments. As the need for quality seed of improved crop varieties grows, and as the competition for public resources increases, these pressures will increase along with the long-standing issue of the quality and timeliness of certified seed sold to farmers.

Some of these issues can be reduced through improved public funding, but it seems to be time to adopt a more liberal stance to private sector engagement. The formal seed system is still dominated by a public sector that has only opened the door to major private sector investment once more than 30 years ago in order to rapidly scale the introduction of hybrid maize with complementary inputs to reduce hunger. While there is a substantial price difference between public and private hybrid maize varieties, small farmers are willing to pay the price for the private hybrids because of seed quality, timeliness of delivery, and responsiveness of the seed company to quickly solve any problems that farmers encounter with their seed. There has been a lot of experimentation in Ethiopia on seed marketing and distribution that improves the efficiency of public seed company distribution, but there are more fundamental experiments and adjustments needed upstream to deliver better-quality seed of improved varieties to farmers and to improve their choices.

This assessment found the following drivers of change to be important to resolving bottlenecks in the public sector and finding a pathway to rebalance public and private investment in the seed system.

Imbalance between public and private investment. Ethiopia has a history of strong public investment and the seed system is dominated by public institutions, state-owned companies, and state-supported cooperatives. These institutions, combined with substantial development partner investment have delivered impressive growth in production, productivity, and income and good returns on investment. However, at least one recent evaluation of the large investments in the ATA states that return on investment to the overall economy would have been higher had more open-market policies been pursued.[9] As importantly, the results of this assessment indicate that the seed system has characteristics more like a command and supply system than one linked to a level of competition for market space that would

[7] Ibid.

[8] FGRE/The Federal Democratic Republic of Ethiopia. 2018. GTP II Midterm Review Report. Addis Ababa, National Planning Commission.

[9] FAO. 2020.

improve marketing effort, increase the search for efficiencies, and foster the growth of responsive seed system services.

The public sector in 2017 accounted for 87 percent of certified seed production.[10] In the SeedSAT sampling for maize, wheat, tef, and sorghum, the public sector accounted for 99.5 percent of pre-basic seed and 94.3 percent of basic seed production (the sample does not include Corteva and its hybrid maize seed production). In addition, the bulk of pre-basic seed comes from two parastatal seed companies Ethiopian Agricultural Businesses Corporation (EABC) and Oromia Seed Enterprise (OSE). More important than these figures are the weaknesses in good business practices, such as insufficient enterprise cost accounting for breeder seed and most EGS operations, which is evidenced by the fact that 85 percent of EGS producers have no preordering and deposit requirements, no formal rules for EGS allocation when production falls short, 76 percent of EGS producers with no customer performance tracking, and 55 percent without a marketing budget. It seems clear that greater competition would speed the realignment of public company priorities and probably generate efficiencies for public investment faster than direct skills transfer. Also, about 55 percent of EGS producers do not have confidence that their clients who produce certified seed have the capacity to produce high-quality seed.

The current situation limits revenue generation for reinvestment and promotes a strong reliance on donor funding. Current positions and rules seem to disadvantage private sector investment in Ethiopia's seed system and reduce the potential for the existing enterprises to engage in seed trade that would increase their business and provide stronger demand signals to its upstream R&D infrastructure. All stakeholders, public and private, highlight this last constraint.

Funding and revenue generation constraints mean that key government-led components of the system that are needed to generate the vision of a healthy system—breeding, QA, and planning and coordination—are underfunded, there is a lack of equipment and infrastructure, and staff lack capacity, points which are reinforced in surveys and interviews across all thematic areas. Some of the underfunding can be partially addressed through improved government revenue generation and attracting more-targeted donor investment. However, there is also a need to open the system to more private sector investment, specifically in breeding and EGS production, through seed company registration rule changes, land access, and seed pricing changes, and the implementation of varietal licensing. This would inject much-needed capital into the system that is responsive to market demands and profit incentives, generate license fees and royalties, and ultimately generate higher revenue streams for the government through taxes. Some stakeholders interviewed also suggested more incentives for public companies to operate like private companies, including restructuring for popular or corporate equity investment using examples from Kenya and Zambia, and further professionalization of seed-producing cooperatives as full cooperative enterprises. Ethiopia has been open to important experimentation in the past. The new Seed Policy and the pending Act may support transformation that will yield faster and higher returns and improve the sustainability of change at lower public cost. To make this transition, there are a number of business enabling environment issues that need to be resolved so that Ethiopia can attract and retain private investment.

Need for improvement of the business enabling environment. Ethiopia has made great strides to improve the PLR environment in the past 10 years with the passing of the new Seed Policy in 2020, a new Draft Seed Proclamation at an advanced stage of enactment, the creation of the ATA, and the creation of national programs such as Agricultural Commercialization Clusters and Direct Seed Marketers (DSMs). A lot of progress has been made in improving the efficiency and direct public cost of seed distribution and making the linkage back to the supplier more visible to distributors and to farmers.

Other reforms are needed, as frequently expressed by seed producers interviewed who view policy statements as theoretical and have lowered their expectations that policies will lead to beneficial

[10] ESA, 2018.

implementation of regulations that all seed actors must follow. Many of the legal reforms are incomplete and need regulations to be developed and/or need existing regulation and guidelines to be improved. For example, during the final stages of this assessment, the Plant Breeders' Rights (PBR) 1068/2017 Law was approved by the Attorney General and moved to the Ministerial Directive stage, but it needs regulations drafted, followed by implementation. These and other practical tools to manage plant breeder rights are an important element to attract and securitize investment in breeding. QA policies have clear regulatory guidelines, but this assessment suggests that the general level of approval of the QA process by public and private seed producers (if not fee levels) masks underlying weakness in seed certification, reducing the system's ability to identify and fix seed quality issues. Ethiopian QA policy and regulations are aligned with International Seed Testing Association (ISTA) and Organisation for Economic Co-operation and Development (OECD), but Ethiopia has let its membership in ISTA lapse and the strong trend to regional authority is leading to some spread in regional QA practice.

Regionalism issues. Regional autonomy is a political economy good in Ethiopia. Strong regional seed industries certainly should be encouraged. However, there are some persistent issues in terms of the level of investment and operating costs needed to maintain, manage, and grow key seed system resources and to coordinate research, breeder seed, and pre-basic seed unit investments in the same crops across regional and national research institutes. There is a clear call among those interviewed across SeedSAT components to establish a national seed agency to play a coordinating role, and to help ensure that regional seed authorities operate with standards and procedures that are harmonized with the national standard, including Common Market for Eastern and Southern Africa (COMESA) regulations that would foster seed trade in both directions, and also reduce the potential for confusion in seed commerce among the regions.

Public funding and the PLR reform linkage. The ATA was established to advance transformation strategies and implementation designs, and to test them and help the MOA and Regional Bureaus of Agriculture (RBOAs) to scale them, but not to play a regulatory coordination function. Scaling and deepening reach to the full agricultural population is the duty of the MOA and RBOAs, cooperative enterprise, and the private sector. This assessment has noted that across all seed systems functions there is a common view that public institutions are underfunded and suffer talent losses to better-funded agencies like the ATA and development projects. As mentioned above, the funding shortfall to fund activities can partially be addressed through improving how government earns non-tax revenue—some recommended solutions are to enable the government to license varieties to the private sector, modify service fees as services are improved, and retain those revenue streams within the implementing agency so that reinvestment can be made. Ethiopia's formal seed sector is large enough that substantial portions of operating costs of the key function of QA should be recoverable through fees. SeedSAT findings are that QA is an essential element of the business enabling environment and needs to be a first priority.

Need for improvement of national QA as a priority. Assessment of the national QA system is described in detail in Annex II. There has been an erosion of QA capacity in terms of staff, facilities and equipment, and laboratory performance—especially at the regional level—and extending to the lack of an ISTA-accredited laboratory to maintain whole-system standards, improve performance, and audit other lab-testing accuracy; serve as a training center for regional QA agencies and QA personnel in seed companies; and establish national competent authority capacity for seed import and export. On the seed trade issue, there are also substantial gaps in phytosanitary/plant quarantine capacities.

The QA investments recommended later in this report are prioritized to focus on establishing the core capacity in a single ISTA-accredited laboratory first, with a small offset to upgrade two other seed labs to ISTA standards, but without immediate engagement in ISTA accreditation. Participants in the validation workshop supported a more expansive set of laboratory investments, but experience in East and Southern Africa suggests that greater overall progress will come from building core strength to test and improve QA function and coordination with other labs, before additional public investment in accreditation is

pursued. This approach will also provide a public audit capacity to permit the development of third-party seed sampling and testing services in the private sector that would be recognized for trade purposes, and ideally nationally.

A high priority on QA should help resolve some of the persistent issues around seed quality and seed certification, which include questions like the following: Are private company hybrid maize varieties substantially superior to national varieties, or is it the seed quality issue arising from seed production and post-harvest handling and storage control, timeliness of supply, seed company responsiveness, and support to dealers that makes them more valuable to farmers?; and Why are many seed producers happy with current seed-certification practices if there are clear indications of seed testing deficiencies? More broadly, establishing a consistent national QA system can nudge producers toward a culture of continuous improvement and improve farmer ability to make more-informed choices about the performance and suitability of new varieties coming out of breeding pipelines.

Need for improvement of NARS and breeding effectiveness. The NARS and breeding effectiveness assessment compares national programs against high-quality, advanced private seed company breeding programs to identify high-priority areas for improvement. The assessment prioritizes efforts that the Ethiopian Institute of Agricultural Research (EIAR) should make to realize genetic gain in the breeding programs and for farmers. Across maize, wheat, sorghum, and tef, product profiles with market segments and stress priorities are in development, except for tef, but these need to be improved, formally documented, and used to drive decision making for all crop improvement. Also, none of the four crops have a formal system in place to monitor performance of released products in smallholder or commercial farm production. Seed produced is considered as a proxy for adoption. It is likely that variety turnover at the farm level is lower than current survey methods reveal and that the age of varieties in common use is older than desirable. Post-release product performance and the data used to drive decisions in the breeding program need to be monitored, which will require new resources. There is inadequate scaling out to test varieties in larger target areas, which may be constrained by extension and demonstration linkages. Measuring genetic gain-post release at the farm level is constrained by the cost of data collection.

While there are substantial resource challenges, with the Modernizing Ethiopian Research on Crop Improvement (MERCI) project addressing some of them for maize, wheat, and sorghum, the programs could gain significant efficiency by tracking cost metrics and evaluating some aspects of mechanization for field and post-harvest operations, barcoding for seed storage and inventory and organization, and introducing improved information management for tef. There are many shared challenges and opportunities for improvement at EIAR, and a team approach is needed to bring scientists together across crops and disciplines to make best use of available expertise. It is incumbent on EIAR to better integrate the disciplines of breeding, pathology, entomology, agronomy, and data management to achieve the common goal of continuously improving genetic gain efficiently and to contribute to advancing EIAR's strategy.

The incentive for breeders should not be on the quantity of varieties released, but on the genetic gain in productivity stress tolerance and responsiveness to market segments. Ethiopia has strong data collection and analysis systems that could be retooled to better measure adoption rates and the farm level performance of released varieties against those most grown today. There is already DNA sampling data that shows that farmer identification of crop varieties is faulty more often than not. Better measures of adoption should cause results—go back and measure the benefits of the new variety—providing better feedback than the current sales data on how to prioritize breeder and EGS investment, marketing efforts, and linkages to certified seed distribution and marketing.

Need to incentivize and catalyze investment and make system planning and coordination changes in the EGS and CSP&D. EGS production is currently falling short of demand. Stakeholders interviewed across the spectrum indicated that better information sharing and coordination, as well as funding, and new financial tools are needed. If public investment is declining, then greater engagement with and

support for private sector investment is needed, especially in capacity building and access to finance. In addition, faster experimentation with opening to large private seed companies to produce, sell nationally, and export their varieties, perhaps with negotiation of service provision to smaller national seed production companies and the development of marketing and distribution channels, would accelerate the transition. Policy changes and improvements in sectoral planning and coordination are essential if greater foreign private investment is sought to accelerate improvements in the seed value chain.

Large public sector companies continue to dominate EGS and certified seed production with their strong linkages to public capital, substantial physical asset base, and deep distribution networks through cooperatives and the new forms of seed distribution developed and piloted by the ATA and MOA partnership.

National private seed companies already have a list of key changes that they need to level the playing field in the national seed system. These are to make EGS planning transparent and contractually binding, which should improve business performance; provide access to irrigable land or remove the requirement to hold land to register a seed company; and adjust the current national raw seed pricing mechanism that incorporates more cost-based profitable margins and pricing flexibility. Technical and business capacity building, access to credit, tax incentives, and access to irrigated land are also among the pressing needs.

Working capital is a key constraint to the growth of agriretailers who cover the last mile to farmers. These are the multitude of marketing agents, agricultural one-stop shop (AOSS) owners, and formal agrodealers. The agriretailers source of working capital is mainly obtained through informal loans from friends and relatives or their own resources and cash flow. Providing preferential access to credit for inventory management (working capital) and investment, and capacity building for marketing agents (seed product knowledge, marketing, customer relationship management [CRM] technology) was viewed favorably by Ethiopian stakeholders. A broader look is needed at value chain finance solutions upstream, underwriting risk of default on supplier credit, or downstream (like the current input voucher program of ATA, but with additional design). Buying in public seed companies through joint exploration of how risk or cost sharing could improve their forecasting to avoid carryover seed and build agent capacity would be one avenue to explore.

Need for improved coordination. Throughout the assessment and at the validation workshop, Ethiopian leaders pointed to the need to improve coordination of the stakeholders and their institutions and their frustration in trying to generate coordination. They advocated for a strengthened national platform that brings stakeholders together to support faster operationalization of policy and regulatory implementation, to develop and guide an agenda to address standing and emerging seed systems issues. This trend should be supported to help establish regular, two-way dialogue between public and private sectors in the seed industry with federal and regional services; ensure that regular public-private meetings are held, with joint agenda setting, including varietal release, varietal adoption, and performance; QA; and EGS demand and allocation issues; and to establish regular feedback channels for meeting discussions and follow-up. National stakeholders advocated for the creation of an apex platform at the national level that would support the establishment of a national seed agency using the Egyptian National Seed Council, Kenya Plant Health Inspectorate Service, or Nigeria's National Agriculture Seed Council model. There is some concern that national leadership is hesitant to create a new national agency after reinforcing regional autonomy.

Seed producers are represented in Ethiopia by the Ethiopian Seed Association (ESA). It is a fragile, largely development partner-funded organization, but it does represent all of the seed producers, including public, private, and cooperative organizations. This assessment recommends investment in a staged support to strengthen ESA staff capacity for advocacy for seed producers at the national and regional levels, intermediation of resources and services for private seed enterprise capacity building, and information management for the seed industry. ESA will continue to be primarily donor dependent until it can deliver more services to members at national and regional levels.

Conclusion. The seed system needs a more liberal market economy if Ethiopia is going to obtain greater returns from its successful investment in the food crop transformation effort. Ethiopia has succeeded in achieving remarkable results with a public sector approach, but there is some erosion of capacity and resilience in key regulatory institutions like QA and research institutions that are underfunded and having difficulty responding to demand for EGS in ways that appear to have knock-on effects throughout the seed value chain. These capacities can be restored with greater public funding and more coordinated effort among stakeholders, and if there is additional effort put into identifying and prioritizing investments that focus on delivering greater access and choice of quality seeds of improved crop varieties.

There is already substantial experimentation done by the ATA in partnership with the MOA that has shown strong returns. This assessment suggests that it is also time to experiment further with changes in incentives and the competitive landscape for national public enterprises and cooperatives. Cooperatives are on the path to professionalization of management. Public seed companies are gradually experimenting with more market-like practices, but still dominated by supply side management. Policy and regulatory changes could help to further incent public companies to operate more on a private sector basis, but the challenge is how to get there because they are so large and can control market access, flows, and prices. Ethiopia has shown that they can restructure to provide operating space for new export-oriented, private investment, for example, the rapid expansion of greenhouse flower production that became the country's largest horticultural export, or the fast transformation with foreign investment in textiles and clothing. Ensuring that national seed supply is treated as a strategic commodity is key to the food security and income agenda. Currently, there is not the political will to radically restructure public seed companies and cooperatives, but the recommendations from this assessment can be used to improve their efficiency and effectiveness.

NATIONAL QUALITY ASSURANCE (QA)

Vision

National governments want to ensure that farmers are receiving high-quality seed from the formal and intermediate sectors, yet often do not: 1) have proper QA regulations in place; and/or 2) implement or assure implementation of their existing QA regulations, resulting in low-quality seed for farmers. A healthy seed system is one in which farmers have confidence that formal and intermediate sector seed in the market meets labeled quality standards, and actively patronize the brands with the highest-quality seed of the varieties they want to plant; and one in which seed companies work to exceed quality standards and view the regulator as their partner in this quest. Effective regulatory QA will incorporate the following:

- Collaborative design and oversight of effective and affordable processes that are fit-for-purpose, including authorizing and auditing third-party inspectors, to ensure that seed producers and merchants are supplying their customers with seed that meets best practice standards for seed quality and phytosanitary testing.
- Proactive focus on engaging seed producers and merchants in a continuous cycle of seed quality improvement through training, coaching, process oversight and improvements, and timely feedback on quality and phytosanitary testing results.
- Presence of functional, two-way dialogue and feedback mechanisms related to farmers' experience of seed quality (including feedback on counterfeit seed) to support ongoing improvement in the quality of seed planted by farmers.

Methodology

The assessment used best practice standards for seed quality and phytosanitary testing (such as ISTA or OECD, where applicable), plus best practice standards for a customer-focused sector for benchmarking. The methodology used for NARS included the following seven strategic objectives:

1. QA regulations that are consistent with best practices.

2. Implementation of production-related QA activities for *locally produced* seed.
3. Implementation of national QA requirements for *imported* seed.
4. Implementation of point-of-sale/distribution QA activities (for both locally produced and imported seed).
5. Efficiency and affordability of QA compliance for seed producers and importers.
6. Service focus: QA dialogue, support, training, and feedback.
7. Institutional support for QA.

Based on these seven objectives, the experts developed 28 indicator questions to guide the assessment. Evidence gathered to conduct the assessment included: desk research conducted by the research team; information requested and submitted by the regulatory entities; recently released and technically qualified third-party reports; site visit observations and data collected by an expert local consultant; phone-based and short message service (SMS) survey results of seed producers and importers, seed distributors, and representatives of farmer groups; and in-person consultations with additional stakeholders in the Ethiopia seed sector. A total of 17 reports from third parties and key government QA studies and strategies were selected as important contributors to scoring and the evidence for scores. Of particular note, the report titled *Status of Seed Quality Control and Assurance in Ethiopia: Required Measures for Improvement Performance*[11] was especially relevant since it was released during the assessment period and provided a comprehensive overview of both the issues and potential solutions. The expert team used both a Likert scale (0 to 3) to assess the relative level of satisfaction and health of the QA system. More detailed information on the methodology can be found in Annex II and in the *SeedSAT Guide.*

Findings

Certified seed volumes for the study focus crops (maize, wheat, tef, and sorghum) totaled 78,819 metric tons (MT) in 2018. An estimated 75 percent of certified commercial seed is produced by public seed companies, 15 percent by farmers and cooperatives, and 10 percent by private seed companies. Seed import levels are very low. An estimated 69 percent of EGS is produced by public seed producers, 21 percent by unions, 7 percent by private seed producers, and 2 percent by research institutions. QA authority is shared by national and regional entities. A new Seed Policy was released in 2020, but is not yet available in an officially released English translation. The most recent Seed Proclamation and Plant Quarantine regulations are still in draft form. Third-party inspectors are allowable by law, but are not yet functional. A recent and positive development has been the emergence of DSMs, which can sell seed directly to farmers. DSMs currently account for an estimated 60 percent of the sales volume, while centralized government distribution accounts for the remainder. Counterfeit seed does not appear to be a major issue, but complaints about low-quality seed are significant. Labels in use vary by federal agency and by region. Scratch-off authentication labels are not in use. Ethiopia used to have an ISTA membership, but it has lapsed. There is no ISTA-accredited laboratory in the country, public or private.

Seed QA in Ethiopia can be characterized as highly fragmented, lacking a clear leadership champion at the MOA, and suffering from a lack of enough qualified, trained, and experienced personnel, in addition to a parallel absence of consistently functional transport and laboratory testing capacity. The QA system needs considerable support to meet both national needs and international standards. However, under the current organizational and institutional structure, which lacks clear and clearly implemented mandates for federal and regional regulators, it is not clear that additional support will deliver the desired results. A number of good recent studies and strategy documents accurately point the way to improved QA in Ethiopia, but operational understanding and funding to efficiently, systematically, and effectively improve QA are lacking. Assessment results indicate that QA in Ethiopia suffers from significant deficiencies in equipment, laboratory and office space, adherence to processes and procedures, logistics support,

[11] Nigussie, Mandefro, Karta K Kalsa, Amsula Ayana, Dawit Alemu, Mohammed Hassena, Tefera Zeray, Abeneazer Adam, and Amsale Mengistu. EIAR, 2020.

information technology (IT) capacity, and trained staff. Key institutional issues contributing to these deficiencies are a lack of regulatory autonomy, funding, and investment plans; insufficient stakeholder dialogue; and a lack of functional regulations for some QA areas.

For a QA system such as Ethiopia's, the scientific QA basics must first be put in place at the national level and at several key regional locations. Once this is done, these sites can serve as training, replication, and audit sites for other QA field offices and laboratories, in addition to the work of third-party inspectors. It then also becomes possible to digitize the procedures once they are done properly, with scientific validity. Without several key sites operating properly, there is risk of digitizing erroneous processes and/or licensing third-party inspectors without any way to train them adequately, monitor their performance, or determine the continued validity of their licenses. The only success will be greater efficiency of inaccurate processes, and more people who are authorized to carry out the inaccurate processes. None of these improvements can be carried out in the absence of a clear mandate for regulatory agencies, and the ability to make scientifically valid decisions that will not be overridden. Either complete autonomy, or strong semi-autonomy, is required.

The recommendations below represent the beginning of a journey, not the complete journey. They have been developed in harmony with the following guiding principles on improving national seed QA.

- The main goal of the recommendations is to ensure high-quality and large-scale seed QA implementation, whether directly by a national government, or through delegating activities to qualified third parties and providing the necessary audit and training functions.
- QA improvement must build on basic QA functionality and technical capacity and accuracy. Without these basics, other improvements such as e-certification do not make sense, although improvements such as digitized certification efforts can help to scale a system once the basics are present.
- Seed QA costs do not need to be prohibitive on a per unit basis once scale is achieved, and participants in a growing and functional seed sector will generally willingly contribute their fair share of the costs if they feel they are receiving good value for money.
- In many cases, efforts to improve QA are already underway through various donor activities and grants. The recommendations attempt to consider these efforts and build on them, noting potentially constructive repositioning when they are believed to be constructive
- Finally, QA is a highly technical undertaking. There are no viable shortcuts, nor is it possible to deliver solid QA without the requisite technical proficiency among staff, functional and calibrated equipment, lab infrastructure, and inspection and sampling activities. All recommendations made are consistent with this reality.

Strong partnerships between government, private sector, technical experts, and donors will be required to undertake these first steps, and also to continue the journey by expanding to additional sites and degrees of efficiency. QA is not overwhelmingly difficult or intellectually challenging. With solid staff training, disciplined management, and good facilities, seed QA can reliably make extremely significant contributions to the Nigerian economy on many fronts.

A list of documents requested and supplied is in Annex VII. A summary of the top bottlenecks, issues, and associated recommendations are below, and more detail behind the assessment results can be found in Annex II.

- **Clarity and enforcement of mandates between federal and regional authorities need to be improved, particularly with respect to the federal agency taking ownership for overall QA improvement (*This constraint was also highlighted under PLR*).** At present, QA is handled at both the federal and regional levels, with federal having the mandate to certify imported seed and seed sold across various regions, and regional entities having the mandate to certify seed produced and sold in their region. In addition, the federal entities have the mandate to set standards and serve as the reference agency to validate and audit test results from regional entities. However, the clarity of

mandates needs to be improved, particularly with respect to taking ownership for overall QA improvement in the country, and enforcement of mandates also warrants significant improvement. An example of loose enforcement is the recent situation where reference checks of regional lab testing were conducted at the federal level, with somewhat discouraging results. Follow-up corrective actions, however, or enforcement of national standards with respect to entities conducting tests poorly, did not occur. The autonomy of regional entities as it relates to initial testing, sampling, and certification decisions is often weaker than usual with respect to their linkages with regional government. Certification of seed lots is approved even though the seed sampled and tested is not sampled and tested according to accepted scientific practices, protocols, and/or procedures. In some cases, labels are distributed prior to test results being available, based on imprecise yield estimates. There are strong indications that regional seed production entities and private sector entities do not operate on a level playing field, given the pressure from regional governments on their own seed production entities to meet targets and timing.

- **Absence of ISTA-accredited and tier 2 labs (*This constraint was also highlighted under PLR*).** There is no ISTA-accredited lab and the labs that do exist have substantial inadequacies, such as lack of or poor equipment, poor infrastructure and storage, and low technician capacity (see Annex V Seed Lab Site Visit Report for more details).
- **Lack of QA for EGS (*This constraint was also highlighted under EGS*).** Stakeholders reported a variety of issues in EGS volume and quality. Lot numbers are not assigned to fields, so there is limited ability to track EGS lots, or specific grower fields for certified EGS. Shortages of EGS are reported, in addition to low quality, which may open the door for traceability shortcuts. The volume of EGS is coming from limited sources, mostly government NARS (national and regional), and sometimes appears to have mixed varieties. The government has been working on improving traceability.
- **Additional QA functions need to be in place for information and communications technology (ICT) solutions (e.g., global positioning system [GPS] tracking and e-certification) to be more effective.** Accuracy, efficiency, and transparency of QA are all strengthened by appropriate and sustainable use of ICT tools. The MOA is already working with donors on adoption of ICT tools, such as GPS use for field inspection activities and an e-certification system. However, the successful employment of ICT tools for national QA needs to be carefully sequenced with overall QA system maturity and capacity, in addition to being rigorously vetted to ensure that it can work in a country's ICT environment. The assessment highlighted issues related to how prepared Ethiopia's QA system is to adopt and effectively utilize ICT tools to improve efficiency and effectiveness. It became clear that additional technical vetting could be beneficial if the rollout and desired implementation of ICT tools targeted for adoption was to be successful and achieve the desired results. For example, most digitized seed QA starts with assigning lot numbers to sections of production fields, which is currently not done in Ethiopia.
- **Lack of effective two-way dialogue with private sector (*This constraint was also highlighted under PLR and NPC*).** Farmer representatives surveyed indicated dissatisfaction with communication channels available for reporting problems with the quality of certified seed. Seed producers surveyed were more positive about channels of communication, however, communication is highly unlikely to be accurate given deficiencies in inspection and laboratory testing practices. Some producers report receiving testing results late, which leads to marketing delays, but generally cite QA resource constraints as the cause for late delivery of results. These findings were supported by literature review.
- **Insufficient funding for QA activities (*This constraint was also highlighted under PLR and NPC*).** Funding constraints are apparent by the low level of field inspectors and vehicles to support the high hectarage of field that needs coverage, as well as the low capacity of inspectors. Inspections are not timely and sampling levels are 66 percent below where they need to be for the volume of certified

seed. Labs are poorly equipped and maintained and technicians need capacity building. Fees charged for suboptimal QA service are extremely low, which limits the government's ability to reinvest in improvement. From the seed producer survey, 60 percent referenced the need for greater investment. These findings were supported by literature review.

- **Insufficient regulations and enforcement for QA, including anticounterfeiting measures (*This constraint was also highlighted under PLR and NPC*).** Stakeholders reported that some regulations are in place, but do not conform to best practices or do not give enough information, such as lot-numbering requirements and label content. Regulations reference ISTA for best practices, but do not specify the detail for the users. There is a lack of phytosanitary regulations for certification and the legal framework for plant quarantine and sanitary and phytosanitary (SPS) issues is incomplete and outdated. No anticounterfeiting labels are in place; and regional labeling practices will make anticounterfeiting labels hard to implement. In terms of counterfeit seed, no prosecuted cases were reported, and local government enforcement is reported to be weak. That being said, it seems that poor quality of seed from poor QA practices (such as seed that was certified that should not have been, poorly stored seed, seed that should have been retested) are more of an issue then counterfeit seed.

Proposed Interventions

1. **Create and enforce clear regulatory mandates for seed QA for federal and regional authorities, to include sufficient autonomy and oversight powers for the federal seed regulator, so that independent scientific decision making by qualified experts drives seed regulatory activities and decisions.** Setting up an autonomous National Seed Authority (NSA) will require legislation, which will take time and incur additional costs. Alternatively, it is possible to empower the current QA units to run semi-autonomously and maintain scientific integrity. Setting up the organizational autonomy or semi-autonomy, alone, is not sufficient to develop and maintain effective QA practices, but it is the essential first step.
2. **Upgrade to basic levels of functionality in two regional labs (tier 2) and to ISTA standards in the federal seed quality and phytosanitary lab(s).** Undertake a scoping study led by a highly competent QA technical team to specify what needs to be done to bring Ethiopia's essential QA processes and procedures up to ISTA accreditation standards at the two national laboratories (for seed quality and phytosanitary), and to basic, reliable testing standards at three selected field offices: Ambo, Asella, and Bahir Dar. Each location has a different starting point, but all need meaningful improvements. These locations are recommended due to their regional importance in seed production. However, they can also provide upgrade and training expertise for laboratory strengthening in other regions. Module 3 of the FAO Seeds Toolkit,[12] which focuses on seed QA, can provide a good guide to best practices, which should be covered in a scoping study and the resultant specific technical recommendations. The lab site visit report and recommendations conducted along with the assessment can be used as a starting point (see Annex V).
3. **Ensure that number and experience of QA and field office staff are sufficient to meet QA needs at each site and deliver comprehensive training for QA staff.** Once the scoping study and procurement plans are in place to upgrade the labs, then: 1) review staffing number and skill needs at all locations, and reassign staff to meet, but not excessively exceed, QA requirements, including near-term anticipated future requirements; and 2) design and carry out training programs for both federal and regional QA staff to ensure that appropriate procedures are followed for all QA activities, and that all staff assigned to perform QA activities have the requisite training. Training should be developed to cover all functional areas of QA, including registering growers and grower fields, sampling, sample intake, sample storage and disposal, testing, analysis, record-keeping, equipment maintenance and calibration, auditing, and communication with service users. In addition, training to

[12] FAO. "Seeds Toolkit Module 3: Seed Quality Assurance." 2018. Available at: http://www.fao.org/plant-treaty/tools/toolbox-for-sustainable-use/details/en/c/1310563.

contribute to user knowledge and improvement will be important, as will be training on basic computer skills, such as Excel usage. Staff assignment planning should also include planning for career paths, continued education, rotational assignments, and preparation for future responsibilities, such as auditing third-party inspectors and coordinating the development and oversight of e-certification.

4. **Develop and implement a plan to deliver QA for EGS that is aligned with best practices for QA, and to support improvement among QA producers not meeting standards.** While this recommendation is directed specifically at EGS, it must also be viewed as laying the foundation for the larger effort to improve overall QA for all seed classes, which will be undertaken largely in alignment with the recommendations to upgrade the labs. However, EGS QA issues are sufficiently urgent, and the seed class volume is relatively small, so it makes sense to begin to address EGS QA issues immediately. The recommendation is to have an expert team develop a plan to put in place process improvements for the entire range of QA for EGS, beginning with entities and field registration and ending with labeling and distribution. Once overall process improvements are identified, the team conducting the plan will then need to identify the sites upon which they want to focus for proposed implementation. These sites may, however, overlap with the labs to be upgraded, and possibly include an additional site for a focus crop if that is missing.
5. **Review current and desired IT tools and capacity, including viable pathways to implement full and effective usage of GPS tracking for field activities, record-keeping for certificates of competence, and digital QA activity tracking, with particular attention paid to pre-conditions for effective IT use.** Conduct an expert review of Ethiopia regional and national QA readiness for full adoption of tools, such as e-certification, GPS field activity tracking, and other tools that may be identified for review. The review will also include a technical IT review to cover issues such as technical IT capacity building, with respect to hardware, software, project management, data capture and analysis, user interface, and more. In addition, if national and regional QA entities are to fully employ and recognize the benefits of digital tools in seed systems, it is important that the relevant QA entities have the internal project management and technical capacity in place to fully underpin QA activities. Work needs to be done to scope, plan for, and implement the internal IT capacity needed to effectively implement QA activities using ICT tools. The recommendation is to contract technical expertise to work with the ministry to address the issues highlighted above, covering both internal national and regional ICT capacity and effective use of tools such as e-certification and GPS field inspection support as potentially important support tools for QA in Ethiopia.
6. **Ensure functional, two-way stakeholder dialogue on QA issues (*More detail provided under NPC*).** This will entail ensuring that regular public-private meetings are held, with joint agenda setting, including QA issues, with sufficient advance notice, joint agreement on optimal meeting times, and openness to participation by all relevant stakeholder. This may be accompanied by establishing regular feedback channels for follow-up on meeting discussions.
7. **Develop and implement sustainable funding plans (both operating and capital expenditure) for QA activities (*More detail provided under NPC*).** This will entail establishing clear payment flows for government-provided seed services back to the agency providing services to generate investment revenue; exploring the feasibility of significantly increasing fees charged to QA service users, in parallel with increased delivery of strong QA value through improved services (i.e., accuracy, timeliness, support for improvement); establishing a budget for covering a portion of operating expenses not covered by service fees, or requiring bridge funding while fees are collected; and developing capital expense investment budget to cover acquisition of assets for labs and QA activities such as vehicles, building repairs, equipment, etc.
8. **Develop and ensure legally mandated approval of functional regulations for QA that align with international best practices.** Develop functional operational regulations for both seed quality and phytosanitary QA purposes. Specify standards in regulations versus using general references to ISTA

standards. Bring elements of current de facto regulations, such as labeling content and lot/reference number assignment, in line with best practices.

9. **Implement legal enforcement measures to uphold QA standards.** This will entail ensuring legal enforcement for violations of government QA regulations, including the following: seed company knowingly promoting sale of low-quality seed, or failing to take the steps necessary to determine seed quality before sale; manufacturing and/or sale of counterfeit/fake seed by any party; seed distributors knowingly promoting sale of low-quality seed, or failing to take the steps necessary to preserve seed quality prior to sale; and enforcing accuracy of information on all seed labels. Then the government will need to publicize legal enforcement efforts and results.

Cost Estimates

Overall, high-level cost estimates for implementing the recommended interventions range from a low of $460,000 to a high of $890,000. More detail of elements included in the cost estimates along with the expert's suggestions in terms of sequencing can be found in Annex III.

No.	Recommended Intervention	Low (US$)	High (US$)
1	Create and enforce clear regulatory mandates for seed QA for federal and regional authorities.	Requires institutional decisions about structure. Estimated cost for legal work included under PLR	
2	Upgrade to basic levels of functionality in two regional labs (tier 2) and to ISTA standards in the federal seed quality and phytosanitary lab(s).	117,000	256,000
3	Ensure that number and experience of QA and field office staff is sufficient to meet QA needs at each site and deliver comprehensive training for QA staff.	159,100	311,100
4	Develop and implement a plan to deliver QA for EGS that is aligned with best practices for QA, and to support improvement among QA producers not meeting standards.	109,600	203,400
5	Review current and desired ICT tools and capacity, including viable pathways to implement full and effective usage of ICT solutions.	75,000	120,000
6	Ensure functional, two-way stakeholder dialogue on QA issues.	Included under NPC	
7	Develop and implement sustainable funding plans (both operating and capital expenditure) for QA activities.	Included under NPC	
8	Develop and ensure legally mandated approval of functional regulations for QA that align with international best practices.	Included under PLR	
9	Implement legal enforcement measures to uphold QA standards.	Included under PLR	
	Grand Total	***$460,700***	***$890,500***

Validation, Prioritization and Feedback

Validation feedback. The Ethiopia validation breakout session held on March 3, 2021 to cover the QA and seed system production and distribution thematic areas included representatives from MOA, EIAR, private seed companies, farmer cooperative unions (FCUs), ESA, donor agencies, AGRA, and BMGF. The sections below highlight the major suggested changes and how they were integrated into the bottlenecks and recommendations mentioned above.

Upgrading laboratories to ISTA standards. Participants suggested that ALL the labs are below standard in terms of facility and human resources, and thus need capacitating work, thereby implying that they all need to be upgraded to ISTA standards. The assessment views this issue as one of prioritization and sequencing. The sample of seed labs visited for this assessment supports the upgrading need for facilities, equipment changes and calibration, and staff upgrading, with a focus on improving their operations to meet the ISTA standard. However, this assessment recommends prioritizing ISTA accreditation for a national laboratory first to improve its capacity as the national reference laboratory, as a training location, and to better fulfill Ethiopia's international trade obligations.

In addition, participants commented that training of personnel engaged in EGS production on QA should be considered for support.

Lastly, participants pointed out that for the country to be competitive in exporting seed (a recommendation made under the seed production and distribution component of this assessment), that investing in the national QA system should be prioritized.

Prioritization feedback. The table below displays the proposed prioritization and sequencing of interventions given by the expert along with the prioritization feedback from the participants given during the validation workshop (impact and ease of implementation scores were not provided in this session). Participants prioritized current operating concerns focused on improvements to staffing, QA for EGS, and national funding for QA. System improvement requires action on all recommended fronts, with this assessment continuing to stress the need to sequence investments, especially by development partners, in strengthening the application of the national regulatory standard as a single standard and focusing on a progressive build-out of laboratory capacity in the central lab with ISTA accreditation and two regional labs with high EGS and certified seed production volumes.

No.	Recommended Intervention	Expert Proposed Priority	Validated Priority
1	Create and enforce clear regulatory mandates for seed QA for federal and regional authorities.	1	3
2	Upgrade to basic levels of functionality in two regional labs (tier 2) and to ISTA standards in the federal seed quality and phytosanitary lab(s).	2	5
3	Ensure that number and experience of QA and field office staff is sufficient to meet QA needs at each site and deliver comprehensive training for QA staff.	3	1
4	Develop and implement a plan to deliver QA for EGS that is aligned with best practices for QA, and to support improvement among QA producers not meeting standards.	4	1
5	Review current and desired IT tools and capacity, including viable pathways to implement full and effective usage of ICT solutions.	5	4
6	Ensure functional, two-way stakeholder dialogue on QA issues.	6	7
7	Develop and implement sustainable funding plans (both operating and capital expenditure) for QA activities.	7	2
8	Develop and ensure legally mandated approval of functional regulations for QA that align with international best practices.	8	6
9	Implement legal enforcement measures to uphold QA standards.	9	6

SEED PRODUCTION AND DISTRIBUTION

Vision

Certified seed of improved staple food crop varieties in low-income countries often holds a total market share of 10 to 25 percent because of reuse by farmers of open-pollinated and self-pollinating varieties, with hybrid maize being the exception. For example, review by this assessment showed that certified seed covers not more than 10 percent of total cultivable land in Ethiopia, and supply of certified seed from the formal system only meets about 60 percent of government targets. Recycling of seed leads to a decline in the vigor and genetic drift that limits upper bound of productivity that farmers can achieve. A healthy seed system that can redress these issues can be envisioned as one in which the seed production and distribution system includes the following:

- Farmer awareness of new varieties and the benefits of replacing old varieties with newer ones that are more productive, climate smart, and aligned with demand.

- Commercially sustainable production of high-quality, improved seed of demanded varieties that is responsive to the evolving needs of farmers.
- An extensive and robust distribution network that enhances farmer access to and choice of improved varieties.

Methodology

The assessment of the seed production and distribution system was broken down into three sub-thematic stages: EGS production (breeder, pre-basic, and basic seed), commercial production (certified seed), and distribution (agroretailers.) The methodology used for each of these stages was designed to respond to the type of stakeholder participating in that stage (such as seed units of research institutions and public seed enterprises producing EGS; public seed enterprises, private seed companies, FCUs producing certified seed, and agrodealers; AOSSs; and marketing agents for companies and cooperatives, who sell seed to farmers.) The disaggregation of findings by stakeholder type was important, because each one has unique operating models, access to resources, and therefore, different experiences and perceptions. The assessment was guided by three primary strategic objectives with tailored indicators and questions to each stage of the system. The primary strategic objectives were the following:

- Strategic planning and management (clear business models, organization strategy, performance management, roles and responsibilities).
- Capabilities (seed production, post-harvest processing and storage and distribution, internal quality control (QC), and seed marketing).
- Resources (budget and finance, personnel experience, infrastructure).
- Crosscutting (perceptions of suitability of varieties released, equitable access to seed, awareness of programs).

For each stage, the experts gathered three types of information that were both quantitative and qualitative: 1) basic demographic information; 2) data to help determine the vitality of the system, such as volumes produced and sold and access to infrastructure and finance; and 3) attitudinal responses that were stakeholder perceptions of the health of the system and awareness of government programs. In Ethiopia, the experts used a combination of digitized and phone-based surveys, guided questionnaires, key informant interviews, and facilitated focus group discussions (FGDs). More detailed information on the methodology can be found in Annex II and in the *SeedSAT Guide.*

EARLY GENERATION SEED (EGS) PRODUCTION

In Ethiopia, EGS is produced primarily by three types of producers: research institutes, public seed enterprises, and private seed companies. The assessment was in the form of an expert-led, in-person self-assessment questionnaire of 113 questions given to 28 key EGS producers for the focus crops, coupled with a supplemental seed volume trend analysis. The assessment originally intended to produce cost-of-production analysis that could then be used to provide benchmarking analysis to the stakeholders. However, as the experts began to conduct the assessment, it was apparent that the stakeholders were not keeping track of their expenses at a level of detail that would make this possible. The assessment also produced an EGS production and distribution summary, which can be found in Annex VI.

Findings

Overall, the assessment found that there has been a near-term downward trend in EGS production across most focus crops, which is being driven by reduced pre-basic and basic seed production by the two largest public seed enterprises, EABC and OSE. Only half of basic seed producers indicate that they are consistently able to achieve production targets. Most producers believe in the suitability, performance, and commercial awareness of released varieties and most also indicate that there are clear organizational strategies, roles, and performance indicators, but EGS production is not being managed with a continuous improvement approach. Basic seed producers cite challenges with breeder seed quality and supply, and

there are many areas where capacity building could support production capabilities, including EGS production protocols. Current public sector funding levels are insufficient to resource EGS production operations. Research institutions lack irrigated land and necessary post-harvest resources, including seed-processing equipment and acclimatized storage facilities (see Annex II for graphic results of the EGS self-assessment). The assessment highlighted the following constraints and proposed interventions:

1. Limited seed system development policy and strategy until recently. The seed system was built on a central public sector and cooperative ordering and supply system coordinated by the National Agricultural Input Authority, which was disbanded in 2004. EGS strategies have been developed and revised over the last five years, but a policy and strategy that identifies the coordination of resources and institutions to manage the four seed classes (breeder, pre-basic, basic, and certified) has lagged behind sectoral needs. The Seed Policy of 2020 builds on the accumulated efforts and evidence of the past decade, but the seed strategy needs to squarely address a model focused on varietal demand and principles of forecasting demand on a rolling four-year basis, with special emphasis on EGS supply. There is limited crop and varietal coverage of the formal seed system due to a lack of clear incentives and mandate delineation for demand creation. Seed is not considered a commercial commodity despite Ethiopia's potential as a seed exporter to the rest of the region. Proposed interventions:

a) Designate a responsible unit within MOA to guide the sector.
b) Delineate roles for demand creation of new varieties.
c) Increase seed information availability and exchange.
d) Establish center of excellence for short- and long-term seed skill development.
e) Advocate for the government to recognize seed as a potential export commodity.

The establishment of a center of excellence will facilitate the required minimum skill development at management and operational levels of EGS production, processing, and marketing; facilitate clear delineation in roles and responsibilities among seed actors (public seed enterprises, agricultural research institutes, and private seed companies); and design a mechanism that provides incentives for demand creation of newly released public varieties. Support should be provided to the MOA, ATA, and National Seed Advisory Group (NSAG) to scope and prioritize these seed system improvements as the implementing regulations for the Seed Act, which are being considered.

2. EGS supply, quality, and diversity are constrained by resource limitations at research centers that have knock-on effects throughout the seed value chain. EGS is the key lever on the quantity, quality, and diversity of improved crop seed. Errors that occur at the breeder seed level in varietal purity or seedborne disease status are easily magnified by four orders of magnitude or more at the certified seed level. Underproduction of EGS in Ethiopia leads to allocation decisions that may prevent private seed companies from producing preferred varieties in the shortfall year.

Public seed companies indicate that it is "becoming impossible" to get sufficient breeder seed from research institutes. Private seed companies indicate quality problems with pre-basic seed and basic seed, such as mixed varieties and broken seed. The four focus crops show an overall decline in pre-basic seed supply of 24 percent from 2007 through 2019 and a 21 percent decline in basic seed production. On average, EGS producers get about 26 percent of their funding for EGS from grants, but this varies widely by institution from zero to 100 percent. About 46 percent of EGS producers agree or somewhat agree that their annual operating budgets for producing and distributing pre-basic and basic seed is sufficient to meet demand. The overall reduction in EGS volume production is driven primarily by decreases in EGS production by EABC and OSE. The assessment found that this is due to several overlapping and inter-related issues outlined below.

First, the prevailing EGS system presents challenges related to limited clarity of the roles and responsibilities of key stakeholders engaged in the production of EGS; inadequate coordination of production plans of the four successive generations (breeder seed, pre-basic seed, basic seed, and certified

seed) of seed production, because of low ownership, commitment, and accountability of pertinent stakeholders, resulting in mismatch between demand and supply; and poor communication and networking between basic seed producers and certified seed producers, which is further exacerbated by scattered distribution of small private companies and seed producer cooperatives/ unions.

Second, the production and marketing of EGS is highly influenced by the overall operational framework of the national seed system, where EGS production is often for varieties that are demanded by certified seed producers, which are very old varieties due to the lack of a system for demand creation for newly released varieties at the user level (per the MOA, 2019). This implies the need to strategize the issue of demand creation with clear roles and responsibilities for EGS and certified seed producers. And, while a considerable proportion of the EGS producers indicate the presence of an organizational strategy/business model, but in reality, the strategies and business models are public led and centrally planned activities with only recent consideration of EGS contract arrangement. In centrally managed demand assessment and distribution systems like Ethiopia's, the type of varieties covered, and volume of production depend on not only the production capacity of respective EGS producers, but also the communicated demand centrally.

EGS customers are public seed enterprises, domestic small and medium seed companies, seed unions, and seed-producing FCUs. The demand for EGS are fulfilled either from government EGS production or through purchase from EGS producers. The EGS directive (2019) and prevailing practices indicate that EGS annual demand is estimated by the MOA based on certified seed demand reported by the RBOAs each year. To ensure that certified seed demand is real, the RBOAs organize an annual meeting of seed producers from respective regions that have applied formally (in writing) for EGS. The directive further indicates that the demand for EGS at the national level is estimated before each December of every year which considers the certified seed demand to be fulfilled after three years. These figures are then revised and adjusted every year considering changes in demand for EGS. Even though these procedures are in place, forecasting real demand remains a challenge linked with the change in revealed demand for certified seed associated with changes in grain market conditions, weather conditions, and incidences of disease and pests. This often has resulted in shortage of EGS for some varieties and leftover EGS for other varieties, creating limitations on the type, amount, and quality of certified seed production. The total amount of left-over EGS in 2019 was more than 30 thousand quintals (3,000 MT) .

Third, following the sequence of discussions to address the challenges of EGS supply, mainly in coming up with a mechanism to match EGS demand and supply, the EGS management directive was approved by the MOA in 2019. The directive is mostly about how to effectively implement contract farming between EGS producers and certified seed producers based on experiences in previous years. However, the experiences show that there is prevalent cancellation of contracts linked with changes in production and marketing conditions during a year. The ongoing effort to formalize contract arrangement between EGS producers and customers (i.e., certified seed producers) is expected to enhance effective demand forecasting and proper planning of EGS production. However, the existing experiences indicate that EGS contract enforcement is still a challenge, because it is not associated with adequate tools of enforcement. Thus, it will also be important that the contract arrangements consider enforcement tools, including requiring certified seed producers to make a down payment/ deposit to secure their seed orders.

Lastly, linked with the national seed price-setting procedure, pricing of EGS is made through a joint decision on price setting by the joint meeting of federal and regional public seed enterprises, which is conducting quarterly reviews on a rotational basis. After the decision is made, each enterprise reports the price to its respective board of directors for approval, and the boards accept the price without any changes. The set price is communicated to key stakeholders and is applied accordingly. However, the Amhara and South seed enterprises do not own land for seed multiplication; hence, their seed production costs vary due to overhead for production and transportation costs. Therefore, for these producers, the seed-selling price for major crops is slightly higher than OSE and EABC. The overall direction in price

setting is to sell EGS and certified seed at the relatively same price throughout the country. Currently, the price of EGS of public research institutes are determined based on the price of certified seed. For instance, the price of basic seed is higher by 10 percent, pre-basic 20 percent, and breeder seed by 30 percent above certified seed price. Moreover, except for hybrid maize varieties, there is no differentiation of price between varieties of a given crop. This system is not competitive and affects the volume, quality, and timeliness of EGS that is produced and distributed. Proposed interventions:

a) Address breeder seed quality concerns.
b) Establish inclusive, decentralized, ICT-enabled EGS demand assessment.
c) Establish autonomous seed units within research institutes for EGS production.
d) Furnish irrigation funding for seed production actors.
e) Define minimum internal QC facilities, capacity, and standard operating procedures.
f) Improve the quality of seed storage, processing, and treatment capabilities at EGS producers.
g) Contract EGS production to capable private sector producers.
h) Design incentives for EGS production contract enforcement.
i) Improve EGS access to private seed companies and FCUs.

To do this, the experts recommend that the MOA appoint an institution to chair/coordinate an inclusive EGS platform for annual planning among seed producers, EGS providers, plant breeders, and partners/donors to strengthen the EGS supply and distribution system. The platform should be assigned to a government institution (such as the MOA or EIAR) in the short term and ESA in the long term, should be inclusive of the different key stakeholders, and should include as part of its mandate monitoring equity in accessing EGS for its proper implementation. They should also facilitate ICT-based production planning of the different classes of seed by crop and variety.

Addressing these interventions will require a blend of national and development partner investment, along with organizational and management changes in research institutes and public companies to generate support to build/rebuild EGS production capacity. Direct investments are needed for EGS ICT demand, irrigation, QC facilities, and post-harvest handling and storage. An exercise could be conducted with the MOA and NSAG to see if these investments could be used to incentivize the establishment of autonomous seed units within research institutes, modification of cost accounting, and harmonization of standards, engagement of breeders with pre-basic seed producers, and greater reliance on contracting with private sector seed companies for EGS.

COMMERCIAL PRODUCTION

In Ethiopia, commercial certified seed is produced by three types of producers: public seed enterprises, private seed companies, and FCUs. The assessment was initially in the form of a self-assessment questionnaire of 113 questions, however, due to the robust nature of the research that had evaluate this stage, including a 2018 survey conducted by the ESA, the experts adapted their methodology. Instead of issuing a large self-assessment questionnaire, a comprehensive scan of the existing studies was conducted, and issues and recommendations were extracted and systematically catalogued for two-day FGDs with 35 seed producers from the four agricultural focus regions of the country. The following studies were scanned:

- Alemu, Dawit, S. Rashidu, R. Tripp. *Seed system potential in Ethiopia. Constraints and opportunities for enhancing the seed sector*. International Food Policy Research Institute (IFPRI). 2010.
- ATA. *Seed system development strategy*. 2012.
- ATA. Early generation seed study: Final report. USAID. February 2016.
- ATA. Overview of the ATA and the agricultural transformation agenda in Ethiopia's GTP I and II ATA briefing. 2016.

- Abebe Atilaw, Dawit Alemu, Zewdie Bishaw, Tekeste Kifle, Karta Kaske. Early Generation Seed Production and Supply in Ethiopia: Status, Challenges and Opportunities. *Ethiopian Journal of Agricultural Sciences, 27 (1)*, pp. 99–119. January 8, 2016.
- Edward Mabaya, Bezabih Emana, Fikre Mulugeta, and Mainza Mugoya. *Ethiopia Country Brief*. TASAI. 2017.
- ESA. *An assessment and identification of policy constraints to private seed sector development in Ethiopia.* 2018. [Supported by: the AGRA Micro Reform for African Agribusiness (MIRA) Policy Advocacy Program].
- NSAG, Transforming the Ethiopian seed sector: Issues and strategies. 2019.
- L. K. Mekonen, N. Minot, J. Warner, and G.T. Abate. Performance of direct seed marketing pilot program in Ethiopia: Lessons for scaling up. Ethiopia Strategy Support Program Working Paper 132. IFPRI. 2019.

From this scan and categorization of issues and recommendations, a shorter survey was developed to gather recent perceptions, which was administered to 35 seed producers representing the three types of stakeholders. The experts then held four regional FGDs in central, west, south, and northwest agricultural zones with these stakeholders to rank the importance of constraints and discuss the consolidated recommendations related to the constraints to set up their assessment of recommendation impact and ease of implementation. The companies were also polled on their knowledge and perceptions of eight ATA seed-related projects. The findings were then used to refine the primary bottlenecks and recommendations listed below.

Findings

Overall, the assessment found that, in general, commercial producers are unsatisfied with the current state of commercial seed production and marginally encouraged by recent trends. The varietal release process is perceived as long and not inclusive. The low supply and quality of EGS is constraining commercial producers. Private seed companies are less satisfied with QC than private seed enterprises and FCUs. The DSM program is perceived favorably, but public sector enterprise pricing remains an issue for private seed companies and FCUs. All commercial producers, especially private seed companies, are unsatisfied with capacity-building initiatives and all producers cite technical, financial, and human capital constraints with the external QA system. All producers perceive policies as theoretical and uninformed by private sector constraints; policies lack implementation; and the government has a deep skepticism of the private sector. Commercial producers' awareness of government initiatives and perceived impact on their businesses was as follows: poor satisfaction and negative to neutral on crop variety releases; and negative perception and a downward trend on policy and capacity building. In contrast, most seed producers of all types found the DSM, AOSS, and AgriHub initiatives to support their operations and sales (see Annex II for graphic results of commercial production findings). The assessment highlighted the following constraints and proposed interventions:

1. Private seed sector still in its infancy in terms of size and farmer reach. The private sector can be divided into large international companies like Corteva Agrisciences, a set of private companies that have scale to the point that they can undertake pre-basic and basic seed production, and emerging small companies that often started as outgrowers to public seed companies or to larger private firms. Eighty-seven percent of certified seed in Ethiopia is supplied by public seed companies,[13] mainly hybrid maize and wheat, with increasing amounts of barley and tef, but there is very little interest in sorghum. The private sector has 10 percent of seed market share and focuses almost exclusively on hybrid maize and to a lesser extent bread wheat. Proposed interventions:

a) Provide credit guarantees for investment in the seed sector.

[13] ESA, 2018.

b) Provide access to credit for raw seed buyback from outgrowers (working capital).
c) Incentivize private sector investment through tax relief and forex priority support.
d) Provide irrigable land for private seed producers with isolation distances.
e) Eliminate requirement of land as prerequisite for producer certificate.
f) Promote development of seed sector services industry (e.g., seed testing, cleaning, storage).

The proposed interventions on finance mechanisms for smaller firms will require substantial design work. The banking sector does not regard the private domestic seed industry as a bankable one, given the risks associated with public control prices and market presence.

Land availability is a significant problem and one that has become more difficult because there are no easy access points to the quality and size of land needed to ensure isolation distances. As a matter of policy, the MOA and the government may foster greater private sector investment in the seed sector by allocating land for lease in its planned irrigation expansion investments. This will require planning and advocacy work that could be intermediated by the ESA and NSAG.

2. Maize and wheat-centric commercial seed production. Current marketing efforts of elite varieties is limited, especially in public varietal development programs. Funding for elite variety promotion is limited in public research systems, reducing the opportunity for demand feedback from farmers, seed companies in terms of seed production characteristics, and end-users. Demonstrations are done of released varieties in a wide variety of programs, but there is also significant evidence from DNA testing that farmers are misidentifying crop varieties at a high rate, which suggests that recall demand estimates are not accurate. In addition, Ethiopia's slow domestication and harmonization of its seed trade regulations act as a further constraint on investment by national and international companies in seed production for export. Proposed interventions:

a) Demonstrate differential performance of elite seed varieties of staple grain, legume, and tuber crops to farmers, seed producers, and industry.
b) Incentivize seed production and marketing of prioritized staple crops, plus export-potential crops.

Scoping work is needed to identify and prioritize these interventions.

DISTRIBUTION

In Ethiopia, commercial certified seed is distributed by three main types of agroretailers: agrodealers, AOSSs, and marketing agents, for private seed companies and cooperatives. The experts evaluated the pros and cons of several surveying approaches and chose to pilot an SMS-based survey because of the potential speed and cost advantages over more intensive, in-person approaches. Therefore, a GeoPoll phone survey was designed with AGRA and ATA input, and administered to 150 agroretailers in Amhara; Oromia; Tigray; and the Southern Nations, Nationalities, and Peoples' Region (SNNPR). A limitation of this method was that while the experts were able to gather self-reported information and demographics about the agroretailers, there was no opportunity to follow up with key informant interviews to explain data anomalies or inconsistencies or to gather commentary and gain insight as to the reasons for the answers given (the "why"). However, there are some clear inferences that can be drawn from the responses to access to finance.

Findings

Sixty-seven percent of agroretailers surveyed were marketing agents, 93 percent were male, and 71 percent were the owners of the business. The sample was relatively well-balanced across Amhara, Oromia, and SNNPR, with about 17 percent of the sample drawn from Tigray. Overall, the assessment found that seed sales are a primary source for 47 percent of the respondents. Wheat, tef, and hybrid maize are the most marketed seed products. Agroretailers sell nearly 80 percent of seed directly to farmers. The majority (>70 percent) of AOSSs and agrodealers indicated they are serving more than 1,000 farmers

annually, while this was true for only 38 percent of marketing agents. All the agroretailers rely on informal financing to resource their businesses. Financing and seed supply are the top constraints to selling more seed (see Annex II for graphic results of distribution findings). The assessment highlighted the following constraints and proposed interventions:

Agroretailers are small and capital constrained. The agroretailers surveyed generally sell small amounts of seed, especially the marketing agents, some of whom are engaged in ATA agrodealer capacity-building programs to help reach the requirements for a competency certificate and to develop their businesses into shops selling a broader range of agricultural inputs and services, like those who have graduated to AOSSs. Sixty-six percent of the agroretailers indicate lack of cash to pay suppliers as the main constraint to increasing their seed sales. This seems to be driven by the source of their capital as thirty-six percent get their working capital from relatives and friends and 29 percent list other, which responders' comments suggest is their own savings and retained earnings. Proposed interventions:

a) Provide preferential access to credit for inventory management (working capital) and investment.
b) Capacity building for marketing agents (seed product knowledge, marketing, CRM technology).

The financial intervention could be upstream (underwriting risk of default through supplier credit) or downstream (like the current ATA input voucher program), but needs additional scoping and design work. Buying in public seed companies through joint exploration of how risk or cost sharing could improve forecasting to avoid carryover seed and build agent capacity would be one avenue to explore.

Validation, Prioritization, and Feedback Responses

The Ethiopia validation break-out session held on March 3, 2021 to cover the QA and seed system production and distribution thematic areas included representatives from the MOA, EIAR, private seed companies, FCUs, ESA, donor agencies, AGRA, and BMGF. The sections below highlight the major suggested changes and how they were integrated into the bottlenecks and recommendations mentioned above.

Validation feedback. Attendees agreed with the overall recommendations and presented additional recommended interventions and approaches.

EGS breeder and pre-basic seed. Designate one or two breeders within the EIAR to coordinate EGS production. This does not require a lot of land and would generate a high return if combined with strong general and agronomic management and the building of better working relationships between the breeders and the seed production agronomists for each major crop.

This would require the designation of three research centers (one for highland, one for mid-altitude, and one for lowland) to produce the pre-basic seed needed to reverse the current trend, provided that there are strong contractual agreements and pre-orders with research centers and basic seed producers. It would also require identifying facilities with 10–20 ha of land available (irrigable land, if possible) for seed production; aerated cold storage, depending on elevation; planters; and smaller-scale post-harvest handling, cleaning, and conditioning equipment. The land needs to have the recommended area for the right isolation distances and for the necessary crop rotations to avoid soil, pest, and disease issues. Capital investment and operating budgets will need to be carefully planned and qualified personnel recruited.

Capacity building. Everyone in the seed value chain is responsible for producing and delivering quality from internal controls reinforced with external regulatory QA. Installing a culture of quality improvement will require more training of personnel and cross-training of seed producers with regulatory staff. Doing this requires collaboration and trust between regulators and seed producers, which is currently insufficient. The emerging national private seed companies must be capacitated in terms of human resource development and facilities to perform their internal QC.

Prioritization feedback. The table below presents prioritization feedback from validation workshop participants based on impact and ease of implementation scores.

No.	Recommended Intervention	Impact	Ease of Imple-mentation	Validated Priority
Whole Seed Production and Distribution System				
a)	Designate a responsible unit within the MOA to guide the sector.	High	Low	3
b)	Delineate roles for demand creation of new varieties.	High	Medium	2
c)	Increase seed information availability and exchange.	High	High	1
d)	Establish center of excellence for short- and long-term skill development.	High	High	1
e)	Advocate for the government to recognize seed as potential export commodity.	High	Low	3
EGS Production				
a)	Address breeder seed quality concerns.		High	1
b)	Establish inclusive, decentralized, ICT-enabled EGS demand assessment.		High	1
c)	Establish autonomous seed units within research institutes for EGS production.		Low	3
d)	Furnish irrigation funding for seed production actors.		Low	3
e)	Define minimum internal QC facilities, capacity, standard operating procedures.		Low	3
f)	Improve the quality of seed storage, processing, and treatment capabilities at EGS producers.		Medium	2
g)	Contract EGS production to capable private sector producers.		Medium	2
h)	Design incentives for EGS production contract enforcement.		Medium	2
i)	Improve EGS access to private seed companies and FCUs.		High	1
Commercial Seed Production				
1 a)	Provide credit guarantees for investment in seed sector.		Medium	2
b)	Provide access to credit for raw seed buyback from outgrowers (working capital).		Medium	2
c)	Incentivize private sector investment through tax relief and forex priority support.		Medium	2
d)	Provision irrigable land for private seed producers with isolation distances.		Low	3
e)	Eliminate requirement of land as prerequisite for producer certificate.		Medium	2
f)	Promote development of seed sector services industry (e.g., seed testing, cleaning, storage).		Low	3
2 a)	Demonstrate differential performance of elite seed varieties of staple grain, legume, and tuber crops to farmers, seed producers, and industry.	High	Low	2
b)	Incentivize seed production and marketing of prioritized staple crops, plus export-potential crops.	High	Low	2
Distribution				
a)	Provide preferential access to credit for inventory management (working capital) and investment.	High	Low	2
b)	Capacity building for marketing agents (seed product knowledge, marketing, CRM technology).	High	High	1

Prioritization feedback. The table below displays the prioritization feedback from the participants given during the validation workshop based on impact and ease of implementation scores.

NATIONAL AGRICULTURAL RESEARCH SYSTEMS (NARS)

Vision

The key metric for the success of a breeding program is the rate of genetic gain it delivers in farmers' fields. Investments in breeding programs in the EIAR can only be justified if there is genetic gain over time, thus the need to embark on system changes that would improve the ability of the research system to generate and deliver products efficiently and in a timely manner. The vision of a healthy system includes the following:

- Well-articulated and prioritized product profiles that are consistent with producer needs based on market surveys to guide the breeding program.
- A clear varietal pipeline management strategy.
- Research supported by a team of interdisciplinary scientists focused on the crop product profile.
- Adequate budgetary support from government or other potential sources.
- A program that works in tandem with downstream actors (such as EGS producers, extension and commercial producers, regulatory bodies, etc.) to assure proper handoff and post-release support.
- A focus on continual improvement (product replacement) and adaptation to the changing needs of farmers and markets.

Methodology

The SeedSAT methodology for NARS is a modified version of the BPAT methodology, which addresses key performance metrics that evaluate a breeding program's potential to deliver genetic gain and measure the level of gain achieved by farmers in their production conditions. BPAT was initially developed over a five-year period to focus on plant breeding by CGIAR centers and is currently being tested and modified for use with NARS. The process is intended to support crop-breeding programs that are committed to continually improving the rate of genetic gain. The process is structured to assess program organization, management, and performance using criteria commonly used to evaluate commercial plant-breeding programs. The methodology used for SeedSAT included the following eight strategic objective areas:

1. Customer-centric breeding program with a product development focus.
2. Team capacity and skills to deliver improved varieties.
3. Research infrastructure.
4. Breeding program design.
5. Variety testing program.
6. Variety release.
7. Support for varietal development.
8. Program impact.

The assessment was conducted in three phases: 1) socialization of the NARS component of SeedSAT with MOA and research institute leadership to obtain buy-in; 2) information gathering through two extensive pre-visit surveys retained from the BPAT process; and 3) an assessment questionnaire applied during an in-person, on-site evaluation visit by the product development expert working collaboratively with the plant-breeding teams and the management of the research institutes. For phase 3, the expert revised the BPAT assessment instrument, selecting nationally relevant questions from the original 155 questions to arrive at 127 questions for the in-person SeedSAT assessment.

In Phase 2, each national crop breeding program was requested to complete two pre-visit surveys, one for the breeding program leader and another for the research institute's director. The pre-visit survey for the programs provided relevant content and processes. The pre-visit institutional survey dealt with infrastructure, personnel, budget, and other support functions. These surveys were delivered using the Kobo Toolbox web-based application which enabled offline completion on a range of digital devices. The

detailed information requested through the pre-visit surveys was invaluable in orienting the assessment prior to the in-person, on-site visit. In Phase 3, the in-person, on-site interviews engaged the stakeholders, starting with an institute director briefing, a presentation by the breeding program lead, and the application of a structured questionnaire with follow-up FGDs and facility visits. Based on review of strategy, assessment of program strategy documents and data, answers, discussions, and available direct observations, each question was scored on a 1-4 Likert scale that measures each aspect assessed against criteria commonly used to evaluate commercial plant breeding programs. A scorecard and report were generated describing program strengths and areas for improvement. While accurate scoring is essential to identify priority gaps for filling, the effort is also intended to demonstrate a process that combines the discipline of the framework and external perspective with internal experience to identify strengths and weaknesses. Research institutions are also encouraged to use the tool for self-improvement regardless of donor direction, and to repeat the assessment to measure change about three years into implementation of improvements.

For the NARS assessment, the expert collaborated with EIAR research programs to assess each of the four focus crops—maize, sorghum, wheat, and tef. In Ethiopia, maize, sorghum, and wheat breeding programs already receive support from the MERCI project. Their inclusion and their comparison with the tef program were designed to test the interpretive power and to enable further adjustments to this component of SeedSAT.

The results of the assessment are intended to assist institutions to develop and implement program improvement plans nationally, with the complementary assistance of interested investors, including donors. The relatively recently created CGIAR Platform for Excellence in Breeding (EiB) may be a useful link to support elements of program improvement plans. More detailed information on the methodology can be found in Annex II and in the *SeedSAT Guide*.

Findings

The EIAR was established to carry out crop and livestock improvement research through a network of 21 national research centers spread throughout representative agroecosystems in Ethiopia. EIAR programs are relatively well-resourced, with a significant amount of the total budget allocated to each program provided by the Ethiopian Government. The breeding teams have trained scientists, with breeders and scientists of complementary disciplines. Each breeding team has been productive with releases in each of the four focus crops in the last five years.

The breeding program assessment identified high-priority areas that the EIAR should address to realize genetic gain in breeding programs and for farmers. Key product profiles need to be formally documented and used to drive decision making for all crop improvement. The basis of good product profiles at the EIAR was evident (except for tef), but all need refining to drive the breeding program and allocation of resources.

There are many shared challenges and opportunities for improvement at the EIAR and a team approach is needed to bring scientists together. Cross-crop and discipline interactions should be encouraged to make the best use of expertise and knowledge. Multidisciplinary scientists organized as a team will be able to deliver on the specific traits indicated in the product profiles. It is incumbent on the EIAR to better integrate the disciplines of breeding, pathology, entomology, agronomy, and data management to achieve the common goal of continuously improving genetic gain efficiently and to contribute to advancing the EIAR strategy.

None of the four crops have a formal system in place to monitor performance of released products in commercial production. Seed produced is considered as a proxy for adoption. Post-release product performance needs to be monitored and the data used to drive decisions in the breeding program. It will be important to have methods in place to estimate genetic gain made in each program.

Regarding breeding methodology, sufficient planning is essential to set up the crossing block and numbers in the various stages/generation of breeding, so that after each subsequent generation of selection there would be adequate testing material at the end of inbreeding.

Significant efficiency could be made by tracking cost metrics, which would lead programs to consider mechanization or find alternate ways of doing field and post-harvest operations to better utilize resources. Some aspects of mechanization need to be addressed in all four breeding programs with emphasis on planting and harvesting operations, barcoding for seed storage, and inventory. The Tef program should introduce data capture, labeling, data analysis, and inventory management that will provide substantial efficiencies in many breeding program operations.

The inability to have testing material at the end of the inbreeding cycle results from lack of advanced planning and insufficient resources (personnel, budget, land, etc.). Entries are at times so few, it is difficult to exercise good selection pressure to result in elite material, though this is gradually changing in maize, sorghum, and wheat crops.

A high-level presentation of the top bottlenecks, issues, and associated recommendations is given below. More detail behind the assessment results and scores by crop can be found in Annex II.

1. Breeding organization. Collaborations among disciplinary scientists is largely ad hoc and there is limited staff capacity to manage a results-driven breeding agenda.

2. Product profiles. Market segments and priority constraints are not well-defined, especially for tef. There is diffuse program focus and a lack of rationale for investments.

3. Infrastructure. There are limited facilities to screen for defensive traits; inadequate mechanization, digitization, and data management protocols; and poor seed storage facilities that result in losses.

4. Breeding and testing strategy. Crossing strategy for developing superior varieties was not well-defined. There is an inadequate breeding pipeline (such as the number of crosses, population size, and germplasm diversity). The testing effort is of limited size and quality.

5. Program impact. The variety turnover/age of varieties on farm is not adequately monitored. Variety turnover at the farm level is lower than current survey methods reveal and the age of varieties in common use is older than desirable. There is inadequate scaling out to larger target areas, which may be constrained by extension and demonstration linkages. Measuring genetic gain-post release at the farm level is constrained by the cost of data collection.

6. Budget and cost metrics. Poor financial planning and tracking of costs has resulted in an increasing proportion of the budget being spent on salaries rather than operations.

It was apparent that three crops—maize, sorghum, and wheat—showed better scores for many of the assessment components relative to tef. This is mainly due to the fact that in the last four years there has been a concerted effort to modernize the breeding approaches of the three crops through involvement of a University of Queensland (UQ) team supported by BMGF. The EIAR partnered with UQ to successfully implement the MERCI project and improve its breeding programs' capacity through specific interventions in strategic planning for capacity improvement, enhanced varietal development pipelines, product support, and go-to-market strategies. Proposed interventions:

> **1. Breeding organization.** Organize disciplinary scientists as a team to work on priority issues and establish performance-management metrics. The EIAR needs to establish formal mechanisms to encourage collaboration across disciplines or divisions that would help in meaningful interaction across various disciplines and breeding teams. Moreover, the EIAR should integrate these complementary disciplines (breeding, pathology, entomology, genomics, data management, etc.) toward a common goal of achieving genetic gain efficiently and contribute to advancing the EIAR vision. Sustained interaction across discovery, development, validation, and deployment teams is

essential to realize intended outcomes. Considering the available budget and skill gap of each commodity, a plan should be put in place to train and retain and researchers in various disciplines. A mechanism that facilitates interaction across research disciplines is essential to help the breeding programs become efficient and effective in meeting the expectations of developing a required product, i.e., an improved variety or hybrid. Interactive communication and collaboration between breeders and other disciplines will enable joint planning and establish expectations and time frames for achieving them; documenting current status; sharing best practice; and discussing priorities, requirements, and costs to implement the activities.

To achieve this, an organizational set-up is needed to foster teamwork and establish incentive systems focused on a product. A good example is the private sector seed industry's organizational focus and team incentivization around successful product development. Gaining each other's confidence and communicating expectations should be guided by the end-product, i.e., an improved variety or hybrid. Current research around this objective does not appear to be formalized and remains ad hoc. It is incumbent on project leaders, with support from relevant team members, to map out performance plans (such as annual targets, timeline, cost, cross-crop efficiency, workload, etc.) both in the lab and field, so that priority projects are completed.

2. Product profiles. Develop well-defined and market survey-based product profiles consistent with producer needs to guide the breeding program. There is a need to focus on product specifications for the main production areas and consumers. EIAR breeding programs should articulate a clear product profile that will guide product development, deploy the most efficient and economical processes that enable timely identification of a superior product, and ensure handoffs to downstream actors in the seed value chain, seed producers, and extension personnel.

An efficient breeding program is guided by focused product profiles and/or breeding targets to align all crop improvement disciplines on priorities. It defines project objectives and assignments with respect to traits, maturities, and geography. Product profiles provide direction and a check on the proportion of effort to address each of the markets/ecologies. Product profiles will help decide: 1) the combination of products required by stakeholders (growers, processors, marketers, and consumers) to ensure that the program is addressing stakeholder needs; 2) which traits to prioritize based on market size consistent with beneficiary requirements; 3) size of nursery and yield test entry lists to reflect breeding targets; and 4) product lifecycles.

With the exception of tef, the product profiles for maize, wheat, and sorghum resulted from internal strategic discussions enabled through MERCI project assistance. The basis of good product profiles was evident from presentations made by the breeders, but these need some refinement and linkage to the breeding and testing effort. The challenge is to develop product profiles that incorporate the needs of target regions and serve as a blueprint for each of the crop improvement teams. Product profiles should largely be based on consumer/producer needs within the broader production zones. The size of effort, resources, and cost for each zone in nursery; yield tests; and screening activities should reflect the priorities. This will enable more effective alignment of the breeding program by addressing the right environments and clients.

Detailed discussion revealed that different programs have started collating information on product profiles; however, breeders should question whether they have too many product profiles for the resources at their disposal. In addition, the product profiles should be market-data driven, something requiring additional effort to document this information. Some of the information is available, but needs to be better organized to direct the breeding and testing activities.

3. Infrastructure. a) Establish greenhouse/field screening for defensive traits, mechanization, digitization, and data management; and **b)** ensure adequacy of seed stores, labs, irrigation facilities, etc. The EIAR should consider investments addressing infrastructure improvements at the

institutional level to enable better planting and harvesting capacity, including irrigation and upgraded labs. Electronic data capture, field books and bar coding, and other management improvements have started and should be integrated into other national programs, like tef. A breeding program relies on basic infrastructure that enables timely and cost-effective operations along with maintenance and engineering support. A successful breeding program requires short-term and long-term seed storage, both of which need to be put in place and combined with well-planned inventory management.

A important component of the program is the ability to screen materials for resistance/tolerance to a range of pests and diseases. Since the overall aim of the breeding program is to improve yield due to reduced impact of pests and diseases, it is imperative that resistant phenotypes be accurately identified. To do this effectively, labs, green/screen houses are needed to evaluate young plants under artificial conditions of disease or pest infestation, in addition to screening phenotypes at field sites where the disease or pest is present at sufficiently high levels.

Lack of mechanization has a negative impact on a program's rate of genetic gain. The existing level of mechanization at the EIAR was limited and had little impact on the breeding programs. Most field operations are done manually, other than some land preparation and the beginning use of threshers on some crops for yield trials. There are several examples of poor engineering support for machinery maintenance at the stations. This is due to a lack of knowledgeable technicians and spare parts, and, at times, inappropriate machinery for the operation being done. Mechanization, automation, and digitization improve accuracy and timeliness. Planting and harvesting at the right times are important consideration for successful pipeline development. The EIAR needs to apply a higher priority to the support infrastructure and machinery that will improve the effectiveness of product development.

4. Breeding and testing strategy. a) Establish a well-defined crossing strategy based on comprehensive data sets on parent lines; **b)** set a pipeline strategy to include variety development, parent development, and trait donor development; and **c)** revise testing strategy, including experimental design, number of locations, and repetitions. EIAR programs should connect breeding pipelines to final commercial products and put in place a system that is more consistent and well-articulated. Numbers in the various stages/generation of breeding should be such that after subsequent generation of selection there would be adequate test material at the end of inbreeding. The focus on number of crosses should shift toward a more targeted approach based on combining the best genetic attributes. The selection of parents in the crossing blocks should be prioritized based on highest-priority needs. A long-term breeding plan needs to be developed that demonstrates a focused approach, which will improve the quality of breeding populations. There has been some effort to define early generation nursery population sizes, as well as the target selection intensities to be applied. In addition, the number of entries at each stage of testing, plot sizes, and target selection intensities were established for maize, sorghum, and wheat. There has been an increased number of entries in yield testing stages across all crops, with the exception of tef. The yield test programs for maize, sorghum, and wheat were redesigned by establishing metrics around numbers at each stage: observation tests, preliminary, national, and variety verification trials, along with number of locations, repetitions, and plot dimensions. Establishing representative testing sites in the appropriate environments so that breeding, selection, and testing will be efficient and effective in delivering products with critical traits and local adaptation will require interpreting available data through analysis and delineation of the target population of environments. It is imperative to assess whether test environments were correlated in terms of discriminating among genotypes.

5. Program impact. a) post-release data collection; **b)** measuring genetic gain (era studies, long-term trial data, regression of yield over time; and **c)** alignment of the value chain from R&D to adoption through better coordination of activities. Post-release product performance should be monitored, and data used to drive decisions in the breeding program. There has been some preliminary data from the Diffusion and Impact of Improved Varieties in Africa (DIIVA) project that collected data on

improved crop varieties of maize and wheat in Ethiopia. Investing resources in impact assessment and impact pathways should be strengthened through adoption studies. If newer releases do not provide an advantage based on yield and other required traits, adoption may be low; thus, it is necessary to align releases with product profiles to enable the right placement of improved varieties. It will be critical to have methods in place to estimate genetic gain made in each program. Any methodology developed to measure genetic gain in the breeding program should also incorporate realized genetic gain (i.e., the benefit to the farmer). There are indirect and direct measures of genetic gain. The indirect measures of genetic gain would be how, and to what extent, the breeding program is adopting/ implementing changes in internal efficiencies and germplasm use that will set the breeding program on a path of genetic gain. It is important that the genetic gain of released varieties be actively monitored by periodically assessing the performance of newer products relative to varieties previously released. Performance of released varieties, including proportion of cropped area under improved varieties, should be tracked to determine the impact of new varieties.

6. Budget and cost metrics. a) provide adequate budgetary support from government or other potential sources; **b)** improve financial planning and tracking of costs so that budgets reflect the need for investment and; **c)** establish performance-management plans. Tracking of activity-based breeding costs will drive efficiencies in the programs. Assessment of the opportunities to repurpose current budget investments from low-return activities and redirect their use to high-impact outcomes requires determination of the cost metrics of all breeding program activities. This effort should be viewed as an enabler of change and innovation within the breeding program. A costing tool has been put in place where initial costs of nursery and yield trial plot components (PCs) are defined and costed. Three teams (maize, sorghum, wheat) have gone through this exercise and modeled their breeding and testing activities using the costing tool. The pipelines for all PCs were costed, and costs were compared for the current pipeline and the planned maximum size. The planned required area for trial series for each PC was calculated and discussed with all cooperating centers. Tracking financial metrics on an organizational level will drive efforts in continuous improvement through benchmarking. Going forward, breeders need to disaggregate these figures and establish some financial metrics that will help not only in budgeting, but also in the search for cost savings. Initially, it is a good idea to take stock of the most expensive operations for cost analysis. The idea is to question current practices and come up with alternatives that are less expensive.

Cost Estimates

Overall, high-level cost estimates for implementing the recommended interventions ranges from a low of $2.5 million to a high of $4.5 million per crop. The high-level cost estimates given in the following table are given for tef only. They are modeled after the investment made under the MERCI project over a four-year period per crop for wheat, maize, and sorghum. The low estimate covers interventions #1–3a only, while the high estimate includes the additional interventions. However, a more comprehensive program improvement plan needs to be worked out to get more detailed and accurate component costing. Designers of the improvement plan may find the EiB costing tool useful, as it provides a standardized output for consideration by investors. The maximum cost includes the expertise that will be needed to develop and execute the comprehensive program improvement plan, incorporating the other recommended interventions.

Please note that the extent of the effect of the bottleneck varies from crop to crop and that additional investment or reprogrammed investment may be needed for maize, wheat, and sorghum, following consideration of the recommendations by the teams for those breeding programs.

No.	High-Level Costing of Recommended Interventions	Low (US$)	High (US$)
1	Organize disciplinary scientists as a team to work on priority issues.	580,000	
2	Develop well-defined and market survey-based product profiles.	700,000	

3a	Establish greenhouse/field screening, mechanization, digitization, data management.	1,300,000	
3b	Ensure adequacy of seed stores, labs, irrigation, greenhouse facilities.		
4b	Set pipeline strategy: variety, parent, trait donor development.		
4c	Revise testing strategy: design, number of locations/repetitions, etc.		
5a	Conduct post-release data collection for measuring genetic gain.		
6a	Provide adequate budgetary support from the government or donors.		
6b	Track activity costs to drive efficiencies in the program.		
6c	Establish performance-management metrics.		
	Grand Total	***$2,580,000***	***$4,500,000***

Validation, Prioritization. and Feedback

During the SeedSAT Ethiopia validation workshop, a breakout session was devoted to NARS and breeding effectiveness. This session included 20 participants from the MOA, ATA, EIAR, RBOA Amhara, parastatal and private seed companies, International Maize and Wheat Improvement Center (CIMMYT), International Center for Agricultural Research in Dry Areas (ICARDA), and AGRA. The guided and facilitated session aimed first to validate the findings—in other words, determine if the bottlenecks and interventions were accurate and complete; and second, prioritize the interventions based on their estimated level of impact (high, medium, low) to the system and their relative ease of implementation (high, medium, low).

Validation Feedback

Breeding organization and institutional collaboration. During the summary presentation, participants pointed to a bottleneck at the national level, where they noted there is a lack of collaboration between national and regional research institutes working on the same crop. This has been a vexing issue for a long time. In 2016, the Ethiopian Agricultural Research Council and a Council Secretariat were established to coordinate national and regional institutions and improve the linkage between agricultural research and users of research products, but progress has been slow. Participants also suggested that the recommendations include the need for collaboration between national programs and the CGIAR platform for EiB.

Production profiles/market segment and priorities. Participants suggested that a recommendation is needed to prioritize investment levels across the 60 crops in national research programs. The scope of the assessment was limited to the four cereal crops and focuses on prioritization of recommendations within those crops. The NARS and breeding effectiveness expert agree that more prioritization among crops is needed.

Infrastructure. Participants suggested that a recommendation is needed to support investment in irrigation for speed-breeding, and another is needed for laboratory upgrading and rehabilitation. The NARS and breeding effectiveness full written report includes recommendations for investment in irrigation and for facility upgrading and rehabilitation.

Breeding and testing strategy/crossing strategy. Researcher consensus in the meeting was that the wheat, maize, and sorghum strategies were stronger than the assessment indicated. They stated that only the tef program needed a better breeding strategy. They also were looking for more specific recommendations on improvements to testing site specifications and for better varietal maintenance (preservation of morphogenetic features) of the seed used for testing. The expert agrees that the scores for breeding and crossing strategies for wheat, maize, and sorghum are higher than for tef, which needs immediate attention, but that all four crop programs should upgrade their breeding strategies as part of an improvement program. In terms of testing strategy, the recommendation is that each crop program needs to identify, based on available data, which testing sites would represent the total population of environments to generate data that would represent the broader production environments.

Program impact, scaling out new varieties. Participants stated that the assessment misses the fact that there is limited EGS for scaling, and that current breeding programs have only limited varietal promotion activities (note that EGS is covered extensively in another part of SeedSAT, along with the linkage of research programs to varietal promotion).

Program impact, measuring genetic gain. Researchers indicated that they needed capacity building in measuring genetic gain and methods to apply to measuring genetic gain under farmer conditions. The full narrative assessment report has outlined approaches to this need.

Program impact, variety turnover. Participants asked: "Why is varietal turnover a good thing?" The assessment applies a commercial breeding program perspective that a well-designed improvement program will identify new and better products every so often to replace products released in previous years. Varietal replacement measured at the farmer level as adoption that displaces older materials is a demonstration that genetic gain is being perceived and delivered to the market for that crop.

Budget and cost metrics. There was controversy about the finding that breeding programs were increasing the proportion of their program spending on salaries versus operations and why this was a problem. Participants asked that this metric be better defined. The assessor's explanation is that scores are reduced when an imbalance is created by an increased proportion of budget being allocated to personnel. When budgets are flat or variable, fewer funds would be available for operations and maintenance. In extreme cases, programs would end up paying researchers and staff who would not able to execute the business of research, because there would be little or no funds for trials, travel, labor, fuel, and other variable expenditures.

The participants also commented that perhaps the bottlenecks may not apply to all crops uniformly. What is true for wheat may not necessarily apply to tef. The assessor agrees and notes that the assessment scores show both strengths and areas for improvements across all crops, and that these differ by crop.

The participants did not have time to discuss the costing in detail, however, the general opinion was that the costs seem to be lower than what the actual costs may be. The expert noted that the high-level costing done was primarily for the tef program, which is underfunded, and that performance-improvement plans are needed to permit more comprehensive costing for tef, as well as wheat, maize, and sorghum.

Prioritization Feedback

There was general agreement that all interventions recommended are important and need to be pursued to achieve system improvement. They judged that all are potentially high in impact, but differ in the ease of implementation, which may affect their sequencing. Participant consensus scoring is shown below. The recommendations seen as hardest to implement are organizing researchers from different science disciplines to work as a team, developing well-defined product profiles based on market surveys, tracking activity costs to drive efficiencies in the program, and establishing performance-management metrics. These all require shifts in management orientation and practice.

Participants found the rating definitions for ease of implementation of "high," "medium," and "low" confusing. They recommended that future workshops use the terminology "difficult," "medium," and "easy" for implementation.

No.	Recommended Intervention	Impact	East of Implement-ation	Expert Proposed Priority	Validated Priority
1	Organize disciplinary scientists as a team to work on priority issues.	High	Low	N/A	
2	Develop well-defined and market survey-based product profiles.	High	Low		
3a	Establish greenhouse/field screening, mechanization, digitization, data management.	High	Medium		
3b	Ensure adequacy of seed stores, labs, irrigation, greenhouse facilities.	High	Medium		
4b	Set pipeline strategy: variety, parent, trait donor development.	High	High		
4c	Revise testing strategy: design, number of locations/repetitions, etc.	High	Medium		
5a	Conduct post-release data collection for measuring genetic gain.	High	Medium		
6a	Provide adequate budgetary support from the government or donors.	High	Medium		
6b	Track activity costs to drive efficiencies in the program.	High	Low		
6c	Establish performance-management metrics.	High	Low		

NATIONAL POLICY, LEGAL, AND REGULATORY (PLR) FRAMEWORK

Vision

PLR systems provide a lens through which to assess a country's seed system; evaluate implementation challenges; identify relevant regulatory good practices and models that have worked in other markets; integrate legal and political economy considerations to evaluate how policy, law, and regulation can work as an incentive (or disincentive) for change; and identify which interventions could be prioritized. A well-developed policy and regulatory environment is central to a functioning seed system that ensures farmers access to affordable, available, and high-quality seed. Key elements of the seed system: 1) breeding and variety release; 2) EGS supply; 3) certified seed production; 4) awareness by farmers; and 5) seed marketing and distribution are affected by, and require adequacy of, the policy and regulatory environment at national, regional, and international levels. The vision of a healthy seed system includes components, policies, and regulations that:

- Promote rather than restrict private sector access to public varieties.
- Allow the private sector to produce EGS to complement government institutional capacity to meet the needs of farmers.
- Provide for third-party seed inspection with audit and oversight from government regulatory agencies.
- Promote quality and standard seed inspection services.
- Are conducive to the domestication and implementation of regional harmonized regulations.
- Prevent the distribution and sale of fake or counterfeit seed.
- Provide clear and simplified registration processes for seed producers and traders.
- Provide guidelines for strong variety development and variety release.
- Provide guidelines that stipulate, ensure, and enforce adherence to packaging and labeling requirements.

- Ensure that the private sector is aware of policies and rules and has access to updates; and that channels and systems exist to allow for private sector engagement, feedback, and right of action where appropriate (e.g., against counterfeit products).

Methodology

The assessment of Ethiopia's PLR environment was based on the structure of the enabling environment and an existing methodology focused on legal and regulatory design and implementation aspects developed by New Markets Lab.[14] The methodology used for SeedSAT included the following five strategic objectives:

1. PLR design (structure of system and process of regulatory development).
2. Efficiency of the PLR system that tracks the time and cost of completion of regulatory processes.
3. Legal and regulatory gateways that establish regulatory preconditions.
4. Engagement in the PLR system, with assessment of channels for clear stakeholder participation.
5. Effectiveness of the PLR system designed to assess the extent to which policies, laws, and regulations achieve their purpose.[15]

Based on these five objectives, the experts developed a master list of 112 indicator questions to guide the assessment. The expert team then conducted a comprehensive legal assessment of Ethiopia's PLR system guided by the 112-question master list through primary and secondary research to identify gaps in the regulatory framework and possible issues with implementation. Based on the results of the initial legal assessment, the expert team then identified a sub-set of 40 indicator questions from the master list that represented the most common issues noted. The expert team then developed questionnaires to guide in-person consultations with public and private stakeholders that aligned with the selected 40 indicators. The team consulted stakeholders from the public sector, including the MOA, RBOA, EIAR, and members of the technical and variety release committees. Private sector stakeholders include the seed trade association and seed companies of different sizes, as well as farmer producer organizations and cooperatives. The expert team used both a Likert scale (1 to 4) to assess the relative level of satisfaction with the PLR system, as well as non-scored qualitative questions. More detailed information on the methodology can be found in Annex II and in the *SeedSAT Guide*.

Findings

Ethiopia's PLR framework has recently begun undergoing transformation, with the passage of a new Seed Policy in 2020 and a new Draft Seed Proclamation at an advanced stage of enactment. The changes to Ethiopia's PLR framework are mainly aimed at making the seed sector more open to the private sector; streamlining the processes involved in the development, production, distribution, and trade of seed; creating and defining institutional mandates; and aligning the system with the 2014 COMESA Seed Trade Harmonisation Regulations and international standards. In addition, regulations under the PBR Proclamation are under development, as are new Plant Quarantine Regulations, although the latter have been in draft form for more than a decade. While the new policy and proposed draft proclamation are commendable developments, many of the new PLR instruments remain in draft form and have not yet been enacted. Consultations with the private sector have revealed that private sector interests are largely unrepresented within the current legal framework, and, while this is a gap that would be addressed by the proposed draft proclamation, the new law is not yet in place. The seed sector is currently regulated under the Seed Proclamation of 2013, Council of Ministers Seed Regulation No.375 of 2016, Rate of Fees for Seed Competency and Related Services, Council of Ministers Regulation No. 361 of 2015, PBR Proclamation No. 1068 of 2017, Plant Quarantine Proclamation No.36/1971, Plant Quarantine

[14] New Markets Lab, "Dimensions of Policy, Legal, and Regulatory Implementation," 2019, available at https://www.newmarketslab.org/about and Katrin Kuhlmann and Bhramar Dey, "Using Regulatory Flexibility to Address Market Informality in Seed Systems: A Global Study," *Agronomy* 2021, 11, 377.

[15] Ibid.

Regulations No.4/1992, 2013 MOA Seed System Development Strategy, and several ministerial directives, including the Public Crop and Forage EGS Administration, No. 005/782/2012.

A list of relevant PLR instruments consulted is in Annex VIII. A summary of the top bottlenecks, issues, and associated recommendations are below and more detail behind the assessment results can be found in Annex II.

- **Weak private sector participation and capacity to influence policy and regulatory measures** (*this constraint was also highlighted under NPC and QA*). Unfortunately, most private seed sector stakeholders in Ethiopia noted that they are usually not engaged during development of regulatory instruments. Seed companies noted, for instance, that only public seed enterprises and a few farmer cooperatives tend to be consulted. This limited engagement was also cited as the main reason that the current legal framework affords preferential treatment to public seed enterprises over private seed companies. Seed companies noted that even where a negligible effort is made to engage them through the seed traders' association, private sector issues and interests are often not reflected in regulatory instruments. Notably, although not binding, the Seed Policy passed in 2020 was designed to make the seed industry more inclusive of the private sector, including through recognition of practices like "self-QA" that allow for private seed QA programs and harmonization with regional seed rules to allow more private sector engagement in the market. These issues have been reiterated in the Draft Seed Proclamation, which is currently at an advanced stage of enactment. This need for private sector improvement is addressed under the NPC thematic area and the recommendations to strengthen the ESA and to strengthen national and regional coordination entities.
- **Insufficient funding for public institutions, including research** (*this constraint was also highlighted under NPC*). Under Ethiopia's Science and Technology Policy of 1993 (revised in 2007), the government committed to spending 1.5 percent of the country's GDP on R&D.[16] This, however, has never been realized. In fact, government funding for public research has significantly decreased, falling from 0.61 percent in 2013 to 0.23 percent in 2017.[17] Stakeholders noted that funding for public research institutions continues to be limited, even where supplementary financial support is provided by donors through grants. Limited funds have affected timely production of quality EGS, development of quality varieties, and capacity for personnel.[18]
- **Lack of independent national and regional seed authorities** (*this constraint was also highlighted under QA*). Both the MOA and RBOA have limited capacity for addressing seed issues, which adds to the time and cost of PLR processes, such as variety registration and release and certification.[19] Establishment of an NSA, as called for by COMESA, as well as regional/sub-national regulatory authorities, will improve the PLR system and build institutional infrastructure through specialized institutions at the federal and regional levels, which can prioritize seed-related matters and improve coordination with authorities under seed rules. There should, however, be sufficient budgetary allocations to implement institutional activities without going through the formalities of obtaining funds through the MOA.
- **Inadequate legal infrastructure for EGS supply** (*this constraint was also highlighted under EGS*). EGS distribution is regulated under the Public Crop and Forage EGS Administration, No. 005/782/2012. Research institutions enter into memoranda of understanding (MOUs) with private

[16] UNCTAD, "Ethiopia Science Technology and Innovation Policy Review," 2020 at page 6. Available at: https://unctad.org/system/files/official-document/dtlstict2020d3_en.pdf.

[17] See, Wondwosen Tamrat, "Catalysing R&D – The need for More Government Funding," available at: https://www.universityworldnews.com/post.php?story=20191028062534176.

[18] See, Abebe Alilaw, et al., "Early Generation Seed Production and Supply in Ethiopia, Challenges and Opportunities," Ethiop. J. Agric. Sci. 27(1) 99–119 (2017), at pg. 114–15.

[19] New Markets Lab, "Annotated Comments and Recommendations on Ethiopian Seed Laws and Regulations," with AGRA and COMESA, November 2020.

sector actors, including seed companies, to supply them with EGS,[20] and a demand assessment is made prior to EGS production.[21] These MOUs, however, are not binding, nor are they complied with in practice. In particular, stakeholders noted that EGS demand is usually not met and that even the minimum that is supplied is sometimes of poor quality, which results in losses for seed producers. The private sector also noted that public research institutions usually fail to comply with the EGS MOUs to which they agree.

- **Incomplete legal framework for licensing of public varieties.** Private sector stakeholders consulted showed overwhelming interest in entering into licensing agreements with the public sector to commercialize publicly developed varieties. Public sector breeders and research institutions also supported licensing of public varieties to seed companies, with the EIAR noting that there is a directive in draft form awaiting ministerial approval to allow public research institutions to license their varieties to private seed companies, which they recognize will be a platform for earning extra income that can be directed toward development of research and motivation of breeders.
- **Incomplete legal framework for plant variety protection (PVP)/PBR.** Unfortunately, the legal framework on protection of varieties and PBR is still incomplete in Ethiopia. The PBR Proclamation was enacted in 2006 and amended in 2017, but no regulations have been passed under it to provide procedural guidance on enforcement of the law. Moreover, the institutional framework for PBR is incomplete. The absence of a complete legal framework on PBR could discourage investment in the seed sector, especially by international seed companies that are planning to expand operations in Ethiopia. Stakeholders ranked relevance of a legal framework on PBR high.
- **Insufficient institutional capacity and resources to conduct distinctness, uniformity, and stability (DUS)and value for cultivation and use (VCU) testing.** According to Seed Regulation 5, the MOA is responsible for conducting DUS testing and national performance trials (NPTs) prior to registration of varieties. However, at present, variety testing is done by research institutions and universities, based on letters of support from the MOA, subject to an application process.[22] If a research institute or university applies for variety registration, the institute will conduct the NPT itself.[23] Stakeholders noted a likely conflict of interest, since the same research institutions that conduct the evaluation testing are ultimately in competition with the private sector. Stakeholders also noted that the fees charged by the research institutions are not in accordance with the Fees Regulation, making the process more expensive and at odds with legal measures, with the cost of NPT ranging between $5,650 and to a reported high of $33,700 depending on the type of crop.[24] This prevents companies from registering varieties that may be of greater public interest, yet which are not as commercially viable. Companies have also expressed frustration with management of the evaluation tests by the research institutions, contending that they lack the required capacity to effectively assess certain characteristics (for example, several varieties have previously failed to exhibit clear VCU traits).[25] This was validated through stakeholder consultations.
- **Insufficient funding for technical and National Variety Release Committee (NVRC) meetings.** The government lacks sufficient funding to cover the costs of the NVRC to evaluate NPT data and convene the NVRC. The MOA brings experts from different organizations to form the NVRC for variety evaluation on an almost voluntary basis. What the Ministry can afford to pay in terms of per

[20] Abebe Alilaw, et al., "Early Generation Seed Production and Supply in Ethiopia, Challenges and Opportunities," Ethiop. J. Agric. Sci. 27(1) 99-119 (2017), 106-107. file:///C:/Users/golde/AppData/Local/Temp/07Abebeetal.Page99-119.pdf.

[21] Abebe Alilaw, et al., "Early Generation Seed Production and Supply in Ethiopia, Challenges and Opportunities," Ethiop. J. Agric. Sci. 27(1) 99-119 (2017), pgs. 106-107. See also, Bishaw, Z. and Atilaw A., 2016, "Enhancing Agricultural Sector Development in Ethiopia: the role of Research and Seed Sector," Ethiopian Journal of Agricultural Sciences (EJAS) (Accepted).

[22] Mohammed Hassena, et al., "Institutional Mapping and Needs Assessment of Ethiopia's Public Seed Sector Services," Wageningen Centre for Development Innovation Wageningen, February 2020. https://www.rvo.nl/sites/default/files/2020/03/IMNA-Ethiopia-Public-Seed-Sector-Services.pdf.

[23] Ibid.

[24] Ibid.

[25] Ibid.

diem and travel costs is insufficient, which discourages participation.[26] The MOA is also short of funds to convene the NVRC in a timely manner. For instance, in 2019, the NVRC only met once instead of the officially scheduled twice per year (indicator 36 on the regularity of the NVRC meeting schedule).[27] This was validated through stakeholder consultations.

- **Incomplete legal framework on trade and SPS.** Importers and exporters must comply with Ethiopia's SPS measures, which are provided for under the Plant Quarantine Proclamation No.36/1971 and Plant Quarantine Regulations No.4/1992. The two regulatory instruments, however, do not address non-compliance notifications[28] or define terms like phytosanitary measures, quarantine, and point of entry, contrary to the COMESA Seed Trade Harmonisation Regulations.[29] The national quarantine pest lists are also not updated or published, which is out of alignment with the COMESA regional rules. Ethiopia could address these gaps under the Plant Quarantine Regulations, which are currently under revision.[30] This was validated through stakeholder consultations.
- **Absence of ISTA-accredited lab** (*this constraint was also highlighted under QA*). Under the 2016 Seed Regulations, Ethiopia's certification process must be in alignment with ISTA requirements.[31] Ethiopia does not yet have an ISTA-accredited laboratory, which affects regional and international acceptance of locally produced seed and increases importation costs, because all seed is required to be accompanied by an ISTA Orange Certificate.
- **Incomplete harmonization with regional seed rules.** The COMESA Seed Trade Harmonisation Regulations are binding on Member States, but still require domestication at the national level to enter into effect.[32] While Ethiopia is taking steps to align the national PLR system with the COMESA Seed Trade Harmonisation Regulations through the 2020 Draft Seed Proclamation, Ethiopia's current seed system follows the 2013 Seed Proclamation, which is not aligned with COMESA rules. However, even the 2020 Draft Seed Proclamation does not address all gaps. Ethiopia does not provide for an expedited (fast-tracked) variety registration processes as required under the COMESA Seed Trade Harmonisation Regulations. Under COMESA seed rules, a variety that has been registered and released in one COMESA Member State only needs to undergo one additional season of confirmation testing (DUS and VCU/NPT) in order to be released in another Member State; and varieties registered in two or more COMESA Member States should be accepted without confirmation testing.[33] Ethiopia, however, requires an additional confirmation test even where a variety has been registered in two COMESA member states, contrary to the COMESA regulations. In consultations, stakeholders noted dissatisfaction with the requirement for retesting.
- **Ineffective implementation of anticounterfeiting measures.** Under Article 26 of the 2013 Seed Proclamation, sale of counterfeit, substandard, or fake seed is an offense punishable by imprisonment of 5–10 years and a fine ranging from Birr 50,000 to 100,000. However, neither the 2013 Seed

[26] Mohammed Hassena, et al., "Institutional Mapping and Needs Assessment of Ethiopia's Public Seed Sector Services," Wageningen Centre for Development Innovation Wageningen, February 2020. https://www.rvo.nl/sites/default/files/2020/03/IMNA-Ethiopia-Public-Seed-Sector-Services.pdf.

[27] Ibid.

[28] Article 34 of the COMESA Seed Trade Harmonisation Regulations require that the regulatory authority of an importing Member State issue a prescribed non-compliance notification to the regulatory authority of an exporting Member State under described circumstances.

[29] COMESA Seed Harmonisation Implementation Programme (COMSHIP), Mutual Accountability Framework Meeting Proceedings, Addis Ababa, Ethiopia, February 23-24, 2016, pg. 7. Available at: http://africaleadftf.org/wp-content/uploads/2016/09/COMSHIP-Mutual-Accountability-Meeting-Final-Report-8-4-2016.pdf.

[30] New Markets Lab, "Annotated Comments and Recommendations on Ethiopian Seed Laws and Regulations," with the Alliance for a Green Revolution in Africa and COMESA, November 2020.

[31] Regulations 26, 28 and 29 of the 2016 Seed Regulations.

[32] Katrin Kuhlmann, "Harmonizing Regional Seed Regulations in Sub-Saharan Africa: A Comparative Assessment," Syngenta Foundation for Sustainable Agriculture, 2015. See also, New Markets Lab, "Annotated Comments and Recommendations on Ethiopian Seed Laws and Regulations," November 2020.

[33] ACTESA, Ethiopian Wider Stakeholders' Meeting on COMESA National Aligned Seed Regulations, COMSHIP Proceedings on 20th to 21st March 2019, Addis Ababa, Ethiopia.

Proclamation nor the subsidiary regulations describe the process through which anticounterfeiting measures can be implemented, including if and how to lodge a complaint. Stakeholders noted that the stated anticounterfeiting measures were not applied in practice.

Proposed Interventions

1. Accelerate enactment of the New Seed Proclamation and develop implementing regulations. The new Draft Seed Proclamation will address several current challenges in Ethiopia's seed sector, including the following: **a)** allowing for the private sector to be more integrated in Ethiopia's seed system (among other things), the new Draft Seed Proclamation would recognize private seed laboratories that meet Ethiopian seed standards[34] and the private sector's and cooperatives' seed QA programs).[35] Engagement of all stakeholders is critical as seed policies, laws, and regulations are developed and amended; engagement makes legislation more inclusive and incorporates diverse interests, giving laws legitimacy and improving their implementation; **b)** Establishing new institutional bodies, including an NSA at the federal level,[36] and a regional regulatory authority designated by a RBOA at the regional level.[37] The establishment of the NSA and regional regulatory authorities will create specialized institutions to address and give priority to seed related matters. For example, once established, the NSA will be responsible for overseeing the variety registration and release process, protection of PBR, and seed QA at the national level.[38] Both the MOA and RBOA have limited capacity to fulfill their mandates, because they are covering a plethora of other issues in the agricultural sector beyond just seed issues. This makes the administration of processes, such as variety registration and release and certification, lengthy and bureaucratic, rendering these processes costly for seed companies.[39] Stakeholders also noted that the creation of an independent NSA would make more funds available for the technical committee and the NVRC. Establishment of the NSA would also undergird implementation of COMESA.[40] As these institutions are established, they will require institutional capacity and sufficient resources; **c)** Aligning the national seed regulatory framework with the 2014 COMESA Seed Trade Harmonisation Regulations on issues of variety release and registration, certification, and trade. Alignment of national laws with regional seed rules is a good practice that has been adopted by other countries in the region, such as Kenya and Zambia. The Draft Seed Proclamation will provide an exemption from testing for varieties already registered in other countries, subject to availability of relevant test data. Another important development is the provision for registration of a variety in Ethiopia's national variety register if such variety is listed in a variety catalogue established in accordance with international agreements ratified by Ethiopia, including COMESA.[41] This will allow for cross-listing and trade of varieties listed in the COMESA Plant Variety Catalogue without requiring that these varieties go through the variety registration and release process in Ethiopia[42]; and **d)** providing for the designation of internationally recognized seed-testing laboratories at the regional and federal levels that will implement international seed-testing procedures,[43] including ISTA, in accordance with COMESA seed rules. Having such a legal

[34] See Clause 11(2) of the Draft Seed Proclamation.
[35] See Clause 12(1) Draft Seed Proclamation.
[36] See Clause 12(6) of the Draft Seed Proclamation, 2020.
[37] See Clauses 12(3) and (4) of the Draft Seed Proclamation, 2020.
[38] Clause 12(6) of the Draft Seed Proclamation, 2020.
[39] Mohammed Hassena, et al., "Institutional Mapping and Needs Assessment of Ethiopia's Public Seed Sector Services," Wageningen Centre for Development Innovation Wageningen, February 2020. See also, ACTESA, Ethiopian Wider Stakeholders' Meeting on COMESA National Aligned Seed Regulations, COMSHIP Proceedings on 20th to 21st March 2019, Addis Ababa, Ethiopia.
[40] ACTESA, Ethiopian Wider Stakeholders' Meeting on COMESA National Aligned Seed Regulations, COMSHIP Proceedings on 20th to 21st March 2019, Addis Ababa, Ethiopia.
[41] Draft Seed Proclamation, Clause 5.
[42] New Markets Lab, "Annotated Comments and Recommendations on Ethiopian Seed Laws and Regulations," with the Alliance for a Green Revolution in Africa and COMESA, November 2020.
[43] See Clause 11 of the Draft Seed Proclamation.

framework is a first step; institutional and financial capacity will need to be built, including proper training of personnel and laboratory infrastructure and equipment.[44]

2. Develop PVP regulations and establish the relevant institutional framework to implement the PVP regulatory framework. The legal framework for PVP could be completed through the development and enactment of regulations under the PBR Proclamation. For effective implementation, the legal framework must be supported by the establishment of the relevant institutions. Note that as of March 3, 2021, the PBR 1068/2017 Law has been approved by parliament.

3. Accelerate adoption and implementation of policy that permits the EIAR to license public varieties and build public research institutions' capacity to license public varieties. Research institutions are unable to meet EGS demand because of a lack of funding, which has resulted in limited staff, limited facilities (equipment, land for EGS multiplication, storage), and general inability to comply with EGS supply contracts in a timely manner. The EIAR is currently using a mix of funding options from both the government and grants, but this model does not have clear legal authority and is ultimately not sustainable in design or application. The MOA and EIAR have developed a directive that is under review to license public varieties to earn and retain royalties. For this to be of value, the royalties from licensing must go back to the licensing institutions, not to the national treasury. This requires a regulatory framework that establishes the licensing institution or allows the licensing institution to license public varieties to the private sector. In addition, a complete legal framework for the provision of PBR and protection of plant varieties can provide a strong legal foundation for licensing. Funding commitments for R&D should also be increased to at least meet the committed 1.5 percent of the GDP called for under the Science and Technology Policy. The EIAR must also be well-equipped to license public varieties, balancing interests among public research institutions, the farmers for whom they develop the varieties, and the private seed companies that commercialize the varieties. This capacity could be built through proper training and other institutional support.

4. Strengthen SPS framework and risk-assessment capacity. Currently, the legal infrastructure for trade and SPS is weak, and relevant institutions lack the ability to conduct risk-based SPS assessments. A pest list should be developed and adopted that is risk-based and reflects national and regional quarantine and phytosanitary conditions. The Ethiopian Plant Quarantine Proclamation No.36/1971 and Plant Quarantine Regulations No.4/1992 need to be harmonized with regional COMESA seed rules (regulations under revision). Relevant staff at the Plant Health and Quality Control Unit could also be trained and provided with proper resources to allow for effective risk-based SPS assessments.

5. Build the MOA's and regional regulatory capacity to implement anticounterfeiting measures. The government currently lacks the capacity to implement anticounterfeiting measures contained in law, which will have to be addressed to make the system operational. The MOA's capacity will have to be improved to receive individual complaints from seed sector actors, conduct proper investigations, and impose penalties, including fines, other penalties, and prosecution. This will require resources and proper training of the MOA's relevant staff.

Cost Estimates

Overall, high-level cost estimates for implementing the recommended interventions range from a low of $525,000 to a high of $740,000. All cost estimates below are for legal work only and do not include any downstream estimates for implementation of legal instruments (such as capacity building, procurement of equipment, etc.). More detail of elements included in the cost estimates along with the expert's suggestions in terms of sequencing can be found in Annex III.

[44] Katrin Kuhlmann, et al., "Seed Policy Harmonization in COMESA AND SADC: The Case of Zambia," Syngenta Foundation for Sustainable Agriculture Working Paper, 2019 at pg. 26.

No.	Recommended Intervention	Low (US$)	High (US$)
1	Accelerate enactment of the New Seed Proclamation and develop implementing regulations.	100,000	170,000
2	Develop PVP regulations and establish the relevant institutional framework to implement the PVP regulatory framework.	100,000	150,000
3	Accelerate adoption and implementation of policy that permits EIAR to license public varieties and build public research institutions' capacity to license public varieties.	150,000	180,000
4	Strengthen SPS framework and risk-assessment capacity	100,000	140,000
5	Build MOA's and regional regulatory capacity to implement anticounterfeiting measures.	75,000	100,000
	Grand Total	***$525,000***	***$740,000***

Validation, Prioritization, and Feedback

The Ethiopia validation break-out session held on March 3, 2021 to cover the PLR and NPC thematic areas included representatives from the MOA, EIAR, RBOA, ATA, ESA, donor agencies, AGRA, and BMGF. The sections below highlight the major suggested changes and how they were integrated into the bottlenecks and recommendations mentioned above.

Validation Feedback

PVP/PBR. During the plenary opening session of the validation, we were informed that PBR 1068/2017 law was approved by parliament and regulations are in preparation for signature by the Minister. It is important that effective implementation of these regulations still take place, but these were ranked lower than using current policy to move forward with licensing now while implementing regulations are developed. In 2018, the EIAR prepared guidelines for a wide variety of intellectual property instruments including varietal licenses, patents, and contracts with recommended allocations of revenue from them.[45] These will need to be updated and turned into operating instruments for use by the EIAR.

Private sector engagement in developing regulations. Participants suggested changing the wording (and meaning) of the original bottleneck #1 from "Private sector not effectively engaged during development of regulatory measures" to "Weak private sector participation and capacity to influence policy and regulatory measures." This reflects that there are capacity gaps with both the private and public sectors in effectively engaging in dialogue, feedback, and advocacy mechanisms. Private sector capacity issues are covered under the NPC thematic area.

Funding research. In addition, the participants added the following intervention: "Design mechanism to enhance finance for research and regulatory institutions/semi-commercialization of the research service and improve the existing service fee, enhance allocation of the percentage of public budget, enhance the contribution of development partners, outsourcing of services to accredited firms." This recommended intervention would include a wide array of activities from revision of fees and advocacy to government restructuring of research funding models across the spectrum of public, private, and donor partners. A scoping study would be needed to address how to improve budgetary allocation and diversify revenue sources for research to achieve priority programs.

ISTA accreditation. Lastly, the participants added the following intervention: "Ensure ISTA-accreditation of the seed labs in the country." This recommended intervention is discussed under the QA section, where the establishment of an ISTA-accredited national seed laboratory needs to take top priority.

Prioritization feedback. The table below displays the proposed prioritization and sequencing of interventions given by the expert, along with the impact, ease of implementation, and prioritization feedback from the participants given during the validation workshop, with the expert prioritization taking precedence.

[45] EIAR, 2018. Intellectual Property Management and Technology Transfer. Guideline.

No.	Recommended Intervention	Expert Proposed Priority	Validated Priority
1	Accelerate enactment of the New Seed Proclamation and develop implementing regulations.	1	2
2	Develop PVP/PBR regulations and establish the relevant institutional framework to implement the PVP/PBR regulatory framework.	2	3
3	Accelerate adoption and implementation of policy that permits the EIAR to license public varieties and build public research institutions' capacity to license public varieties.	3	1
4	Strengthen SPS framework and risk assessment capacity.	4	4
5	Build the MOA's and regional regulatory capacity to implement anticounterfeiting measures.	5	5

NATIONAL PLANNING AND COORDINATION (NPC)

Vision

African nations have made the Comprehensive Africa Agriculture Development Programme (CAADP) Malabo commitments to make public investments equal to 10 percent of agricultural GDP to achieve agricultural transformation with an 8 percent annual sector growth rate. Prioritized translation of these political commitments into policy, policy into strategy, and strategy into seed plans and operations will lead to clear identification of roles and responsibilities and improvement in public, private, and development partner annual planning and coordination. The vision of a healthy system is one in which there is better planning and coordination that supports continuous improvement of the supply of quality seed of crop varieties that improve productivity and respond to the demand of both farmers and end-users of crops. The more that planning and coordination is based on shared knowledge and understanding of farmer and end-market crop demand, the more likely it is that quality seed supply will be organized to meet the demand.

Methodology

The assessment of the NPC thematic is based on four themes: the clarity of the national seed strategy; the strength of the public-private joint effort for seed sector planning; the strength of the public-private joint effort for seed sector coordination; and, if applicable, the effectiveness and efficiency of subsidies. These themes are broken down into eight strategic objectives:

1. National vision and seed strategy (national agriculture investment or transformation plan linkage to seed strategy, balance between public and private sector roles).
2. Institutional support at the MOA for seed sector planning (roles, responsibilities, resources).
3. Adequate data on demand trends, supply trends, and formal sales of quality-assured seed of crop varieties (advance planning for 3–4-year pipelines of EGS and annually adjusted quality-assured seed needs).
4. Planning activities and communication with stakeholders.
5. Private sector coordination, including strong seed trade associations with strong leadership and value-added propositions for members.
6. Public sector coordination.
7. Clear and open channels of communication for public-private sector dialogue.
8. Seed subsidies (clear, explicit, and evidence-based reasons why seed subsidies are needed, application of the SMART framework, and a defined exit strategy).

Based on these eight objectives, the experts developed a list of 41 indicator questions. The assessment considered evidence from information and documents requested from public institutions and agencies; review of institutional websites; recent published reports and studies; in-person interviews of stakeholders using questionnaires; and data on institutional and company planning, coordination, and communication issues provided by the other thematic areas—NARS, QA, EGS, and CSP&D. Aggregated information was applied to a 1–4 Likert scoring to determine the overall health of the NPC system. One of the eight strategic objectives—the effectiveness and efficiency of seed subsidies—is not relevant to Ethiopia. More detailed information on the methodology can be found in Annex II and in the *SeedSAT Guide*.

Findings

Ethiopia has conducted extensive internal and partner-assisted analysis of its seed system organization and coordination issues over the past decade, identifying the challenges that arise from the country's devolution of regulatory and implementation responsibilities to regions and restructuring of central ministries, while also making large, sustained investments in agricultural production and transformation. Ethiopia's seed system remains almost fully dominated by the public sector. Seed demand is established by RBOAs using legacy systems focused on production targets for food security and income objectives. Parastatal enterprises dominate seed supply and set market prices sanctioned by the central government for most cereals, pulses, and oilseeds, with an overall formal market share of about 83 percent. Only hybrid maize has a 40 percent private company market share, dominated by a single multinational company with a decades-old presence and small emerging seed companies focused on hybrid maize and wheat. Seed companies are represented by a national seed association that has intermediated strong efforts on seed policy advocacy and member capacity building, but needs strengthening to play its private sector advocacy, planning, and coordination roles.

The government dismantled the National Agricultural Input Authority in 2004, leading to what Ethiopian seed system experts describe as diffuse coordination, suboptimal linkage between breeding research and market uptake, and deterioration in regulatory functions at national and regional levels. The NSAG and the national seed platform advocate for the creation of a national seed coordination body that is legally empowered to lead planning and coordination efforts, like the National Seed Council of Egypt, or incorporate broader regulatory, sector coordination and sector promotion roles, like the Nigerian National Agricultural Seed Council. This assessment supports that recommendation, but recognizes that extensive consultation will be needed to arrive at a structure that balances central and regional and public and private sector interests.

Strong administrative information supply, central statistical capacity, planning and action through projects, such as the ATA has improved scaled experimentation with seed distribution system strategies (such as public efficiency measures, AOSSs, DSM, and strengthening close-to-farmer seed distribution capacity), but investment return is reduced because of weak QA, weak EGS contract enforcement and allocation procedures, and resistance to experiment with market seed pricing and seed market liberalization. More detailed information on the methodology can be found in Annex II and in the *SeedSAT Guide*.

- **Lack of a unified government-led coordination mechanism coupled with a reduced ability to attract talent and resources has weakened the system's ability to plan for and implement a shift from an industry that is historically dominated by public investment to one that can effectively attract and retain private investment, which is needed to catalyze growth.** Coordination responsibility is split among directorates for Input Supply and departments under Agricultural Development at the MOA, EIAR for breeder seed, and RBOAs. The lack of an apex coordination body is consistently referenced by those surveyed as an issue that affects the ability of the MOA to attract and retain industry-seasoned leadership. At the same time, the ATA is seen as a competitor for leadership talent given staff compensation levels and the availability of operating funds. The public extension system is large in the core agricultural regions, with those surveyed expressing different

levels of coordination and effectiveness—weak in linkage to varietal development and testing and stronger in terms of demand estimation and farmer training. EABC has an embedded seed marketing and extension service, but also has had to transfer significant seed farm and related assets to regional parastatal companies, with a larger portion moving to Oromia, making OSE the largest EGS producer in the country. While OSE is the largest EGS producer in the country, the restructuring of assets from EABC to OSE has led to reductions in overall EGS production. These legacy coordination mechanisms, which are split between federal institutions, regional bureaus, and the MOA reinforce the power of long-standing public sector enterprises and cooperative unions that have strong inherited regional roots, which can result in direct interference in seed production by the smaller emerging private sector seed companies, reducing contracted allocation of EGS, dictating which seed crop they can grow, or ordering them not to produce seed. Even large seed companies may be required by the government to sell their seed stocks to them, providing a ready market and reducing distribution costs, but disrupting their brand development.

- **Strong annual and longitudinal data by crop species from seed production to distribution at the farm level needs to be refined to the variety level to guide demand planning and coordination.** Current demand information is based on prior season and year production and seed carryover data, annual crop production surveys, and sample surveys. Reporting mechanisms are good for EGS and certified seed volumes given public enterprise dominance of the seed system, but these are not widely or adequately shared. Potential demand at the crop level follows standard ordering forecasting for major production zones. Demand estimates for the public seed enterprises and cooperatives are generally timely. There is good availability of longitudinal data for the major cereal and pulse crops that have been used over the past decade to reduce carryover seed stocks. There is not a good online system to identify stocks that seed companies and dealers could use to make up gaps in production by accessing surplus production from other regions. Recent DNA-based studies of farmer identification of crop varieties of wheat suggest that recall studies are only about 35 percent accurate in varietal identification. This finding means that state and private sector planners for Ethiopia's seed system do not yet have the information they need to allocate the large public investments in staple cereals and pulses to ensure adequate supply of the most demanded varieties and reduce the potential for overproduction of varieties that are being taken up slowly.
- **Stakeholder consultations with the private sector are not elevated to decision makers to accelerate change from regional legacy patterns.** Seed producers surveyed indicate that the linkages are weak between the private sector with MOA and RBOA decision makers. Stakeholder meetings are held regularly for planning purposes, but communications are characterized as mainly top-down. Parastatal and private seed producers surveyed express the need for greater two-way communication. Seed producers state that their views are listened to, but not acted on by central and regional authorities. Private sector associations invite public sector attendance regularly and get high-level participation, but ask for deeper engagement on policy and planning issues at the RBOA level, including a consistent request for engagement with both political and administrative leaders in the region to advance seed sector change.
- **Data on seed availability is currently held by different parties such as the Integrated Seed Sector Development Programme (ISSD), ATA (on cooperative union seed production), EIAR, EABC, regional seed enterprises, and seed companies, which increases the difficulty of balancing seed supply with seed demand.** Reporting mechanisms are good for EGS and certified seed volumes given public enterprise dominance, but these are not adequately shared regionally. Potential demand at crop level follows standard ordering forecasting for major production zones. Demand estimates for public seed enterprises and cooperatives are generally timely, but driven by supply side planning. There is good availability of longitudinal data for the major cereal and pulse crops that have been used to inform planning to reduce large carryover seed stocks. However, there is also not a good online system to identify stocks of EGS that seed companies can use to make up gaps in production or local availability.

- **Currently, EGS supply to the private sector is a residual allocation and therefore unpredictable, restricting growth of the private sector.** The unpredictability of EGS allocations to private seed companies operates as a barrier to market development and growth. EGS production has declined or been inconsistent for the four focus crops assessed over the 2017–2019 period, despite development partner investments in some programs. EGS allocation and delivery shortfalls crowd small private seed companies out. Uncertainty about EGS allocations also increases the performance risks of the Southern Seed Enterprise in the SNNPR region, which has no land and is dependent on EGS supplied by other regions to produce certified seed using outgrowers. There are knock-on effects in terms of finance, where lenders provide funding to parastatals and regional government, but are reluctant to provide working capital to private firms. Seed producers report that contracts may be canceled based on market conditions throughout the year that are not part of contract agreements.
- **Raw seed (not cleaned/sorted) prices set by the public sector are too low, reducing the recovery rate of seed from outgrowers.** Currently, seed prices are established in consultation among parastatal enterprises, with review and sanctioning of their final levels by the Minister of Agriculture. Exceptions at the certified seed level are private hybrid maize seed companies such as Corteva that have their own seed distribution markets. EGS of public research institutes are determined based on the price of certified seed. For instance, the price of basic seed is higher by 10 percent, pre-basic by 20 percent, and breeder seed by 30 percent over certified seed price. Moreover, except for hybrid maize varieties there is no differentiation of price between varieties of a given crop. This system is not competitive and affects the volume, quality, and timeliness of EGS produced and distributed. While the public sector seeks to keep seed prices low, there is feedback on the quality of seed produced and delivered to farmers. Lower profit margins have negative consequences in the flow of production. Seed producers and outgrowers across all classes of seed struggle to generate a sustaining profit margin from current prices, which leads to delivery shortfalls, problems with timeliness of delivery, and quality of seed delivered. Information from seed retailers in the agrodealer survey suggests that some delivery shortfalls to seed companies from outgrowers could be due to outgrower side-selling of contracted seed to retailers. Some seed companies supported what is still a speculative observation.
- **The ESA is fragile operationally and financially, needing an expanded presence at the regional level, but is currently unable to staff and support a strong national or regional presence.** The ESA is functioning, but is a fragile, largely development partner-funded organization. It has a functioning website with clear access to its mission and objectives. It is considered to be successful in terms of seed producer membership with more than 80 percent of private and parastatal seed producers participating. Members have been satisfied with ESA's policy advocacy and capacity-building services delivered through projects, but this level of satisfaction is not reflected by the number of seed companies paying dues, with only about 25 percent of membership currently paying dues. ESA lacks the staff, funding, or capacity to provide key requested value-added benefits, such as regional representation for advocacy, capacity building of emerging seed companies, or development of seed quality programs.
- **Regional decentralization of key seed system functions prevents coordination on major QA standards and uneven funding (reference QA and PLR). Coordination in developing capacity in and implementing shared standards is low and faces divisions because of strong and strengthening regionalism, and underfunding at the national and regional levels of key supporting institutions.** As noted in the QA thematic area section of this assessment, there has been an erosion of QA capacity for inspection, sampling, and testing for seed quality, and a great reduction in the phytosanitary and quarantine services capacity to meet its seed health and trade regulatory obligations. While ISTA and International Plant Protection Convention (IPPC) standards are recognized and referenced, Ethiopia is no longer an ISTA member, and there are large gaps in practice and capacity. This means that while seed producers state that they are relatively happy with the official seed QA and certification services, problems with quality still exist. Recommendations are

made under the QA thematic area for rehabilitation of QA facilities and operations to bring them back up to standard. However, each region is also applying its own seed service decisions to key elements of seed trade, with large differences in seed identification and quality information on seed labels for seed sold within a single region, rather than application of a country-wide ISTA (and thus COMESA) aligned label for all seed. The PLR thematic area assessment contains recommendations to realign regional regulations with a single national code. Both efforts will require adjustments to national budgets for facilities, personnel, and operations and maintenance to sustain QA capacity. Ethiopia also has the potential to become a regional seed exporter and already exports sesame seed for planting, but its phytosanitary and plant quarantine service has not aligned and domesticated with COMESA rules.

- **Public budgets have declined for agricultural research institutes that breed crops and produce EGS, national and regional agencies that perform seed inspection and testing, and phytosanitary and plant quarantine agencies that regulate trade in seed and agricultural commodities.** Ethiopia budgets for national ministries and institutions and provides block grants to regions. At the national level, EIAR budgets have declined with research programs becoming more dependent on grants, while larger amounts of public budgets are consumed with personnel costs, as noted in the NARS component. As noted in the seed production and distribution component, lack of investment and reduced operating budgets have led to swings in breeder, pre-basic, and basic production. Almost all Ethiopian breeder seed comes from ARIs (agricultural research institutes) or RARI's (regional agricultural research institutes). Declines in breeder seed production translate into overall reduction in EGS production. While ATA has made efforts to redress the EGS decline, this is not a system-wide remedy. The Ethiopian Agricultural Research Council and its Secretariat were given authority to improve revenue capture through licensing, patents, and contracts for both ARIs and RARIs, but enabling legislation has not been available. As described in the QA assessment, there has been a deterioration in seed laboratory operations at the national level and in regional seed agencies and inspections. The plant quarantine agency no longer has a functioning laboratory and depends on university and research station for analyses. Mandatory users of seed inspection and testing services would like to see fees reduced rather than increased. Phytosanitary certification fees are similarly viewed as high for the service delivered. The more important issue is whether there is sufficient funding for port-of-entry operations and pest risk assessments, although seeds make up a small part of agricultural commodity flows.

Proposed Interventions

1. Support policy and regulatory changes through a national seed platform, regional seed coordination groups, and development partners to coax change toward increases in private sector seed production and distribution. National stakeholders advocate for this intervention to establish and sustain planning and coordination dialogue with the creation of an apex platform at the national level, building on the NSAG, that would support the establishment of a national seed agency. There is some concern, however, that national leadership is hesitant to create a new national agency after reinforcing regional autonomy. This intervention will require scoping assistance and technical assistance to build dialogue between the public and private sectors through regular semi-annual meetings based on a jointly established agenda and to support the complementary/supplementary costs of the joint meetings and their feedback channels. These will need to include support for technical working sessions at the regional level to prepare national platform discussions that could be timed to precede events like the recently held National Seed Forum, but may be more frequently be applied to regularizing stakeholder preparation and participation in an advisory capacity at regional and central ministry, research institution, joint parastatal company and MOA, and regulatory bodies.

2. Design next step investment in improvements in crop production surveys to apply DNA technology to varietal identification to rebase into seed adoption and demand forecast processes. This intervention will need additional study and consultation with the MOA, EIAR research institutes,

central statistics service, the countries' seed producers, ATA, and projects such as EDGE. Current survey practices depend on farmer identification of crop varieties that they grow. Recent publications using DNA markers to compare farmer recall with varieties show that Ethiopian farmers misidentify wheat varieties around 65 percent of the time. The use of SNPS (Single Nucleotide Polymorphisms) as DNA markers to identify varieties and traits has become common place in plant breeding and increasingly in varietal identification in the field for both research and commercial purposes (PVP). Use of this technology will help reduce the massive recall errors in current methods and should create a clear identification of dominant, preferred varieties to inform demand forecasting and to adjust research product profiles.

3. Ensure access to national and regional administrative and political leaders on seed system issues on land access, raw seed pricing, and EGS. Both parastatal and private seed producers surveyed ranked the lack of effective public/private engagement and feedback mechanisms high and indicated a need for support for shaping consultations with national and regional leaders on these issues. While this is a natural function of a seed association, it is currently beyond ESA's immediate ability to address. Therefore, there is a need to support the seed association and others to effectively design and implement advocacy agendas and campaigns. Grant support will be needed to advocate through annual meetings of the association, national and regional dialogue platforms, and working sessions with decision makers on industry feedback on policy and regulatory implementation. Examples of policy issues that arose through consultations include: the value case for changes in policy and practices that would open up the relatively small amounts of land, preferably irrigated and with adequate isolation to securitize pre-basic and basic seed production; the relationship between pricing and delivery completion for EGS and certified seed by contracted institutions and outgrowers; and the adequate public funding of breeder, pre-basic, and basic seed production for crops that have a large public good profile.

4. Bring data on seed availability together in a single, transparent, and online database on seed production and marketing and invest in capacity building for the operators of the information system and for end-users. This intervention will facilitate strong, multi-stakeholder engagement in the diagnostics and design of the seed information management system, including seed trade data. System analysis is necessary to be able to map the operations behind information flows before the information is aggregated and disseminated in ways that add value to current operations, e.g., the quarterly meetings of parastatal seed enterprises to plan EGS production and track EGS recovery, certified seed production, and seed distribution and marketing. This intervention needs a complementary design along with government and development partner co-investment in seed demand (varietal level) estimation that is needed to improve planning and coordination across the seed value chain from research institutes through seed distribution.

5. To ensure reliable and predictable EGS volumes available to the private sector, make EGS planning and allocation transparent and contractually binding. Further scoping will be needed to design this effort, and external funding will be needed to support it for two to three annual cycles. The proposed intervention is in three stages:

1. Conduct an operations review of the EGS demand estimation and supply allocation system, to identify stronger financing, contracting, and dispute resolution procedures.
2. Elevate the findings to consultations with the RBOAs, Ministers and State Ministers of appropriate agencies to advance the policy and legal options agenda on transparent allocation policy.
3. Support an EGS platform for annual planning with agricultural research institutes, state enterprises, FCUs, private companies, and supporting projects. One of the current quarterly meetings of parastatals with the MOA on seed supply might be used to leverage this platform.

6. Establish the legal framework and enforcement mechanism for raw seed (not cleaned/sorted) prices that incentivizes outgrowers through profitable price premiums for seed over grain that are referenced to near-by markets. This intervention needs to source both a design effort and support an

advocacy effort that leads to the development of a legal framework and an enforcement mechanism to achieve the following:

- Minimum price guarantee in the contract document that is based on costs of production and delivery terms that will be subjected to enforcement.
- Price setting adjustments that consider crop type, grain price trend, and yield potential for the class of seed and for grain produced from seed.
- Adjustments for premium seed quality contracts.
- Identification of regional grain reference markets and transportation cost differentials if these are included in the legal framework for setting raw seed prices.

7. Invest in strengthening ESA through staff capacity building for advocacy for seed producers at the national and regional level and for developing a financial sustainability model with intermediate support for resources and service delivery for capacity building and information management for the seed industry. ESA needs assistance to refine its current restructuring concept and develop a revenue-generation plan with its membership and partners. A grant is needed to add staff, a part-time legal advisor, office space, logistics, computer, and communication support to improve its central operations and improve its representation of members with RBOAs and regional administration, so that it can restart service delivery to increase payment of dues and service fees and attract additional funding. As resources are added, support will be needed to phase in seed business and leadership capacity development, seed information and database services, and potential seed quality control and assurance as value-added services.

8. Develop and implement sustainable funding plans for operating and capital expenditure for QA. The core of this intervention is to provide resources to plan and support the transition of QA and phytosanitary institutions to meet agreed harmonized standards. This will require the scoping of assistance to develop and implement sustainable funding plans for operating and capital expenditure for the public expenditures on QA for both nationally produced seed for domestic or export use and on imported seed.

9. Review and develop improved funding mechanisms for agricultural research and seed regulatory agencies. The QA recommendation is found above as recommendation #8. The entry points for review and development of funding mechanisms for agricultural research institutes and their EGS operations should be the EIAR, along with the Ethiopian Agricultural Research Council and Secretariat as the body authorized to investigate and implement research coordination and revenue generation. This effort should start with a scoping exercise to review past efforts to structure similar mechanisms. As the NARS, QA, and PD components have recommended the research institutions need to be supported to set up enterprise cost accounting to benchmark their current expenditures and seek efficiencies to build their case for their added value to support advocacy for public budget increases.

Cost Estimates

Overall, high-level cost estimates for implementing the recommended interventions ranges from a low of $1.8 million to a high of $2.7 million. More detail of elements included in the cost estimates along with the expert's suggestions in terms of sequencing can be found in Annex III.

No.	Recommended Intervention	Low (US$)	High (US$)
1	Support policy and regulatory changes through an apex national platform, regional seed coordination groups, and development partners.	250,000	300,000
2	Design next step investment in improvements in crop production surveys to apply DNA technology to varietal identification to rebase into seed adoption and demand forecast processes.	150,000	300,000

3	Ensure access to national and regional administrative and political leaders on seed system issues on land access, raw seed pricing, and EGS.	125,000	200,000
4	Bring data on seed availability together in a single, transparent, and online database on seed production and marketing and invest in capacity building for the operators of the information system and for end-users.	300,000	500,000
5	Make EGS planning and allocation transparent and contractually binding.	200,000	300,000
6	Establish the legal framework and enforcement mechanism for raw seed (not cleaned/ sorted) prices that incentivizes outgrowers through profitable price premiums for seed over grain that are referenced to near-by markets.	125,000	175,000
7	Invest in strengthening ESA.	150,000	200,000
8	Develop and implement sustainable funding plans for operating and capital expenditure for QA.	282,000	350,000
9	Review and develop improved funding mechanisms for agricultural research and seed regulatory agencies.	300,000	400,000
	Grand Total	***$1,882,000***	***$2,725,000***

Validation, Prioritization, and Feedback

The validation break-out session held on March 3, 2021 to cover the PLR and NPC thematic areas included representatives from the MOA, EIAR, RBOA, ATA, ESA, donor agencies, AGRA, and BMGF. The sections below highlight the major suggested changes and how they were integrated into the bottlenecks and recommendations mentioned above.

Validation Feedback

Participants discussions resulted in a major shift in emphasis on constraint #1. There was a strong consensus that the national platform should be formalized as a recognized body for public/private stakeholder consultation and that this platform should support the creation of a national seed agency.

In addition, participants also re-ordered the recommendations using the combined impact and ease of implementation scale. Participants placed all coordination and dialogue recommendations related to center-regional harmonization in a single cluster with highest priority and more technical recommendations following.

Lastly, while participants rated recommendation #6 with the potential for a high impact, the participants' consensus was that this recommendation would be very difficult to implement, positioning it as the last recommendation that could be implemented.

Prioritization Feedback

The table below displays the proposed prioritization and sequencing of interventions given by the expert along with the impact, ease of implementation and prioritization feedback from the participants given during the validation workshop, with the expert priority taking precedence.

No.	Recommended Intervention	Expert Proposed Priority	Validated Priority
1	Support policy and regulatory changes through an apex national platform, regional seed coordination groups, and development partners.	1	1
2	Design next step investment in improvements in crop production surveys to apply DNA technology to varietal identification to rebase into seed adoption and demand forecast processes.	2	2
3	Ensure access to national and regional administrative and political leaders on seed system issues on land access, raw seed pricing, and EGS.	3	1
4	Bring data on seed availability together in a single, transparent, and online database on seed production and marketing and invest in	4	3

	capacity building for the operators of the information system and for end-users.		
5	Make EGS planning and allocation transparent and contractually binding.	5	2
6	Establish the legal framework and enforcement mechanism for raw seed (not cleaned/sorted) prices that incentivizes outgrowers through profitable price premiums for seed over grain that are referenced to near-by markets.	6	4
7	Invest in strengthening the ESA.	7	3
8	Develop and implement sustainable funding plans for operating and capital expenditure for QA.	8	2
9	Review and development of improved funding mechanisms for agricultural research and seed regulatory agencies functions	9	1

Annexes

ANNEX I: BIBLIOGRAPHY

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ANNEX II: ASSESSMENT DETAIL

This annex is found in a separate PowerPoint document, entitled SeedSAT Annex II_Ethiopia v2.ppt. This document includes further detail on the following:

1. Assessment Notes – Beta, implementation, confidentiality, costing, and scoring.
2. National PLR framework.
3. NPC.
4. National agriculture research and breeding effectiveness.
5. National QA.
6. Early generation seed production/commercial seed production and distribution.

ANNEX III: COSTING AND VALIDATION DETAIL

This annex is found in a separate Excel document, entitled SeedSAT Annex III_Costing and validation detail_Ethiopia.docx. The spreadsheet includes a tab for each of the six thematic areas in the format below. There are additional tabs for the QA cost estimates.

SeedSAT
improving investment in seed systems

Thematic Area Name											
High Level Cost Estimate								Prioritization			
No.	Bottleneck(s) to Address	Recommended Investment	Steps and/or elements to consider	Minimum Estimated Cost (USD)	Maximum Estimated Cost (USD)	Sequencing - Thematic Area	Sequencing - System	Impact	Ease of Implementation	Total	Priority Notes	Final Priority Selected
								A	B	AVG (A+B)		
1				$ -	$ -							
2				$ -	$ -							
3				$ -	$ -							
4				$ -	$ -							
5				$ -	$ -							
6				$ -	$ -							
7				$ -	$ -							
8				$ -	$ -							
9				$ -	$ -							
10				$ -	$ -							
Grand Total				$ -	$ -							

ANNEX IV: LAB SITE VISIT SUMMARY TABLE, EXAMPLE LAB EQUIPMENT LIST, ILLUSTRATIVE TRAINING OUTLINE

A. Lab site visit summary table

Ethiopia: Status of quality assurance labs and field offices assessed

	Physical Assessment Description	National Seed Quarantine	National Seed Quality	Oromia - Asella	Oromia - Ambo	Amhara - BahirDar	Amhara - DebreMarkos (virtual)	SNNPR - Durame (virtual)	Tigray - Mekelle (virtual)
1.	Lab space is of adequate size and is functional	No	No	Yes	No [1]	Yes	No	No	Yes
2.	Required technical and managerial staff is employed at site	No (N/A)	No [2] (2)	Yes (6)	Yes (10)	Yes (10)	Yes (8)	Yes (8)	Yes (4)
3.	Staff is adequately trained	No	No	No	No	No	No	No	No
4.	All basic equipment is on site	No	Partial	No	No	No	No	No	Yes
5.	Basic required equipment on site is functional and calibrated	No [3]	No [4]	No	No [5]	No	No	No	No
6.	Equipment maintenance plan in place and implemented	No	No	No	No	No	No	No	No
7.	Sample storage is adequate and functional	No	No	No	No	No	No	No	No
8.	Required volume of tests are carried out (Ave. of 2018 + 2019 volume)	No (not operational)	No (392/yr)	No (864/yr)	No (479/yr)	No (504/yr)	No (399/yr)	No (241/yr)	No (140/yr)
9.	Lab tests are done on time	No	No	No	No	No	No	No	No
10.	Operational vehicles are available to adequately support basic QA field work	No	No	No	No	No	No	No	No
11.	Power and water are adequate, and backed-up	No	No	No	No	No	No	No	No
12.	Internet connectivity is sufficiently present	No	No	No	No	No	No	No	No

[1] Lab site is extremely unsafe from a structural perspective
[2] There appears to be no lab manager, only two analysts
[3] Lab is essentially closed, and tests are conducted on a voluntary basis by a lab at EIAR
[4] Equipment is in temporary space (just 2 rooms) or in boxes
[5] Equipment level is better than many other labs, but some critical equipment is still missing

B. Example lab equipment list

List 1: Illustrative basic equipment required for seed testing laboratory – approx. 10,000 samples/year

Source: Government of India, MOA, Director of Seeds, 2010

Line #	Equipment	#
1	Seed Divider (Soil type) and Boerner type	1+1
2	General seed blowers-model ER type with kit & transformers	1
3	Binocular magnifier	1
4	Simple microscope	1
5	Electrically heated oven with thermostatic control	2
6	Universal moisture tester and improved moisture tester with transformer	2
7	Electronic timer	1
8	Grinding mill (At ISTA specification)	1
9	Balance with readability up to three decimal places	1
10	Cabinet type germinator	1
11	Refrigerator (165 Ltr.)	1
12	Air conditioner for walk in germinator (germination room)	2
13	Timer, temperature control for walk in germinator(germination room)	2
14	Humidifier for walk in germinator (germination room)	5

Line #	Equipment	#
15	Steel trolley	2
16	Hot Air oven (seed sterilizer)	1
17	Auto clave	1
18	Moveable open trolley	4
19	Wild stereo bio-noculars microscope wild M-5A as per required caliber	2
20	Compound Research microscope DIAPLAN Microscope(wid levy company)	1
21	In Calculator maintaining 20 degree centigrade fitted with NUV tubes, timer, racks etc.	1
22	Incubator	1
23	Laminar flow of Horizontal/vertical	1
24	Dehumidifier for sample storage room	1
25	Air conditioner for sample storage room	2
26	Generator	1
27	Digital Moisture Meter	1
28	Automatic Seed Analyzer	1
29	Vacuum seed counter	1
30	Purity work board	1
31	Digital Thermo hygrograph	1
32	Seed Blower	1
33	U.V. Chamber	1
34	Mini centrifuge	1

List 2: Illustrative layouts, equipment and staff calculations for a seed health lab:

Source: Worede Woldemariam

The following assumptions are made to calculate the required equipment and supplies:

Visual inspection:	40 samples/analyst/day
Washing test	15 samples/analyst/day
Blotter test, 4 x 100 seeds	20 samples/analyst/day
Agar plate test, 40 x 10 seeds	5 samples/analyst/day
Embryo test, 2000 seeds	10 samples/analyst/day

Number of samples to be tested per year:

Visual inspection:	3000 samples = 75 mandays
Washing test	750 samples = 50 mandays
Blotter test	1400 samples = 70 mandays
Agar plate test	300 samples = 60 mandays
Embryo Test	700 samples = 70 mandays
Total	325 mandays
One analyst works 200 days/year, including time for lab maintenance, reporting, etc:	2 analysts

The laboratory should be furnished with benches along the wall (height for comfortable sitting while working), with cupboards with glass sliding doors, and if space permits with a center bench with bench-top shelves (height for comfortable standing while working). At least one rectangular sink, approx. 35 cm deep. Sufficient stools and chairs, whiteboard, coat hangers, filing cabinet.

1. Basic equipment for testing fungal pathogens

1	Incubation room, well insulated and air conditioned, with movable shelves, equipped with daylight fluorescent tubes or black light tubes, e.g. Phillips 'TL'D 18W/08, 600 mm long, dia. 26 mm, Ord. No. 9280 480 008 and timer
1	Thermograph with weekly record sheets
2	Compound microscopes, one of them with phasecontrast, with 4x, 10x, 25x, 40x and 100x lenses, with measuring eyepiece and calibration slide
1	Stereo microscope with sub-stage and incident illumination, with 10x, 25x, and 50x magnification
1	Balance, top-loading, capacity 1 kg, readability 0.1 g, digital display
1	Analytical balance, capacity 160 g, readability 0.001 g, digital display
1	Centrifuge, up to 5,000 rpm, with graduated centrifuge tubes
1	Freezer, upright type, volume approx. 250 liters
1	Refrigerator, household type, volume approx. 250 liters
1	Autoclave, pressure cooker type, pressure 1.5 bar, capacity 20 liter, if possible with integrated heater
1	Incubator, volume approx. 120 liter
1	Water still, capacity approx. 2 liter/hour

2. Basic supplies (glassware, chemicals, etc.) for testing fungal pathogens

4	Erlenmeyer flasks, 2 liter
6	Erlenmeyer flasks, 1 liter
10	Erlenmeyer flasks, 500 ml
10	Erlenmeyer Flasks, 100 ml
6	Beakers, plastic, 1 liter
10	Beakers, glass, 500 ml
10	Beakers, glass, 100 ml
2	Measuring cylinders, plastic, 1 liter
4	Measuring cylinders, glass, 250 ml
2	Measuring cylinders, glass, 100 ml
2	Measuring cylinders, glass, 10 ml
2	Aspirator bottles, 10 liter, white plastic
6	Washing bottles, 500 ml, clear plastic
6	Funnels, 100 mm dia.
6	Funnels, 150 mm dia.
1 m	Rubber hose, to fit above funnel stems
10	Pinchcock clamps
4	Thermometers, range -20 to 100 °C
4	Reagent bottles, amber, 250 ml
4	Reagent bottles, amber, 500 ml
4	Reagent bottles, amber, 1000 ml
10	Pipettes, 1 ml
10	Pipettes, 2 ml
10	Pipette, 10 ml
20	Pipette teats
10	Alcohol burners, with spare wicks
10	Dropping bottles, amber, 10 ml
500	Glass petri dishes 9 cm
100	Test tubes
6	Test tube racks, each for 12 tubes
4	Support stands
4	Support rings, 10 cm dia.
2	Funnel supports, each holding 2 funnels
10	Wire gauze squares, 10x10 cm
1	Set of sieves, 1 mm and 2.5 mm mesh
6	Scoops, various sizes
4	Kolle needle holder
20	Inoculation loops
10	Lancet needles
10	Spatulas, various sizes
10	Tweezers, various sizes
1000	Microscope slides
5000	Cover glasses
2	Haemocytometers, e.g. Fuchs-Rosenthal, with cover glasses
500	Germination boxes, e.g. 13 x 8 cm, with tight fitting lid
5000	Sheets thick flat blotter paper, to fit boxes
5000	Pc. pleated filter paper to fit boxes, 50 pleats
2	Draining boards
4	Tally Counters
4	Brushes, various sizes

	Labels, Aluminum Foil, Cotton, Parafilm, Pencils, Felttip Pens, Clorox, Detergent, Vim, Sponges, Towels (paper and cloth), Tool kit
10 l	Alcohol, (methylated spirit)
3 kg	Phenol
2 kg	NaCl
5 l	Glycerol
5 l	Lactic Acid
2 kg	NaOH
100g	Trypan Blue or Cotton Blue
2 kg	Potato Dextrose Agar

3. Safety equipment

6	Pot holders
4	Labcoats
2	Packs disposable gloves
2	Safety pipette fillers (rubber)
1	First-aid kit
1	Eye wash station
1	Fire extinguisher

4. Equipment for a more advanced laboratory

1	Laminar air flow bench
1	Fume hood on cupboard base, with light, gas and water supplies, size approx. 120 x 80 x 240 cm
1	Oven, volume approx. 100 liter, temperature range 50 to 250°C
1	pH meter with combination electrode, electrode holder, buffers, and electrolyte
1	Magnetic stirrer with hot plate, with magnetic bars of various sizes and retriever
1	Shaking waterbath, approx. 40 x 25 x 15 cm, with stainless steel tube racks
3	Microliter pipettes (Eppendorf), 20 to 100 µl, 100 to 500 µl, 200 to 1000 µl, with appropriate tips
1	Household microwave oven, standard
1	Household blender
1	UV analysis lamp with 366 nm radiation
2	Lab carts, one with shelves, one with plastic container and lower shelf, size approx. 80 x 40 cm, 1 m high

List 3: Illustrative equipment list for labs of 5,000 and 2,000 samples per annum

Source: Worede Woldemariam

ITEM #	# required for 5,000 samples	# required for 3,000 samples	Description
SAMPLING, RECEIVING			
1	2	1	Large spear trier (beans, peas) brass tube with pointed end; whole length 65.3 cm; pointed end of 8.2 cm long; slot 4.0 cm x 1.5 cm; outside ø at open end 1.9 cm.
2	2	1	Standard spear trier (cereals, small legumes, etc) brass tube with pointed end; total length 60 cm; pointed end of 8.5 cm long; slot 3.3 cm x 1.1 cm; outside ø at open end 1.5 cm.
3	2	1	Small spear trier (clovers, brassicas) brass tube with pointed end; total length 43.2 cm ; pointed end of 4.3 cm long; slot 2.0 cm x 0.75 cm; outside ø at open end 1.2 cm.
4	2	1	Stick trier (large size seed-beans, peas), double tube, 160 cm long, 9 openings; open end, without partitions; 3.8 cm outside ø; heavy bronze point.
5	2	1	Stick trier (medium size seed-cereals, chaffy seed), double tube, heavy bronze point, 76.2 cm long, 6 openings; open end, without partitions; 2.54 cm outside ø.
6	2	1	Stick trier (small size seeds-clovers, etc), double tube, heavy bronze point, 76.2 cm long, 9 openings; open end, without partitions; 1.3 cm outside ø .
7	2	1	Stick trier, double-tube, heavy bronze point, 183 cm long; 12 openings; open-end, without partitions; 3.4 cm outside ø.
8	2	1	Stick trier, brass, 3.05 m long; 20 openings, with partition; extra heavy bronze point.
9	-	1	Trier, deep bin cup, with T-handle and four 90 cm extensions; brass cups, 3.8 cm outside ø, 37.5 cm deep, 265 g capacity.
10	1	1	Divider, Riffle type; with hopper and attached 18 channels and frame to hold hopper; 3 receiving and 1 pouring pan.
11	1	1	Label printer, stencil printing type similar to machine for printing library cards; with all required components.
12	1	1	Numbering stamper, hand used, dating stamp type with consecutive numbering.
13	2	1	Thermometer, dial; with 30 cm stem; range -10 to 100oC; stainless steel; 5" dial; bimetallic system, accuracy 1%;
14	-	1	Thermometer (bulk seed); with standard T-handle and four 90 cm handle extensions; 21.1 cm brass cover over 13.8 cm glass thermometer protected by cover; range 0-60oC with 1oC divisions.
15	1	1	Sling psychrometer; with wicks and thermometers; two 12.5 cm etched mercurial lens magnifying thermometers attached to aluminum back with metal handle for field use; scale range -5 to 45oC.

ITEM #	# required for 5,000 samples	# required for 3,000 samples	Description
16	1	1	Hygrothermograph, weekly recording; oC; recording mechanism with 8 day spring wound clock; gear for 7 day chart rotation; rh range 0-100% in 1% increments, accuracy ± 3%.
MOISTURE DETERMINATION			
17	2	1	Moisture tester, portable electronic; with charts for all crop; temperature or moisture correction indicator; direct dial reading for common seed; balance meter for adjustment; built-in sample scale.
18	1	1	Oven, heated-air, electric; temperature, 130oC ± 3oC; double wall with aluminum interior, enameled steel exterior; bimetallic oven thermostat with indicator; mercury thermometer mount in top.
19	2	2	Desiccator with cover and silicagel; heavy annealed glass; sealing with greased internal edge of flanges; 200 mm ø; with 190 mm not breakable polypropylene plate with no feet, with flanged outside rim.
20	1	1	Grinder; non-moisture absorbent; adjustable, suitable for all size seeds; easy to clean; set of three sieves with 0.5, 1 and 4 mm ø.
21	1	1	Balance, precision; electric; 160 g capacity, 1 g x 10 mg graduations; 1 mg readability; direct reading and tare mechanism.
22	50	30	Dishes for moisture test; aluminum, with straight edge and flat bottom; approx. 0.5 mm thickness, ø base 6 cm, depth 3 cm; with tight fitting lids.
23	2	2	Tongs, for removing sample containers from oven; general purpose, nickel plated steel; 20 cm, 2.5 cm stirrup jaws with teeth.
24	50	30	Can, for moisture samples; polyethylene plastic, tight fitting enameled plastic cap and gasket insert for air seal; capacity, 1 liter.

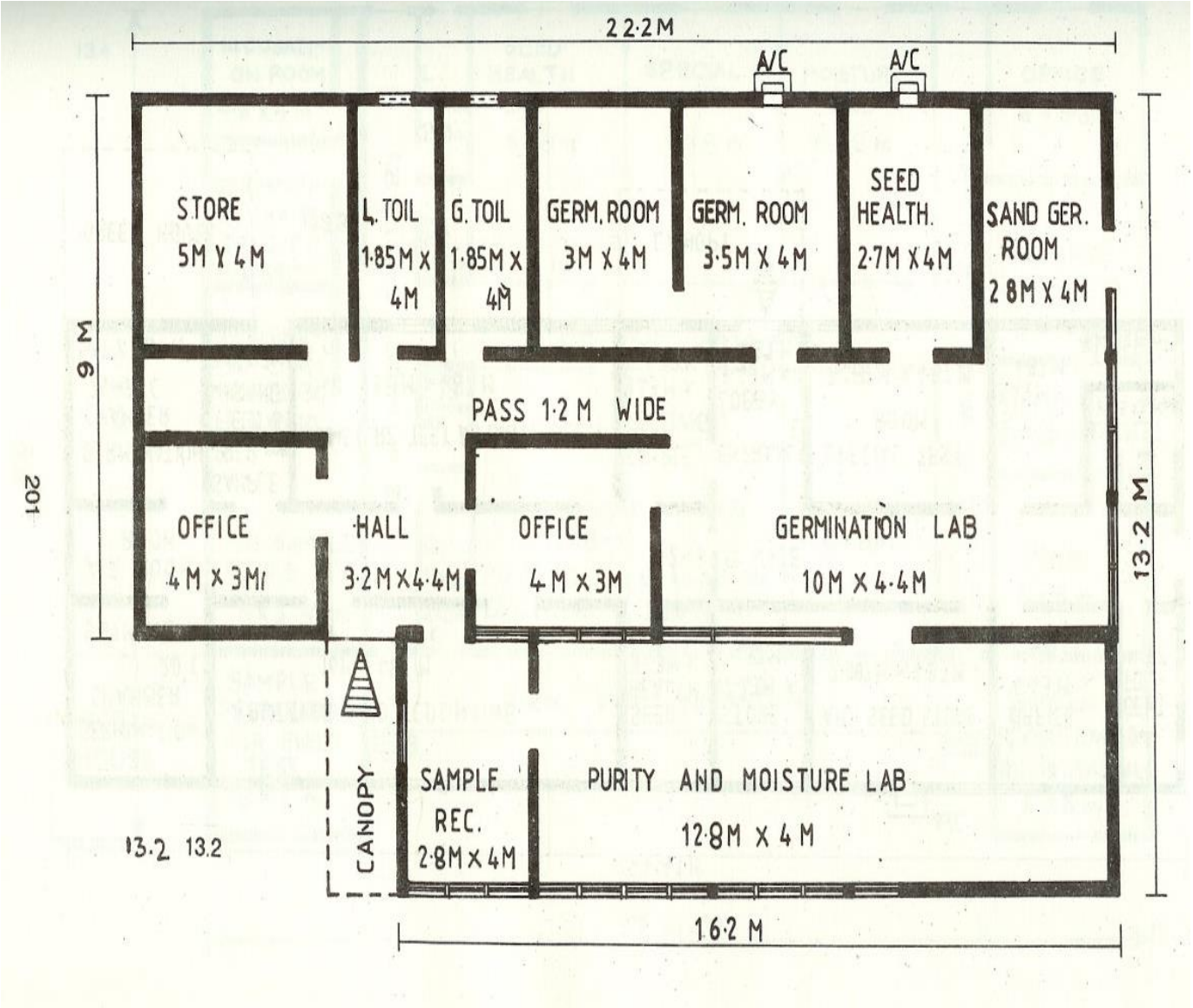
ITEM #	# required for 5,000 samples	# required for 3,000 samples	Description
SAMPLE DIVIDING			
25	1	1	Divider, Riffle; with 3 receiving and 1 pouring pans; with hopper & attached channels alternating in opposite direction; 18 channels & 18 spaces (each 1.3 cm) with a frame.
26	1	-	Divider, Boerner; with pans (4) and extension; hopper over center separating cone, 19 sections for separating seed in alternating direction; steel legs and supports.
27	1	-	Divider, Gamet, with pans (4); sample divided by centrifugal motor driven revolving neoprene disc under hopper; smooth inside finish; hopper and cylinder top lift off.
PURITY TESTING			
28	1	-	Seed blower; with separating column; air control by a calibrated valve on column cap; trap in upper column for lightweight materials, screen in bottom column to collect heavy good seed; mounted in operating cabinet; 5-minute timer; adjustable stop/on/off; with complete set of separating columns.
29	1	-	Seed counter, electronic; electro-magnetic vibratory action to move seed upward along counting track in single file and layer; sensor threshold sensitivity adjustable to avoid counting chaff; with 25 mm feeder bowl to handle seed up to 9 mm ø x 25 mm long; batch count 1 - 9,999; dual switchable bag chutes.
30	1	-	Test weight apparatus; in kg-hl, with hopper, 1-liter dent proof bucket, triangular pans for overflow, kg-hl calibrated weigh beam; hopper with sliding gate valve and standard 3 cm opening; hopper height adjustable to give standard 5 cm above bucket; cast iron base.
31	10	6	Purity workboard (30 x 50 cm) or diaphanoscope fitted with 20 W light; work area of smooth opal glass surface; light off/on switch under the glass to shine through when required for seed examination.
32	10	6	Desk lamp; with magnifier and correct fluorescent lighting; 12.5 cm lens; 45 cm adjustable arm, 25 cm long light fixture with three 6-W tubes.
33	10	6	Magnifier, hand-held; compound lens; corrected for aberrations; lens swings into cover for protection in carrying; 14x power; 11 mm lens ø, 1.9 cm focus.
34	1	1	Binocular microscope, with light; stereo-zoom, magnification, 16x; illuminating system.
35	15	10	Forceps, analyst, 13.1 cm, medium-sharp point for manipulating medium and small seed.
36	15	10	Forceps, analyst, 15 cm, blunt point; for manipulating large seed.

ITEM #	# required for 5,000 samples	# required for 3,000 samples	Description
37	300	100	Containers for purity fractions; pure seed; aluminum or metallic with well fitting lids; large (20 mm x 40 mm ø, depth 20 mm).
38	600	200	Containers for purity fractions; other fractions; aluminium or metallic with well fitting lids; small (10 mm x 40 mm ø, depth 10 mm)
39	1	1	Cupboard; metalic with plastic drawers; storage for weed seed collection.
40	1	1	Glass test tubes; fitted with tight stopper; to store weed seed for reference.
WEIGHING			
41	1	1	Balance, precision; 1000 g capacity; 1 g x 10 mg graduations; 10 mg readability; scoop of polished stainless steel; with weight loader; 9 g total x 1 g increments.
42	1	1	Balance, analytical; 160 g capacity; readability, 0.1 mg; touch control bar to turn balance on or sets to zero; digital weight read-out; enclosed weighing cabinet to eliminate drafts.
43	1	1	Balance, electronic; top loading; digital read- out; dual capacity of (1) 3,000 g at 0.1 g readability, and (2) 300 g at 0.01 g readability.
GERMINATION TESTING			
44	2	-	Germination room, with thermal insulation and moisture/vapor barrier and rubber gasket seals on all surfaces and door; inside push door opener; Temperature and humidity controls, fan(s); fluorescent lights with timers; corrosion proof wall, ceiling, floor, and door surfaces; adjustable metal shelves; capable to establish and hold 10, 15, 20, 30, and alternating 10-20, 20-30oC, etc.; capacity 500 samples.
45	2	2	Germinator, with lights; capacity ^{3} 600 liter, with supports for 30 trays; all trays provided; double chamber with fluorescent; exterior and interior finish of stainless steel; reach and maintain 2oC to 40oC ± 2oC; maintain 95% rh.
46	1	-	Germinator, copenhagen tank; capacity for 120 samples; all coils and belljars provided; stainless steel tank; circulator; connecting tubing and draining tap; range 5 to 35oC constant and alternate.
47	1	1	Refrigerator; front opening door, closed with gaskets; capacity 250 liter; maintain temperature between 5 and 10oC.
48	1	1	Oven, heated-air, electric; temperature, 160oC; for sterilizing sand; double wall with aluminum interior, fiberglass insulation, enameled steel exterior; bimetallic thermostat with indicator; mercury thermometer, mount in oven top.
49	1	-	Mixer; small concrete mixer; to mix water and sand for germination test; set of sieves 0.8, 0.05 mm ø.

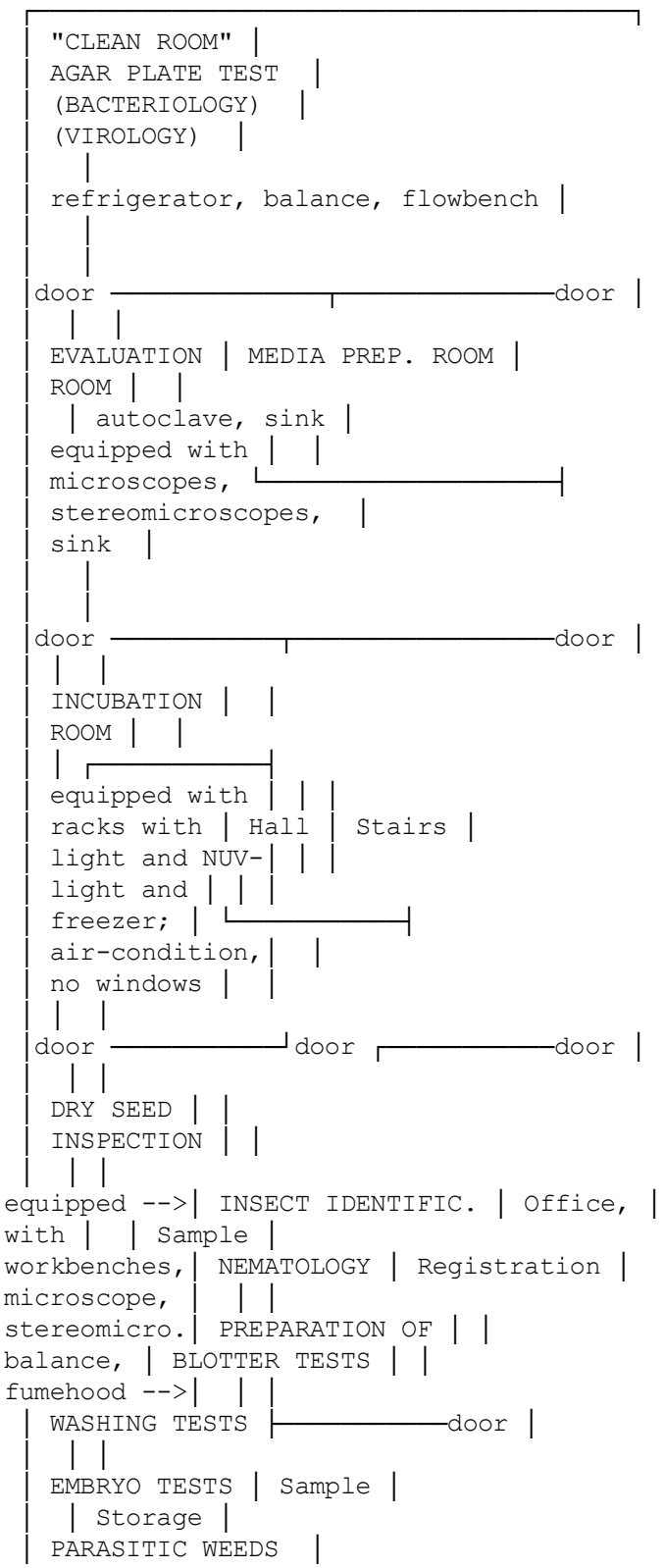
ITEM #	# required for 5,000 samples	# required for 3,000 samples	Description
50	4	2	Rakes and scrapers; rust-proof metal; for loosening and smoothing the seed beds ; compatible with box size.
51	6	4	Counting boards, for large seed (beans, peas, maize); tray for 25, 50 or 100 seed; acrylic and brass to allow washing or sterilization; tray size < 0.75 cm for rectangular or ø of seed bed.
52	1	1	Vacuum seed counter, for medium or small seeds; with all interchangeable heads for all crop seed (cereal sized -1.1 mm, brassica sized- 0.3 mm); self-contained unit installed in cabinet.
53	1000	500	Boxes; germination in sand (cereals, pulses); size 17 cm x 14 cm x 4.5 cm; tight fitted with 9 cm deep transparent cover.
54	200	100	Boxes; germination in pleated paper; shallow and transparent; size 21 cm x 5 cm x 3 cm; fitted with 9 cm deep transparent cover.
55	300	100	Pan, aluminum, rectangular, approx. 25 cm x 50 cm x 7.5 cm deep, for rolled and folded paper towel tests.
56	500	200	Petri dish, standard size; plastic, with loosely fitting cover; ø 10 cm, depth 1.6 cm.
57	10	5	Thermometer, lab; Centigrade, red alcohol, white back; temperature range -20oC to +110oC, 305 mm long, immersion 76 mm.
58	15	10	Tweezers; short-arm, not thin or sharp tips; to manipulate small and tender seedlings
59	15	10	Spatula; metallic or plastic; for counting seeds.
CONDITIONING TESTING			
60	1	1	Hand testing screens, complete set of different perforation sizes & shapes for various crops; with storage racks, 12 blank screens; 30 cm screen frame size, wood frame with design to permit secure stacking of screens for hand shaking.
61	1	1	Lab-model air-screen cleaner; to process samples or small lots; with screens of different size to clean all seed; air aspiration before and after screen separation; dust collector; ³ (not less than?) 3 screens in sequence flow, 2 scalping and 1 grading; rubber ball screen cleaning system; mounted on work table; adjustable feed hopper; variable speed screen shake with tachometer to indicate shake speed to facilitate reproducible testing; seed pans to collect all discharged fractions; with all required motors, drives, switches.
62	1	1	Lab model indented cylinder separator; variable speed drive; adjustable liftings discharge; seed pans for discharged fractions; mounted on worktable; adjustable feed hopper; with 10 common grain indented cylinder sizes; all motors, switches, and drive. With complete conversion kit for sizing (width and thickness, perforated cylinders) separations, including commonly used perforation sizes and shapes for major field crop seed.

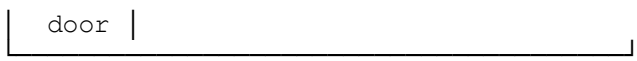
ITEM #	# required for 5,000 samples	# required for 3,000 samples	Description
63	1	1	Lab model seed scarifier; with brush type adjustable feed hopper; adjustable scarifying mechanism to provide different degrees of polishing hulling or scarifying action; seed pans for all discharged fractions; dust aspiration and collection system; mounted on worktable of standard height; with 20 interchangeable mantles; all required motors, switches, and drive.
64	1	1	Lab model gravity separator; with precise air control system; 5 interchangeable deck surfaces for small to large seed; deck slope adjustable from end-to-end and from side-to-side; adjustable deck speed with tachometer to indicate exact speed to allow reproducible testing; seed pans for all discharged fractions; adjustable feed hopper; mounted on worktable of standard height; all required motors, switches, and drive.
65	1	40	Sample pan; aluminum, rectangular with pouring spout; size approx. 21.3 cm x 30 cm x 3.75 cm.
66	1	40	Sample pan, triangular; heavy tin; approx. size 25 cm x 25 cm x 6.3 cm.
CALCULATION			
67	1	1	Desk top calculator; for calculating test results
68	1	1	Computer software and printer, for typing test results and certificates
OPERATIONS			
69	1	1	Air compressor, heavy duty; with ³ 7.5 gallon tank; portable, on semi-pneumatic tires, with pull handle; oil-less twin-cylinder air pump; one 15-m hose with quick-snap connectors, trigger operated air gun; pressure regulator; automatic pressure actuated on/off compressor switch; 2 extra complete (male and female units) quick-snap connectors.
70	1	1	Vacuum cleaner, heavy duty industrial type; to handle solid, liquid, and semi-liquid materials ; portable, on casters; with hose ³ 5 m long, floor sweeping tools and handle, crevice tool, and other cleaning attachments; tank to hold heavier materials; filter bag to filter light dust; liftings tank of stainless steel, ³ 16 gallons; detachable carrier, running gear; fixed handle and utility basket; ³ 50 ft. attached electric cable.
71	1	1	Hand tools, complete set, for small repairs to mechanical and electrical equipment; with socket, ratchet, key, open-end and ignition wrench set; torque wrench; set of pin punch, hammer, plier and phillips screwdrivers; pinch bar, tin snips, hacksaw, screwdrivers etc.; with steel toolbox and lock.

Site example 1: Seed Laboratory – Illustrative floorplan example
Source: Worede Woldemariam



Site example 2: Seed Laboratory – Illustrative floorplan example
Source: Worede Woldemariam




door

C. Sample of QA training agenda tied to indicative cost estimate

Source: Training organized by Monsanto/Bayer (Godwin Lemgo, Regulatory Policy and Scientific Affairs Lead- Africa), with sponsors

Workshop on International OECD Seed Certification
Arusha, Tanzania
24 September – 4 October 2019

DRAFT PROGRAMME

Sunday September 22 – Gerry, Kobus and Eddie arrive			
Monday November 23 – familiarisation and final preparation day, participants arrive			
Day 1 – Tuesday, 24 September 2019 General, OECD Seed Certification Schemes			
08:00	08:30	*Registration of participants*	
08:30	9:00	Welcome address, opening ceremony	
9:00	9:10	Introductions	
9:10	9:30	Zero Assessment	
9:30	10:00	***Coffee / Tea break***	
10:00	10:20	International (OECD) Seed Certification – overview, different seed programs, benefits and scope	Eddie
10:20	10:40	Status of implementation of OECD Seed Scheme in Zambia	Tanzania
10:40	11:30	The Role of International Organisations in the Global Seed Trade (ISF, IPPC, UPOV, ISTA, OECD)	Eddie
11:30	12:00	OECD Seed Schemes Rules and Regulations: Part I. Legal and General Terms Common to All Seed Schemes - Council Decisions, Basic Principles, Methods of Operation, Application Procedures, Participation in Meetings, etc.	Gerry
12:00	13:00	OECD Seed Schemes Rules and Regulations: Part II. General Rules and Regulations of all Seed Schemes- Eligibility criteria for varieties; Categories of seed, Definitions & Common appendices	Eddie
13:00	14:00	***Lunch***	
14:00	14:20	The SADC Seed Harmonisation – progress	Eddie
14:20	15:00	General Discussions – TASTA Topic	TASTA
15:30	15:50	***Coffee / Tea break***	
15:50	16:20	The OECD Scheme for Maize Seed	Eddie
16:20	16:50	The OECD Scheme for Cereal Seed (Rice)	Gerry
16:50	*17:00*	*General Discussions*	

Day 2 – Wednesday, 25 September 2019 Seed Certification Lectures			
09:00	09:30	The OECD Scheme for Sorghum Seed	Eddie
09:30	10:00	The OECD Scheme for Grass and Legume Seed (Common Beans & Soybeans)	Kobus
10:00	10:30	The OECD Scheme for Crucifer Seed and Other Oil or Fibre Species (Sunflower)	Eddie
10:30	11:00	***Coffee / Tea break***	
11:00	11:30	Eligibility criteria and acceptance of varieties – DUS and VCU testing procedures in the context of OECD Seed Certification	Gerry
11:30	12:00	Rules and Directions for listing of varieties/hybrids under OECD Seed Scheme in Tanzania	Tanzania
12:00	13:30	Registration of seed production fields, general crop and field requirements, Field Inspections	Eddie
13:30	14:30	***Lunch***	
14:30	15:00	Authorization of Inspectors, samplers, seed testing laboratories	Gerry
15:00	15:20	Labelling 1. – Colour coding, examples of OECD Labels, required information on labels and OECD Varietal Certificates	Kobus
15:20	15:35	Labelling 2. - Supply of OECD labels in Tanzania	Tanzania
15:35	15:50	***Coffee / Tea break***	
15:50	16:10	Rules and Guidelines for Multiplication Abroad	Eddie
16:10	17:00	Database & Record maintenance – RSA Example	Kobus
17:00	*17:20*	*General Discussions*	

Day 3 – Thursday, 26 September 2019 Sampling Lectures (ISTA)			
09:00	10:00	Overview on ISTA Rules Development and Seed Testing	Eddie
10:00	10:30	Heterogeneity (Smiley Exercise)	
10:30	10:50	***Coffee / Tea break***	
10:50	12:00	General principles of seed sampling	Gerry
12:00	13:00	General introduction to sampling methods	Eddie
13:00	14:00	***Lunch***	
14:00	14:30	General introduction to sampling methods (Continued)	Eddie
14:30	15:00	Dividing composite samples into submitted sample	Gerry
15:00	15:30	***Coffee / Tea break***	
15:30	16:15	Control, calibration and maintenance of sampling equipment	Eddie
16:15	16:40	Sealing Methods	Gerry
16:40	*17:00*	*General Discussions*	
19:00	22:00	Workshop Dinner (Optional, can be any other night)	Organisers

Day 4 – Friday, 27 September 2019 Sampling Practical (ISTA)			
08:00	*09:00*	*Transfer to venue for practical exercises*	Organisers
09:00	10:15	Practical Session: Sampling of containers, bags and boxes.	All
10.15	10:45	***Coffee / Tea break***	
10:45	11:30	Practical Session: Sampling of containers, bags and boxes (continued)	All
11:30	13:00	Practical Session: Dividing composite samples into submitted sample	All
13:00	14:00	***Lunch***	
14:00	15:00	Practical Session: Calibration of dividing equipment	All
15:00	15:30	***Coffee / Tea break***	
15:30	17:00	Practical Session: Calibration of dividing equipment	All
17:00		*Transfer back to Hotel*	Organisers

Day 5 – Saturday, 28 September 2019 Post Controls			
09:00	10:15	Presentation 'Post-Control general'	Gerry
10:15	10:30	Harmonisation of seed testing for OECD seed certification	Tanzania
10:30	11:00	***Coffee / Tea break***	
11:00	12:00	Presentation 'Planning and management of control plots"	Gerry
12:00	13:00	Group assignment 'Planning a post control field'	
13:00	14:00	***Lunch***	
14:00	15:00	Group assignment 'Planning a post control field' (ctd)	
15:00	15:30	***Coffee / Tea break***	
15:30	16:00	General Discussions on Post Controls	

Day 6 – Sunday, 29 September 2019 Rest Day			
08:00	*18:00*	*Free Time*	*All*

Day 7 - Monday, 30 September 2019 Field Inspection Lectures			
09:00	10:30	General principles of OECD field inspection	Gerry
10:30	11:00	***Coffee / Tea break***	
11:00	11:45	OECD Requirements: Field Inspections on Maize (Including the taxonomic characteristics)	Eddie
11:45	12:15	OECD Requirements: Field Inspections on Soya (Including the taxonomic characteristics)	Kobus
12:15	13:00	OECD Requirements: Field Inspections on Rice (Including the taxonomic characteristics)	Gerry
13:00	14:00	***Lunch***	
14:00	14:45	OECD Requirements: Field Inspections on Sorghum (Including the taxonomic characteristics)	Eddie

14:45	15:30	OECD Requirements: Field Inspections on Common Beans (Including the taxonomic characteristics)	Kobus
15:30	16:00	***Coffee / Tea break***	
16:00	*17:00*	*General Discussions*	

Day 8 – Tuesday, 1 October 2019 Control Plot Practical			
08:00	*09:00*	*Transfer to venue for practical exercises, Divide in Groups*	Organisers
09:00	10:00	Practical exercises in control plots (soya)	
10:00	10:30	***Coffee / Tea break***	
10:30	13:00	Practical exercises in control plots (maize, sorghum)	
13:00	14:00	***Lunch***	
14:00	15:00	Practical exercises in control plots (rice)	
15:00	15:30	***Coffee / Tea break***	
15:30	16:45	Practical exercises in control plots (beans)	
17:00		*Transfer back to Hotel*	Organisers

Day 9 – Wednesday, 2 October 2019 Crop Inspection Practical Day 1			
08:00	*10:00*	*Depart from hotel and travel to Inspection fields*	Organisers
10:00	10:30	***Coffee / Tea break***	
10:30		Group 1 – Crop inspection training (Maize & Sorghum) Group 2 – Seed Industry Visit	
13:00	14:00	***Lunch***	
14:00	15:30	Group 1 – Crop inspection training (Beans & Soybeans) Group 2 – Seed Industry Visit	
15:30	16:00	***Coffee / Tea break***	
16:00	17:00	Group 1 – Crop inspection training (Rice, Sunflower) Group 2 – Seed Industry Visit	
17:00		*Transfer back to Hotel*	Organisers

Day 10 – Thursday, 3 October 2019 Crop Inspection Practical Day 2			
08:00	*10:00*	*Depart from hotel and travel to Inspection fields*	
10:00	10:30	***Coffee / Tea break***	
10:30		Group 2 – Crop inspection training (Maize & Sorghum) Group 1 – Seed Industry Visit	
13:00	14:00	***Lunch***	
14:00	15:30	Group 2 – Crop inspection training (Beans & Soybeans) Group 1 – Seed Industry Visit	
15:30	16:00	***Coffee / Tea break***	
16:00	17:00	Group 2 – Crop inspection training (Rice, Sunflower) Group 1 – Seed Industry Visit	
17:00		*Transfer back to Hotel*	Organisers

Day 11 – Friday, 4 October 2019 Assessment & Closure			
09:00	09:30	Final Assessment	Participants
09:30	10:30	Position of BMT in the OECD Seed Schemes	Gerry
10.30	11:00	***Coffee / Tea break***	
11:00	12:00	Open session with Zambian NDA	
12:00	12:45	OECD seed Schemes in the UK	Gerry
12:45	14:00	***Lunch***	
14:00	14:45	OECD Seed Schemes in South Africa	Eddie
14:45	15:15	Assessment answers	Gerry / Eddie
15:15	15:45	***Coffee / Tea break***	
15:45	16:15	Final discussions and round-up	Gerry / Eddie
16:15	17:30	Presentation of Certificates and Closing Ceremony	

Day 12 – Saturday, 5 October 2019 Departure			
08:00	*18:00*	*Depart for Home*	*All*

ANNEX V: LAB SITE VISIT REPORT

This annex is found in a separate Word document, entitled SeedSAT Annex V_Lab site visit report_Ethiopia.docx.

ANNEX VI: EGS SUMMARY REPORT

This annex is found in a separate Word document, entitled SeedSAT Annex VI_EGS report.docx.

ANNEX VII: INSTITUTION INTERVIEW LISTS

QA Interview List	
Farmer Groups	**Crops/Industry**
Amhara Farmer Cluster	6 Representing Maize, Tef, and Wheat
Tigray Farmer Cluster	2 Representing Tef and Wheat
SNNPR Farmer Cluster	6 Representing Maize, Tef, and Wheat
Oromia Farmer Cluster	6 Representing Maize, Tef, and Wheat
Seed Producing Groups	**Crops/Industry**
Amhara Seed Producers	6 Representing Maize, Wheat, EGS, and Community-based Seed Production
National Seed Producers	5 Representing Maize, Wheat, Sorghum, Tef, EGS, and Community-based Seed Production
Oromia Seed Producers	8 Representing Maize, Wheat, Tef, and Community-based Seed Production
SNNPR Seed Producers	2 Representing Maize, Wheat, Tef, EGS, and Community-based Seed Production
Tigray Seed Producers	1 Representing Wheat, Tef, and Community-based Seed Production

NARS Interview List	
Institution/Organization	**Location**
MERCI coordinator	Addis Ababa
EIAR	Addis Ababa
EIAR, sorghum	Melkassa
EIAR, maize	Ambo, Bako, Melkassa
EIAR, wheat	Kulumsa, Oromia
EIAR, tef	Bishoftu (Debre Zeit)

PLR Interview List
Institution
Ministry of Agriculture
Agricultural Inputs Quality Control and Quarantine Authority
Agricultural Transformation Agency
Amhara Agricultural Research Institute
Amhara Plant Seed and Other Agriculture Quality Control Authority
Ethiopian Institute of Agricultural Research

ANNEX VIII: DOCUMENT LISTS

A. List of Legal and Regulatory Instruments:

- MOA, National Seed Policy, 2020.
- Seed Proclamation No. 782/2013.
- Council of Ministers Seed Regulation No.375 of 2016.
- Rate of Fees for Seed Competency and Related Services Council of Ministers Regulation No. 361 of 2015.
- PBR Proclamation No. 1068 of 2017.
- Plant Quarantine Proclamation No.36/197.
- Plant Quarantine Regulations No.4/1992.
- MOA, Seed System Development Strategy, 2013.
- Public Crop and Forage Early Generation Seeds Administration, No. 005/782/2012.
- Biosafety (Amendment) Proclamation No. 896/2015 and Regulations
- COMESA Seed Trade Harmonization Regulations, 2014.

B. List of documents requested for QA:

Item #	*DOCUMENT REQUEST - ETHIOPIA*	
	Information requested	**Completion Status**
1	Organogram of institutional QA entities within the MoA, and within each entity	Partial
2	Ministerial level seed policy and legislation (e.g., Seed Act plus amendments)	Completed
3	The last three years of available annual reports from the certification agency and/or the phytosanitary agency, if agencies are separate	Not in English
4	List of varieties currently planted by farmers, with date of registration and indication of current level of commercialization or distribution	Don't Have
5	Seed classes covered by government mandated QA activities, e.g. breeder, pre-basic, basic, full certified, standard certified, QDS	Completed
6	Current and historical certified seed volume by crop, seed class -- for both locally produced and imported seed, by both ha inspected and mt certified	Partial
7	List of registered seed companies and other seed production entities, with date of initial registration, location, and contact information if available	Pending
8	List of officially registered seed distribution entities, location, designation by type (hub agrodealers, retailer, cooperative, seed company store, government site, etc.), and contact information if available	Don't Have
9	Relevant QA standards followed by the country, e.g. ISTA, IPPC, ISPM, OECD, regional body, etc., by crop and by class of seed	Completed
10	Officially gazetted regulations and amendments for locally produced seed, plus draft of any new regulations if they are being updated	Only some in English
11	Officially gazetted regulations and amendments for imported seed, plus draft of any new regulations if they are being updated	Completed
12	Documentation of inspection, analysis and/or testing protocols (or standard operating procedures, or other relevant documents) for government QA employees for SSAT focus crops, if separate from the	Pending
13	Documentation of inspection, analysis and/or testing protocols (or standard operating procedures, or other relevant documents) for QA employees of independently authorized entities, if separate from the regulations	Don't Have
14	Samples of all QA labels (by crop, by seed class) including anti-counterfeiting labels, if any	Completed
15	Any other public materials related to QA given to seed producers by the government	Pending
16	Any other public materials related to QA given to seed importers by the government	Pending
17	Any other public materials related to QA given to seed distributors by the government	Pending
18	Regulatory authority schedule of fees for certification activities, plus phytosanitary activities if separate	Partial
19	Service charter from regulator, and from phytosanitary authority if separate	Completed
20	Service charter from phytosanitary authority	Completed
21	Documentation of official process for seed producer or importer challenge of QA results	Completed
22	List of all government QA facilities and location (listed by purpose, e.g. branch/field office, lab, quarantine facility, growout field), with capacity of premises, and total number of seed QA staff	Partial
23	For the facilities listed above, list of equipment, storage capacity (including cold), land available for post control growouts, vehicles, ICT infrastructure and status of IT connectivity	Partial
24	List, including location, services delivered, and owner, of all licensed labs other than government labs	Completed
25	Names, locations, qualifications and years of QA experience of all public seed inspectors, samplers, analysts	Completed
26	Names, locations, qualifications and years of QA experience of all fully licensed independent seed inspectors, samplers and analysts	Don't Have
27	List of registered members of seed trade association	Completed
28	Last three years of budget information for seed quality and phytosanitary agencies	Pending