MODELS

Models are defined as a standard or example for imitation, comparison, or emulation.
Examples include:

- Community-based seed production schemes to produce open-pollinated varieties and clonally propagated crop varieties,
- Early-generation seed production through commercial entities, and
- The use of mother-baby trials for testing new varieties against existing popular varieties.

Three models emerged as critically important for Africa's seed system:

- **EGS models** that consider the role of commercial companies, NARS, NARS + seed companies, and seed companies providing EGS to other seed companies,
- **Farmer awareness** includes small packs, field days, markets, on-farm trials, radio programs, and other marketing platforms to inform farmers of improved varieties and the advantages they offered over older varieties,
- **Seed certification models** from different countries to build trust in seed quality while ensuring certification processes did not impede the flow of quality seed into the market.

Three condensed version of models are represented herewith:

1. Early Generation Seed (EGS) Models for Africa

Early Generation Seed models need to consider the respective role and strengths of **commercial companies**, **NARS**, and **seed companies providing EGS to other seed companies** to optimize EGS delivery for different crops under different contexts across Africa.
Early generation seeds (EGS) encompass breeder, pre-basic, and basic seeds. EGS is the critical connection between breeding activities and the eventual production and distribution of varieties to farmers. About 80% of SME seed companies struggle to produce a consistent supply of quality foundation seed due to technical, infrastructural, and financial challenges. EGS access in Sub Sahara Africa has impeded the advancement of the formal seed system to effectively commercialize new varieties and improve Variety Replacement Rates (VRR). Possible business models for EGS include:

- Seed companies produce their own EGS (Commercial seed companies)
- Public-private collaboration and partnerships for EGS production (NARS + Seed companies)
- Government support of public breeders to produce EGS for the private sector (NARS)
- Seed companies produce EGS for other seed companies (Seed company – Seed companies)
- Foundation (EGS) seed companies.

EGS production and use are dependent on 1) the level of demand for crops grown with the quality seed of improved varieties, and 2) the marginal economic value of quality seed of improved varieties. Four scenarios of EGS production have been summarized (de Beof et al., 2015):

- **EGS of a crop with a high level of demand of EGS and high marginal economic value of the seed is more attractive to production by the private sector**. Quality seed of improved varieties that are both attractive for private sector actors to produce and that produces crops the market demands. This results in robust private sector investment with minimal public sector involvement. For example, hybrid maize and vegetable seeds.
- **Production of EGS of a crop with a high level of demand and low marginal economic value of the seed needs a public-private collaboration**. Quality seed of improved varieties for crops with strong market demand but for which the cost of production or demand risk create barriers to private-sector investment and innovation resulting in public sector involvement. For example, OPV maize and cowpea.
- **EGS, a crop with a low level of demand and high marginal economic value of the seed needs a niche private investor for its production**. Quality seed of improved varieties for crops with niche market demand but which are profitable to produce in certain quantities, which are produced by a vertically integrated private sector with minimal public involvement. For example, disease-resistant sweet potato or sorghum for the brewing industry.
- **Production of EGS of a crop with a low level of demand of EGS and low marginal economic value of the seed can only be done by the public sector.** Quality seed of improved varieties for crops that are not highly desirable or profitable to produce, but which are promoted by the public sector to advance a public goal such as food security or seed security. For example, OPV sorghum and common beans.

Within each scenario, the ideal state of who invests at each value chain stage is determined by who derives value from the activity, though the work may be contracted to other actors.

Concluding remarks

Various EGS models have been presented from Africa and other regions. These demonstrate the wide range of models based on the crop characteristics, demand for seed, and economic and nutritional value of specific crops within a culture. These cases point to partnership models for EGS for different crops as a starting point for further refinement to enhance the availability of quality seeds of appropriate variety for African farmers.

References

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2. Farmer Awareness Models

Farmer awareness includes small packs, field days, markets, on-farm trials, radio programs, TV programs, and other marketing platforms to inform farmers of improved varieties and the advantages they offer over older varieties.

Studies show that farmers' awareness of new and improved varieties has a bearing on the adoption of the improved varieties (Ullah et al 2022). While there are factors like farmers' education, risk appetite, farm size, and access to credit that influence farmer awareness and adoption, there are some proven interventions that positively influence farmers' awareness and thereby adoption of improved varieties.

In some cases, farmers' participation in co-operatives or other community organizations and thereby access to processing facilities and services show a tendency to adopt improved varieties (Abdoulaye et al 2014).

Awareness interventions include:

1. **On-farm trials and demonstration plots** – farmers and extension workers immensely benefit by visiting demo plots where improved varieties are managed using farmer practices. In Mali, ICRISAT and the Institut d'Economie Rurale (IER), improved varieties of sorghum and other dryland crops were combined with improved agronomy and post-harvest processing technology to unlock the full value of improved varieties.
2. **Radio and other mass media** – these mediums are effective in raising the awareness of farmers, especially when delivered in an entertaining format. A study of 822 randomly selected rural households in north and central Tanzania showed that radio and mass media can increase farmer awareness. Programs like Shamba Shape Up with 12 million viewers can be coupled with farmer information services (e.g., iShamba) to help farmers deepen their learning following interest generated by engaging programs.
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    3. **Small packs** – instead of farmers having to invest considerable money to buy a large bag of seed, small seed packs are often available at local fairs at a low or subsidized cost to enable farmers to experiment with improved varieties at little financial risk (Kalibata et al., 2018). In the case of self-pollinated crops, seeds for the harvest of desirable varieties can be saved for and increased in the next season. This approach has been very effective in conflict and areas impacted by climate disasters to enable farmers to get re-established, especially in areas underserved by commercial seed companies.
    4. **Participatory Variety Selection** – has proven to be an effective way to both create awareness and demand for improved varieties. These trials can be conducted in a variety of ways including mother-baby trials where a mother trial is conducted on a community or research-managed plot

[1] https://shambashapeup.com/
[2] https://ishamba.com/

with all varieties and the baby trials have 2 to 4 varieties from the larger set that are tested by local farmers under their management. Regular meetings at the mother trial enable farmers to share their observations on the performance of different varieties. At harvest, farmers make recommendations on what is most appropriate for their conditions and production goals that also inform future breeding efforts.

References:

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3. Seed Certification Models

Seed certification models from different countries to build trust in seed quality while ensuring certification processes did not impede the flow of quality seed into the market.

Seed Certification:

Seed certification is the process by which a state seed certifying agency gives official recognition to seeds produced of a cultivar or named variety under a limited generation system which ensures genetic purity, identity, and a given minimum level of quality. Seed certification is a legally sanctioned system for quality control of seed multiplication and production.

Seed certification is part of the formal seed system. Seed systems are the vehicle through which farmers get good quality seeds for the new crop varieties they want and need. These can be either formal or informal seed systems. Formal seed systems are deliberately constructed systems that involve a chain of activities leading to genetically improved products: the certified seed of verified varieties. Commercial seed stockists, government or research outlets, and relief supplies constitute formal channels. Informal seed systems are where farmers own seed stocks, exchange them with other farmers and purchase them through local grain markets. The objective of seed certification is to supply high-quality seed to farmers, which is true to identity, high in purity and germination capacity, and free from pests and diseases.

There are different Seed certification models practiced by different countries. These were presented here to build trust in seed quality while ensuring certification processes do not impede the flow of

quality seed into the market. The seed certification models range from strict government control to limited government restrictions. Examples are given as follows: 1) Kenya's most strict government control, 2) India's strict government control, 3) Zambia's less strict government control and 4) South Africa's least strict government control. ICRISAT in India, therefore, practices trained farmer quality declared seed systems for crops that are not as attractive to the seed companies, and thus government regulatory agencies do not invest in regulating seed certification. More models can be found at ICRISAT's Seed Systems Models and Lessons Learned.[3]

The use of improved varieties was key to the Asian Green Revolution. However, adoption of improved varieties is low, accounting for 35 percent of all food crops grown in SSA[4] in 2010. One reason for the limited use of improved cultivars has been the slow pace of varietal release. Historically low rates of variety introduction in countries such as Zambia can be traced to government controls involving variety performance tests and fees, followed by government committees deciding if varieties will be useful for farmers and therefore permitted for seed sales.

In addition to the groups mentioned above, policymakers have drawn on new sources of pressure both inside and outside Zambia to improve and open the seed industry. Zambian seed companies have become the most important exporters of quality seed in SSA, which increases their interest in fewer trade barriers. Zambia's formal seed system is now considered more advanced than the seed system of most countries in East and Southern Africa (Abate et al., 2017). Key metrics on the impacts of the policy changes include 1) An increase in the number of new varieties annually registered and available from just 19 in the late '90s to more than 210 by 2016. Of these, 24 were drought tolerant and the average age of the varieties sold in 2016 had shortened to 10 years for maize, 4 years for rice, and 12 years for beans, and 2) An increase in maize seed exports to other SSA countries (37,000 t in 2015). Zambia ranks as Africa's largest exporter of maize seed to other African countries and accounted for more than 41 percent of Africa's intra-regional seed trade over the period covered. Access to Seeds for Zambia.[5] South Africa certification – Role of SANSOR[6] - SANSOR provides a good model seed certification[7] for Africa Access to Seeds 2019 report for South Africa.[8]

Recommendations for CESSA

- **The Access to Seeds Index annually provides a summary for each country and the seed company scores** based on how well the company is positioned to reach smallholders for food and nutritional security. It is important to note that Access to Seeds Index does not cover all seed companies but only those who meet their criteria. There's an opportunity to incentivize more seed companies in Africa through some competitive criteria.
- **Shaping the future of seeds (cross-cutting issues)-Seed quality control: Cost-effective ways to build trust**. Quality control is key to ensuring seeds will be of certain quality standards (purity, germination) and deliver what farmers pay for, in terms of yield, grain quality, and other traits.

[3] https://www.icrisat.org/seed-systems-models-lessons-learned/
[4] https://vtechworks.lib.vt.edu/bitstream/handle/10919/81300/WalkerBinder.pdf?sequence=1
[5] https://www.accesstoseeds.org/index/eastern-southern-africa/country-profile/zambia/
[6] https://www.sansor.org/#
[7] https://www.sansor.org/#
[8] https://www.accesstoseeds.org/index/eastern-southern-africa/country-profile/south africa/

Quality control has a cost, and a formal certification scheme may impede the development of local seed organizations. ICRISAT advises farmers and seed organizations on the most appropriate quality insurance system depending on crops, country, and maturity of seed markets. Community-based seed systems may follow less stringent rules, more adapted to smallholder seed growers like the Quality Declared Seed system in Tanzania, or Truthfully Labelled Seeds in India. In Malawi, to support the seed certification agency, ICRISAT has trained barefoot seed inspectors. A mobile application for seed quality control is being developed to improve transparency and lower the cost of seed certification. There is a school of thought that argues for liberalization to support both informal and formal seed systems.

Additional models for future development based on user demands shall be captured and shared through the CESSA website.

Key takeaways from models

- Models are not static and are expected to adapt over time to serve multiple contexts across Africa.
- Models for future consideration include financing mechanisms, community-based seed production, and seed production for self-pollinated and vegetatively propagated crops among others.
- There is need to apply models to different contexts, for example, in-country assessment could be done to identify the best models for different crops and intra-country regions.
- CESSA uses strategic grants to advance its knowledge of products for scaling seed production, processing, and marketing. This is especially important for underinvested crops including vegetatively propagated crops, dry land cereals, and legumes.
- CESSA prioritizes knowledge sharing including Knowledge Management and capturing learnings through grant reporting.