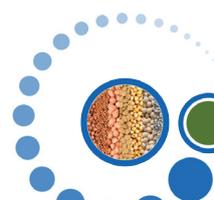


# Strategic Framework to Foster Grain Legume and Dryland Cereal Seed Systems Innovations

## Guidelines to Drive Seed Delivery Systems through Commodity Value Chains

Chris Ojiewo, Essegbemon Akpo, Jürgen Hagmann and Rajeev K Varshney



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# Contents

1. Rationale for a seed systems strategy for Grain Legume and Dryland Cereal crops .....	1
The strategy .....	1
The aim .....	1
2. Systemic bottlenecks hampering efficient GLDC seed systems .....	2
3.1. Strategic framework for seed systems intervention .....	3
3. Strategy to enhance GLDC seed systems.....	3
3.2. Strategic Thrust 1: Gaining access to dynamic market intelligence to aggregate and project demand and trigger investment .....	4
3.3. Strategic Thrust 2: Enhancing GLDC demand through diversified product development to influence consumer preferences .....	5
3.4. Strategic Thrust 3: Technologies that respond to market demand driving GLDC seed systems....	6
3.5. Strategic Thrust 4: Seed business development for quality, quantity and timely availability of seed .....	8
3.6. Strategic Thrust 5: Creating policy and incentives to spur GLDC crops' value chains .....	9
4.1. Strategy implementation model: getting to the ground .....	10
4. Implementation of this strategy .....	10
Annexure 1. Supplementary material.....	13



# 1. Rationale for a seed systems strategy for Grain Legume and Dryland Cereal crops

Millions of smallholders in the drylands continue to use non-improved seed with lower productivity. About half of these farmers live below the poverty line with only US \$1.90 per day or less sustaining them. This Grain Legume and Dryland Cereal (GLDC) crops seed systems strategy has been put together to deliver realized genetic gains to these farmers' fields.

## The strategy

- Focuses on sorghum, finger millet, pearl millet, groundnut, chickpea, pigeonpea, lentil, cowpea and soybean but can also inspire improvement in delivery systems of other crops such as rice, maize and wheat.
- Involves staples, 50-90% of whose production serves as subsistence for more than half a billion people; contain key micronutrients required for normal human health and development (e.g., iron, zinc, vitamin PP, calcium, fiber); best fits for input-constrained, poor smallholder farmers in marginal zones as these crops are drought tolerant, resilient to harsh weather conditions and are easy to grow.
- Challenges the observation that about 80% of smallholder farmers in developing countries – mainly sub-Saharan Africa (SSA) and, to some extent, South Asia (SA) – rely on non-improved GLDC variety seed for planting while the GLDC breeding programs made substantial breakthroughs with hundreds of improved and high-yielding, pest- and drought-tolerant, nutrient-use-efficient varieties developed for different agroecological regions.
- Understands that poorly organized seed systems and inefficient seed supply systems hinder large-scale use of improved variety of seeds.
- Underscores the main rationale for it, being that farmers use their own-saved seed, the bulkiness of seed of some GLDC crops (e.g., groundnut, chickpea), difficulty in storage and poor knowledge of GLDC's comparative advantage (e.g., nutrients, production ecologies, etc.).

## The aim

### Guide the design and implementation of seed systems interventions to systemically address bottlenecks in a concerted way with partners

- Elaborate on the strategic thrusts to systemically challenge identified bottlenecks to make breakthroughs in GLDC seed systems
- Share approaches and pathways to meet set targets
- Define the general framework to guide action to be taken.

### Trigger innovations and investments in GLDC through dynamic learning mechanisms across partners

- Create space for increased stakeholder interactions to show and distil innovations
- Initiate a global Community of Practice for different actors
- Deliver genetic gains generated over years through breeding programs down to farmers' fields
- Work towards raising the current low investments in GLDC crops for technologies adapted to diverse and changing environments.

### Converge key actors in GLDC to work around critical challenges for breakthroughs in seed systems

- Joint analysis and a common understanding of major challenges facilitates breakthroughs
- Enables shared perspectives and harmonization of views
- Key problems and opportunities at different seed systems function levels were discussed: seed policy and regulatory frameworks, varietal improvement and development, varietal evaluation, registration and release, seed production, seed quality control, seed marketing and use by farmers
- Priority areas defined to facilitate decision making by different actors for future seed systems interventions.

## **Create synergies and partnerships for actions to move forward efficiently and effectively**

- There are many seed systems interventions implemented by public, private, and non-profit organizations but no guidelines to show areas for synergies and joint actions
- Building on each other's experience enables better channeling of resources and delivery block by block
- Clarity on different stakeholder roles helps identify their best fit in the seed chain
- Joint efforts crystallize achievements to show meaningful impacts in a short period of time
- Help each actor to embrace the thrusts in order to unleash the full potential of GLDC seed systems.

### **This strategy was developed through a consultative process leading to:**

- Content which is the outputs from different actors' meetings
- Participation by and interactions between public, private sectors and development partners, i.e., scientists, managers, policy makers, NGOs, and farmer organizations to come up with different action points
- Encouraging buy-in to refine the content to best fit the user context and be shared as a work tool for seed systems actors.

**This strategy covers a five-year period starting 2020.**

## **2. Systemic bottlenecks hampering efficient GLDC seed systems**

**The following two questions form the crux of issues hampering the efficient performance of GLDC seed systems:**

- How quickly can the best varieties replace 15–40-year-old ruling varieties in farmers' fields?
- What appropriate business models can scale out improved seed of modern varieties?

The answers to these questions lie in addressing issues pertaining to:

- Policy and regulatory frameworks e.g., development of new standards and operationalization of existing regional harmonization efforts
- Market-driven GLDC crop improvement attracting private sector investment
- Cost-effective crop evaluation and release, capacity building for seed production and dissemination and cost-effective and more participatory quality control and assurance.

Effective GLDC seed systems need to address three systemic bottlenecks: (i) profitability of GLDC targeting current business models; (ii) market information systems to drive investments; and (iii) ineffective policy support.

### **Current business models along the seed chain do not fully exploit GLDC profitability potential**

- There is lack of clarity on the overall profitability of GLDC crops (profit margin from new varieties, non-availability of supporting data, etc.) for seed companies and farmers to strongly invest in
- There is low productivity, poor use of good agronomic and agricultural practices (GAAP), inadequate inputs, finance systems, limited value addition.
- There is negligible comparative advantage of certified seed vs recycled seed of GLDC crops, high cost of quality assurance, high crop volume with low multiplication ratio leading to high cost e.g., for groundnut and chickpea, logistical issues in moving huge volumes.

### **Lack of clear market information systems to drive investment**

- Limited data for informed decision making about demand segmentation for various purposes e.g., food processing, industrial uses, livestock feeds that also change over time and space
- Domestic markets and industrial uses, changing diets

- Planning for seed demand constrained by lack of consistent demand for large volumes of GLDC products and limited linkage of product development to output market with no clearly defined market traits.
- Marketing challenges such as the packaging volume being beyond farmers’ financial capacity, poor entrepreneurship, perceptions towards GLDC crops and technical complexities.

**Current policies are ineffective in creating incentives to unleash the potential of GLDC**

- Unsustained technical support, low investment on value chain, poor subsidy mechanism, complex regulations by governments
- Inadequate support for early generation seed production through effective linkage of breeding and basic seed production, interference due to lengthy processes along seed business
- Policy change to provide opportunities in the seed systems e.g., GLDC use in large consumption food products.

Overall, efforts should focus on food research and development, and understanding needs of clients and farmers:

- Information on the target market is essential while developing a food product
- Identifying areas in the value chains to enhance efficiencies
- Market segmentation and product diversification are also important to drive the market
- Distribution of large seed volumes at locations with maximum consumers is a critical challenge.

### 3. Strategy to enhance GLDC seed systems

#### 3.1. Strategic framework for seed systems intervention

- This strategy will address systemic bottlenecks in GLDC seed systems by working towards demand pull and responding to the generated demand
- The guiding model suggests creating demand pull and developing capacity to respond to seed demand (Figure 1).
- Demand pull incentivizes the private sector to make investments.

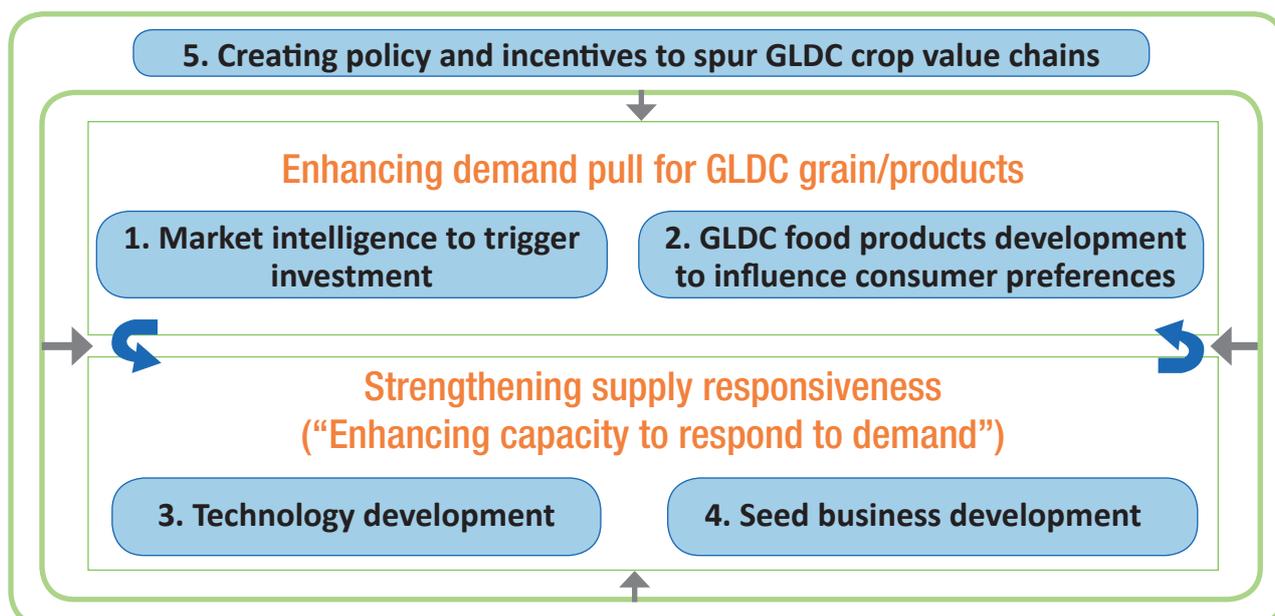


Figure 1. Strategic framework for seed systems interventions to foster GLDC innovations.

The two strategic orientations are:

- Creating demand pull for seed, involving two thrusts: (1) access to dynamic market intelligence to aggregate and project demand and trigger investment and (2) enhancing GLDC demand through diversified product development to influence consumer preferences.
- Enhancing capacity to respond to seed demand, involving the following two thrusts: (1) technologies that respond to market demand driving GLDC seed systems and (2) seed business development for seed availability and access.
- Strategic thrust 5 is cross-cutting, creating policy and incentives to spur GLDC crops' value chains.

The strategic thrusts:

- Taken individually, each strategic thrust involves key interventions that will eliminate critical challenges that GLDC seed systems face
- Taken together, the five strategic thrusts form complementary action points that would crystallize the various initiatives to be implemented across priority areas, crops and geographic areas
- They will guide interventions to create demand pull for GLDC products and simultaneously respond to the generated demand.

## 3.2. Strategic Thrust 1: Gaining access to dynamic market intelligence to aggregate and project demand and trigger investment

### 3.2.1. What Thrust 1 entails

Gather relevant information for stakeholders to harness market opportunities, market penetration strategy and development. It involves:

- Understanding market behavior by compiling and analyzing intelligence around market demand, and how population dynamics influence demand in the future
- Understanding agro-ecological demand, competition from other crops and socio-cultural factors driving seed demand
- Produce profiling, demand creation for products currently without demand, awareness creation on comparative advantage of GLDC (e.g., nutrition and health benefits of GLDC), mapping GLDC opportunities at country and regional levels, and organizing national and regional online platforms for seed demand and supply.

### 3.2.2. What to achieve in five years

- Have major produce intelligence profiled for industrial and commercial uses and for health and nutrition
- Develop and disseminate appropriate messages based on intelligence
- Have a vibrant seed industry shown by increased sales and more targeted variety release system based on intelligence
- Have a body of farmers and consumers well informed about GLDC products.

### 3.2.3. Critical challenges to address

- How can reliable and accurate data be made available for informed decision making?
- How can unpredictable market forces be handled for the private sector to make large investments?
- How can consumers' poor awareness of the uses of GLDC products be improved?
- How can the low profit margins of GLDC compared to crops like maize be increased?

### 3.2.4. Strategies and actions

- Make accurate and reliable data available through partnerships with governments, universities and market research organizations
- Develop and deploy data collection and management system covering current and future demand
- Develop and maintain strategic messages on the comparative advantage of GLDC vis-à-vis various users, involving experts such as nutritionists, health and communication professionals, against the poor product awareness
- Follow product development processes for GLDC products to the end of the value chain.

### 3.2.5. Partnership and arrangements for successful implementation

Engage strategic partners from various levels and sectors to provide relevant data for analysis and subsequent actions.

**Table 1. Strategic partners and roles to deliver on Thrust 1.**

Strategic actors/partners	Roles
Ministry of Agriculture, Ministry of trade	National statistics on GLDC production, imports, exports per year
Research Institutes & Universities	In-country product and market research
ASARECA (Association for Strengthening Agricultural Research in Eastern and Central Africa), CORAF/WECARD (Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles / West and Central African Council for Agricultural Research for Development)	Regional product and market research
IFPRI	GLDC commodity supply and trends over time
East Africa Grain Council	Grain volume traded per year, market traits, consumer preferences
Food Trade East and Southern Africa (Food Trade ESA)	Grain volume traded per year, market traits, consumer preferences
Large individual grain buyers	Grain volume traded per year, market traits, consumer preferences
Farmer organizations	Seed volume, market traits, consumer preferences
ICT & GIS companies	Mass communication and information, broadcasting relevant messages, organize social media platforms, track GLDC produce

## 3.3. Strategic Thrust 2: Enhancing GLDC demand through diversified product development to influence consumer preferences

### 3.3.1. What Thrust 2 entails

- Map the end use, current and future demand
- Segment the market to match produce with consumer need and farmer preferences, carry out demand-driven breeding through product profiling, diversify uses to influence consumer preferences
- Intensify food and feed research and development for GLDC crops
- Incentivize farmers and seed value chain actors through promotion and education activities and awareness creation of new products developed.

### 3.3.2. What to achieve in five years

- Develop and communicate diverse product profiles to help the private sector make informed decisions
- Understand elements of the market to fit new products
- Steadily increase market penetration for developed products
- Facilitate the private sector and farmers to invest in GLDC products at scale.

### 3.3.3. Critical challenges to address

- How can GLDC market produce be expanded?
- What new products should be developed to respond to new consumers' demand, behavior and market preferences?
- How can robust markets with a clear demand scheme be developed and sustained?
- How can we support GLDC product development processes for the end of the value chain?
- What capacity development can help stakeholders manage the value chain processes, including financing along the value chain – from the farm to market operations?

### 3.3.4. Strategies and actions

- Robust and intensive research and development to make GLDC products that consumers value, expand array of GLDC products, target different market segments, fit the local and regional contexts, say norms, values, quality standards, regulations
- Product profiling, describing the nature and comparative advantage of GLDC for consumers, making products and related services available to consumers, influencing purchasing habits of consumers
- Test appropriate mechanisms to reach a certain market segment
- Broker strategic partnerships for close linkages between products developer, researchers and private sectors along the commodity value chains

### 3.3.5. Partnership and arrangements for successful implementation

Strategic partners involve government entities, research institutes, universities, food industry, ICT companies and other private sector players.

**Table 2. Strategic partners and roles to deliver on Thrust 2.**

Strategic actors/partners	Roles
Ministry of trade	National statistics of processed foods, imports, exports per year
Research institutes and universities	In-country product, food and feed research
ASARECA, CORAF/WECARD	Regional product and market research
IFPRI	GLDC commodity supply and trends over time
Food and feed processing plants, malls, warehouses	Market traits, consumer preferences
Farmer organizations	Market traits, consumer preferences
ICT & GIS companies & Kalgudi platform	Mass communication and information, broadcasting relevant messages, organize social media platforms, tracking GLDC produce

## 3.4. Strategic Thrust 3: Technologies that respond to market demand driving GLDC seed systems

### 3.4.1. What Thrust 3 entails

- Increase investment in technology development for hybrid GLDC crops, improved productivity, high nutritional value, resilient and efficient inputs use varieties
- Have in place decentralized, diversified and competitive production channels, including packaging and promotion arrangements of these technologies
- Develop early generation seed supply strategy to include hybrids and Open Pollinated Varieties (OPVs).

### 3.4.2. What to achieve in five years

- Develop hybrid varieties of GLDC crops for specific markets, e.g., industrial, food security, animal feed, and biofortification
- Enhance GLDC productivity through testing and up-scaling sustainable crop intensification and innovative management practices
- Develop GLDC varieties that can be used in mechanized farming, e.g., planting, protection, harvesting and processing
- Enhance availability of early generation seed of GLDC crops
- Increase sourcing of locally produced grain by agro-processors and traders.

### 3.4.3. Critical challenges to address

- How can best-fit technologies be developed working together with stakeholders from the market to farm levels?
- How can farmer awareness of the improved technologies be improved to avoid enhanced technologies failing due to lack of knowledge?
- What capacity development is needed for various actors involved in technology development and use?
- How can partnerships be built to sustain early generation seed availability, increase seed volume and bring down costs?

### 3.4.4. Strategies and actions

- Shift from current supply-push breeding to (industry) demand-led breeding
- Introduce germplasm, characterize, hybridize and evaluate relevant traits
- Enable access to farm services, e.g., making inputs available, accessible and affordable to majority of farmers, enable easy access to funding
- Develop a robust roadmap to sustain early generation seed, including processing and storage
- Synergize project interventions.

### 3.4.5. Partnership and arrangements for successful implementation

- Delivering on the actions of this thrust will require regional technology testing and close networking with governments, research institutes and universities leading the initiatives and the private sector
- Partners' and clients' involvement in technology development is critical to facilitate its knowledge and use in a short period of time.

**Table 3. Strategic partners and roles to deliver on Thrust 3.**

Strategic actors/partners	Roles
Ministry of Agriculture	National agricultural priorities and challenges
Research institutes & universities	In-country technology development, testing, early generation seed production
ASARECA, CORAF/WECARD	Regional coordination of technology research and development
ICRISAT, ICARDA, CIAT, IITA	Technology development and sharing with NARS, including germplasm
Farmer organizations, NGO & seed companies	Technology scaling, market traits, consumer preferences, early generation seed
ICT companies	Broadcasting relevant messages, tracking availability and price of early generation seed, social media platforms, traceability of genuine technologies

## 3.5. Strategic Thrust 4: Seed business development for quality, quantity and timely availability of seed

### 3.5.1. What Thrust 4 entails

- Capacitate various actors involved in GLDC seed systems to respond to seed demand pull generated by upstream work
- Supply seed of varieties that meet consumer traits and farmer preferences in quality and quantity, geographical and timely fashion for farmers, including those in remote areas
- Supply affordable seed matching the purchasing power of most farmers.

### 3.5.2. What to achieve in five years

- Enhance production and marketing of decentralized, certified and quality declared seed
- Facilitate private branding of public varieties through innovation platform and licensing mechanisms
- Strengthen ties between grain off-takers, farmers, seed producers and agro-dealers
- Increase number of gender-inclusive agri-business start-ups where youth and women are well represented
- Establish digital platforms for seed and grain business development
- Develop effective business models for SMEs and other interested partners.

### 3.5.3. Critical challenges to address

- How can the large majority of farmers using their own and non-improved seed be brought to quality seed market?
- What seed business models effectively enhance public and private partnership to leverage and mainstream the seed sector development?
- What are the areas of capacity building (e.g., quality seed production and seed business management) for seed chain actors?
- How should seed delivery systems be organized for proximity, timely, and affordable seed access to farmers in remote areas?
- How can we address seed inspection and associated costs in terms of qualified human resources and modern technology integration?
- How best can linkages between GLDC seed systems stakeholders be strengthened?

### 3.5.4. Strategies and actions

- Training seed producers in quality seed production and farmers in good agricultural practices
- Pilot or enhance private licensing of public varietal technologies
- Strengthen community to national-level farmer organizations, link them to grain off-takers, seed producers and support the development of economy of scale
- Support the development of input shops and community and higher-level aggregation centers for seed, other inputs and grain trading
- Incentivize women and youth business agri start-ups for gender-inclusive seed systems
- Develop digital platform, including e-learning systems for information sharing among economic partners for farm services access (inputs, credit, insurance, technical support).

### 3.5.5. Partnership and arrangements for successful implementation

A smart partnership for articulated seed production and delivery systems, facilitating farmers' organizations and local business actors' participation.

**Table 4. Strategic partners and roles to deliver on Thrust 4.**

Strategic actors/partners	Roles
Ministry of Agriculture	National agricultural priorities and challenges
Research institutes & universities	In-country early generation seed, technical and managerial support
ASARECA, CORAF/WECARD	Regional coordination of seed agenda implementation
ICRISAT, ICARDA, CIAT, IITA	Technology development and sharing with NARS, including germplasm
Farmer organizations, NGO, Local seed businesses, seed companies, agro-dealers	Early generation seed, certified and quality declared seed production and marketing, market traits, consumer and farmer preferences
ICT companies, GIS companies	Broadcasting relevant messages, digital platforms, social media platforms, tracking seed supply, demand and price

### 3.6. Strategic Thrust 5: Creating policy and incentives to spur GLDC crops' value chains

#### 3.6.1. What Thrust 5 entails

- Providing evidence to policy makers on the comparative advantage of GLDC crops
- Lobbying and advocacy activities to transform GLDC seed systems
- Advocacy for strategic policy interventions by governments, influencing supportive policy for increased utilization of GLDC products at the household and industrial levels
- Lobby to raise the profile of GLDC crops for increased investment in their research and development.

#### 3.6.2. What to achieve in five years

- Enhance harmonized seed trade policy at the regional level
- By-laws and regulations enacted by governments to include GLDC in large consumption products, e.g., bread, brewery, cooking flour and cookies
- Enhance investments in GLDC crops
- Raise the profile of GLDC crops at national and international levels
- Active interactions for knowledge and technology exchange between the public and private sectors.

#### 3.6.3. Critical challenges to address

- How can we drive regional seed trade policy to harmonize regional seed trade regulation?
- What policy advocacy to government will incentivize the private sector to make large investment to boost GLDC grain business as a mechanism to drive seed demand
- How do we enhance the low investment by government in GLDC crops compared to crops like maize, rice and other cash crop commodities?
- How can we raise the low profile of GLDC crops?

#### 3.6.4. Strategies and actions

- Advocacy for strategic policy interventions by governments, including harmonized regional seed trade policy
- Developing advocacy models to reach out to stakeholders in the seed and the grain industries
- Influencing supportive policy for increased utilization of GLDC products at household and industrial levels

- Human and infrastructure capacity enhancement for GLDC
- Advocacy to unfold investment in GLDC crops
- Initiating public-private policy dialogues
- Lobby for the declaration of the International Year of Sorghum and Millets by the United Nations.

### 3.6.5. Partnership and arrangements for successful implementation

Higher level meetings with government officials, interested NGOs, radio and TV events, rallies and awareness campaigns.

**Table 5. Strategic partners and roles to deliver on Thrust 5.**

Strategic actors/partners	Roles
Ministry of Agriculture, Ministry of trade, Ministry of Legislation	By-law enactment
Research institutes & universities	In-country advisory
ASARECA, CORAF/WECARD	Regional coordination of seed trade policy
ICRISAT, ICARDA, CIAT, IITA	Global level functional policy experience sharing
Farmer organizations, NGO & seed companies	Participation to lobby events
ICT companies	Broadcasting relevant messages, social media platforms

## 4. Implementation of this strategy

### 4.1. Strategy implementation model: getting to the ground

This strategy will be implemented at various levels of functions (Figure 2).

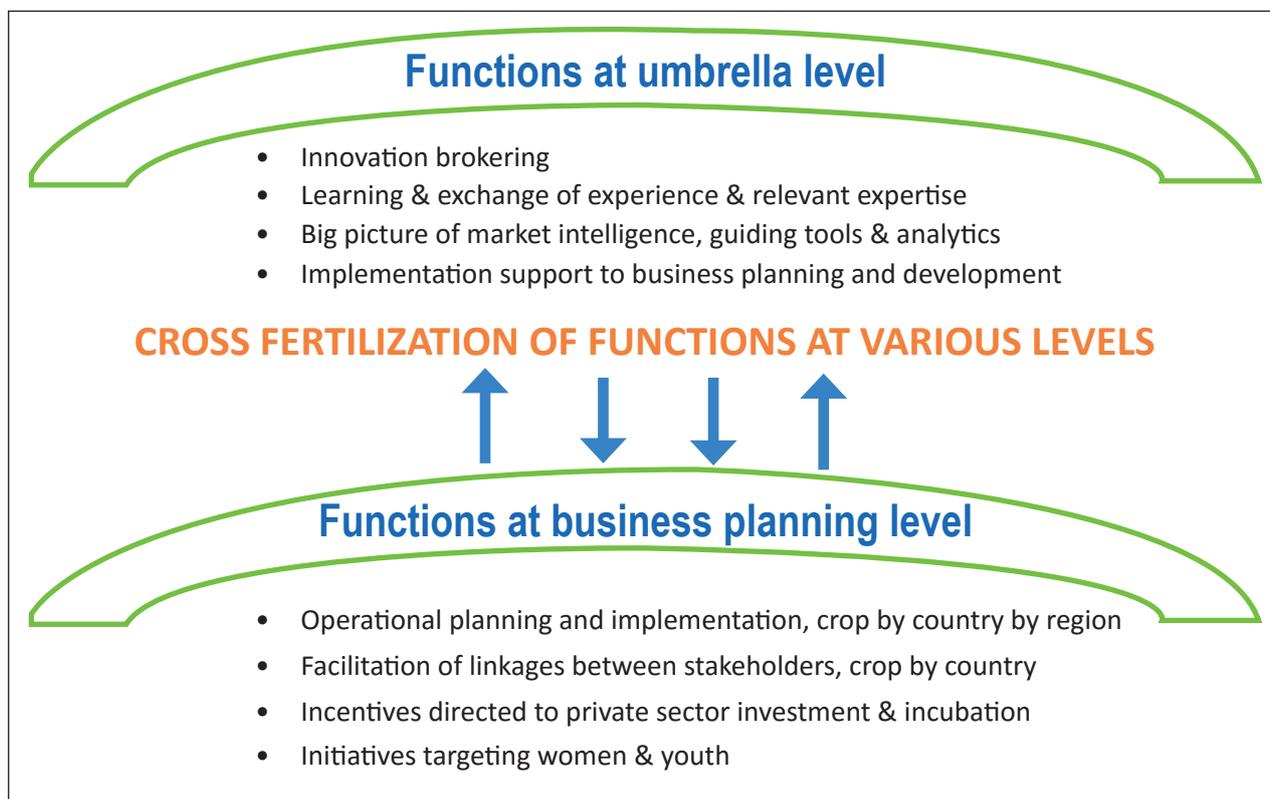


Figure 2. Model of strategy implementation.

#### **4.1.1. Functions at the umbrella level**

- Strategically guide the seed systems agenda's implementation and monitoring process, be accountable for strategy delivery in close connection with country partners
- Involve actors with global and regional responsibilities in agricultural development agenda in sub-Saharan Africa and South Asia
- CGIAR centers such as ICRISAT, IITA and ICARDA to take global leadership; functional regional organizations such as CORAF/WECARD and ASARECA to facilitate regional anchoring of the strategy
- Mobilize resources and stakeholders for higher level meetings and decision making, bring in missing expertise in specific domains per country to make the strategy work
- Facilitate sharing of experiences across countries to learn from the successes and failures of one another, avoid repeating the same mistakes and build on the breakthroughs of others.

#### **4.1.2. Function of business planning at the crop x country x region levels**

- Involves regional-, country- and crop-wise disaggregation of this strategy's action points to get interventions closer to the specific reality of each geographic area to match beneficiary needs as GLDC seed systems challenges vary with region, country and crop
- A clear roadmap per region, country and crop for specific action points, highlighting key priority areas, categories of stakeholders and services needed to make innovations happen
- Clearly defined nature of the relationship between various actors and their roles in the innovation processes and the key roles of the private sector to be better articulated
- Work planning will take a step further to make relevant arrangements at the zonal and ward/district levels to propel GLDC business for different categories of stakeholders, e.g. contractual arrangements under the leadership of local administrators/elected leaders
- Technologies that fit specific agro-ecological zones, market traits and farmer preferences can be evaluated and promoted at scale
- Various farmers' services that hinder GLDC business growth would be analyzed and addressed based on specific realities of each country and crop
- Different economic agents to engage in business planning, development and implementation to boost GLDC commodity value chains
- Private sector participation can be further increased though setting up a grant system to produce and market seed at the community level and at scale.

#### **4.2. Institutional arrangements to drive the strategy**

- A general overseeing committee composed of representatives of CGIAR centers and regional and national partners will be formed for online interactions and physical meetings
- Multi-dimensional arrangements among organizations of various scales, at different levels (community, zonal, national, regional and international)
- Collaboration between CGIAR centers (ICRISAT, ICARDA, IITA); the CGIAR and national partners (research, universities, extension, local government); partnerships with community level stakeholders (farmer organizations, NGOs, seed companies, seed entrepreneurs, agro-dealers, grain off-takers); and donors
- ICRISAT to take the lead as the coordinating organization; CGIAR centers working in the drylands to lead this initiative at the international level with their priority crops guiding the different interventions
- CGIAR centers' collaboration has a long history through bilateral projects and CGIAR Research Programs, with good examples of successful joint impacts delivery; the collaboration between CGIAR centers and national partners to follow the usual intervention mechanism
- Collaboration with stakeholders at the community level to build on existing joint work experiences in the past; develop work plans, project activities to shape collaboration
- Engagement with other initiatives with similar goals.

### 4.3. Monitoring, learning and evaluation

- The five-year strategy will see a mid-term assessment after two years of implementation and a final assessment after five years
- Periodic monitoring and evaluation meetings to assess progress mainly at the country level through activity reports at different levels
- Delivery metrics: developed work plans; number of technologies developed and released; number of demonstrations; availability of early generations for consumer-fit technologies; number of private seed companies engaged; amount of improved seed produced and timely and geographic availability; number of capacity building events; number of smallholders who have improved knowledge; rate of productivity increase; number of input shops and aggregation centers developed; number of farmers who have access to farm services; increase in farmers' assets; number of seed fairs and exhibitions organized; number of radio and TV events; number of fact sheets developed; number of posters made, working papers published, workshop and conference outputs; number of peer-reviewed journal papers; number of change stories (success and failures) recorded; and so on.

### 4.4. Resource mobilization

- Resources required to successfully implement and deliver on this strategy are estimated in hundreds of millions of US dollars.
- Donors are increasingly interested in impact-oriented initiatives; this strategy is a good fit; various categories of actors including donors are involved in its development; follow up higher level meetings with donors to leverage their support by introducing them to the initiative and their active engagement for financial support for strategy delivery at various levels
- Donors of interest are the ones already active in the drylands, such as USAID, Bill & Melinda Gates Foundation, BMZ, EU fund, AU fund and Irish fund for additional funding
- The CGIAR Research Program - Grain Legumes and Dryland Cereals (CRP-GLDC) is a ready client to support strategy implementation; bilateral projects implemented jointly with national partners to be leveraged to fill in gaps in resources
- Grant proposal mechanisms to be used to support seed systems research, seed bulking initiative and distribution activities in line with action points of this strategy; scientists, seed companies, farmer organizations and NGOs can participate through national and regional competitions
- Resources mobilized through Country Strategies can be partly channeled to meet some resource requirements of this initiative.

### 4.5. Risks and assumptions

- Some countries are undergoing significant challenges e.g., ethnic and political uncertainty in Ethiopia, repeated terror attacks in Burkina Faso and Northern Nigeria. Frequent insurgencies in Northern Uganda from DR Congo and other sporadic political instabilities in some parts of Africa represent true threats that may affect the delivery of this strategy. We are prepared to make subsequent adjustments to ensure the safety of personnel and national program partners through careful selection of work locations.
- Non-availability of resources to address different action points may undermine effective strategy implementation and timelines. While action points for which CGIAR centers are responsible may not suffer much, those requiring actions by country partners may underperform due to limited resources for operations. We are prepared to leverage funding sources (e.g. CRPs and bilateral research projects) to mitigate these limitations.
- Involvement of donors at the outset of this strategy's development and follow-up discussions with them will enhance their support in order to avail resources for strategy implementation. We are prepared to widen the array of donors to make enough resources available for the smooth and successful implementation of this strategy.
- Staff availability and commitment at both CGIAR and NARS levels to deliver on this strategy may be a limiting factor. We are prepared to leverage current CGIAR and NARS staff working on ongoing projects.

## Annexure 1. Supplementary material

### 1. What is unique about GLDC crops?

- The drylands host about one-third of the world's population
  - » Home to 2.5 billion people of whom more than half a billion are resource-poor farmers and account for about 60% of the world's poor.
  - » GLDC crops are staple with about 50-90% of the production serving as subsistence (sorghum, finger millet and pearl millet but also cowpea, chickpea, pigeonpea and lentil) while the rest are used for markets (groundnut, soybean).
  - » GLDC crops' haulms and stover are major feed and fodder for livestock, improve fodder quality and enhance animal productivity; providing resource-poor farmers with milk, meat and additional income.
- GLDC are nutritious crops
  - » They pack more micronutrients required for normal human health and development than maize, e.g., iron, zinc and vitamin in pearl millet, and iron, calcium and fiber in finger millet
  - » The amino acid profiles of grain legumes complement that of dryland cereals; so consuming them together raises the nutritional effectiveness of the cereal-dominated diets of the poor
  - » Grain legumes are considered 'poor people's meat' in sub-Saharan Africa.
- GLDC are drought-tolerant crops, resilient to harsh weather conditions
  - » They're best fits for smallholder farmers in marginal zones subject to food and feed insecurities and livelihood uncertainty
  - » GLDC crops need less water than other cereals like maize to survive, e.g., millets can grow in arid lands with 350-400 mm annual rainfall, pearl millet survives in up to 64°C temperature, chickpea and pigeonpea do well in water limited areas
  - » Late-sown legumes are reported to often escape drought or disease that devastate other crops, securing the farm family's food availability.
- GLDC are well-adapted to smallholder farming systems
  - » Sorghum and millets are easier to grow by poor farmers with scant access to inputs as they can adapt to a wide range of soil conditions, including poor and low fertility soils; some millets can mature within 60-65 days, and groundnut in 75 days against 100-140 days for wheat.
  - » They respond well to good agricultural practices with significant yield increases, e.g., fertilizer micro-dosing on millet.
  - » Grain legumes are nitrogen-fixing crops that maintain excellent soil fertility.
  - » Grain legumes break cycles of weed and disease in crop rotation, extend the duration of protective land cover, and protect the soil from erosion.
- GLDC crops share similar constraints
  - » Inadequate support and investments in the GLDC value chains by the public and private sectors
  - » They are sometimes called "orphan crops" with respect to private sector investments in their seed, variety promotion and value chain
  - » Less competitive crops compared to maize and rice.
- GLDC demand and supply trends and projections
  - » Demand for GLDC crops in sub-Saharan Africa is estimated to be about 80 million tons by 2025 and 120 million tons by 2040.
  - » South Asia is expected to supply more than 90% of the world's total demand for chickpea, pigeonpea and lentils; sub-Saharan Africa will account for more than 50% of the world's demand for sorghum, millet and cowpea by 2040.

- » Supply-demand gaps in these regions are projected to increase drastically with climate change
- » Aggregate supply and demand projections for sorghum, millets, groundnut, chickpea, cowpea, lentil, pigeonpea and soybean in low income countries in sub-Saharan Africa and South Asia follow an increasing trend against projected growth in population
- » GLDC crops are sensitive to climate change and their production is expected to decline by 3% by 2025 and by 5% by 2050.
- The way forward for GLDC crops to meet food demand
  - » The increase in GLDC production will not be enough to meet the growing demand
  - » A food and nutrition-secure dryland area requires the development and diffusion of appropriate technologies
  - » For sorghum, pearl millet and finger millet, developed technologies should include key traits, e.g., high Fe, Zn, disease and insect resistance, early maturity and drought resistance, high grain and stover yield, market taste, digestibility, etc.
  - » For grain legumes pigeonpea, cowpea, groundnut, chickpea, soybean and lentil, the developed technologies will include cooking time, protein, Ca, low P, high oleic oil and low aflatoxin, disease and insect resistance, early maturity and drought resistance, high grain and haulm yield, color, etc.

GLDC are of special importance for women farmers and consumers as, although underdeveloped, they share multiple values in agrifood systems. To meet the rising food demand due to population growth and weather uncertainty, the supply of diverse foods needs to increase. GLDC are critical to meeting this need.

## 2. Progress made so far

Joint efforts by different actors significantly narrowed GLDC yield gaps and increased genetic gains in breeding, agronomic practices, pest resistance, drought tolerance, market demand and traits, and consumer and farmer preferences. Hundreds of improved farmer-preferred varieties and hybrids have been developed.

- Superior improved and hybrid varieties developed
  - » Dozens of OPVs and hybrids with 30-40% yield advantage over farmers' OPVs developed and deployed
  - » Extra-early groundnut and pigeonpea lines with 75-95 days maturity with yield potentiality developed
  - » Hybrid pigeonpea varieties released and about 1000 tons of hybrid seed availed by farmers.
- Integrated crop management practices
  - » About 60% higher yield than those from farmers; an estimated marketable surplus of more than 400 kg/ha for sorghum
  - » Grain yields increase by over 110-320% in West Africa
  - » 35-60% yield increase compared to traditional cropping systems in Eastern and Southern Africa.
- From state control to 'uberization' of seed systems
  - » About three decades ago, seed production was not a business but a parastatal service, with breeding, production and distribution in most of sub-Saharan Africa under government control and breeders focusing on traits they considered important to farmers and the market. This led to the development of varieties unsuitable for markets and not catering to farmers' preferences.
  - » Over time, farmers took up seed production as a business, agri-businesses emerged, and greater focus was on cash crops such as cotton against food crops and GLDC crops. There were initiatives to redefine laws to bring the private sector on board. More defined roles of different stakeholders in the commodity value chains were observed.
  - » Seed has now become a veritable business with a focus on sustainable business models with

more value for money. Awareness and demand creation activities are taking place and there is improved collaboration among stakeholders with development organizations mobilizing and organizing farmers to improve their access to quality seeds at affordable price.

- » Modern information and communication technologies provide room to 'uberize' seed access; seed availability can be tracked and priced based on location and uses.
- Seed business development
  - » Thousands of farmers including about 50% women were trained in seed production and marketing techniques to enhance seed businesses.
  - » Thousands of tons of quality seed of improved cultivars of chickpea, groundnut, cowpea and lentil were produced and used by farmers in South Asia and East Africa.
  - » More than a two-fold increase in legume production was recorded in most countries.
  - » Overall, over 160 new seed varieties of grain legumes have been recently released, replacing old ruling varieties.
- Recent developments revolutionizing GLDC seed systems
  - » Availability of early generation seed, once a major challenge, is now being addressed through investment in production and dissemination of basic seed. For instance, QualiBasic is a private seed company whose main purpose is to produce and commercialize only quality foundation seed in Eastern and Southern Africa that will be used by other seed companies to produce commercial certified seed. To avoid competition with partner seed companies, QualiBasic will not commercialize certified seed.
  - » A small policy change made a huge difference in facilitating GLDC seed access to smallholder farmers in India, where the government reoriented its seed subsidy to only improved seed of recently released superior varieties. This policy change led to new varieties becoming much more popular in recent years.
  - » Public-private partnership is boosting GLDC seed systems. Many private and public seed enterprises have been and are being established in various countries to promote seed business with close collaboration between research programs and seed companies for early generation seed supply and capacity building in technical skills. For instance, the Agricultural Seed Agency (ASA) in Tanzania was established as a public seed company to take care of crops that are less attractive to the private sector, mainly GLDC crops.
- Labor-saving technologies
  - » Animal and motorized labor-saving technologies were developed and deployed across the drylands to save labor for male and female farmers, such as seeders in Mali and Tanzania, finger millet threshers in ESA and harvesters for chickpea and lentil in ESA and SA.

Even though millions of people in SSA and SA have benefited from genetic gains in GLDC through excellent breeding programs, genomic-assisted selection, released varieties, seed systems interventions and input services, the target is yet to be reached.



ICRISAT is a member of the CGIAR System Organization

**We believe all people have a right to nutritious food and a better livelihood.**

ICRISAT works in agricultural research for development across the drylands of Africa and Asia, making farming profitable for smallholder farmers while reducing malnutrition and environmental degradation.

We work across the entire value chain from developing new varieties to agribusiness and linking farmers to markets.

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