CGIAR Research Program on Grain Legumes & Dryland Cereals (CRP-GLDC)
A network and prospectus to leverage joint actions by partners

Peter Carberry
Director, GLDC
SCIENCE FOR HUMANITY'S GREATEST CHALLENGES

Towards a world free of poverty, hunger and environmental degradation CGIAR is the world's largest global agricultural innovation network.

DISCOVER OUR IMPACT

A gender focus
OUR ASSETS

15 top-class research centers
CGIAR’s global network of 15 research centers contributes to an unrivaled mix of knowledge, skills and research facilities able to respond to emerging development issues.

3,000+ partners
Unequalled partnerships network of more than 3000 partners from national governments, academic institutions, global policy bodies, private companies and NGOs.

70 countries
We have a local presence in over 70 countries with a deep knowledge of customs, values and market operations in developing countries.

50 years experience
A wealth of experience and knowledge spanning 50 years that builds on a track-record of innovation and world-class research.

DISCOVER OUR RESEARCH
Agri-Food Systems CGIAR Research Programs

The first of these is the innovative, integrated, agricultural systems research planning and resilience outcomes at scale.

Global Integrating Programs

The second cluster consists closely with the Agri-Food

Research Support Platforms

Three research support Platforms will also underpin the research of the whole system.

- CGIAR Platform for Big Data in Agriculture
- CGIAR Excellence in Breeding Platform
- CGIAR Genebank Platform
Excellence in Breeding Platform

Module 1: Breeding program management
- Measurement of Genetic Gain
- Initiation of Stage Gate process

Module 2: Optimizing breeding schemes
- Marker identification using linkage mapping & GWAS
- Development of diagnostic markers

Module 3: Genotyping/sequencing tools and services
- Genotyping services to CGIAR and NARS partners for 14 crops as part of HTPG
- Deployment of genomic selection

Module 4: Phenotyping tools and services
- Distribution/rationalization of MLTs
- Reduces cost precise phenotyping network

Module 5: Bioinfo, biometry & data mgmt tools & services
- GOBii database for genomics data in breeding
- CoP on Biometrics & Bioinformatics
- Deployment of BMS and Decision support tools
The objective of the 2016 Science Forum is to rethink the pathways for agricultural research to stimulate inclusive development of rural economies in an era of climate change. The Forum will marshal evidence and build on lessons learned to date, to suggest an updated list of priority research areas and approaches which involve more strategic and inclusive engagement with partners.
What evidence for research’s contribution to poverty alleviation?

Pathways
1. **Innovations to increase productivity – Breeding**
2. **Innovations to increase productivity – Agricultural Practices**
3. **Innovations to minimize production risks – Breeding**
4. **Innovations to minimize production risks – Agricultural practices**
5. **Market imperfections and failures – input systems**
6. **Market imperfections and failures – Value chains**
7. **Agricultural diversification**
8. **Natural resource management**
9. **Natural resource governance, property rights, and livelihoods**
10. **Human nutrition**
11. **Human health – food consumers**
12. **Human health – farmers and farm workers**
13. **Education (agricultural skills)**
14. **Food supply**
15. **Food waste**
16. **Food safety nets**
17. **National agricultural R & D**
18. **National food and agricultural policy**

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Pathway from staple crop research to poverty reduction

- Ability to adopt, intensity of adoption and productivity gains determine poverty reduction potential of new germplasm.
- Poor farmers are generally able to adopt.
- Intensity of adoption by poor farmers limits direct poverty-reducing effects.
- Other pathways may be critical to poverty reduction effects of new germplasm

Research role in supporting transformation of food systems in developing regions

- Food system is dendritic cluster of value chains.
- African, Asian, and Latin American food systems transformed fast in past two decades with “modern” and “quiet” revolutions.
- Technology innovations and R&D systems are important to the transformation of food systems, for farms and off-farm segments.
- Transformation brings incomes to farmers and lower food prices to consumers, but also exclusion, climate, energy challenges.
- IARCs and NARS need the lens of the food system in their strategies, plans, and innovations in technologies and products.

Food systems perspective. Adapted from a figure by Michele Grant, World Food System Center, ETH Zurich. Sourced from Tomich et al. 2018

GlDC: A prospectus for transforming Agri-Food Systems in the drylands of sub-Saharan Africa and South Asia

An R4D investment of
~$400 million over five years (2018-2022)
$150M Secured (38%)

A global initiative of partners for the grain legume and cereal crops of the drylands of sub-Saharan Africa and South Asia

Tackling extreme poverty and malnutrition in the most fragile ecologies
THE PROCESS

Five Flagship Programs deliver into two impact pathways

FP1: Priority setting, impact acceleration
FP2: Transforming Agri-Food Systems
FP3: Farm, household management
FP4: Variety/hybrid development
FP5: Pre-breeding & Trait Discovery

- M&E with key indicators
- Prioritize women and youth
WHY

TO ADDRESS THE GRAND CHALLENGES

1. >300 million poor and malnourished live in the target ecologies

2. Highest risk of hunger (2030-50 projections)

3. 199 million stunted children (as of 2016)

4. Food prices could double due to climate change

5. Other major issues:
   - Land degradation
   - Competition for land
   - Aging and changing workforce

WHERE

The GLDC project area covers the semi-arid and sub-humid dryland agro-ecologies of sub-Saharan Africa and South Asia, which have some of the highest rates of poverty prevalence.
**Foresight projection suggests increasing deficit between long-term aggregate supply and demand for these crops, especially for *grain legumes*.**

**WHY**

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**a:** Supply and demand projection of aggregate GLDC crops in Low Income, Food Deficit Countries with and without climate change.

**b:** Projected disaggregated sources of demand of GLDC crops by region in 2025 and 2040 (‘000 MT).

**Source:** IMPACT version 3.3, IFPRI, based on SSP2 with ‘No Climate Change’ (NoCC) and Climate Change using RCP 8.5 and the Hadley Climate Model.
### Prioritization of research investment

**Relative economic importance of select crops in 2014 aggregated across 14 countries**

Burkina Faso, Ethiopia, India, Kenya, Malawi, Mali, Mozambique, Myanmar, Niger, Nigeria, Senegal, Sudan, Tanzania, Uganda

<table>
<thead>
<tr>
<th>Rank</th>
<th>Crop</th>
<th>No. of countries grown</th>
<th>Value of production (US$ million)</th>
<th>Share of value of production (%)</th>
<th>Cumulative share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Groundnut</td>
<td>10</td>
<td>10,680</td>
<td>24.2</td>
<td>24.2</td>
</tr>
<tr>
<td>2</td>
<td>Sorghum</td>
<td>8</td>
<td>9,087</td>
<td>20.6</td>
<td>44.8</td>
</tr>
<tr>
<td>3</td>
<td>Chickpea</td>
<td>6</td>
<td>7,730</td>
<td>17.5</td>
<td>62.4</td>
</tr>
<tr>
<td>4</td>
<td>Pearl millet</td>
<td>8</td>
<td>7,165</td>
<td>16.2</td>
<td>78.6</td>
</tr>
<tr>
<td>5</td>
<td>Pigeonpea</td>
<td>7</td>
<td>3,612</td>
<td>8.2</td>
<td>86.8</td>
</tr>
<tr>
<td>6</td>
<td>Cowpea</td>
<td>8</td>
<td>2,992</td>
<td>6.8</td>
<td>93.6</td>
</tr>
<tr>
<td>7</td>
<td>Finger millet</td>
<td>4</td>
<td>1,339</td>
<td>3.0</td>
<td>96.6</td>
</tr>
<tr>
<td>8</td>
<td>Lentil</td>
<td>2</td>
<td>978</td>
<td>2.2</td>
<td>98.8</td>
</tr>
<tr>
<td>9</td>
<td>Soybean</td>
<td>6</td>
<td>511</td>
<td>1.2</td>
<td>100.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>59</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

**Heat map of quality, market and environmental traits; darker the shading, higher the contribution.**

**Return on investment of ‘region x country x crop x breeding trait’**

<table>
<thead>
<tr>
<th>Crops</th>
<th>Countries</th>
<th>Breeding priorities</th>
<th>NPV US$ million</th>
<th>IRR %</th>
<th>BCR</th>
</tr>
</thead>
</table>
| West Africa
| Sorghum | Nigeria, Mali, Burkina Faso | Early maturing varieties and hybrids with tolerance to drought; resistance to Striga; tolerance of stem borer/midge | 289-1555 | 76-130 | 5-23 |
| Groundnut | Nigeria, Mali | Drought-tolerant, short-duration, rosette and early- and late-leaf spot-resistant varieties | 52-173 | 40-49 | 6-21 |
| Soybean | Nigeria | Drought-tolerant, disease-resistant varieties | 43-58 | 53-58 | 14-16 |
| East & Southern Africa
| Sorghum | Ethiopia, Sudan, Uganda | Early maturing varieties/hybrids, tolerant to drought; resistant to Striga; tolerant of stem borer/midge | 158-468 | 83-129 | 8-28 |
## PROMOTE KEY NUTRITIOUS CROPS

### First order priority crops and countries

<table>
<thead>
<tr>
<th>Crops</th>
<th>West Africa</th>
<th>East &amp; Southern Africa</th>
<th>South Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nigeria</td>
<td>Mali</td>
<td>Burkina Faso</td>
</tr>
<tr>
<td>Sorghum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundnut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soybean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cowpea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearl millet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigeonpea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chickpea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finger millet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lentil</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Product Concept Notes for all GLDC crops

Product Concept Notes of GLDC Crops

This report is commissioned by ICRISAT to accompany the proposal on CGIAR Research Program on Grain Legumes and Dryland Cereals Agri-food Systems

(This document is not to be used for citation purposes)

Authors


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Ousmane Boukar and Godfree Chigeza3

1 International Crops Research Institute for the Semi-Arid Tropics
2 International Centre for Agricultural Research in the Dry Areas
3 International Institute of Tropical Agriculture
GLDC: bringing together the R4D capabilities of the CGIAR in cereal-legume-tree-livestock systems

**ICRISAT**: Sorghum, pearl millet, finger millet, chickpea, pigeonpea and groundnut

**IITA**: Cowpea and soybean

**ICARDA**: Lentil and chickpea

**ICRAF**: Agroforestry and Natural Resource Management

**ILRI**: Crop-livestock integration

**IWMI**: Water management

**Biodiversity International**: Promote biodiversity on farms

**WLE**: Interface farms and landscapes, increase water-use efficiency

**A4NH**: Biofortification and food safety

**CCAFS**: Climate-risk management tools and information

**LIVESTOCK**: Dual-purpose varieties and hybrids

**PIM**: Foresight modelling tools to assess impacts

**RICE, WHEAT, MAIZE, ROOTS, TUBERS AND BANANAS**: Intercropping with dominant crops of the CRPs
## GLDC Partners

<table>
<thead>
<tr>
<th>Apex and SROs Sub-Saharan Africa</th>
<th>Private Sector companies &amp; consortia</th>
<th>USAID Feed the Future Innovation Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>NARES</td>
<td>DuPont Pioneer</td>
<td>Sorghum and Millet</td>
</tr>
<tr>
<td>FARA</td>
<td>Advanta Seeds</td>
<td>Peanut &amp; Mycotoxin</td>
</tr>
<tr>
<td>CORAF/WECARD</td>
<td>Syngenta Foundation</td>
<td>Legume</td>
</tr>
<tr>
<td>CCARDESA</td>
<td>Seed Co, Zimbabwe</td>
<td>Climate-Resilient Sorghum</td>
</tr>
<tr>
<td>ASARECA</td>
<td>Mars Chocolate</td>
<td>Climate-Resilient Chickpea</td>
</tr>
<tr>
<td>RUFORUM</td>
<td>Microsoft</td>
<td>Climate-Resilient Cowpea</td>
</tr>
<tr>
<td>WACCI</td>
<td>MANOBI-AFRICA, Senegal</td>
<td></td>
</tr>
<tr>
<td>AWARD</td>
<td>Hybrid Parent Research Consortium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>African Seed Trade Association</td>
<td></td>
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<tr>
<td></td>
<td>India Pulses &amp; Grains Association (IPGA)</td>
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<tr>
<td></td>
<td>Farmer Producer Organizations, India</td>
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<table>
<thead>
<tr>
<th>South Asia NGO &amp; Large Programs</th>
<th>ARIs</th>
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</thead>
<tbody>
<tr>
<td>SAARC Agriculture Centre</td>
<td>CSIRO, Australia</td>
</tr>
<tr>
<td>APAARI</td>
<td>CIRAD, France</td>
</tr>
<tr>
<td>ICAR, India</td>
<td>IRD, France</td>
</tr>
<tr>
<td>National Institute of Nutrition, India</td>
<td>FAO Research and Extension</td>
</tr>
<tr>
<td></td>
<td>World Vegetable Center</td>
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<tr>
<td></td>
<td>SLU, Sweden</td>
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<td></td>
<td>UWA, Australia</td>
</tr>
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</table>
GLDC Innovation Fund

• Engage with private and public sector, civil society and smallholder farmers actors in targeted value chains.

• Fund collaborative design, implementation and outreach of GLDC projects that focus on understanding and overcoming constraints on the path to impact.

• Invest in unanticipated opportunities that can build a strong business case for sustainable and equitable benefits for smallholders.

• Critical capacity building activities that address key institutional barriers along GLDC value chains.

• Leveraging co-investment from private, NGO or public sector partners.

• A robust, transparent process will be implemented.
**Build on phase 1 (2012-16): Grain Legumes Achievements**

<table>
<thead>
<tr>
<th>Number of New Cultivars Released</th>
<th>Seed Produced / Distributed (CRP facilitated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>252 Varieties</td>
<td>445,847 metric tons</td>
</tr>
<tr>
<td>4 Hybrids</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management Practices Demonstrated</th>
<th>Demonstration Trials for Management Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>23,582</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Number of Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1081</td>
</tr>
<tr>
<td>ISI 583</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Farmers at Farmer Field Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,032,246</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trainees in Short-Duration Training Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>30,886</td>
</tr>
<tr>
<td>Women: 17,945</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Students Completed Master’s Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>135</td>
</tr>
<tr>
<td>Women: 67</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Students Completed PhD Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>154</td>
</tr>
<tr>
<td>Women: 47</td>
</tr>
</tbody>
</table>
10-Year Pulse Research Strategy

IYP Global Dialogue
FAO, Rome
22-23 Nov 2016

Shoba Sivasankar
Director
CGIAR Research Program on Grain Legumes
Genomes sequenced...

- Pigeonpea (Nature Biotechnology- 2012)
- Chickpea (Nature Biotechnology- 2013)
- Groundnut (Nature Genetics- 2016 PNAS 2016)
- Mungbean (Nature Commun.- 2014)
- Sesame (Genome Biology- 2014)
- Pearl millet- 2016 (in revision)
PL1. Drought and low-phosphorus tolerant common bean, cowpea and soybean

Facilitating legume seed and technology delivery systems

Policy change in ES Africa:
Acceptance of Quality Declared Seed

- QDS produced by trained farmers
- Local production reduces transport costs
- Option of availing locally preferred varieties
- Promotion of local entrepreneurship

Seed produced (MT):
96,000 of bean,
16,549 of cowpeas and soybean
Tropical Legumes III

FAO WORKSHOP HIGHLIGHTS TROPICAL LEGUMES III SEED SYSTEM INITIATIVES IN AFRICA

The Food and Agriculture Organization (FAO) selected several locations of the Tropical Legumes III (TL III) project to illustrate the learning of...

HOPE II Harnessing Opportunities for Productivity Enhancement of Sorghum and Millets in Sub-Saharan Africa and South Asia

NEW INITIATIVE TO HELP SORGHUM AND MILLET FARMERS INCREASE THEIR YIELDS IN SPITE OF HIGH TEMPERATURES AND LOW RAINFALL

Addis Ababa, Ethiopia. (May 11, 2016). A dryland cereals improvement project ‘HOPE Phase 2’ aimed at improving productivity of sorghum, pearl millet...
Bhoochetana - A soil rejuvenation project with Government of Karnataka

20 - 66% yield increase
5% rise in agriculture growth
$130 million in 2011 season
$1 invested = $3-$14 return

3 million farmers
3.7 million ha

Farmers made up to $500 net gain per ha in one season
Breeding Management System – supporting partners

• Working with NARS in ESA, WCA and ASIA

• Migrating fully two ICAR-India Institutions
  • Indian Institute of Millets Research (IIMR)
  • Indian Institute of Pulses Research (IIPR)
  • Separate server for ICAR
    http://bms.icrisat.ac.in

• Also supporting
  • Indian Institute of Rice Research (IIRR)

• Working with NARS of HOPE-II and TL-III
  • Burkina Faso, Mali, Nigeria, Ethiopia, Tanzania, Uganda, Ghana
  • CIAT Bean under TL-III
  • 24 Courses in last 3 years
  • More than 250 Trials in HOPE & TL from above countries
GLDC agri-food systems research aspirations

• Post-farm marketing, trade and processing of GLDC commodities offer pathways to poverty reduction, food and nutritional security, resilience and sustainability impacts.

• Market opportunities within GLDC agri-food systems provide incentives for the adoption of new on-farm and post-farm technologies that will boost both productivity and sustainability.

• Yet many of these opportunities remain unrealized because of failures in the wider agri-food systems:
  • missing or underdeveloped value chains and input and output markets
  • weak policy enabling environments
  • underdeveloped nutritional literacy
  • ineffective organizational policies and practices
  • lack of focus on organizational and institutional development

FP2: Transforming agri-food systems

Not funded in 2018

CGIAR to consider how to contribute
THE OUTCOMES

Intermediate Development Outcomes (IDOs)
1. Increased climate change resilience
2. Improved diets
3. Sustainable agro-ecosystems
4. Increased incomes and employment
5. Increased productivity

System level outcomes (SLOs)
1. Reduced poverty
2. Improved food and nutrition security for health
3. Improved natural resources and ecosystem services

Projected outcomes (2022-2030)
- 8.9-21.7 million farm households adopt improved varieties
- 4.4-11.8 million exit poverty
- 12.7-24.8 million meet their daily nutritional needs
- 50% women benefit

Impact of early chickpea cultivars in Myanmar:
- Seven cultivars released based on CGIAR germplasm
- >96% of the chickpea area in Myanmar during 2014-15 was covered by CGIAR-originated material
- Production increased five folds, 3.3 folds area expansion and 2.2 fold yield enhancement over 15 years
Thank you