Genebanks QMS

Charlotte Lusty, December 2023
Genebanks operations

Acquisition
Characterization
Cryopreservation
Distribution
Germination testing
Germplasm health testing
Information and data management
InVitro subculture
Live Plants
Long-term storage
Medium-term storage
Regeneration /Multiplication
Seed processing
Relevant standards

International Standards for Phytosanitary Measures (ISPMs)
## Diverse crops & collections

<table>
<thead>
<tr>
<th>Crop type</th>
<th>Category</th>
<th>Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Self-pollinated cultivated cereal</td>
<td>Wheat, barley, rice, small millets</td>
</tr>
<tr>
<td>2</td>
<td>Self-pollinated food legume</td>
<td>Beans, cowpea (&amp; other leguminous spp at IITA), chickpea, lentil, pea</td>
</tr>
<tr>
<td>3</td>
<td>Self-pollinated wild cereal</td>
<td>Wild relatives of crop type 1</td>
</tr>
<tr>
<td>4</td>
<td>Cross-pollinated cultivated cereal</td>
<td>Maize, sorghum, pearl millet</td>
</tr>
<tr>
<td>5</td>
<td>Cross-pollinated wild cereal</td>
<td>Wild relatives of crop type 2</td>
</tr>
<tr>
<td>6</td>
<td>Cross-pollinated food legume</td>
<td>Grasspea, faba bean, pigeon pea</td>
</tr>
<tr>
<td>7</td>
<td>Cross-pollinated forages, species that are difficult to manage</td>
<td>Forages, trees, wild potato &amp; sweet potato held as seed at CIP, groundnut</td>
</tr>
<tr>
<td>8</td>
<td>Clonal</td>
<td>Banana, cassava, potato, sweetpotato, yam, Andean roots and tubers</td>
</tr>
</tbody>
</table>

### Collection size

![Graph](image_url)

*Graph showing collection size*
Performance management system

Backlogs in CGIAR genebanks in 2012

All genebanks (except IRRI) had backlogs
- Of total 708,761 accessions
  - 34% not physically available without regeneration or cleaning
  - 45% not safety duplicated in two locations

Genebanks CRP response

- Performance targets
- Online reporting
- Quality management system
- SOP documentation audit
- External review and validation.
Genebank performance management

2006 - ongoing
Long term grants

Costing study 2010

First phase of technical review
Genebank CRP
2012 - 2016

Second phase of technical review
Genebank Platform
2017 - 2021

2018 – ongoing
Long-term Partnership Agreements
Costing study 2020

Online reporting (ORT) & Performance targets
Genebank quality management systems

Reporting to the Crop Trust
Online reporting

<table>
<thead>
<tr>
<th>Total number of accessions</th>
<th>Live plants</th>
<th>LTS</th>
<th>MTS</th>
<th>Total number accessions counting individual accessions only once</th>
<th>Summed total</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the costed collection</td>
<td>3</td>
<td>122,538</td>
<td>127,678</td>
<td>127,917</td>
<td>250,219</td>
</tr>
<tr>
<td>Legally available within the costed collection</td>
<td>3</td>
<td>117,640</td>
<td>122,782</td>
<td>123,019</td>
<td>240,425</td>
</tr>
<tr>
<td>Genetic stocks within the costed collection</td>
<td>0</td>
<td>3,546</td>
<td>8,916</td>
<td>8,916</td>
<td>12,462</td>
</tr>
<tr>
<td>With health status tested</td>
<td>0</td>
<td>104,473</td>
<td>109,148</td>
<td>109,185</td>
<td>213,621</td>
</tr>
<tr>
<td>Health tested in 2016</td>
<td>0</td>
<td>2,851</td>
<td>8,065</td>
<td>8,065</td>
<td>10,916</td>
</tr>
<tr>
<td>With health status clean</td>
<td>0</td>
<td>104,389</td>
<td>109,054</td>
<td>109,093</td>
<td>213,443</td>
</tr>
<tr>
<td>Disease cleaned in 2016</td>
<td>0</td>
<td>4</td>
<td>1,376</td>
<td>1,376</td>
<td>1,380</td>
</tr>
<tr>
<td>With known viability</td>
<td>120,330</td>
<td>125,509</td>
<td></td>
<td>126,575</td>
<td>245,839</td>
</tr>
<tr>
<td>Tested for viability in 2016</td>
<td>5,031</td>
<td>18,785</td>
<td></td>
<td>21,570</td>
<td>23,816</td>
</tr>
<tr>
<td>With acceptable viability</td>
<td>115,350</td>
<td>120,459</td>
<td></td>
<td>124,923</td>
<td>235,809</td>
</tr>
<tr>
<td>Regenerated (because of low viability) in 2016</td>
<td>437</td>
<td>2,509</td>
<td></td>
<td>2,537</td>
<td>2,946</td>
</tr>
<tr>
<td>With acceptable seed number</td>
<td>117,968</td>
<td>126,688</td>
<td></td>
<td>127,912</td>
<td>244,656</td>
</tr>
<tr>
<td>Subjected to seed increase in 2016</td>
<td>254</td>
<td>3,287</td>
<td></td>
<td>3,291</td>
<td>3,541</td>
</tr>
<tr>
<td>Legally and physically available</td>
<td>111,031</td>
<td>120,071</td>
<td></td>
<td>120,074</td>
<td>231,105</td>
</tr>
</tbody>
</table>

Comments
The proportion of accessions in LTS is decreasing because we no longer routinely put genetic stocks into LTS.
Few LTS germination tests because we’ve fully implemented the new efficiency measure not to test samples in LTS if the equivalent sample in MTS has satisfactory germination.
Few MTS germination tests because (1) we are at the low point in the post-GPG1 cycle and (2) as agreed we are not routinely monitoring genetic stocks.
Because of the policy on genetic stocks, the number of samples with known viability and acceptable viability in MTS will become a decreasing % of total accessions stored in MTS.
Genebanks QMS (rather than ISO)

- Based on FAO genebank standards rather than generic standards
- Holistic: acquisition to distribution rather than selected procedures or processes
- Internally driven with collective and individual goals
- Efficient in terms of the amount of paperwork
- Allows integration of topical issues and emerging risks
- Easily tailored to the unique situation of each genebank
- Suitable for a network with templates and shareable elements across countries, crops and conservation systems
Genebanks QMS

Phased assessment of written SOPs for key processes:

- Conservation (viability testing, processing, storage)
- Regeneration & characterization
- Acquisition
- Distribution
- Safety duplication
- Information management

Same template, but individual genebank’s SOP

Other QMS elements

- Restricted access
- Staff succession
- Barcoding
- Data management system
- Equipment calibration

Document SOPs → Audit for compliance with standards → External validation
GOAL workshops & QMS intensives
Benefits of Genebank QMS

- More meaningful technical reviews and useful recommendations
- Strengthened staff succession and emphasis on long-termism
- Staff empowerment, clarity of responsibility and motivation
- Opportunities for capacity building and alignment between institutes
- Effective prioritization and pipeline for research & optimization
- Basis for costing and cost savings (USD 3 million/yr)
- Strengthened collective thinking
- 350+ drafted SOPs


QMS strongly endorsed in 2017 IEA & 2023 IAES reviews
QMS Harmonization

Persisting issues:

• Switching comprehensively to one data management system
• Parity in costs and standards (esp phytosanitary)
• Evolving beyond mandate crops to a more regionalized approach
• Continuous workflow efficiency
• Expensive crops (e.g. forages, clonal crops)
• How to sustain auditing & updating on top of System, Centre and Crop Trust-commissioned evaluations
Structure and documentation of the CGIAR Genebank Process Model (BPM)

Documents that provide guiding framework to sub-ordinate documents
- FAO Genebank Standards, IPPC, SMTA, ISTA, CGIAR policy, etc

Quality Manual
- Harmonized CGIAR standards and quality management points

SIPOCs
- 1 per Process Group

Process Maps
- 1 per Genebank

SOP’s & Work Instructions
- 1 per process per genebank (some may be shared across genebanks)

Public documents for training and sharing

Global & standardize

Local/Crop-specific
### Genebank’s Process Model

<table>
<thead>
<tr>
<th>Acquisition of germplasm</th>
<th>Collection Management Cycle</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germplasm receipt</td>
<td>Processing</td>
<td>Distribution</td>
</tr>
<tr>
<td>Preliminary assessment</td>
<td>Regeneration/Rejuvenation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiplication, Characterization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conservation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Safety Duplication</td>
<td></td>
</tr>
</tbody>
</table>
# Overall Process Map for Genebanks Process

<table>
<thead>
<tr>
<th>Process Groups</th>
<th>Acquisition of Germplasm</th>
<th>Collection Management Cycle</th>
<th>Germplasm Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Name</td>
<td>Germplasm Receipt</td>
<td>Preliminary Assessment</td>
<td>Regeneration/Rejuvenation</td>
</tr>
<tr>
<td>Activities</td>
<td>Deposit request (User interaction)</td>
<td>Uniqueness, Viability check, Quantity, Health status, Taxonomy check</td>
<td>Site selection, Planting, Data collection for key descriptors, Germplasm harvest &amp; post harvest</td>
</tr>
<tr>
<td>GHU- and other Service Processes</td>
<td>Shipment processing, Quarantine handling, Treatment</td>
<td>Phenotyping, Genotyping</td>
<td>Health monitoring, Field inspection</td>
</tr>
<tr>
<td>Decision(s) at Gateways</td>
<td>Decision to invest into &quot;preliminary assessment&quot;</td>
<td>[1] to assign Accession #</td>
<td>Processing readiness</td>
</tr>
</tbody>
</table>

**Periodic Replacement? Yes-go to Regeneration/Rejuvenation**

*Same process, different purpose*

- Selection of Accessions
- Sub sampling & packing
- Shipping
- Follow-up
Genebank harmonization – Dec 2023

- Processes are different for good reasons
- Chose carefully areas for harmonization vs standardization (e.g. user management, germplasm distribution, phytosanitary health, critical decision & quality points).
- Move from CoPs into self-sustaining cross-Centre teams
- Basis for data management system
Thank you