Roles of National Genebanks and Community Seed Banks for responding food insecurity and safeguarding genetic resources

Bhuwon Sthapit

26-27 August 2015, Kathmandu, Nepal
Outline

✓ Global challenges and Bioversity Initiatives

✓ Theory and misconceptions
  – seed systems,
  – farmer seed networks and sources,
  – evolutionary breeding,
  – resilience

✓ Case studies and gaps

✓ Roles and links

✓ Take home message
Historical Hotspots of Diversity of Major Crops
Climate change is already happening

We cannot predict which new pest or pathogen will develop or how the rain will fall next year -- but we can use agricultural biodiversity to have a diverse set of crop varieties in agricultural systems to increase the options to buffer against an unpredictable change. This explains why on-farm conservation can play key role in future!

Diseases of concern to the US major crops
- Bacteria causing fire blight in apples
- Ug99 + related strains of stem rust in wheat
- New strains of rice blast disease
- Potato blight is re-emerging

Qualset and Shands, 2005
Threats

Continued push towards monocultures; shrinking diversity

Consolidation of seed supply into few, large companies

Reduced funds to public sector agricultural research, education and breeding

Consequences

Loss of options to meet public and private needs:

Biotic and abiotic stress

Diet diversity and nutrition

Market and cultural demands

Ecosystem health and stability
About 7.4 million *ex-situ* germplasm accessions exist and conserved in about 1750 genebanks worldwide; 11% held in trust by the CGIAR genebanks.
The Crop Trust is an international organization working to safeguard crop diversity, forever-safety duplicates from all genebanks!

Number of varieties conserved in the Seed Vault at the end of 2014

839,801

http://croptrust.org
National Genebank (NAGRC)

Collection, Characterization, Evaluation, Conservation, Rejuvenation, Pre-breeding

Use – through exchange (One door policy) - link to SGSV, IGB and CSB

Bigger roles to play!
Integrated Conservation Methods

Complementary Conservation Strategies

In situ
- National parks
- Protected areas
- Biosphere reserves
- World Heritage sites

Ex situ
- Botanical gardens
- Zoological gardens
- Genebanks

Community-based conservation

In situ on farm
- Landraces
- Folk varieties

Ex situ on farm
- Sacred groves
- Community seed bank

(Tribal and rural families, CBOs)

(Forest, Environment and Wildlife departments)

(Government agencies and universities)
Seed Savers Exchange Network

http://www.seedsavers.net
Why important?

- Improve yields and quality
- Improve biotic and abiotic stress tolerance
- Raw materials for plant breeders
- Seed sovereignty and food security
- Farmer’s rights and equity
- Evolutionary services and on-farm conservation
- Base broadening for yield stability
- Managing diseases and pests
- Multi-functionality
- Community resilience
- Future market
Theory: Dynamics of farmer germplasm system

- Natural introgression
- Database
- Seed flow/exchange
- Selection
- Crossing
- Natural selection
- Germplasm Introduction
- Enhancement Studies
- Cultivar Genetic Diversity
Gene Bank (ex situ)

Seed production

Seed quality control

Distribution

Forest / wild

Seed system: On-farm management - adapt, evolve and buffer (evolutionary breeding)

1. Saved own
2. Barter/gift
3. Sale/purchase

LOCAL SYSTEM 90%

Market 3. Sale/purchase

Improving lives through research

FORMAL SYSTEM 10%

Gene Bank

Planting

Cultivation

Harvest

Storage

Breeding

Gene Bank

Seed

Farmers

Exchange 2. Barter/gift

Consumption

Market

Seed production

10%
## Contribution of informal seed sources to livelihood of mountain farmers, Nepal

<table>
<thead>
<tr>
<th>Crops</th>
<th>Humla (2000m)</th>
<th>Jumla (2000m)</th>
<th>Lamjung (1500)</th>
<th>Dolkha (1700)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amaranth</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Barley</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>97</td>
</tr>
<tr>
<td>Beans</td>
<td>100</td>
<td>85</td>
<td>83</td>
<td>72</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>95</td>
</tr>
<tr>
<td>Finger millet</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>97</td>
</tr>
<tr>
<td>Foxtail millet</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>97</td>
</tr>
<tr>
<td>Perso millet</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>NA</td>
</tr>
<tr>
<td>Rice</td>
<td>96</td>
<td>76</td>
<td>98</td>
<td>95</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

GEF LLI-BIRD Baseline survey, 2014
Global context: Access for farmers a secure source of locally adapted seed

<table>
<thead>
<tr>
<th>Country</th>
<th>Crop</th>
<th>Contribution of farmer seed system (source) %</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burkina Faso</td>
<td>Sorghum</td>
<td>95</td>
<td>Kabore, 2000</td>
</tr>
<tr>
<td>Mexico</td>
<td>Maize</td>
<td>75</td>
<td>Ortega-Packka et al., 2000</td>
</tr>
<tr>
<td>Morocco</td>
<td>Durum wheat</td>
<td>87</td>
<td>Mellas, 2000</td>
</tr>
<tr>
<td>Nepal</td>
<td>Rice</td>
<td>97</td>
<td>Baniya et al., 2003</td>
</tr>
</tbody>
</table>

In India alone-100 million farms-15-20% of them use seed from the regular seed trade; the remaining 80 m farms depend on self saved seed or seed supply from farmers! (Swaminathan, 1998)
Who maintains diversity and how? Social seed network

What is informal system?
✓ own saved seed
✓ exchange
✓ gifts
✓ purchase

Who is nodal farmer?
✓ high frequency of exchange seed and information to other farmers

Who is innovator?
✓ search
✓ select
✓ maintain
✓ exchange

Meta-population Theory
✓ migration
✓ colonization

Diversity
Flexibility
Selection

Fig 1. Farmers' network on rice seed flow in Begnas eco-site (Subedi et al 2003. Culture and Agriculture 25(2);41-50)
What is healthy seed system?
Why farmer seed system important?

Germplasm base
- diversity, flexibility, selection

Seed production and quality
- purity, germination, vigor, disease free, quantity

Seed availability and distribution
- seed sources, networks, markets

Knowledge and information
- growing methods, utilization, knowledge of new materials, traits trade off

The system has multiple functions!
The Multiple Functions and Services of Community Seedbanks

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Abstract: Although community-level seed-saving initiatives have existed in many countries around the world for about 30 years, they have rarely been the subject of systematic scientific enquiry. Based on a combination of a literature review and field research, we present a novel comprehensive conceptual framework that focuses on the multiple functions and services provided by community-based seed-saving efforts, in particular community seed banks. This framework is output oriented and complements an input oriented typology of community seed banks presented in 1997. The framework identifies three core functions: conserving genetic resources; enhancing access to and availability of diverse local crops; and ensuring seed and food sovereignty. The framework can be used for analysis of existing seed-saving initiatives and serve as a guide for the establishment of new community seed banks. In addition, it can inform the development or revision of national policies or strategies to support community seed banks. The framework’s utility is illustrated by three case studies of community seed banks in Bangladesh, Guatemala and Nepal.

Keywords: agricultural biodiversity; conservation of biodiversity; plant genetic resources; community seed banks; farmers’ rights; food sovereignty; seed sovereignty; Bangladesh; Guatemala; Nepal
## Conceptual framework: Classification of global community seed banks by **functions**

<table>
<thead>
<tr>
<th>Functions</th>
<th>Case study examples (book chapter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation</td>
<td>Bhutan, Malaysia, Mexico and Rwanda</td>
</tr>
<tr>
<td>Access and availability</td>
<td>Burundi, Canada, Costa Rica and Uganda</td>
</tr>
<tr>
<td>Conservation and Access &amp; Availability</td>
<td>Bolivia, Brazil, China, Guatemala, Honduras, India, Mali, Nepal, Nicaragua, South Africa, Sri Lanka, USA, Trinidad, Zimbabwe</td>
</tr>
<tr>
<td>Conservation; Access &amp; Availability &amp; Seed and food sovereignty</td>
<td>Bangladesh, Brazil, Nepal and Spain</td>
</tr>
</tbody>
</table>

**Result:** Multiple functions; Diverse actors/Diverse objectives
# Multiple functions and services of community seed banks

<table>
<thead>
<tr>
<th>Functions</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation</td>
<td>Short term conservation of locally adapted varieties,</td>
</tr>
<tr>
<td></td>
<td>Rejuvenation of heirloom and rare/unique varieties in situ</td>
</tr>
<tr>
<td></td>
<td>Restoration of lost varieties</td>
</tr>
<tr>
<td></td>
<td>Monitoring of status of local crop diversity</td>
</tr>
<tr>
<td>Access and availability</td>
<td>Easy access of seed to local farmers</td>
</tr>
<tr>
<td></td>
<td>Maintenance of minimum stock of local seeds</td>
</tr>
<tr>
<td></td>
<td>Fostering seed exchange</td>
</tr>
<tr>
<td></td>
<td>Respond to local crises/disasters</td>
</tr>
<tr>
<td>Seed and food sovereignty</td>
<td>Local control over seed conservation</td>
</tr>
<tr>
<td></td>
<td>Income generation through sale of seed</td>
</tr>
<tr>
<td></td>
<td>In situ-ex situ links; platform of learning</td>
</tr>
</tbody>
</table>
Nepal Community seed bank:
A local solution to improve access to quality seed, safeguard of diverse crop varieties, and secure food security
Typologies

- **PGR-focused**
  - Local varieties only (regeneration, conservation focus)

- **Seed-focused**
  - MVs only (seed for food, food security enhanced at the cost of agrobiodiversity loss)

- **Integrated approach**
  - Both LRs and MVs (conservation and food security goal addressed)

[Source: PC Chaudhary, 2012 LI-BIRD]
### Community Driver: Rapid erosion of rice landraces in Kochorwa, Bara
(Shrinking local crop diversity and options)

<table>
<thead>
<tr>
<th>Year of study and type</th>
<th>No. of LRs/MVs</th>
<th>No. of growers</th>
<th>% of area occupied by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LRs</td>
<td>MVs</td>
<td>LRs</td>
</tr>
<tr>
<td>Baseline 1998</td>
<td>33</td>
<td>20</td>
<td>137</td>
</tr>
<tr>
<td>(n=202 HHs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBR 2003</td>
<td>14</td>
<td>26</td>
<td>111</td>
</tr>
<tr>
<td>(n=349 HHs)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: LRs=Landrace, MVs=Modern varieties, HHs=Households, CBR=Community biodiversity Register

[Source: Adapted and modified from Rana et al., 2000]
Community Driver: Weakening social seed networks

Non-commercial: Resilient to climate change

Commercial area: Vulnerable to climate change and adversity

Evidence: Improve access of local varieties for poor smallholder farmers and social equity

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of farmers of different socio-economic</th>
<th>No. of landrace</th>
<th>Seed (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rich</td>
<td>Medium</td>
<td>Poor</td>
</tr>
<tr>
<td>2007</td>
<td>23 (23)</td>
<td>34 (33)</td>
<td>45 (44)</td>
</tr>
<tr>
<td>2006</td>
<td>7 (11)</td>
<td>25 (39)</td>
<td>32 (50)</td>
</tr>
<tr>
<td>2005</td>
<td>17 (20)</td>
<td>37 (42)</td>
<td>33 (38)</td>
</tr>
<tr>
<td>2004</td>
<td>6 (17)</td>
<td>14 (40)</td>
<td>15 (43)</td>
</tr>
<tr>
<td>2003</td>
<td>5 (12)</td>
<td>19 (48)</td>
<td>16 (40)</td>
</tr>
</tbody>
</table>

[Source: Pitambar Shrestha and BR Sthapit, 2008]
Transferring 900 accessions of Community seed banks to National Gene bank, Nepal
A total of 124 aftershocks have occurred in Nepal after the Gorkha earthquake (25 April 2015) till 02 May 2015.

The largest aftershock of the Gorkha earthquake had a local magnitude of 6.9 with epicentre at Dolakha.

Our relief work is being carried out in 17 VDCs of 6 districts. Our partners SAHAS Nepal, Parivartan Nepal and Rural Development Tuki Association are leading the work in Rasuwa, Makwanpur and Sindhupalchok (VDCs yet to be identified).
Emerging roles of Community seed bank in seed relief and reviving local seed system

9750 kg truthfully labelled rice seeds supplied to suitable earthquake affected areas (>3800$); pride feeling
Take home message: Strengthening local capacity for management of local crop diversity for rural livelihoods and income

(Source: Sthapit and Jarvis, 1999)
CSB overarching Method: Community-based biodiversity management (CBM) for livelihood and conservation

1. Site & community selection
2. Understanding the local context
3. Raising awareness
4. Let’s local lead to drive the CBM process
5. Institutional modalities
6. Capacities & skills
7. Develop & implement action plan
8. Mobilize CBM fund

Principles
1: Build upon local innovations, practices & resources
2: Diversifying and safeguarding biodiversity-based livelihood options
3: A platform social learning and collective action
4: Let local lead

Sustainability, innovation & resilience
Take home message

- New roles of community seed banks and national gene banks are emerging and new scope and opportunities
- Cultivate partnership for creating space for country specific innovation in this field
- Misconception-let’s science drive the process of understanding and appreciating
- Strengthen technical capacity of community seed banks (introduce * system by NGB)
- Link to PPB/PVS and crowdsourcing approach
- Policy space for CSB (Seed regulatory framework, Farmer’s Rights, ABS/Nagoya protocol)
- Potential platform of community biodiversity management and social learning and change (institutional issue)
Thank you very much for your kind attention