Interdependency on plant genetic resources for food security and the need of implementing IT/MLS

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Plant Genetic Resources for Food and Agriculture (PGRFA)

- Globally, over 84% of human diet and nutrition comes from plants.
- Asia and the Pacific, the Near East and Africa plants provide about 90% of human diet
- Latin America and the Caribbean 80%
- Europe and North America 75% (FAO, 2010)

Importance of PGRFA

- Humanity has become dangerously reliant on only a few different crops.
- Out of the 10 000 to 12 000 known edible plant species, only 150 to 200 are used by humans and three of them alone-rice, wheat and maize-contribute nearly 60% of calories and proteins that humans obtain from plants (FAO, 1997).
- More than 75% of global crop diversity has disappeared irreversibly during 20th Century (FAO,2004).

Importance of PGRFA

- Climate change is causing new pressures on agriculture.
- Over 70% of the required production increases by 2050 will have to come from higher yields and less than 10% can be expected from an expansion in arable land (Hegwood, 2009).
- The role of crop diversity and plant breeding will become even more important in the near future for achieving food security in a sustainable way.

Countries' Interdependency on PGRFA

- There is global interdependency on PGRs for food and agriculture since all countries largely depend on PGRFA that originate elsewhere.
- No countries in the world are self-sufficient in PGRFA for their food security (IPGRI, 1996; 2000).
  - Potato: Originated in Peru
  - Maize: Originated in Mexico, Latin America
  - Rice: Originated in South East Asia
  - Wheat: Originated in West Asia (Turkey)
  - Soybean: Originated in China
  - Beans: Originated in Mexico, Latin America
  - Groundnut: Originated in South America
  - Millet: Originated in Africa

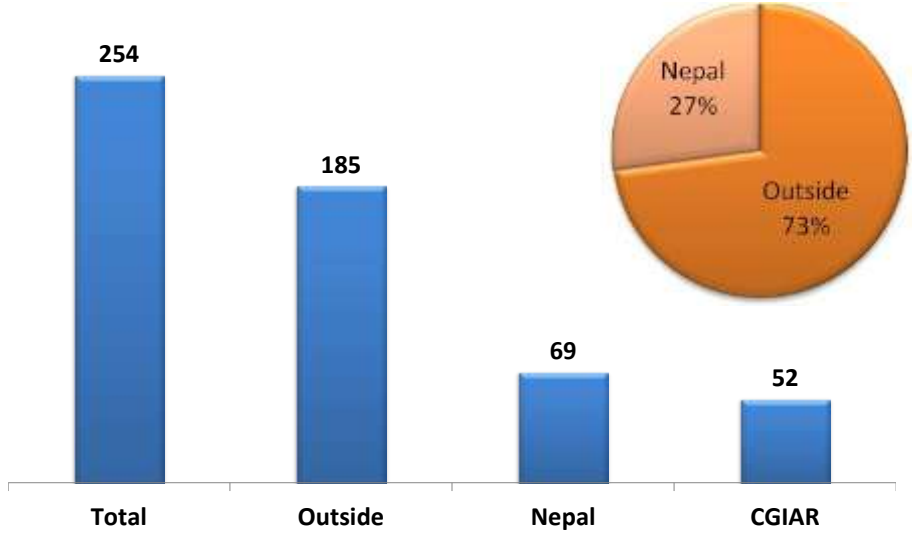
Countries' Interdependency on PGRFA

- Brazil- Megadiverse country: 44,000-50,000 species of vascular plants (18% of the world´s plant diversity), but ...
- Highly dependent on PGR native to other countries for food and agriculture: coffee, rice, potatoes, wheat, sugarcane, etc

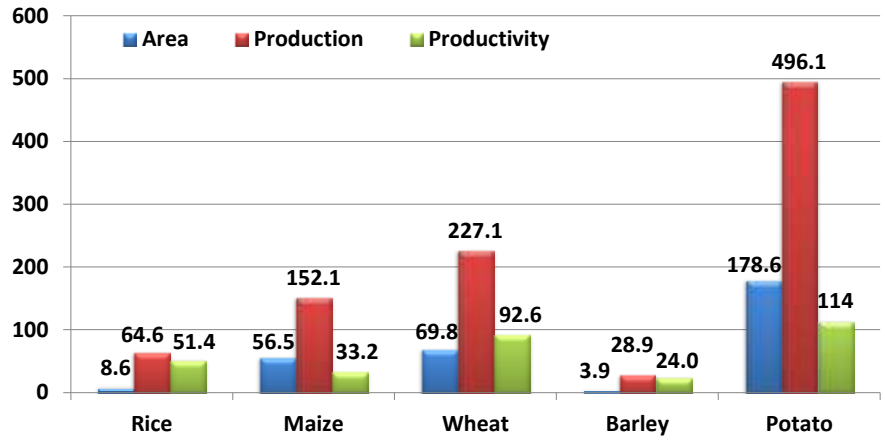
Countries' Interdependency on PGRFA

- The North Western Indian Mega Center comprises about 14-15% of the world's cultivated plants.
- Heavily depended on PGR native to other countries for food security such as wheat, rice, potato, tomato, coffee etc.
- One single wheat variety "PBW 343" (Attila) developed in the MLS and introduced in India occupy 8 million hectares, producing 28 million tones of wheat, worth of 4 trillion INRs in a single season.
- Wheat was said to be introduced in India some where 5000 BC.
- Majority of the popular wheat varieties in India introduced from outside.

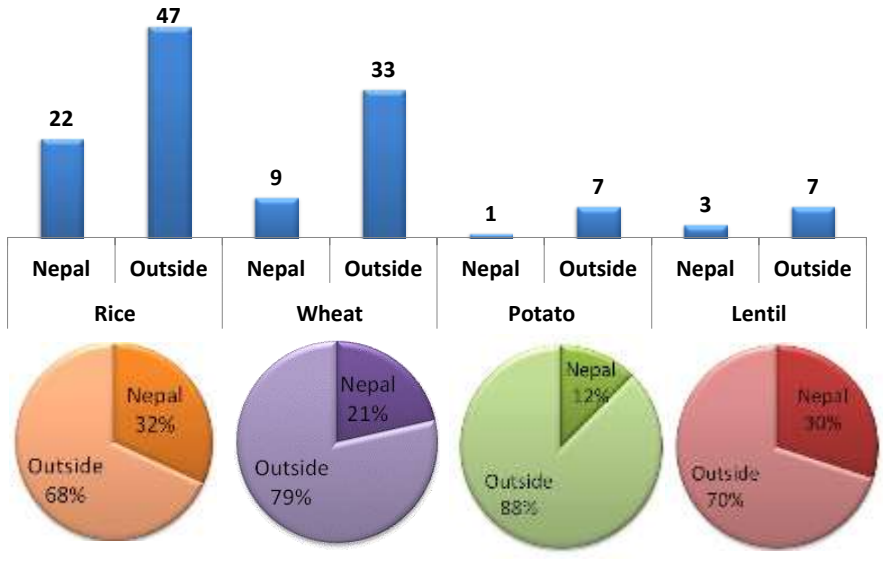
Origin of different Crop Varieties Released in Nepal



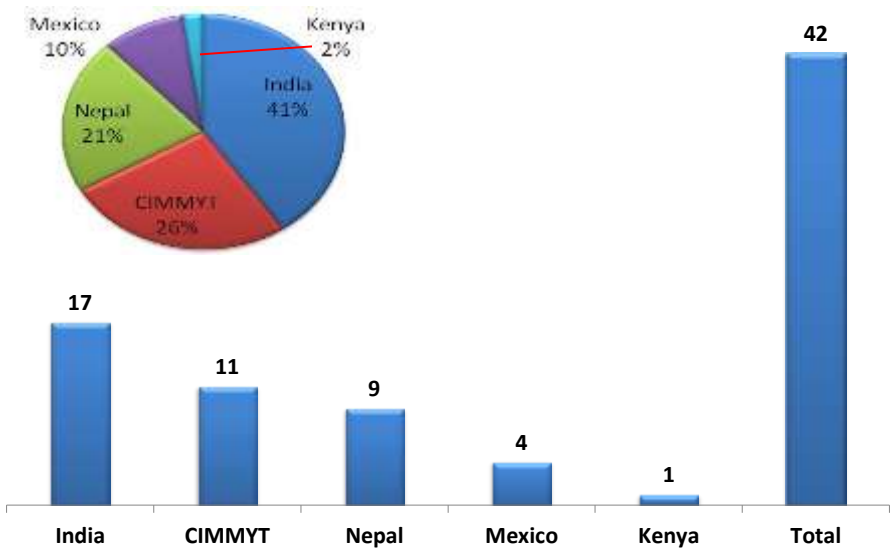
Percent Increase in Productivity of Major Food Crops over 25 Years (1984-2010): Contribution of International Gene pool



Origin of Released Varieties of 4 Selected Crops



Origin of Wheat Varieties Released in Nepal: Evidence of Dependency



Evolution of Hexaploid Wheat in Nature

Triticum urartu/Aegilops speltoides

(AA) (BB)

F1 Chromosome doubling

(AB)

Triticum turgidum (AABB)//*Triticum tauschii* (DD)

chromosome doubling

ABD

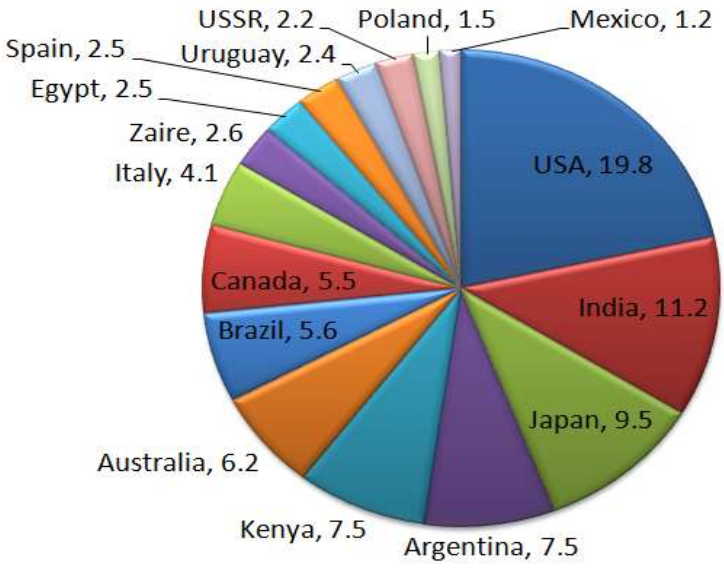
AABBDD *Triticum aestivum* (Bread wheat)

Understanding of the Germplasm (gene pool)

- Yaqui 50
- Nainari-60
- BUC (Ciano 79)
- Frontana (Lr34/Yr18)
- II 8156 (Pj/GB55)
- Pavon 76 (Lr 46/Yr29)
- Bluejay, Nacojari 76
- Crow
- Alondra
- Bhrikuti (Lr34/Yr18+Yr9/Lr26/Sr31)
- Attila
- Bobwhite
- Garuda
- Junco
- Veery (Lr26/Yr9/Sr31+)
- Bluebird
- Parula (Lr46/Yr29+Lr34/Yr18)
- Weaver
- Sabuf
- Oasis 86 (Lr19-an universal leaf rust resistance gene)
- Opata
- Mango
- Kingbird (4-5 minor genes)
- Kiritati (3-4 minor genes)
- Juchi
- Vivitsi
- **Hexaploid Synthetics**

** Wheat genetic diversity has been significantly increased since 1960

Country-wise Cumulative Contribution of Ancestors to Nepalese Wheat Varieties

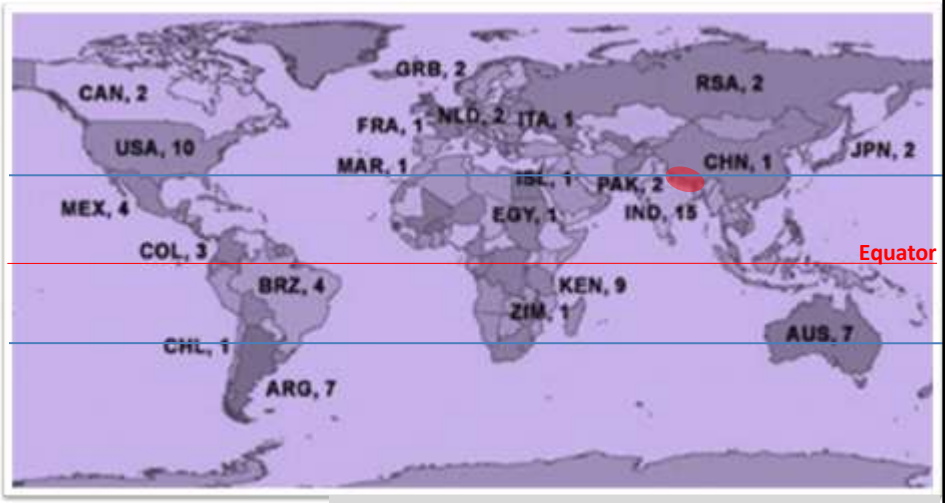


Ancestors, their Origin and Number of Wheat Varieties Contributed

SN	Ancestors	Origin	Varieties Contributed, n
1	Akagomughi	Japan	24
2	Kenya 324	Kenya	24
3	Turkey Red	USA	23
4	Rieti	Italy	24
5	Steinwedel	Australia	20
6	HD 845	India	2
7	Hard Red Calcutta	India	23
8	Oro	USA	23
9	Kanred	USA	23
10	Red Egyptian	South Africa	17
11	Iumillo	Spain	23

Rosyara and Joshi 2005

Origin of Ancestors used to develop Wheat Varieties Released in Nepal



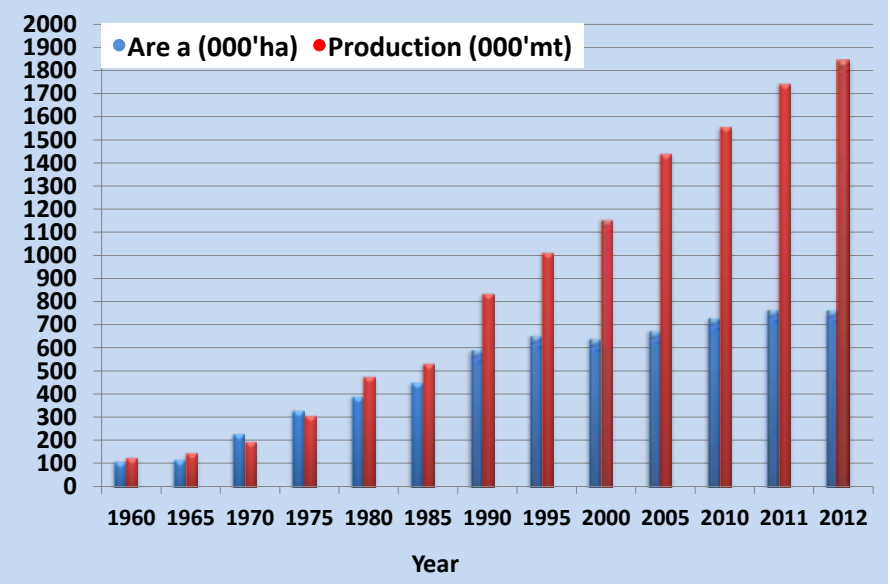
Joshi et al 2006

Similar type of info on rice, potato and lentil

Empirical evidence of dependency of Nepal on foreign PGRFA for wheat research and development

- Mexico, India and Nepal are the origin countries for 35 cultivars
- In Nepal four cultivars were bred and developed using foreign landraces
- Maximum number of cultivars were developed in Mexico
- A total of 89 ancestors originated in 22 different countries were used to develop these cultivars
- Maximum ancestors were from India followed by USA and Kenya
- Pedigrees analysis of modern wheat varieties in Nepal showed that all ancestors and landraces were from other countries and international organizations

Wheat Area and Production since 1960



Nepal's contribution to Global Wheat Gene Pool

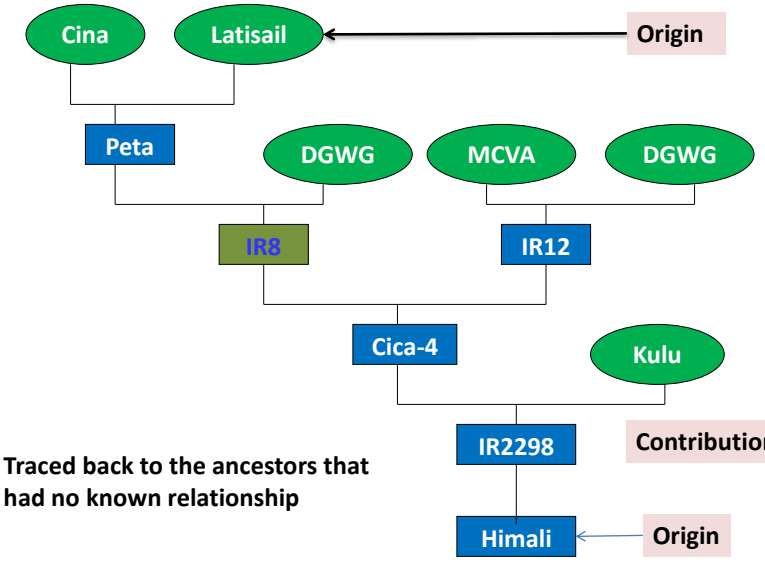
- Nepal not only benefited from Global Wheat Gene Pool but also contributed significantly to it through CIMMYT collaboration.
- Nepal Wheat Research Program shared all released varieties plus many advanced lines to CIMMYT
- Wheat Research Program developed 100s of Helminthosporium Leaf Blight (HLB) resistance lines and shared regionally and globally during late 1990s up to 2010 through CIMMYT.
- Nepal developed and released Ug99 resistant wheat varieties and shared it into Global gene pool as well as individual countries on request with/ out SMTA/MTA

Evolution of cultivated rice in nature

Oriza nivara/Oriza rufipogan

Oriza sativa

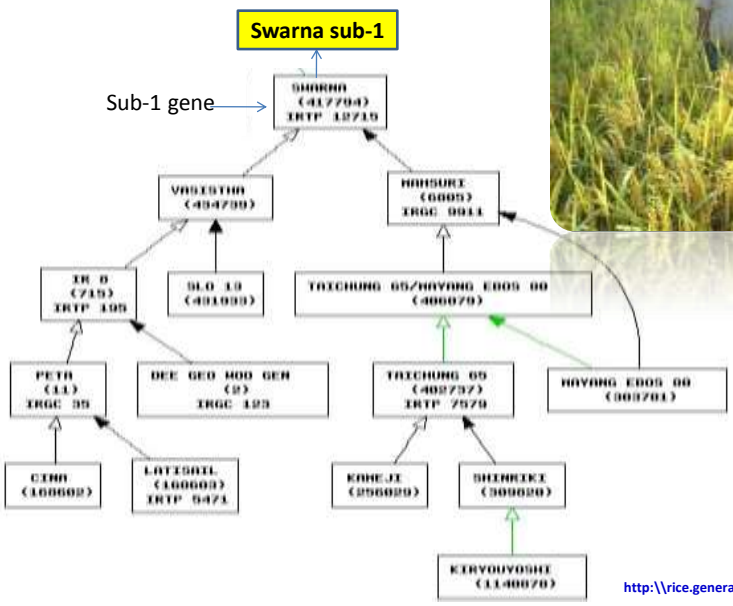
Pedigree Tree of Himali Rice: As an example



Traced back to the ancestors that had no known relationship

Joshi 2008

Pedigree tree of Swarna sub-1

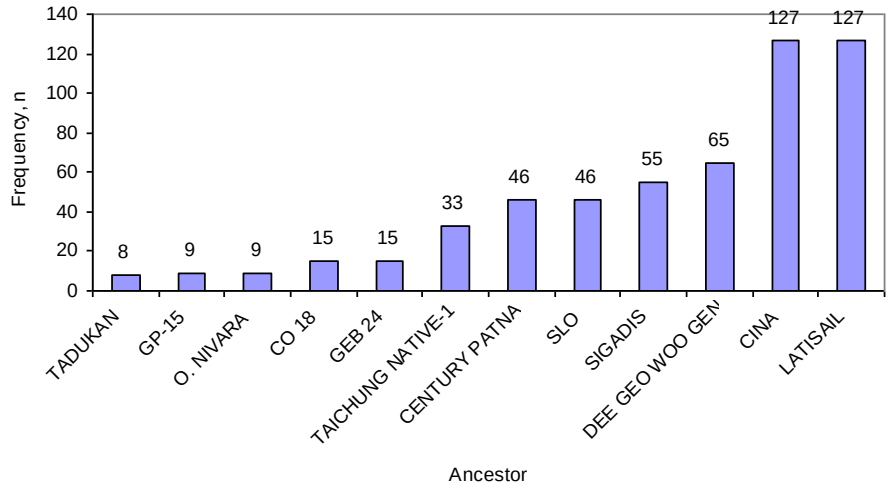


http:\\rice.generationcp.org\germplasm\

Use and sharing of PGRFA for global food security

- **Sonalika (RR 21)**, the most widely cultivated wheat variety in the world, released in India in 1966, it has 17 generations in its pedigree, 420 parental combinations and 39 landraces, and breeders in 14 countries have contributed lines to its pedigree.
- The introduction of **IR-8**, a cultivar of rice derived from a cross between the semi-dwarf variety **Degeowoogen** from Taiwan with the tall variety **Peta**. **Peta** was derived from a cross between **Cina** from China and **Latisail** from Pakistan.
- **IR-64**, a most widely cultivated rice variety (13 mha) has 20 landraces originating from 9 countries.
- The **Veery** wheat (Annapurna-1), was released in Mexico in 1977 and other countries (25mha), has 23 generations in its pedigree and 3,169 parental combinations and 49 different landraces.

Most commonly used Ancestors with their Frequency in Developing Nepalese Rice Cultivars



Joshi 2006

Addressing climate change and Food security

1) Rice:

- Recent release of Drought tolerant varieties such as Shukha Dhan-1, Shukha Dhan-2, Shukha Dhan-3, Tarahara-1 and Hardinath-2
- For submergence tolerance: Swarna sub-1, Samba Mashuli sub-1

2) Wheat:

- Heat tolerance: Gautam, Aditya, Vijay (Ug99 resistant)
- Drought tolerance and Yellow rust resistance: WK 1204, Gaura and Dhawalagiri.

3) Maize:

Drough tolerance, Deuti, QPM-1, Mankamana-4, and Rampur-2 (hybrid)

International Treaty on Plant Genetic Resources For and Agriculture (ITPGRFA)

- ITPGRFA: Adopted by resolution 3/2001 of the 31st Session of the Conference of the FAO in November 2001 and entered into force in June 2004.
- At present 129? countries had ratified ITPGRFA .
- Nepal ratified ITPGRFA on 2 January, 2007 and became party to it on 19 October, 2009.
- MoAD , focal ministry for the Treaty is responsible for taking initiatives required to fulfill the commitments of the Treaty.

ITPGRFA

- This legally binding Treaty covers all PGR relevant for food and agriculture .
- The system is operative within CGIAR system and applicable to 35 food crop species and 29 forages species listed in Annex 1 that account for >80% of human calorie intake from plants, (5th GB is going to expand it).
- Each country that ratifies will then develop the legislation and regulations it needs to implement the Treaty.
- The Treaty is vital in ensuring the continued availability of the plant genetic resources that countries will need to feed their people.

ITPGRFA

- On ratifying the Treaty, countries agree to make their genetic diversity and related information about the crops stored in their gene banks available to all through the Multilateral System (MLS).
- This gives scientific institutions and private sector plant breeders the opportunity to work with, and potentially to improve, the materials stored in gene banks or even crops growing in fields.
- By facilitating research, innovation and exchange of information without restrictions, this cuts down on the costly and time consuming need for breeders to negotiate contracts with individual gene banks.

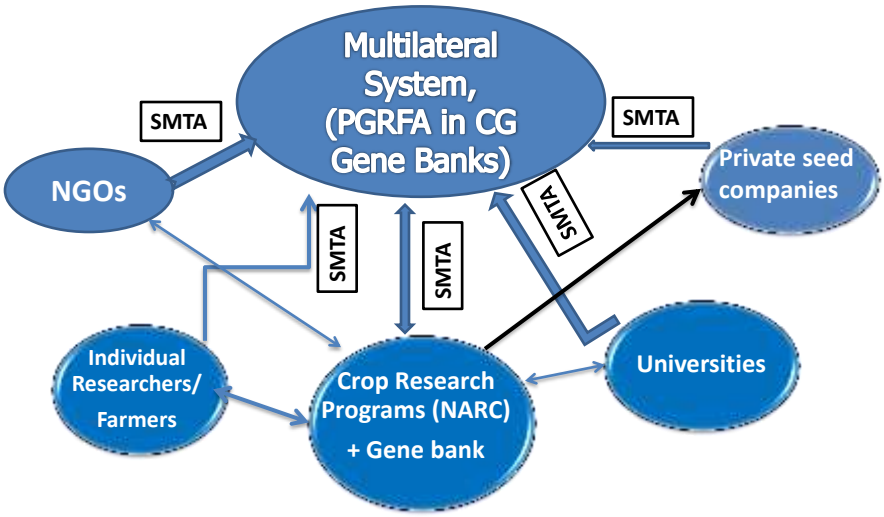
Multilateral System

- Under CGIARC umbrella –different IARCs such as IRRI, CIMMYT, ICARDA, ICRISAT, CIP etc.
- They have the largest collection of PGRFA
- 15 CGIAR centers together maintain over 700, 000 samples of PGRFA in their collections and held in FAO trust that are accessible under the terms of the Multilateral System of the International Treaty (MLS)
- Every year the CG Centers distribute more than 600, 000 seed samples of different crop species around the world.

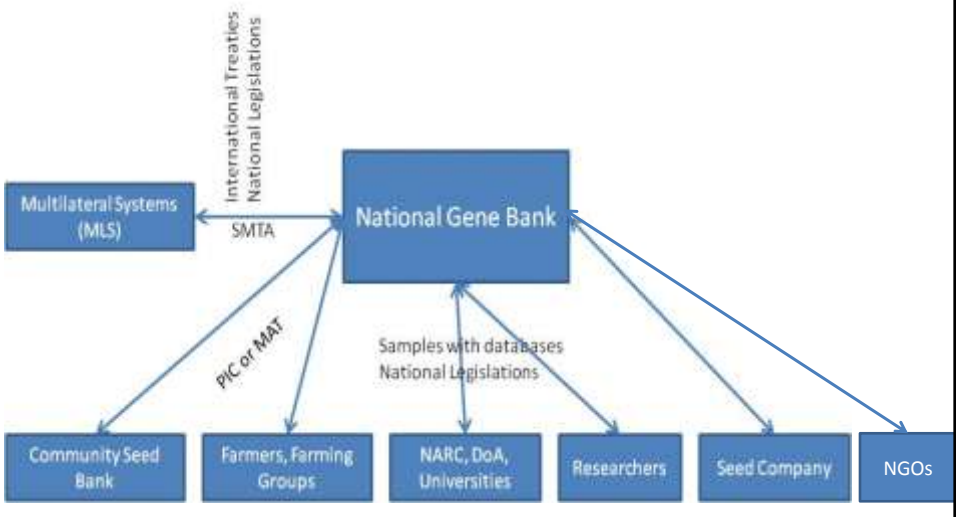
ITPGRFA/MLS

"You think of only how valuable your PGR for rest of the world but you never think how valuable the PGR from MLS for your country's food security"

Existing system of PGR access from MLS in Nepal



Proposed Mechanism of Multilateral System



Genetic Resources Policy Initiative (GRPI-II): Nepal Component (2012-2013)

Main partners: MoAD/NARC/LIBIRD

Approach: 3M (multi-stakeholder, multi-disciplinary and multi-sectoral)

Supported by Bioversity International

National Steering Committee
Chaired by Joint Secretary and IT-Focal Point, MoAD

Project Management Committee (PMC)
Coordinated by Chief, Genebank

Objectives

Overall objective: To develop mechanisms for effective implementation of the Treaty by designing governance structure and developing /revising policies and legal framework through wider consultation and consensus of all the key stakeholders of PGR

Outputs

1. Establish governance mechanisms for IT implementation
2. Policy research to identify options /solutions
3. Communication of the research findings and stakeholder agreement
4. Project Reports, Papers and Policy Briefs

Outcomes

1. Implementation of MLS
2. Policy Revision (existing) and Policy Draft (new) on MLS
3. Suggest strategies for strengthening National Capacity to implement MLS
4. Enhanced Knowledge and Awareness on MLS

Activities

1. Identify/confirm what PGRFA in [country] are 'under the management and control of the Contracting party and in the public domain' (i.e. materials that are automatically in the multilateral system).

2. Identify incentives and disincentives for natural and legal individuals to voluntarily include materials in the multilateral system that are not automatically included. Identify policy options to create incentives/eliminate disincentives for voluntary inclusion of such materials in the MLS.

Activities

3. Clarify who in the country has authority to consider requests for access to materials in the multilateral system. There may be several, depending on the source of the material, so this needs to be worked out and agreed upon at appropriate policy levels to ensure efficient functioning.

4. Identify possible options concerning in situ materials under article 12.3.h of the International Treaty.

Activities

5. Analyze whether there is legal space for the implementation of the MLS. If there is not the requisite legal and administrative space, identify options for the revision of the relevant policies, laws, etc. Develop draft amendments to the relevant instruments.

6. Develop draft policies, executive orders, legislation, regulations and or administrative guidelines, as appropriate, to implement the MLS. The text should reflect, among other things, the issues considered above.

Activities

7. Introduce those draft policies, laws, executive orders regulations, and or administrative guidelines into the formal policy-making processes of the relevant organizations and political bodies.

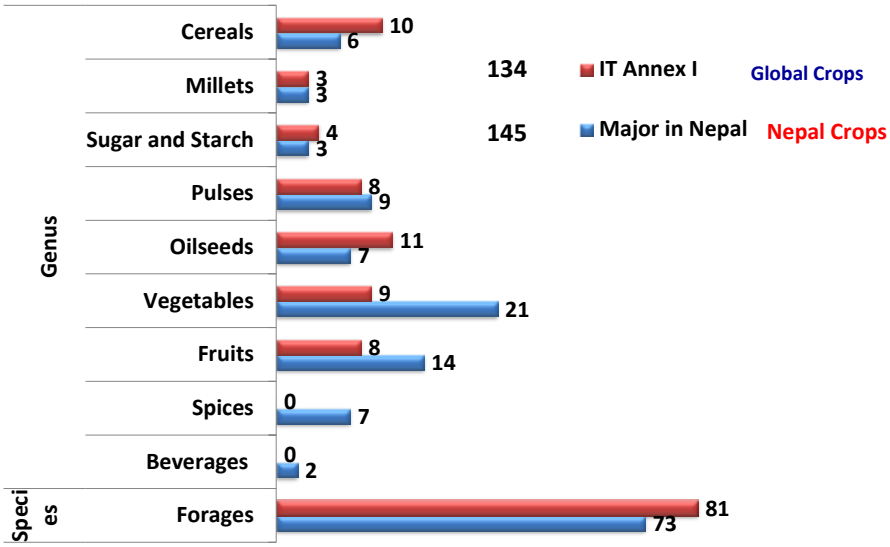
8. Notify the Secretary of the International Treaty concerning collections included in the MLS.

Activities

9. Lead processes whereby relevant competent authorities in the country and representatives of important stakeholder groups are engaged and consulted in consideration of all the issue above.

10. Develop a publishable report setting out the substantive considerations, research, consultative processes, that were involved in the activities and outputs above. The draft laws, policies administrative guidelines would be included (likely as appendixes) to this publishable report.

Major Crops and Forages in Nepal and List of Annex 1



Identification of PGRFA in Nepal that are under the management and control of the Contracting Party and in the public domain:

Information collected :

- Nepalese PGRFA in CGIAR Centers (GeneSys): 11,702 accessions
- Nepalese PGFRA in other than CGIAR Centers (NIAS, EURISCO): 4097 + 3510 = 7,607 accessions
- PGRFA in National Genebank: >9,000 accessions
- PGRFA in CSBs: 1242+

The major initiatives undertaken are:

Thank you

Local unique Chaito

Gujmuje Rayo from Dalchoki