

Global Challenges and Urgency for Partnership

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Global Challenges for the Crop Breeders

Increasing Demands

Global population by 2030 ~ 8.5 billion;
by 2050 ~ 9.7 billion and by 2100
~11.2 billion

- India expected to become the largest country in population size, surpassing China around 2022.
- Nigeria could surpass the United States by 2050

-UN DESA, 2015

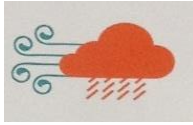
Supply Constraint



Climate Change



Nutrition



Weather Extremes



Heat Stress



New Diseases, Pests



Frequent droughts

After Effects

- Urbanization
- Deforestation
- Pollution
- Conversion of wetlands
- Agricultural modernization
- Changes in diets

Loss of Agro-biodiversity

Worst Situation:

Countries with high demand growth, fragile environments and poor economy

Agriculture & Agrobiodiversity is crucial for such countries

Way Forward

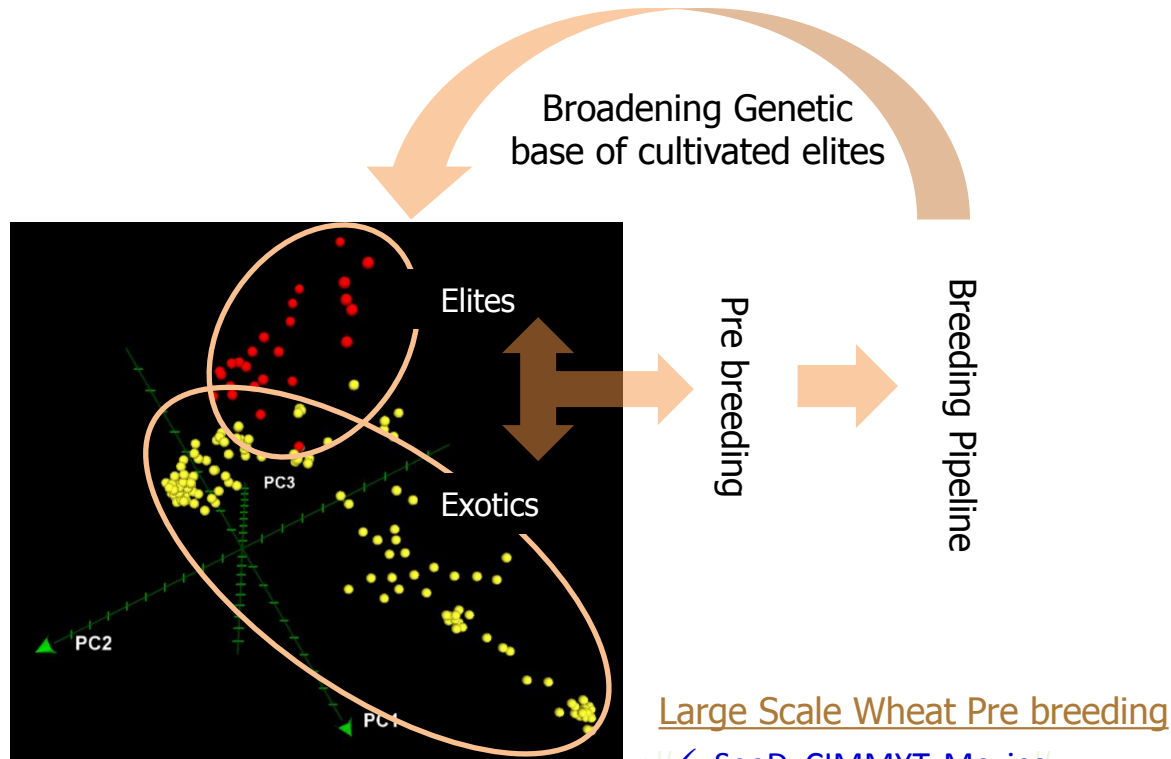
Simultaneously addressing the yield demands, climate resilience, nutrition and continuous broadening of genetic base of crop varieties to handle forthcoming challenge

Synergize upstream and downstream research focusing scientific knowledge and delivering product t the same time.

- Strengthening breeding pipelines
- Establish Pre breeding platform(s)

The Urgency

Expansion of genetic repertoire of cultivated elites

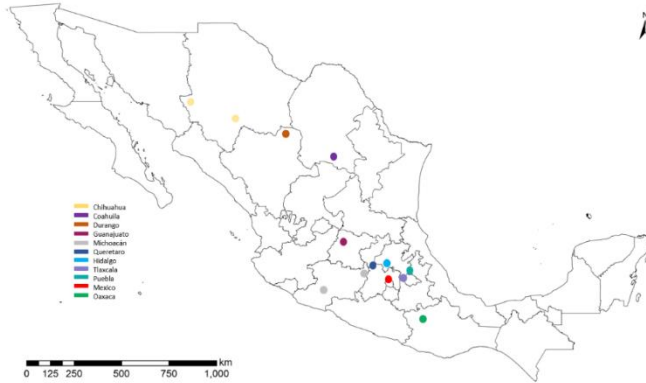


Large Scale Wheat Pre breeding

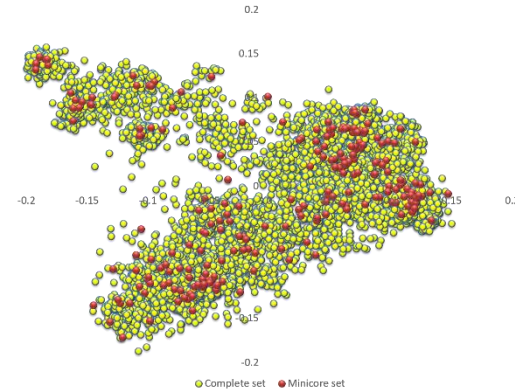
- ✓ Seed, CIMMYT, Mexico
- ✓ WISP, John Inns Center, UK

The Mexican Wheat Landrace Story

High Density Genomic Characterization



Core Set Formulation



Use in pre-breeding

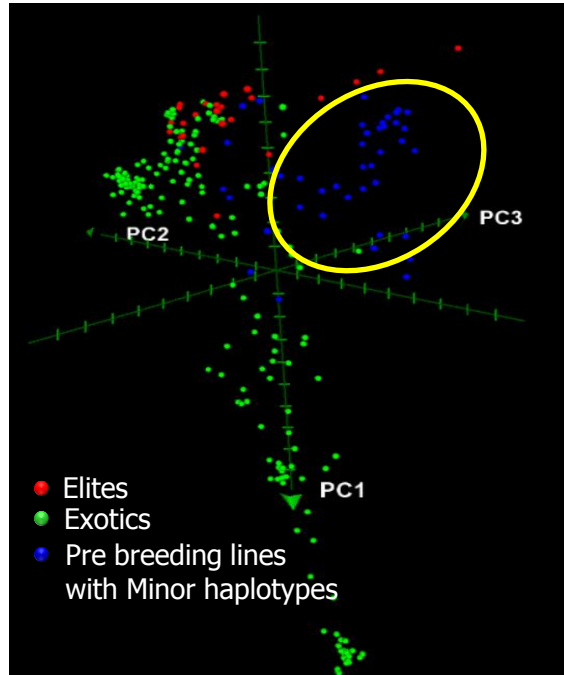
Trait donor identification

Core set evaluation

8000 Mexican landraces thoroughly characterized and systematically utilized in pre breeding in CIMMYT's Seeds of discovery Project

Prashant Vikram et al. 2016, Nature Scientific Reports

Wheat Pre breeding Lines with Minor Haplotypes: Potential in Breeding



Pre breeding lines with Minor haplotypes are genetically diverse from elites & exotics but agronomically more closer to elites i.e. suitable for increasing the genetic base of elite germplasm pool.



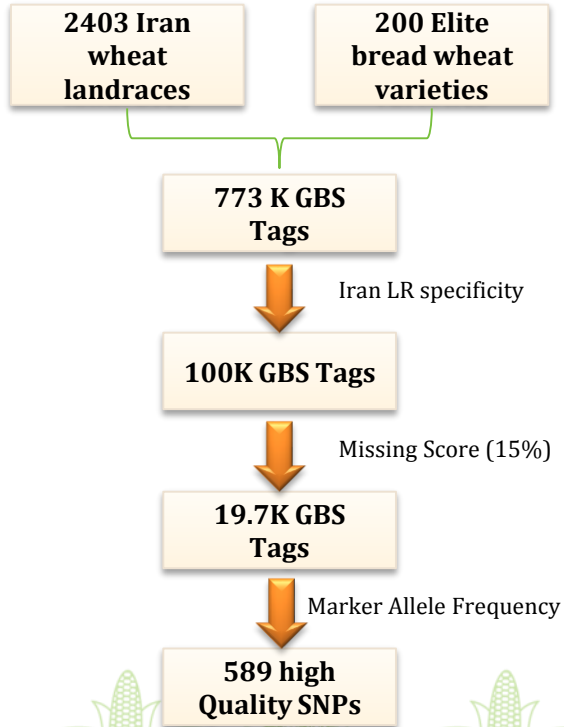
Add multiple minor haplotypes to elites



- Enhancing resilience
- Broadening genetic base



Synergizing Upstream and Downstream Research for Product Development



Identifying the value of landrace specific alleles that are absent in elites to utilize efficiently in breeding for trait improvement as well as broadening the genetic base.

Genome-wide association analysis with high quality landrace specific SNPs

Trait	Marker	Chr	P-value	PV
Grain Weight	5345847 F	1B	9.67E-04	1.22
Test Weight	1143802 F	1A	1.47E-05	2.15
Grain Weight	4909857 F 	1A	9.27E-04	1.23
Test Weight	4909857 F 	1A	5.19E-07	2.56
Grain Length	1209531 F 	1B	4.89E-06	2.39
Test Weight	1209531 F 	1B	7.20E-05	1.94

First Cycle Wheat Pre breeding Germplasm

India

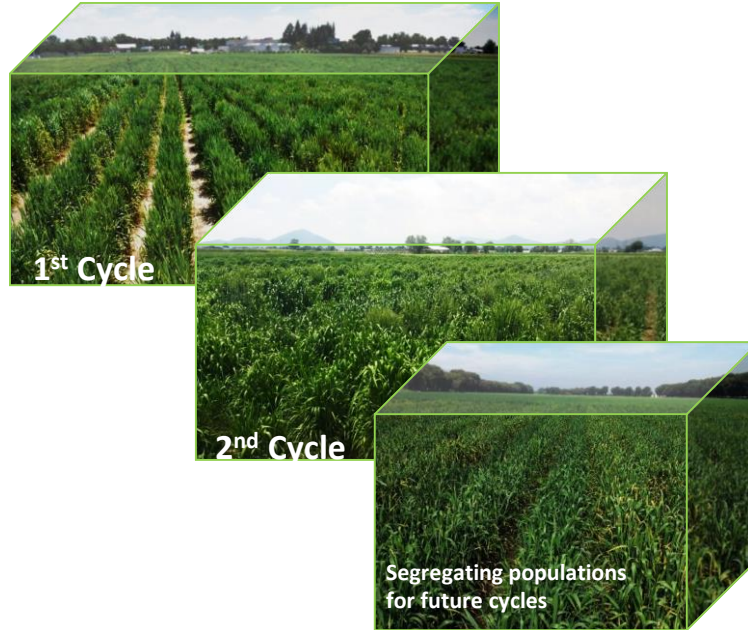


Mexico



- ❖ With limited support wheat pre breeding in Mexico and India initiated
- ❖ Preliminary results are encouraging

Toward Wheat Pre breeding Product Pipeline



From Mexican govt. funding we initiated pre breeding cycles and developed 15000 advanced pre breeding fixed lines



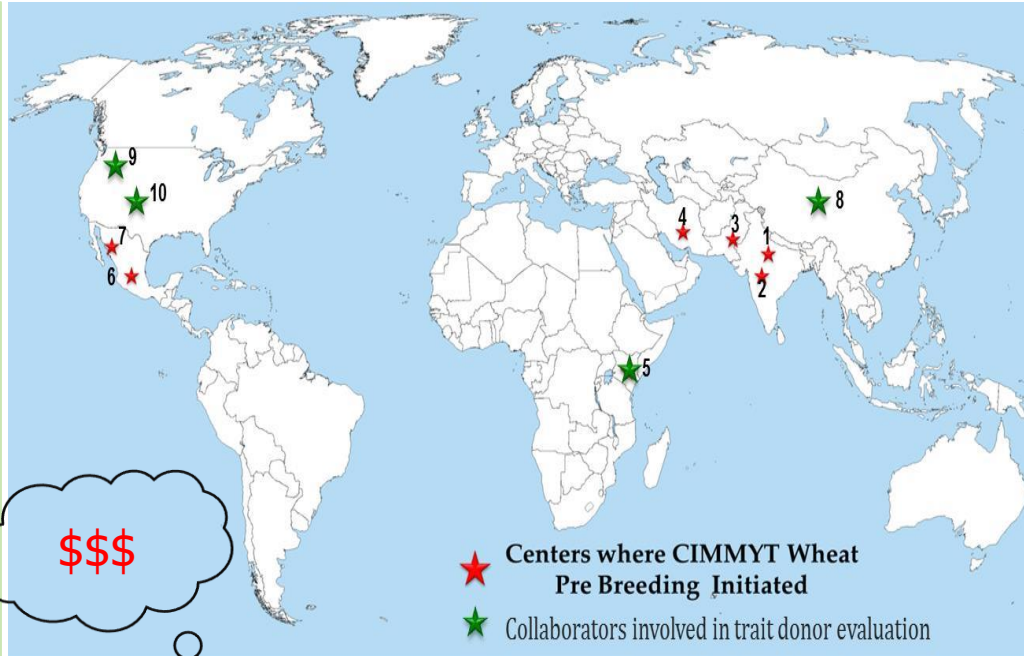
For impact in South Asia and Africa funding support and partnerships are urgently required



Why Partnership

Scale Up Required in Mission Mode to Deliver Impact

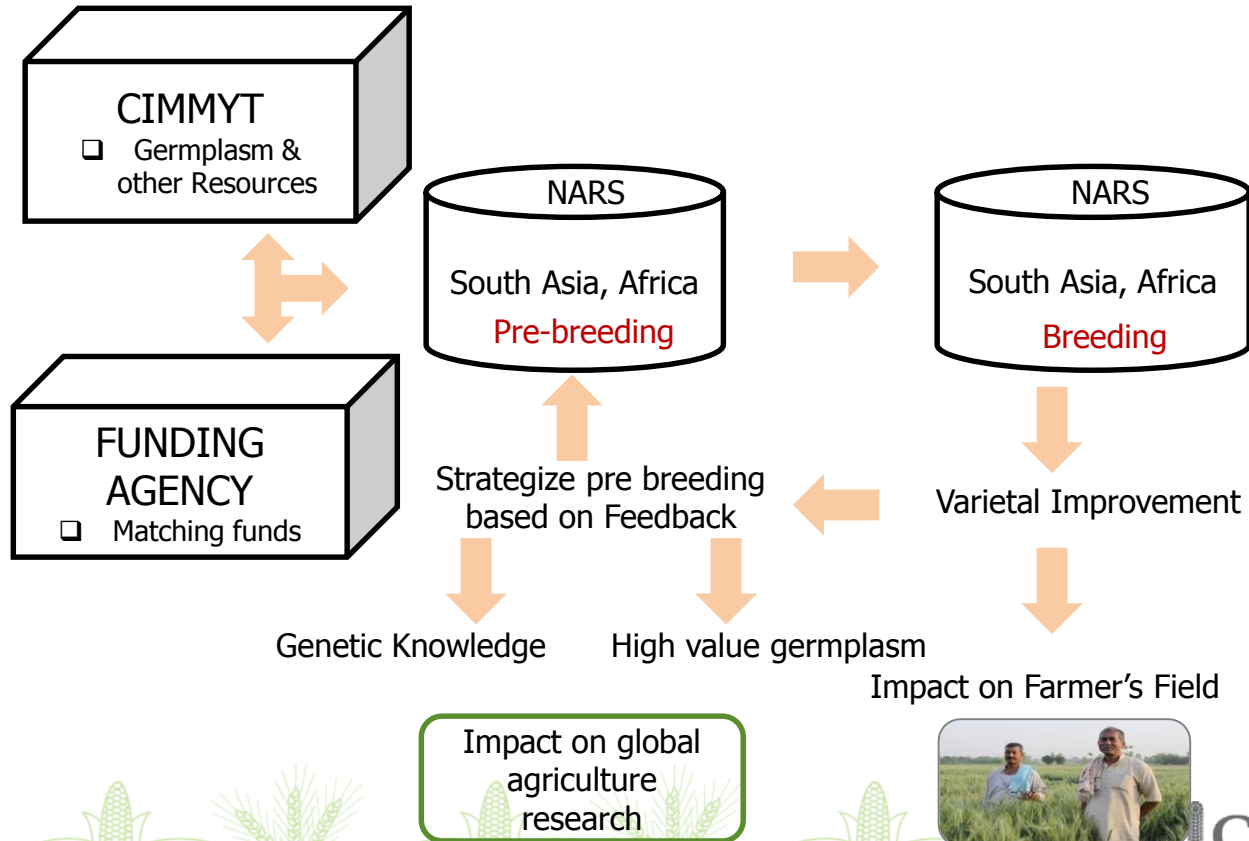
1. a) CIMMYT-BISA, Ludhiana
b) PAU, Ludhiana
c) CSK HPKV, Palampur
2. Nat Inst of Abiotic Stress Management, Pune, India
3. Nuclear Inst of Agric, Tandojam, Sindh, Pakistan
4. Dryland Agric Res Inst, Maragheh, Iran
5. KALRO, Njoro, Kenya
6. INIFAP, Celaya, México
7. INIFAP, Ciudad, Obregon, Mexico
8. Wheat Res Inst, Acad Agric Sci, Ganzou, China
9. Washington State Univ
10. South Dakota State Univ



Seeking dynamic partnership & funding support

The Roadmap

The way forward in impact delivery



SeeD-Wheat Research Progress

Scaling up required !!!

Germplasm sharing

- ❖ Wheat landrace core sets shared with researchers in USA, India, China, Mexico, Pakistan, Iran and Kenya
- ❖ Pre Breeding germplasm: Mexico, India, Pakistan, Iran, China, Kenya

Capacity Building

- ❖ Eric Lopez, Cynthia Ortiz, Lulú Ledesma Ramírez, Yuria medina Uriarte, María del Pilar Suaste Franco

Data sharing

- ❖ Data sharing agreements signed with different institutions in USA, Australia, India and Mexico
- ❖ High density genomics data being made publicly available

Publications

1. Huihui Li et al. A high density GBS map of bread wheat and its application for dissecting complex disease resistance traits. [BMC Genomics-2015 16:216](#).
2. Prashant Vikram et al. Unlocking the genetic diversity of creole wheats. [Nature Scientific Report-2016 6:23092](#)
3. Deepmala Sehgal et al. Exploring and mobilizing the gene bank biodiversity for wheat improvement. [PLoS One- 2015 10\(7\): e0132112](#).
4. Marta Lopes et al. Exploiting genetic diversity from landraces in wheat breeding for adaptation to climate change. [Journal of experimental botany-2015 66\(12\): 3477-86](#).
5. Jose Crossa et al. Genomic prediction of GeneBank Wheat Landraces. [Genes Genetics Genomics \(G3\)-2016 6\(7\):1819-34](#)
6. Saint Pierre et al. Genomic prediction model for grain yield in wheat under diverse climatic regimes. [Nature Scientific Report-2016 6:27312](#).

Four Years Research outcomes

We acknowledge all researchers at CIMMYT or elsewhere who have contributed directly or indirectly to CIMMYT Wheat Pre breeding project

