



## Use of Indigenous Technical Knowledge (ITK) in Breeding Programs

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Indigenous Technical Knowledge (ITK) refers to the age-old wisdom, practices and innovations developed by local farming communities through generations of experience, observation and experimentation. These knowledge systems, often orally transmitted, have contributed significantly to crop domestication, varietal selection and sustainable agricultural practices long before the emergence of formal scientific breeding. In the era of modern plant breeding, ITKs are increasingly recognized as valuable resources for identifying adaptive traits, conserving genetic diversity and ensuring sustainability in breeding programs.

### Role of ITK in Breeding Programs

- 1. Crop and Variety Selection:** Farmers traditionally evaluate varieties based on yield stability, taste, cooking quality, resistance to pests and adaptability to local environments. These selection criteria complement scientific breeding objectives and help breeders align their programs with farmer-preferred traits. For instance, farmer-led varietal selection in crops like rice, wheat and millets has preserved valuable landraces with unique genetic traits.
- 2. Maintenance of Genetic Diversity:** Communities practicing shifting cultivation, mixed cropping and seed exchange have safeguarded diverse crop germplasm. These traditional systems maintain in situ genetic variability, which provides breeders with raw material for developing climate-resilient and high-yielding varieties.
- 3. Identification of Stress-Tolerant Traits:** Local farmers are keen observers of how crops respond to drought, salinity, or pests. Their knowledge about tolerant varieties can direct breeders towards germplasm with specific adaptive traits. For example, traditional rice varieties such as "Pokali" (tolerant to salinity) or "Kalajeera" (adapted to waterlogged conditions) were identified and conserved through indigenous practices.
- 4. Participatory Plant Breeding (PPB):** ITK forms the foundation of participatory plant breeding, where farmers and breeders collaborate in developing new varieties. Farmers' knowledge of local preferences and environmental challenges helps in testing, evaluating and adopting newly bred lines more effectively.
- 5. Seed Conservation and Exchange Practices:** Indigenous seed-saving methods, such as storage in earthen pots, ash treatments, or using neem leaves, have played a crucial role in maintaining seed viability. These practices not only support local agriculture but also ensure the preservation of diverse landraces for breeders.
- 6. Quality Traits Beyond Yield:** Breeding programs often emphasize yield and resistance, but ITK highlights traits like aroma, taste, cooking time, fodder quality and cultural value. These insights enrich breeding objectives to meet nutritional, cultural and socio-economic needs.
- 7. Integration with Modern Tools:** Combining ITK with modern breeding tools such as marker-assisted selection and genomic approaches can accelerate the identification of

beneficial genes. For instance, landraces identified through farmer knowledge can be screened at the molecular level to validate and utilize adaptive alleles.

## ITK Acts as the "Gene of Superior" in Breeding Programs

### 1. Reservoir of Valuable Traits

- ITK preserves and promotes the use of *landraces*, *traditional varieties* and *farmer-selected lines* that have unique adaptive traits.
- These landraces often harbor *superior alleles* for drought tolerance, salinity resistance, pest tolerance, aroma, or nutritional quality, which can be introgressed into modern breeding programs.

### 2. Farmer-Based Phenotypic Selection

- Farmers, through centuries of observation, have acted like *natural breeders*, selecting for *superior traits* (yield stability, taste, cooking quality, seed storability).
- This continuous selection process under local conditions works like a *filtering mechanism*, retaining “superior genes” in the community seed pool.

### 3. Guiding Scientific Breeding

- ITK identifies which landraces or local varieties are “superior” under specific ecological niches.
- For example, *Pokali rice* in saline coastal areas, *Kalajeera rice* for aroma, or *Desi cotton* for pest tolerance—these are all products of indigenous knowledge.
- Modern breeders use this information to trace and isolate genes/QTLs responsible for those superior traits.

### 4. Superiority Beyond Yield

- ITK doesn't only focus on yield; it highlights *multidimensional superiority*—like taste, nutrition, resilience and cultural value.
- These farmer-preferred traits often carry alleles that would otherwise be neglected in conventional yield-focused breeding.

### 5. ITK as a Living Gene Bank

- Farmers conserving seeds in traditional ways maintain *genetic heterogeneity*.
- This wide genetic pool is where “superior genes” are hidden and ITK ensures their survival against genetic erosion.

### 6. Acts as a Pre-Breeding Step

- Before formal breeder's test germplasm, ITK has already “pre-screened” and conserved materials that show promise.
- This reduces the breeder's workload and increases the chance of identifying *superior donor parents*.

**Table 1: Comparative Usefulness of ITK vs. Conventional Approaches in Breeding Programs**

| Aspect                           | Indigenous Technical Knowledge (ITK)                                                       | Conventional/Modern Approach                                                   |
|----------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| <b>Source of Traits</b>          | Based on centuries of farmer observation, preserving landraces with unique adaptive traits | Depends on the scientific exploration of limited germplasm collections         |
| <b>Biodiversity Conservation</b> | Promotes in situ conservation through community seed saving and exchange                   | Focused on ex situ conservation in gene banks, often with genetic erosion risk |
| <b>Trait Preferences</b>         | Multidimensional (yield, taste, nutrition, aroma, resilience, cultural value)              | Mostly yield, resistance and economic traits                                   |
| <b>Cost Effectiveness</b>        | Low-cost, based on local resources and traditional practices                               | High cost, requiring labs, equipment and external inputs                       |
| <b>Adaptability</b>              | Well-suited to local agro-climatic conditions                                              | May face adaptability challenges outside trial sites                           |

|                                     |                                                                                     |                                                                       |
|-------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| <b>Community Involvement</b>        | Farmer-led, participatory, ensures adoption of varieties                            | Researcher-led, limited farmer involvement                            |
| <b>Knowledge Transmission</b>       | Oral, cultural, passed through generations                                          | Documented, scientific publications, formal education                 |
| <b>Seed Security</b>                | Farmers maintain seed sovereignty through local seed banks                          | Seed dependency on commercial companies                               |
| <b>Resilience to Climate Change</b> | Landraces identified through ITK are often tolerant to drought, salinity, or floods | Requires advanced screening and breeding cycles                       |
| <b>Sustainability</b>               | Eco-friendly, integrates traditional pest/disease management and seed storage       | Often input-intensive, reliant on chemicals and external technologies |

### Advantages of Using ITK in Breeding

- Enhances relevance and adoption of improved varieties by aligning with farmer preferences.
- Helps in broadening the genetic base of breeding material.
- Conserves traditional biodiversity and agroecosystems.
- Strengthens community participation and ownership of breeding outcomes.
- Ensures sustainability by preserving ecologically adaptive practices.

### Challenges

- Documentation and validation of ITK are often lacking.
- Knowledge erosion due to modernization and urbanization.
- Intellectual Property Rights (IPR) and benefit-sharing issues need attention.
- Scientific integration requires careful standardization of traditional practices.

### Future Prospects

To harness ITK effectively, breeding programs must:

- Promote participatory varietal selection involving farmers.
- Establish community seed banks to conserve landraces.
- Document and digitize ITK systematically for breeding use.
- Encourage policy support for protecting farmer innovations and ensuring equitable benefit-sharing.
- Integrate ITK with modern genomic tools for identifying genes linked to adaptive traits.

### Conclusion

Indigenous Technical Knowledge offers an invaluable complement to modern breeding programs. By recognizing farmers as custodians of biodiversity and partners in varietal development, breeders can develop resilient, farmer-preferred and sustainable crop varieties. The integration of ITK with scientific breeding approaches not only preserves cultural heritage but also ensures food security in the face of climate change and evolving agricultural challenges.

### References

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