Grassroots breeding of future smart crops, better adapted to climate change: Learnings from Nepal's experience

UPOV Seminar on the Role of Plant Breeding and Plant Variety Protection in Enabling Agriculture to Mitigate and Adapt to Climate Change

Pitambar Shrestha and Niranjan Pudasaini

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Local Initiatives for Biodiversity, Research and Development (LI-BIRD)
www.libird.org | info@libird.org

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National context

Geography, climate and climate change

- Geographically, Nepal's land has been divided as **High Mountains, Mid-hills, Siwalik and Terai** with climatic characteristics varying from **tropical to alpine condition** within a lateral span of 200 Km.
- The meteorological data indicate consistent warming and rise in the maximum temperature at an annual rate of **0.04 to 0.06 °C** (NAPA) where as the **annual precipitation is on the general decline**.
- The **impact of such changes in agriculture is tremendous**, so the future research and development should consider developing climate resilient crop varieties, breeds and technologies.

Smallholder farmers and plant breeding

- The crops such as **Foxtail Millet, Finger Millet, Proso-millet and Amaranth** are known as climate resilient and future smart crops as these crops are cultivated in harsh growing conditions, **has high level of nutritional properties,** and often cultivated by smallholder farmers.
- So far, the formal plant breeding programme in Nepal has paid **no attention on crops such as Foxtail Millet, Proso-millet and Amaranth** except on **Finger Millet**.
- Farmers have little or no option of cultivating these crops to feed the family in some areas. Hence interventions on these crops contribute to food security and income of the smallholder farmers.

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Concept of the grassroots breeding

- Grassroots breeding is a simple approach to plant breeding - **selection from existing diversity** of traditional varieties by farmers under the targeted environment.

- The breeding process involves **need assessment, diversity assessment, selection of preferred traits, registration of the selected line in the National Seed Board (NSB), seed multiplication** and distribution.

- It's a process of bringing farmers' variety under the formal domain

Source: *Sthapit and Rao 2007*

Finger Millet, Jumla

Amaranth, Jumla

Proso-millet, Humla

Foxtail Millet, Lamjung

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Grassroots breeding of future smart crops

Case example 1: *Bariyo* Foxtail Millet, Ghanpokhara, Lamjung District

Background

- Foxtail millet was a major **staple food crop 30-40 years ago** in the area
- But its cultivation started declining due to expansion of the road network in the village as people started eating rice from market. **Only 10% households found cultivated** it on an average area of 635 Sqm/household producing 89.4 kg/household (Household Survey Report 2016).
- Foxtail millet was **jointly identified** by the community and the Local Crop Project team **for seed selection and enhancement** in 2015.
- **15 landraces** including accession from the National Genebank and another project sites, and six locally available varieties were evaluated on farm.
- ***Bariyo Kaguno*** (from Ghanpokhara) was preferred by the local community due to high yielding, good taste and relatively larger grain size.

Locally available diversity of Foxtail Millet

Bariyo Foxtail Millet plot in 2022

Grassroots breeding of future smart crops

Case example 1: *Bariyo Kaguno* (Bariyo Foxtail Millet), Ghanpokhara, Lamjung District (Contd.)

The Grassroots breeding process

- Seed samples of ***Bariyo Kaguno*** were collected from five custodian farmers, it was mixed and planted in the farmers field.
- True to ***Bariyo Kaguno*** type panicles were selected jointly by farmers and scientists.
- Seeds of the selected panicles were multiplied and distributed to many farmers. Market linkage was developed for grain.
- Data were collected and the variety was registered in the National Seed Board by Ghanpokhara Community Seed Bank.
- The Ghanpokhara Community Seed Bank produces and supplies quality seed in the locality and surrounding districts.

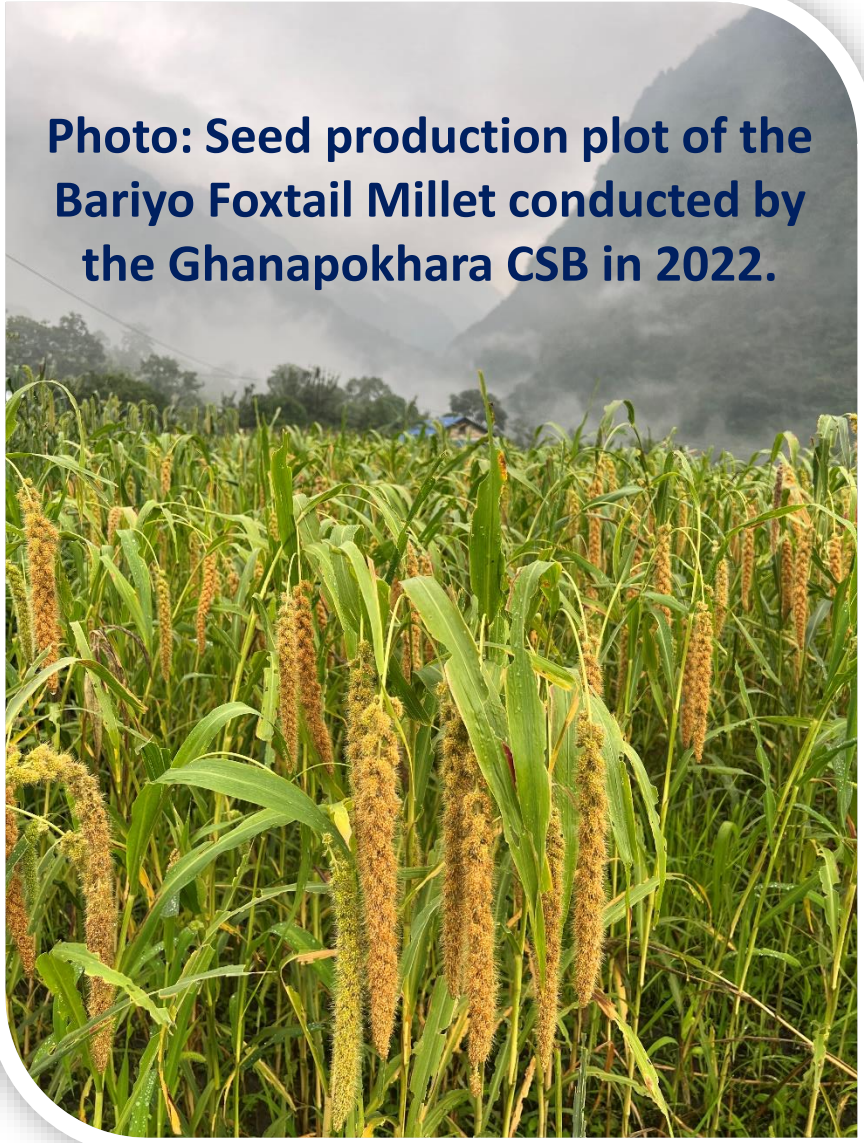

Photo: Seed production plot of the Bariyo Foxtail Millet conducted by the Ghanapokhara CSB in 2022.

Grassroots breeding of future smart crops

Case example 2: *Rato Kodo* **(**Red Finger Millet), Hanku, Jumla District

Background and the grassroots breeding process

- **Finger Millet** was identified as a mandate crop for research by the Local Crop Project in 2015,
- **49 varieties were collected** from different sources and tested at Hanku, Jumla including *Rato Kodo* (Red Finger Millet) of the same locality.
- The *Rato Kodo* from Hanku, Jumla performed well compared to other varieties in terms of **grain yield, grain size and thresh ability**
- Seed samples of ***Rato Kodo* were collected from various locations** to capture the diversity and it was mixed.
- **True type of *Rato Kodo* panicles were selected** from the bulk population, it was further multiplied and the seed was distributed to many farmers.
- Required information was collected and the **variety was registered** in the National Seed Board by Hanku Community Seed Bank, Jumla.
- Hanku Community Seed Bank, Jumla produces and distributes seed of the registered variety every year.

Grassroots breeding of future smart crops

Case example 3: *Rato marse* (Red amaranth), Hanku, Jumla District

Background and the process of grassroots breeding

- A mandate crop identified for research at Jumla District by the **Local Crop Project** in 2015.
- It was **grown by 30%** of the households at the Hanku Village of Jumla District. It is planted as a **boarder crop** rather than as a main crop.
- Several accessions collected from around the community were tested at Talium Village including *Rato Marse* (Red Amaranth) of the same locality.
- ***Rato Marse* from Talium, Jumla was preferred** by farmers compared to other varieties due to high yielding and large grain size.
- **Panicle selection was performed, seed was multiplied and distributed** to many farmers.
- Required information was collected and the **variety was registered** in the National Seed Board.
- Hanku Community Seed Bank, Jumla produces and distributes seed of the registered *Rato Marse* every year.

Grassroots breeding of future smart crops

Case example 4: *Dudhe Chino* (Milky Proso-millet), Chhipra, Humla District

Background and the grassroots breeding process of

- A mandate crop identified for research at Humla District by the **Local Crop Project** in 2015.
- It was **grown by 89% of the households** at the Chhipra Village of Humla District, **second most common cereal crop** after finger millet in the district.
- **22 accessions were collected and tested** at Chhipra Village including *Dudhe Chino* (Milky Proso-millet) of the same locality.
- The *Dudhe Chino* from Chhipra, Humla preferred compared to other varieties in terms **of taste and easy processing/de-husking**,
- Panicle of true type of *Dudhe Chino* were selected from different farms, it was multiplied and the seed was distributed to many farmers,
- Required information was collected and the **variety was registered** in the National Seed Board by Chhipra Community Seed Bank, Humla.
- Chhipra Community Seed Bank, Humla produces and distributes seed of the registered variety every year.

Lessons learned

- **The grassroots breeding has multiple advantages –** a simple process of plant breeding that empowers farmers and their institutions; strengthens the local seed system and on-farm management of local varieties/agrobiodiversity. Thus countries with reach crop diversity should consider grassroots breeding as a strategy to cope with climate change.

- **Advantages to plant breeders:** They can confidently use the grassroots breeding bred varieties in their breeding programme as parents - basic information about the variety is easily available.

- **An innovation that happens in the farmers field:** Grassroots breeding does not require a huge amount of resources and time. There is no need of DUS and IP low. Thus, research institute should support farmers' organization to work on such initiatives that also contribute to the realization of Farmers' Rights as outlined in the Article 9 of the ITPGRFA.

- **Local solution to fight climate change:** The cases shared are examples of how locally adapted crops promoted through grassroots breeding can contribute to meet local needs.

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Further information:

www.libird.org
info@libird.org
pitambar@libird.org

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