Sharing knowledge between scientists and farmers in order to develop and disseminate new sorghum varieties responding to the diverse constraints and needs of farmers in Burkina Faso.

Kondombo C.P., Vom Brocke K., Kaboré R., Sidibé A., Trouche G.
1. Context of sorghum production in Burkina Faso
2. Strategies and steps of Participatory Plant Breeding
3. Participatory diagnostic
4. Farmers’ criteria
5. Breeding methods
6. Results on variety development
7. Seed dissemination
8. Lessons
1. Context of sorghum production in Burkina Faso

- **Sorghum is the first food crop in Burkina Faso (2012-2015)**
  - Production area: 1.7 million hectares (44.0% of cereal growing areas)
  - Grain production: 1.7 million tonnes (34.3% of cereal production)
  - Yield ≈ 1t/ha

- **Sorghum diversity and farmers’ production targets**
  - Presence of four of the five sorghum races (guinea, bicolor, caudatum, durra)
  - Guinea race is largely predominant (93% of the cultivated varieties)
    - Relative low yield potential of landraces (LR)
    - Photoperiod sensitivity confers yield stability
    - Grain quality well suited to local dishes
    - Genetic variability allowing adaptation to diverse environmental conditions
  - Farmers’ production objectives focused on food security
Main production constraints

- Erratic rainfall (frequent droughts, low moisture during post flowering)
- Low soil fertility (due to over exploitation),
- Low or no use of inputs (fertilizers and pesticides),
- Striga infestation,

In general low adoption (< 5%, in 2000) of improved varieties (IV) particularly caudatum, while food demand increases in relation to population growth.
Objective:

Develop a range of diversified varieties with improved productivity and good grain quality, tailored to farmers’ preferences/needs, adapted to local constraints and able to respond to progressive intensification.

Specific objectives:

- Improve researchers’ understanding of farmers’ production objectives and related varietal needs and preferences,
- Initiate farmer-researcher breeding networks, which enable decentralised participatory breeding and efficient variety dissemination.
2. Strategies and steps of Participatory Plants Breeding

Diagnostic in two agro-ecological zones

- Centre-North (CN: 500-700 mm),
- Boucle du Mouhoun (BM: 700-900 mm)

- **Farmers’ production systems** and actual production constraints for sorghum,
- Existing genetic diversity,
- Farmers’ preferences and uses of sorghum varieties,
- The reasons of low-adoption of IV
3. Participatory diagnostic

**1st phase:** collection of cultivars and associated farmers’ knowledge

**Collection of:**
local sorghum LR. in BM/CN (10 villages/region)

**Identification of:**
- Preferred LR.
- Useful traits of preferred LR.
- Traits to be improved in preferred LR.

**2nd phase:** participatory variety evaluation and selection workshops

**Field evaluation of:**
- Farmers’ preferred LR.
- LR. of the Saria gene bank
- Elite lines/IV of Saria gene bank

**Identification of:**
- Preferred LR/IV to be use for the new breeding program
- Farmers’ selection criteria and their importance
## 4. Farmers’ criteria

<table>
<thead>
<tr>
<th>List of criteria</th>
<th>Definition of farmers’ criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earliness</td>
<td>Maturity of grain while plants still green</td>
</tr>
<tr>
<td>Productivity</td>
<td>Longue and dense panicle, high number of grains/panicle</td>
</tr>
<tr>
<td>Good grain quality</td>
<td>Hard grain for ‘ tô ’ (thick porridge), grain resistant to breakage during processing and storage</td>
</tr>
<tr>
<td>Good market value</td>
<td>Large and hard grains, with good maturity, favourable form and colour, white preferred for ‘ tô ’, and red for ‘dolo’ (local beer)</td>
</tr>
<tr>
<td>Forage</td>
<td>Stems and leaves still green at maturity, sweet taste of stems, stems of medium diameter and height</td>
</tr>
<tr>
<td>Resistance to drought</td>
<td>Plants remaining green and reaching full maturity despite water stress</td>
</tr>
<tr>
<td>Resistance to lodging</td>
<td>Sturdy stems that do not break</td>
</tr>
<tr>
<td>Multiple purposes</td>
<td>Grains suitable for preparing several dishes, plants for several uses</td>
</tr>
<tr>
<td>Resistance to striga</td>
<td>Good plant development and yield despite the presence of striga</td>
</tr>
</tbody>
</table>
5. Breeding methods – development and enhancement of base populations

Development of two base populations with desired varieties using male sterility (ms3)

On-station

<table>
<thead>
<tr>
<th>Populations source</th>
<th>Crosses</th>
<th>On-farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pop1 VL89</td>
<td>20 local LR 6 elite caudatum lines/IV</td>
<td>1 Backcross + intermating</td>
</tr>
<tr>
<td>Pop2 97SP2</td>
<td>18 local LR 3 elite caudatum lines/IV</td>
<td>1 Backcross + intermating</td>
</tr>
</tbody>
</table>

Adaptation and recombination for 2 – 3 years (4 farmer fields)

Participatory recurrent selection

- Pop1-1 → Kéra
- Pop1-2 → Lékuy
- Pop2-1 → Ziliémé
- Pop2-2 → Raguitenga

Vom Brocke et al. 2008. Cah Agr
5. Breeding methods — development of specific/sup-populations

Example for Centre-North region: Development of 5 sub-populations

- Degraded
- Lowland
- Striga infested
- Gravelly
- Sandy

Adaptation specific soils and biotic constraints

Adaptation to on-farm environments during 2-3 years

Variety development (3 years)

Role of farmers:
- Growing population
- Identification of ms plants

Role of researchers:
- Training farmers’ of 4 villages on ms identification
- Documentation of farmers choice

Role of farmers:
- Selection of desired progenies within each population
- Testing progenies (40-50 lines per objective) and select next generation lines
- Advanced testing of the best lines per objective

Role of researchers:
- Training on best agronomic practices
- Performing last steps of variety development and registration
6. Results on varieties development
Overview of farmers selection criteria and gender effect

**Centre-North**

### Specific adaptation to soils
- Degraded
- Lowland
- Striga
- Gravelly
- Sandy

### Production objectives
- O1 Consumption
- O2 Market
- O3 Dual purpose

### Selection criteria for men
- Good productivity
- Drought resistance
- Good grain quality
- Earliness
- Good for making to

### Selection criteria for women
- Good for making to
- Drought resistance
- Earliness
- Good grain quality
- Good productivity
6. Results on varieties development

Identification of farmers selection criteria by gender

Choice in the progeny

Men and women choices (CN)
6. Results

Comparison of traits improvement between populations

Example of Centre-North

Mean yield of lines/pop

<table>
<thead>
<tr>
<th>Grain yield (kg/ha)</th>
<th>Striga</th>
<th>Kapelga</th>
<th>Local C.</th>
<th>Gravel</th>
<th>Lowland</th>
<th>Degraded</th>
<th>Sandy</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Cycle duration of lines/pop

<table>
<thead>
<tr>
<th>Cycle duration (sow. 50% heading)</th>
<th>Sandy</th>
<th>Degraded</th>
<th>Local C.</th>
<th>Gravel</th>
<th>Striga</th>
<th>Lowland</th>
<th>Kapelga</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Specific populations
Evaluation and selection in Farmers’ field
### Varieties in the process to be released

<table>
<thead>
<tr>
<th>Adaptation area (mm)</th>
<th>Number of varieties</th>
<th>Cycle duration (days)</th>
<th>Grain colour</th>
<th>Yield on farms’ fields (kg/ha)</th>
<th>Thousand grain weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 - 700</td>
<td>5</td>
<td>90</td>
<td>White</td>
<td>2880 - 3300</td>
<td>22.9 - 24.3</td>
</tr>
<tr>
<td>700 - 800</td>
<td>6</td>
<td>105</td>
<td>White</td>
<td>2000 - 3390</td>
<td>20.4 - 24.7</td>
</tr>
<tr>
<td>800 - 900</td>
<td>7</td>
<td>120</td>
<td>White or red</td>
<td>2200 - 3450</td>
<td>20.2 - 25.8</td>
</tr>
</tbody>
</table>

Yield: 2000 ~ 3400 kg/ha

1000 grain weight: 20.4 ~ 25.8 g
7. Seed dissemination
Two varieties released in 2015

Sariaso 18
(105 days to maturity)
1,8 t/ha
“Dual purpose for grain”

Sariaso 20
(120 days to maturity),
1,6 t/ha
“Good market value”
7. Seed dissemination Impacts resulting of training and support to OP in certified seeds production and marketing

Outputs
Trainings on seeds production and marketing

Outcomes
Professionalization of local producers organizations and other actors in seed production, seeds marketing
7. Seed dissemination
Impacts resulting of training and support to OP in certified seeds production and marketing

Impact 1
Significant increase of production and sale of certified seed by FO partners

Impact 2
Significant increasing of sorghum certified seed production at national level

Quantities of certified sorghum seed (kg) produced and sold by UGCPA-BM between 2005 and 2013

Trend of sorghum certified seeds production at national level in Burkina Faso (2001-2015)
(Source: MASA/DGPV/SNS, 2017)
8. Lessons

Traits improvement

✓ Limited gain on cycle earliness,

✓ Average yield grain improved to over 1 t/ha compared to previous IV,

✓ Grain quality equivalent to local varieties,

✓ **Men** and **Women selection criteria** are relatively divergent but high grain yield, earliness and hard grain are common priorities,
PPB approach

✓ PPB needs a **strong and continuous** involvement of farmers and their organisation,

✓ **Farmers are proud** of the **new released varieties**: “these are our varieties”,

✓ The involvement of local and regional farmer organisations in seed production and commercialization has strengthened the formal seed system and facilitated the dissemination of the new varieties.
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Thank you for your attention