Understanding a local seed system. The example of Sorghum in Southern Mali.

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**Abstract**

Sorghum (Sorghum bicolor (L.) Moench) is the staple crop in southern Mali. Besides providing grain for human consumption, the stover is used for animal feeding and for construction.

Strengths and weaknesses of the local seed system for sorghum were analyzed as a base for the collaboration between plant breeders and farmers: choosing varieties that meet farmers’ needs and strengthening the dissemination of improved varieties.

Over 400 households in two regions were interviewed in 2004 or early 2005 using a questionnaire for individual interviews about variety choice, seed management practices and information exchange. Key issues were clarified during a village level focus group discussion.

Concluding from the analysis strengths of the system in terms of variety improvement are that farmers differentiate a large number of varieties, and regularly test new varieties. Also selecting panicles is an important skill.

Identified weaknesses of the system in the process of varietal change are the slow and geographically limited exchange of varieties, seeds and information. Dissemination is further limited because commercialization of seeds by individuals is a taboo in the traditional society. The access to research generated varieties is still poor.

1. **Background and Objectives**

The context of the study is a participatory plant-breeding project\textsuperscript{1} in southern Mali funded by BMZ/GTZ and managed by ICRISAT Mali. The overall project goal is “…to improve productivity and stability of production of sorghum, by providing access to new varieties and germplasm, …” (ICRISAT, 2002).

An important component of the project is the strengthening of linkages between farmer- and community organizations and formal research institutions.

The project is carried out in two different zones of southern Mali (Mandé and Dioïla), where existing local structures are used in order to establish seed testing- and decentralized seed producing activities.

The background is the agro-ecological change that farmers faced in the last decades:

- Decrease of rainfall
  
  The length of the rainy season has decreased since the severe drought of the early 1970s in Mali and “mean rainfall decreased by 20-49% in the Sahel between the periods 1931-1960 and 1968-1997…” (IPCC, 2001).

\textsuperscript{1} “Enhancing access to genetic diversity through scaling up participatory plant breeding: Roles of different types of farmer and development organizations in Mali.”
- Differentiation of soil fertility
  Soil fertility is decreasing in bush fields, because time of fallows are getting shorter, on the
  other hand farmers are searching for sorghum varieties responding to the increased fertility
  caused by the use of mineral fertilizer in cotton fields.

These variations determine farmers demand for new varieties beside other personal needs.
At the same time farmers lack access to the formal seed sector, that however is of little
importance for sorghum seeds in Mali. The majority of producers has no information about
released varieties. Releases are not frequent and cover only little areas in Mali.
Main Objective of the study:
The study aims to identify the strengths and weaknesses of the local seed system as base for the
collaboration between plant breeders and farmers. It is important to find varieties with
characteristics, that better meet farmers’ needs and to evaluate such varieties faster.
Furthermore the dissemination of these products remains a key research issue that is addressed by
activities with local project partners.
Here only the results of the seed system analysis in the “Mandé” region will be presented.

2. Description of the project areas
The project regions are two rural communes of the Mandé-district (60 km south-west of the
capital Bamako) and more than 8 rural communes in the Dioïla-circle (160 km south-east of
Bamako). The two areas are similar in terms of agro-ecologies, but differ widely in the degree of
mechanization of agriculture, market-orientation, infrastructure and organizational environment
(ICRISAT, 2002). Sorghum is the staple crop.
Some details of agro-ecologies: Rainfalls are about 800 – 1000 mm and the length of the rainy
season varies between 4 to 5 month form May/June to September/October.
Both areas are cotton growing regions, but Dioïla is one of the oldest CMDT (Malian Cotton
Enterprise) regions in Mali, whereas in Mandé the cotton production is not as important as in the
Dioïla circle and farmers did not have access to cotton credits for such a long period. As a
consequence the level of equipment is lower in Mandé.
A difference of the organizational structure is that none of the associations in Mandé, identified
by the farmers as important for agriculture, were established as a response to an external
initiative. In contrary, in Dioïla six out of nine were established as a response to initiatives of
external organisations (Tredal, 2005).
Market orientation for Sorghum is more developed in Dioïla. Cereal producers’ organizations
(OPC) are founded with the support of a Dutch development project, which initiated cereal banks
and commercialization.

3. Methods
To reach the first research objective, a structured survey with individual interviews based on a
questionnaire was executed in 17 project villages and in 8 villages not participating in the project.
In each village 15 to 20 household-heads were interviewed, in total 451 persons in 25 villages.

<table>
<thead>
<tr>
<th></th>
<th>Mandé</th>
<th>Dioïla</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>project villages</td>
<td>9</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>non-project villages</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>all villages</td>
<td>13</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>persons</td>
<td>236</td>
<td>215</td>
<td>451</td>
</tr>
</tbody>
</table>

As a follow-up of the individual interviews, village level focus group discussions with the tools
polarization diagram and “4 square diversity” were conducted in the 25 villages. Interviews and
group discussions were realized in 2004 or early 2005.
For the structured survey a framework for analysis of the local seed system was elaborated on which was based the questionnaire:

1. Variety choice
   - Identification of varieties
   - Characterization of varieties
   - Assessment of local diversity
   - Assessment of varietal change over time

2. Seed management:
   - Seed selection
   - Seed storage
   - Seed availability

3. Seed access
   - Information exchange
   - Sources of information about varieties and seeds

4. Socio-economic data
   - Surfaces
   - Equipment

Focus group discussions were realized with groups of 10 to 20 villagers. The tool “4 square diversity” was used to discuss further about the mentioned varieties during the individual interviews. The tool helps to visualize the distribution of existing varieties by the estimate numbers of households (few or many) cultivating each variety and the estimate surface (small or big), on which they are cultivated. It can lead to the identification of varieties that are of great importance in the village and those, who are threatened with extinction. Also the tool enables to identify different varieties, if there are several names for one variety.

Second the tool “polarization diagram” was used to better locate the origin of the varieties actually cultivated in the village and to identify seed sources.

SPSS is used for data analysis.

4. Results
This presentation bases on the preliminary results of the project region “Mandé”, which represents the more traditional and less developed region concerning agricultural progress. In this region we interviewed 236 individuals in 13 villages.

The presentation of results follows the framework of analysis that was introduced before.

4.1 Variety choice
One component of the seed system is the demand and use of varieties. Varietal issues include the
- identification and characterization of varieties,
- identification of the selection criteria of farmers to grow different varieties,
- assessment of local diversity and diversity on household level,
- assessment of varietal change over time.

4.1.1 Identification of varieties
An important result of the group discussion was the identification of distinct varieties, because one variety in a same village can have different names. So it helped to reduce the number of varieties found in the individual interviews to the number of really different varieties on village level. So the identification of distinct varieties on village level was possible, but not between villages or regions.
Creation of names of varieties:
The names of sorghum varieties are created mostly in two different manners: on the one hand the name of the varieties is given by the place of origin or of the person who introduced the variety (For example “Sekounioni”, “Sekou” is a man’s first name and “nioni” means small cereal). On the other hand names are given by the special characteristics of the variety like the resistance against Striga (=”sege”, name of the variety=“segstana”), the length of the cycle or the color of parts of the plant like the grains, etc.
But to distinguish one variety from an other this system of nomenclature gives no clear definition of a variety. People can chose the same name for different varieties or different names for the same varieties. It is therefore very difficult to distinguish different varieties based on their names alone.

4.1.2 Characterization of varieties
Open questions were asked, so that farmers describe the varieties in their own words. Important, mentioned traits are size of the panicle, color and quantity of grains, color and quantity of glumes, height of the plant, length of the maturity cycle, culinary qualities, yield, resistance and sensitivity.
Farmers grow different varieties to meet different needs such as:
- diverse uses, like animal feeding, sugar juice for children, construction, special food processing, traditional uses etc.
- adaptation to different types of soils, like bush fields, house fields, bas-fonds, poor soils, fertile soils, waterlogged fields, intercropping, etc.
- different maturity cycles, for the “hungry period” before harvest, late sowing dates, changing growing conditions like the shortening of the rainy season etc.
- good storage traits, for commercialization, stocks for poor years, etc.
- different culinary qualities, like content of flour, preparation like rice etc.

4.1.3 Assessment of local diversity
Sorghum shows a broad diversity in landraces. In total about 40 varieties are mentioned in Mandé that are cultivated actually. Most of these varieties belong to the Guinea race of Sorghum bicolor (L.) Moench. Few varieties are classified in the Caudatum race and sweet sorghum pertains to the Bicolor race.
Between 5 and 12 different varieties were found per village.

<table>
<thead>
<tr>
<th>Number of varieties</th>
<th>12</th>
<th>11</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of villages</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

The majority of families cultivates between one and three different varieties.

<table>
<thead>
<tr>
<th>Number of varieties/family</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.39</td>
</tr>
<tr>
<td>1</td>
<td>39.83</td>
</tr>
<tr>
<td>2</td>
<td>30.08</td>
</tr>
<tr>
<td>3</td>
<td>22.03</td>
</tr>
<tr>
<td>4</td>
<td>3.81</td>
</tr>
<tr>
<td>5</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Differences of the varieties in one family are the length of the maturity cycle, adaptation to different soils and culinary qualities.
4.1.4 Assessment of varietal change over time
Many actually cultivated varieties are up to ten years cultivated by the families (57,06%). This can be explained by the search for new varieties for example with a shorter maturity cycle because of the shortening of the rainy season.

<table>
<thead>
<tr>
<th>Years</th>
<th>1 to 5</th>
<th>6 to 10</th>
<th>11 to 15</th>
<th>16 to 20</th>
<th>21 to 30</th>
<th>&gt; 30</th>
<th>“Longtime”</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of varieties</td>
<td>36,53</td>
<td>20,53</td>
<td>4,53</td>
<td>12</td>
<td>8,27</td>
<td>9,87</td>
<td>8,27</td>
</tr>
</tbody>
</table>

N = 375 (number of mentioned varieties)

Most farmers name the short cycle and the culinary qualities as reasons for the choice of the cultivated varieties.

4.2 Seed management:
4.2.1 Seed selection
Source of seeds for each year is mostly the own production. Farmers select panicles in the field before or during harvest: 82,06% of mentioned varieties. 12,92% of the varieties are not selected and 0,53% of varieties are selected after threshing (grains).

4.2.2 Seed storage
In the majority of cases farmers conserve seeds in form of sheaves (71%). Some varieties are conserved in form of grains (19%) or panicles (3,4%). Seeds are kept in the granary (37%), the house (26,1%), the kitchen (12,1%) or in a tree (10,6%). Most of the farmers (91,1%) do not have any problems in conservation issues and describe the conserved quantities as sufficient. Only 6,8% mentioned that they already lost seeds of one variety, due to insect or animal damage.

4.2.3 Seed availability
2003 was a good rainy season, so that this can be a cause for the good supply with seeds of the farmers. In the rare case of seed need, the social system allows to ask for seeds to relatives, friends or neighbors. These seeds are given for free in little quantities or they are exchanged with the same quantity of grains, even of other cereals like millet or maize.

Introduction of new varieties:
The varieties are obtained for the first time most often by exchanges or gifts in the own village (44,92%), by heritage in the family (28,43%) or by exchanges or gifts from other villages (22,84%). 2,03% named markets as sources of seeds, but it means more exactly the supply with grains that are sown. Locally the introduction of new varieties due to activities of projects or extension services can be observed (1,77%).

<table>
<thead>
<tr>
<th>Origin</th>
<th>Family</th>
<th>Own village</th>
<th>Other villages</th>
<th>Extension + projects</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of varieties</td>
<td>28,43</td>
<td>44,92</td>
<td>22,84</td>
<td>1,77</td>
<td>2,03</td>
</tr>
</tbody>
</table>

N = 394 (number of mentioned varieties)

Introduction of tested, improved varieties during project activities is slow, and future studies will examine the acceptance and sustainability of these varieties. Dissemination activities started well and produced seeds are sold to about 300 people in Mandé in the season 2004/2005 (after the survey) via a seed market and seed traders.

If farmers do not know the varieties, they often get little quantities of seeds or grains to test the variety in the own field and for the multiplication of seeds.
Testing of varieties:
Farmers are used to test new varieties in a small part of their field and compare the new variety to the local one. 96.2% already tested sorghum varieties. 43.6% on surfaces between 0.26 and 0.5 ha, 28.7% on surfaces smaller than 0.26 ha and only 9.7% on surfaces bigger than 0.5 ha.

<table>
<thead>
<tr>
<th>Surface</th>
<th>Up to 0.25 ha</th>
<th>0.26-0.5 ha</th>
<th>0.51-1 ha</th>
<th>No exact data</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of persons</td>
<td>28.7</td>
<td>43.6</td>
<td>9.7</td>
<td>17.7</td>
</tr>
</tbody>
</table>

Most often they test new varieties in the same field like the own variety (82.6%) and for a period of 1 (43.2%), 2 (33.9%) or more (17%) years.
63.1% do not choose special conditions for testing and only 28.4% choose fertile parts of the field or add fertilizers.
In the case of adaptation to local conditions, the surface is increased, up to the possible replacement of the old variety if the farmer is satisfied with the characteristics of the new variety.

4.3 Seed access
Farmers hear about new varieties during conversations with other farmers (68.6%), see these varieties in the neighbor fields (64%) or during trips in the country (46.6%). Other sources of information are projects (38.6%), extension services (31.8%), markets (8.9%), radio broadcasting (7.6%), joint harvests (7.2%) and farmers organizations (6.8%).

5. Conclusion and further fields of research
Biodiversity at village level is high and a high variability among local varieties can be found. Strengths of the local seed system in terms of variety improvement can be summarized as follows:
- Farmers differentiate a large number of varieties.
- Farmers select panicles.
- Farmers regularly test new varieties.
- Farmers regularly change varieties.
- Farmers communities are efficient in the preservation of varieties.
Weaknesses of the traditional system in the process of varietal change are the
- slow and geographically limited exchange of varieties, seeds and information,
- limited dissemination because commercialization of seeds of staple crops by individuals is a taboo in the traditional society and
- access and adoption of research generated varieties is still poor.
The weaknesses of the system are addressed by the project activities. The success and sustainability of improved varieties can only be assessed after some years, but the basis for advanced information exchange and collaboration with research institutes are set.

Further fields of research during the project phases will be the examination of project activities linked to the seed system:
- Ways of dissemination of improved varieties
- Follow-up of distribution of produced seeds
- Diffusion of information about the varieties
Assessment methods are structured surveys, action research with project partners and innovation dissemination research.
References


TREDAL 2005: A study of seed commercialization and farmers’ associations’ roles in a participatory plant breeding project in southern Mali. Unpublished