



INTERNATIONAL FOOD
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January 2008

Trading Millet and Sorghum Genetic Resources

Women Vendors in the Village Fairs of San and Douentza, Mali

Melinda Smale, International Food Policy Research Institute
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Environment and Production Technology Division

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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ABSTRACT

In Mali, liberalization of seed markets for sorghum and millet, the staple food crops, has not advanced at the same rate or with the same measurable success as liberalization of grain markets. Most seed of these crops is uncertified and continues to be supplied to farmers by farmers, according to clan and ethno-linguistic group. After poor harvests or when replanting after a dry spell, farmers rely on local markets for grain as sources of seed. This paper summarizes the findings of a vendor survey conducted in two marketsheds during weekly fairs. No certified seed is sold. Almost all vendors are women who are also farmers. Variety integrity is maintained particularly for millet seed in the marketshed of the Sahelian zone, where the range of variety adaptation is very limited. Grain that is suitable for seed is brought to market directly from granaries. Varieties are identified by their provenance. Socially prescribed behavior is apparent in price-fixing, price discounts, procurement practices, and the spatial organization of vendors. Preliminary hypotheses are tested with a simple regression. Marketshed, which is highly correlated with the ethnic composition of the population, agro-ecology, market infrastructure and crop sold, has a dominant impact on quantities sold. Quantities sold do not respond to expected prices. Greater specialization of the vendor in trade as compared to farming, younger age, and additional years in school positively influence amounts sold. A better comprehension of this type of trade could contribute to policies that improve the access of poor farmers to valuable crop genetic resources, enhancing their seed security and productivity.

Keywords: agricultural development, informal sector, seed markets, traders, landraces, millet, sorghum, women, Mali

GLOSSARY

formal seed sector	The chain of seed production and marketing involving scientific plant breeding, multiplication by a seed company following established procedures, processing, bagging, labeling, and marketing.
informal seed sector	The chain of seed production and marketing involving farmers who save seed from harvest to planting, occasionally selling or exchanging seed with other farmers, but without any mechanical processing, testing, or labeling (in contrast to the formal sector). Sometimes called the farmer (or local) seed system.
landrace	A distinct plant population recognized, developed, and reproduced by farmers
local variety	A distinct plant population recognized and managed by farmers. In this document, both landraces and recycled modern varieties are considered as local varieties.
modern variety	A distinct variety that is recognized and developed by plant breeders and meets official requirements for uniformity and stability; reproduced in the formal seed sector.
marketshed	A real or potential trading network composed of a market center, interlinked market outlets, and an associated population living in a geographical area.
vendor lot	The physical unit of grain or seed sold by a vendor. In this study, units of sales are bowls and tins, and grain is sold either for consumption or planting.
grain type	Defined by the characteristics that the vendor uses to distinguish one lot from another.
mixture	A mixture of vendor lots.

*Definitions adapted from Lipper et al. (2007), Minot et al. (2007), and Nagarajan and Smale (2005).

1. INTRODUCTION

Over the last few decades, structural adjustment and the process of economic development have increased the influence of market institutions on farmers in Sub-Saharan Africa. In Mali, liberalization of seed markets for sorghum and millet, the staple food crops, has not advanced at the same rate or with the same measurable success as liberalization in grain markets (see literature summarized in Dembélé and Staatz 1999; Diakité et al. 2007; Vitale and Bessler 2006). The formal seed sectors for sorghum and millet continue largely to be operated by the state, with some participation by registered farmer cooperatives in the multiplication of seed.

The “real circulation” of cereal seeds continues to be through informal seed channels, and most of this seed is uncertified. Each season, the majority of farmers plant the seed of their own local landraces, much of which is acquired through customary exchange or as a gift (Touré et al. 2006). Mali’s seed laws are undergoing reform. Current interpretations of the new laws are somewhat ambiguous; in the past, however, only registered varieties could be certified, and the production of other varieties (local varieties) without authorization was forbidden (Christy 2006).

Few documents report in quantitative terms the extent to which the formal sector provision of sorghum and millet seed meets potential demand in Mali. An evaluation conducted for the *Projet d’Appui à la Filière Semencière* (Fonds Africain de Développement, 2001), which supports seed sector reform, estimates that the annual demand for improved seed of both millet and sorghum is about 1,900 tons, to which can be added a 10 percent stock for national security. The production of certified seed from 1988 to 1993 averaged 230 tons for all dryland crops (millet, sorghum, maize, and cowpea) and only 32 tons per year from 1994 to 1996, equivalent to only 8 percent of the potential area in the earlier period and only 2–3 percent in the later years. Taking all unofficial production and circulation into account, the percentage of area planted with improved seed during the period is estimated at 15 percent. In areas benefiting from certain rural development projects, the percentages of farmers who were using at least some improved seed have been reported to be considerably higher (e.g., Diakité and Diarra 2000). The most recent draft Agricultural Census reports that the rate of use of improved varieties ranges from 1 to 8 percent of the area cultivated for all crops. The proportion of area under improved seed for cereals is estimated to be 10 percent. By contrast, 89 percent of the area in industrial crops is planted with improved seed (Bureau de Recensement Agricole 2006). Among dryland crops, until now, adoption has been more successful for maize and sorghum than for pearl millet and cowpea.

Quantitative analyses of the informal seed sector are even more difficult to find. References to farmer seed provision in Mali’s informal sector are largely anecdotal, detailed in unpublished theses (e.g., Traoré 2006), or summarized generally in project documents (e.g., SOS-USC Douentza 2007a,b,c). A

notable exception is the study conducted by Diakité et al. (2004). The authors viewed the informal seed sector from the perspective of the farmer, employing data collected from farmers regarding their seed sources.

A seed security assessment conducted by Catholic Relief Services and partners (Sperling et al. 2006) shifted the perspective from farmers to local traders. To their surprise, the study team found that following several years of poor harvests, local traders played an important role by providing farmers with the seed of well-adapted landraces. Landrace identity, often linked to the village of origin, was preserved in seed transactions, even though the transactions occurred in grain markets. The study confirmed that in a risky production environment with a high degree of local adaptation among sorghum and millet varieties, the provenance of seed is crucial information for farmers.

The significance of grain markets as sources of seed has been reported in numerous studies conducted in Sub-Saharan Africa (e.g., Cromwell et al. 1993; Sperling and Longley 2002; Tripp 1997, 2001; see also review conducted by Minot et al. 2007). Generally, transactions in grain markets are considered unfavorable for farmers because they provide no assurance of seed quality, unlike transactions with other farmers and kin, which are based on trust or direct observation. Procuring seed in open-air village grain markets is most often described as a last resort. The findings of Catholic Relief Services raise the possibility that, when grain is sold as seed with recognized, valued attributes, vendors are “trading plant genetic resources” (L. Sperling, pers. comm.). A better comprehension of this type of trade could contribute to policies that improve farmers’ access to valuable genetic resources, enhancing their seed security and productivity.

Still, almost nothing is known about transactions of sorghum and millet seed in the local markets of Mali. The purpose of the survey summarized in this paper was to better understand the nature of local markets for sorghum and millet seed by documenting their characteristics, qualitatively and quantitatively.¹ A particular focus of the survey was the extent to which variety identity is preserved in market transactions. All seed sold is of local varieties; seed sales occur in grain markets because sales of landrace seed are not authorized and farmers still rely primarily on their own harvests for seed.

The survey was implemented with a methodology developed specifically for this project, as described in the next section. Based on limited prior knowledge of the markets, the findings reported are

¹ In 2004 the Agricultural and Development Economics Division of the Food and Agriculture Organization initiated a research program to examine the relationships among farmer participation in local seed markets, utilization of crop genetic resources by farmers, and farmer welfare. The research program is motivated by the need for policymakers in developing countries to respond to commitments made under the International Treaty on Plant Genetic Resources to promote the sustainable use of plant genetic resources. The goal of the program is to identify public sector interventions to support farmers’ access to crop genetic resources in local seed markets. Country case studies have been selected to facilitate comparisons between crops and levels of market development, building on previous research by team members. Mali is one of three country case studies in which International Food Policy Research Institute is involved (the other case studies are Kenya and India). This survey is one of several studies undertaken for Mali.

largely descriptive. Nevertheless, they raise several hypotheses, some of which are tested with a simple OLS (ordinary least squares) regression. Further research might be designed to test the hypotheses more fully. Some tentative conclusions from this study are offered in the final section. When the conclusions presented here can be combined with those of other studies under preparation for the same project, more-specific policy recommendations will be proposed.

2. METHODS

The general methodology developed for all case studies in the Food and Agriculture Organization project, which includes analyses conducted at the observational scale of farm, market, seed sector, and national policy framework, is documented in a draft project paper by Lipper et al. (2007). Only those components with direct bearing on the market survey are summarized here.

Site Selection

Study sites were selected in a preceding project implemented by the Institut d'Economie Rurale, with the support of Bioversity International and the International Fund for Agricultural Development. The earlier project aimed to promote the sustainable utilization of plant genetic resources through diversity fairs and diversity field fora. Selection criteria for sites included agro-ecological characteristics, such as rainfall levels and crops grown, evidence of genetic erosion, and market infrastructure.

The San site is in a semiarid, tropical climate with annual rainfall levels of 450–600 mm, which places it in the Sahelo-Sudanian zone. Variation in vegetative cover is linked to variation in soils, and the landscape is a mosaic of cultivated woodland savanna heavily populated by shea nut trees (*karité*). The Douentza site is located in the Sahelian agroclimatic zone, which places it within the 200- and 400-mm isohyets (Matlon 1990). The zone is composed of a series of rocky plateaus and outcroppings, interspersed with sandy plains, forest cover, cultivated areas, and pasture. Villages are located on both the rocky plateaus and the plains. Across the West African semiarid tropics, millet, cowpea (intercropped with millet), sorghum, *fonio*, and groundnuts are characteristic of the Sahelo-Sudanian zone, while migratory livestock and millet production for subsistence are characteristic of the Sahelian zone (Matlon 1990).

The sample structure for the farm survey provided the basis of the sampling for the market survey. Within sites, the criteria for village selection included location in the administrative Cercles of Douentza, San, and Tominian.² A self-weighting random sample of approximately 150 farmers was selected at each site, allocated evenly between control and test villages. Test villages were defined as those affected directly or indirectly by project interventions. In each site, both control and test villages were located within the areas affected by the International Fund for Agricultural Development project and the same nongovernmental organizations. Control and test villages were selected to share similar ethnic representation. In the Douentza site, the major ethnic groups are Dogon, Songhoi, and some Peulh. Bambara and Bobo are the major groups in the San site, although Peulh and several other groups also

² In Mali, a cercle is an administrative unit in a region, followed by the categories of commune and village.

inhabit the area. Despite these broad similarities, field teams observed considerable variation among villages with respect to dialects of the same local language, social norms, and customs.

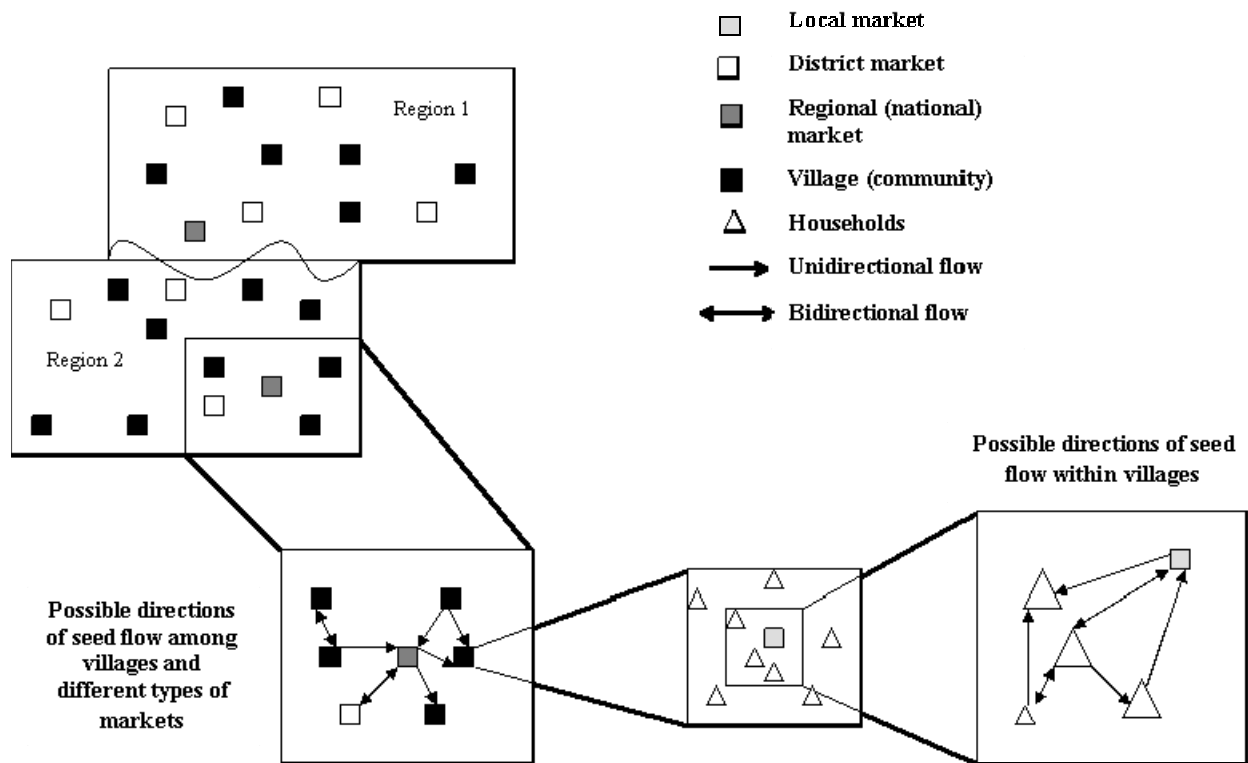
Project interventions focused on enhancing local knowledge and use of crop genetic resources, particularly sorghum and millet varieties. In diversity fairs, project participants were invited to display, explain, and promote the diversity of local varieties and landraces among farmers drawn from surrounding villages. The notion of diversity field fora was built on the concept of farmer field schools. Experiments related to enhancing knowledge of crop genetic resources were designed and conducted by villagers, with technical support from the project staff, on land distributed for that purpose by villagers. Farmers studied both modern varieties and landraces in their diversity field fora.

The primary test villages were Petaka, commune of Petaka, cercle of Douentza, region of Mopti, in the marketshed of Douentza; and Boumboro, commune of Mandiakuy, cercle of Tominian, region of Ségou, in the marketshed of San. Located toward the south, near the city of San, Boumboro and the surrounding villages are better served by a nexus of feeder roads than is Petaka. The San site also has a higher density of weekly markets. The closest city to Petaka is Douentza.

Marketsheds

A marketshed is a real or potential trading network composed of a market center and interlinked market outlets, and an associated population living in a geographical area (Lipper et al. 2007). Several market outlets of varying size and scope may exist within the marketshed, although usually one, a market center, is dominant in terms of size and function. Use of the term *marketshed* focuses on the trading network and linkages with market outlets, rather than on a geographical or administrative zone where markets are located. Figure 1 illustrates a hypothetical marketshed for seed.

Figure 1. Hypothetical distribution of markets, villages, and seed flows in a marketshed



Source Toby Hodgkin and Monica Rodriques, Bioversity International, 2006.

In this study, all markets in the network were retail markets, where farmers interacted directly with traders to obtain seed. A seed market is defined broadly as a physical space where either certified or uncertified seed is exchanged between a buyer and seller in a voluntary transaction.

The city of San and the town of Douentza are the market hubs of the marketsheds identified in each study site. They are separated by nearly 400 km on the national road (Route Nationale). The only interaction between the market hubs for target crops concerns millet grain carried from the San site to wholesalers in the Douentza market. This grain is not sold or used as seed and is recognizable by its appearance. No sorghum is sold by wholesalers in the Douentza market hub.

Each market hub is connected to a cluster of interlinked village markets. Market hubs function daily. Village markets (called fairs) are held on different days once a week. A fair is also conducted once a week in each market hub and is the most important day in terms of farmer participation and turnover of goods. All fairs are conducted in the open air, although the market hubs have permanent shops and infrastructure.

Data collected in the farm-level survey were used to identify 12 weekly markets (fairs) per site. Of those, six markets were identified by site, with three frequented by farmers in control villages and three frequented by farmers in test villages. Strict division between test and control markets was difficult,

given that they represent an interlinked nexus of markets. In San, test and control markets appear to have been separated by sufficient distance. In Douentza, some farmers living in control villages sell grain in both control and test markets, but none of the farmers sampled in control villages sold grain in control markets during the baseline year of the survey. An important distinction between the two sites is that the market hub in San is located in the control area, whereas the market hub in Douentza is among the test markets (Table 1).

Table 1. Market locations, marketsheds, and types surveyed

Location	Marketshed	Type
Douentza town	Douentza	Test
N'gono	Douentza	Test
Petaka	Douentza	Test
Kiro	Douentza	Control
Kerena	Douentza	Control
Dangol-Boré	Douentza	Control
San city	San	Control
Fangasso	San	Control
Dieli	San	Control
Lohan	San	Test
Benena	San	Test
Mandiakuy	San	Test

Nearly all millet or sorghum grain sold by farmers in the Douentza marketshed is harvested from landraces. Farmers in the San marketshed sell grain harvested from modern varieties of sorghum, as well as from local varieties (landraces or recycled modern varieties).

3. INSTRUMENTS

Data were collected through interviews with key informants, a market infrastructure survey, and a vendor survey. Key informants included researchers with the Unité des Ressources Génétiques and Economie des Filières, Institut d'Economie Rural; representatives of nongovernmental organizations working with seed and genetic resource interventions in the study sites (Unité Service Coopération Canada, Fondation pour le Développement au Sahel); and representatives of the local offices of the agricultural department.

The surveys were conducted in April, the month when the rainy season typically begins. Each market was visited on the day of the weekly fair during the late morning and early afternoon, which is the peak period for transactions. The market infrastructure survey was conducted through interviews with key informants at the market and local government officials, supported by direct observations. Overall characteristics of the markets, including product scope, size, and physical infrastructure, were identified. The vendor survey elicited characteristics of vendors, vendor lots, and transactions.³

A protocol was developed to sample vendor lots for agromorphological characterization on the experimental station, which is currently under construction as a separate project activity (M. Grum, pers. comm.). This paper presents results with respect to named varieties, types, and provenance. The original protocol is shown in Box 1.

Box 1. Proposed protocol for sampling seed from vendors in local markets for agromorphological characterization

1. Walk through the market recording the number of vendors of millet/sorghum grain/seed in the market on that day.
2. If 25 or fewer vendors are present, include all of them. If more than 25 vendors are at the market, select 25 at random to include in the sample.
3. Take a paper with a blank matrix that shows grain/seed type or variety $j = 1, \dots, k$ by vendor $v = 1, \dots, n$ in rows. Type is defined by the characteristics that vendors use to distinguish between the grain/seed lots they sell. It may be that type equals variety, so that variety identity is preserved.
4. Go to each vendor and list each type/variety sold across the top of the column, ticking downward each time a vendor sells a variety.
5. Calculate $\ln(v_{jm} + 1) = s_{jm}$, where v = vendor, j = type, m = market, and s = sample size. Thus, the number of grain/seed samples to collect per market per type is equal to the natural logarithm of the total number of vendor lots of each type observed in that market, plus 1.
6. Stratify by vendor type if there is more than one type of vendor.
7. Purchase 1 kg of the vendor lot per vendor sampled. Place it in a bag.
8. Attach a ticket to each bag. Record the market name, vendor name, date, variety or type name, and village of origin of grain/seed lot.
9. Conduct the vendor survey.

³ Instruments are available in French from the authors.

During the implementation of the survey, the team modified the protocol slightly. In both sites, the team found that vendors ranged in occupational status from nearly full-time petty vendors to nearly full-time farmers, and all but a few were women. All sold seated on the ground with their grain spread before them on cloth or in baskets or tins. No objective means of stratifying among vendors by type existed.

The team also found major differences by site in terms of genetic resources traded. In the markets of the Douentza site, millet was more frequently sold than sorghum, while the converse was true in the San site. Vendors reported that they did not mix lots in the Douentza marketshed, while mixing lots was common in San, particularly for sorghum. Mixtures are made by vendors after procuring separate lots from different farmers to bulk the grain or to sell for specific purposes, such as brewing local beer. According to accounts of traders and farmers at the market, vendor mixtures, which are apparent in color and form, are not bought for seed. Thus, they carry no genetic information related to seed.

In addition, in the markets of the Douentza site, types were easily identified by grain form, color, shape, and quality and some confusion arose over whether type was equivalent to variety. Sometimes more than one name was provided for the same type and even for the same vendor lot. Often names appeared to be similar in meaning but varied by dialect and language. Occasionally, vendors disagreed over names.

In the San site, the markets for grain were much larger, not only in the city of San but also in the village markets. Women vendors sold small quantities of grain, but intermediaries were also present in village markets. In Lohan, no single variety was sold. All lots we observed were vendor mixtures of lots purchased from various farmers. Intermediaries intercepted farmers as they reached the market, bought the grain, mixed or bulked it, bagged it, and sold it to dealers.

Another consideration was that because farm women were often in the market for the purpose of selling small quantities of grain to buy their condiments, turnover was high. Not enough time was available to confer with traders over variety names and also conduct the vendor interviews without losing respondents.

Therefore, in both Douentza and San, we conducted rapid visual censuses of types and sampled according to a sampling fraction given by the logarithm of the number of vendors selling the type. The composition of type differed by site. In Douentza, no vendor reported mixtures, but type can include more than one named variety. Names were often variants of names that signify millet or sorghum in a local dialect, sometimes including color or grain size. In San, type is defined as mixture or variety. We separated mixtures from varieties and sampled only varieties. In both sites, when the number of vendors by type was less than 25 (resulting in a very small logarithm), four or five samples were drawn by type to ensure representation. Even if only one or two samples were needed to characterize the vendor lots

genetically, we needed a larger sample of social and economic data to characterize vendors. In San, we sampled from the lots originating in farmers' granaries, because we knew that no farmer would plant a mixture. All things considered, we were able to follow the protocol for type; and in some, but not all, cases, type was highly correlated with farmer-named variety.

The overall sample of 102 vendors was small but highly representative. Given the protocol implemented, the probability of selecting a vendor varied by crop, type of material, and market. Thus, for analysis of the vendor data, each vendor was assigned a weight equal to the inverse probability of selection. Sampling fractions were relatively high given the small number of vendors. The lowest was 13 percent, and the highest was 100 percent (for rare types observed only once per market, such as the mixture of *chibra* and cultivated millet in the Douentza market). The average was 50 percent.

One important caveat is that numerous languages and local dialects of the same language group are spoken at both sites. Sequential translation both lengthened the interviews and posed challenges in interpreting the findings. Vendors had difficulty responding to unfamiliar questions; most had never attended school.

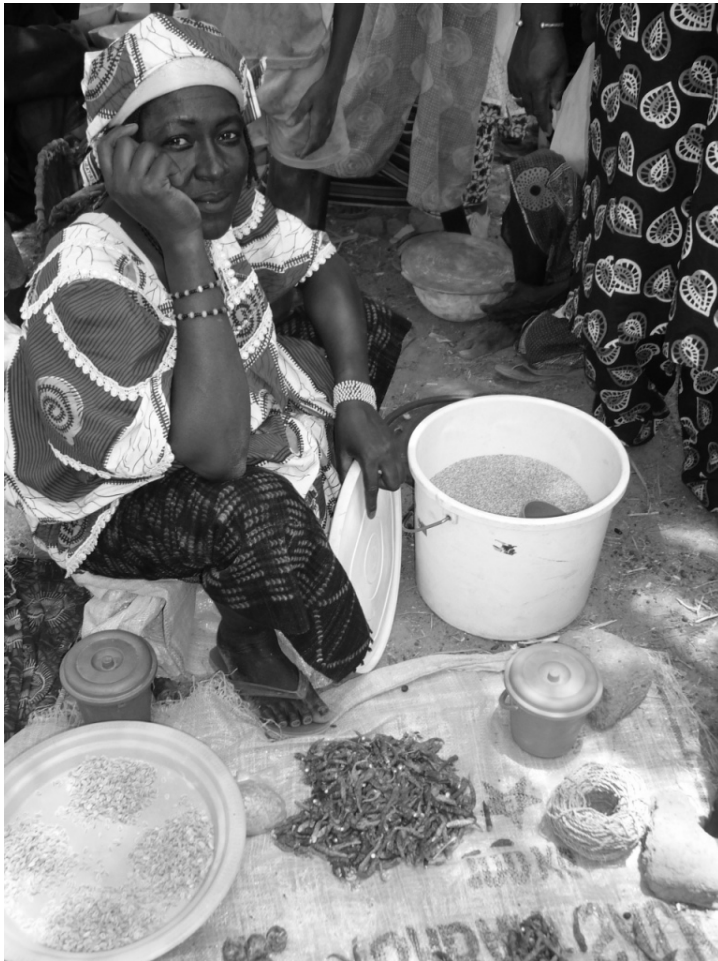
4. CHANNELS FOR MILLET AND SORGHUM SEED IN THE SAN AND DOUENTZA MARKETSHEDS

Typology of Actors in Local Seed Markets

No organized channels exist to produce and market either local or improved seed in the San or Douentza marketsheds. Outside markets, farmers can obtain seed from the following actors: farmers (their own harvests or the harvests of others), nongovernmental organizations, agricultural service technicians, and farmer–seed producer associations.

The survey confirmed that no certified seed is sold by any market actor in either marketshed. The only seed system actors in the two market networks, whether in the hub or in the village fairs, are petty vendors of grain. Key informants described two types of petty vendors, most of whom are women. The first type brings her own grain from the granary of her family farm to the market. Her family farm is a highly structured production unit operated by a patriarch, his sons, and their wives and children. With the money she makes from selling grain, she purchases other products to meet the needs of her nuclear household or to fulfill the responsibilities assigned to her on behalf of the larger production unit. Often she seeks the ingredients of sauces that accompany the millet or sorghum main dishes for the common meal shared by all members of the production unit. Typically, she sells more than one homemade product. She considers herself a farmer. The grain she sells is locally produced, is threshed by hand, and can be used as seed because its village provenance is identifiable. Figure 2 shows one petty vendor in this first category.

Figure 2. Vendor of millet and condiments at Kerena fair



Source: Melinda Smale

A second category of petty vendor, again composed primarily of women, collects grain from producers or purchases grain from wholesalers for resale at the same market. These vendors may be farmers but are more likely to be specialists in petty trade. Buyers can easily differentiate grain that is purchased from wholesalers for resale because of its quality (cleanliness, color, mixture) and because the vendor generally will not know much about its provenance. Thus, women in this second category of petty vendor are less likely to sell grain as seed.

Institutional Characteristics

Several institutional characteristics influence the way local seed markets function in Mali. First, as previously reported and confirmed during the survey, commercial sales of certified millet or sorghum seed are not conducted in weekly village markets. Second, in larger markets, grain wholesalers (*grossistes*) are required to pay for permits to sell, but petty vendors are not. In principal, all petty vendors must also pay a market fee on the day of the weekly fair. Collection of market fees from vendors is

typically patchy; monitoring all participants—especially itinerant traders, part-time traders, and farmers—presents logistical challenges. One reason is that establishing the role of a market actor can be difficult. In particular, part-time traders and farmers visit the marketplace to purchase as well as to sell goods.

Third, grain suitable for food can be differentiated from grain suitable for seed. Grain sold by dealers and wholesalers is not suitable for seed. One category of millet seed sold through wholesalers in either the San or Douentza market hub is from the area between the Bani and Niger rivers, called the “zone inter-fleuve” (interfluvial zone), Darker brown in color, grain from the inter-fleuve is broken and filled with impurities. Key informants explained that this grain is less expensive because it is hulled mechanically by spreading it on the ground and crushing it with tractors, trucks, or other vehicles. A second category of grain is the millet of the Bobo and Minianka from the villages surrounding San, Koutiala, Bankasse-Kora, and Kimparana. Clean and hulled by hand, this grain is bluish white in color and has no broken grains. According to the wholesalers interviewed in the city of San, it can be mixed without diminishing the overall quality of the grain for consumption. Key informants in the Douentza market hub reported it fetches a higher price than the grain from the inter-fleuve and a lower price than the grain sold by women vendors who are farmers.

Quality differences are not important for sorghum in either market hub. Wholesalers reported that in the San market hub, sorghum is sold in a single grade, with mixtures of all varieties. As previously noted, no sorghum is sold wholesale in the Douentza market hub.

These market features imply that the only source of sorghum and millet seed in local markets is grain sold by petty vendors who are farmers participating in the market. Seed purchased in this way has no label and no formal quality control. Grain sales occur throughout the year. Seed purchases take place immediately before and after the first planting rains (generally, from April through May, but rainfall patterns are variable). Farmers may make purchases to replant seed that has failed to germinate because of a dry spell following the first planting rains, as late as July. Purchase for replanting was often reported in San as an example of a situation in which vendors knew that buyers were farmers looking for seed. As a cultural practice, dry planting is reported for Douentza (Sperling et al. 2006).

Fifth, all key informants and published sources that we consulted agreed with, and farm-level data support, the assertion that sorghum and millet are staple food crops for which most farmers obtain seed largely through nonmonetized exchanges within their own villages. A point of contrast is the grain of legumes, which is bought frequently in markets because of its relatively high rate of insect and pest damage in storage. The right to millet and sorghum seed, and having one’s own seed, are strong customary norms in the villages included in this study. To be without seed is to be destitute. Millet seed is

of such value that it is considered “priceless.”⁴ Customarily, *la semence ne se vend pas* (“seed is not sold”). Thus, some shame is associated with not having sufficient seed and with exchanging seed for cash.

A sixth feature relates to plant population genetics. For gene migration to occur through market exchange, only a tiny percentage of planted seed must pass through the marketplace. Especially in millet, which has a high rate of outcrossing, even small amounts of genetic migration could be significant for maintaining the genetic diversity that buffers against variable or fluctuating conditions and stress events (T. Hodgkin, pers. comm.).

The last two features reveal the potential for local markets to play a crucial role in sustainable utilization of crop genetic resources in risk-prone production environments, such as those encountered in the study sites. Local markets can be a means of impersonal exchanges without social stigma. They facilitate gene migration and could enhance genetic resilience when local seed shortages occur. In areas where farmers have a strong hold on their seed supply despite adversity, local seed shortages are most likely to occur after successive seasons of drought, pest damage, or prolonged civil disruptions (Sperling and Longley 2002).

For example, the previously mentioned seed security assessment conducted by Catholic Relief Services and partners in Douentza documented that after three successive poor harvests caused by drought and cricket infestations, the intravillage exchange system failed to meet farmers’ need for millet seed because so many farmers were affected. Droughts occur with some expected frequency, but cricket infestations were unexpected and devastated the crop. Further, the range of adaptation of millet varieties in Douentza is as narrow as 30–40 km. Thus, traders played a crucial role in resolving the crisis by bringing in locally adapted materials from nearby villages to weekly markets in Douentza. Although seed was still sold in the form of grain, the Catholic Relief Services study found that farmers and small traders participating in the market knew variety names and provenance and that some villages in the region were specialized in the production of early-maturing varieties that were in high demand as seed (Sperling et al. 2006). Key informants reported that traders traveled long distances to barter goods for seed from specified locations where farmers were known to produce certain early-maturing varieties (Group interview in village of Tani, confirming information reported by Sperling et al. 2006).

⁴ In an essay titled “Invaluable Goods,” Arrow (1997) argues that although all goods can be given prices and sold on a market, some goods are “so much a part of us as to be inalienable.” For these goods, society sanctions markets. Arrow’s essay was provoked by the critique that economic thinking disregards the deeper and more sacred aspects of life. Arrow points out that utility theory does not contend that everything has a price. He concludes that “regardless of our all-embracing market theories, we economists must recognize that there are goods that might be bought and sold but aren’t.”

5. FINDINGS

Market Infrastructure

In general, all weekly fairs are conducted during the day from early morning until sunset. Except for the permanent market hubs in the town of Douentza and the city of San, none has lighting. Village marketplaces are cleaned by teams hired by the municipality. They do not have concentrations of rats, mice, or insects because they are not permanent. Formal hygiene control is minimal. None of the marketplaces, other than those of Douentza and San, has garbage containers, and in the smaller village fairs, there is little waste. None of the marketplaces has drains. All village fairs are served by agricultural officers, who are also responsible for communicating farmers' requests for the seed of modern varieties. Figure 3 shows the infrastructure of a larger village market before the arrival of participants.

Figure 3. Dangol-Boré marketplace, before the weekly fair



Source: Melinda Smale

Table 2 summarizes the findings from the market inventory for the five village fairs linked to each of the two market hubs.⁵ Each village fair in the San marketshed has at least one or two permanent shops and numerous permanent and semipermanent stalls. Almost no permanent structures were found in the marketplaces of the Douentza marketshed, and semipermanent stalls were also less numerous. In the San marketshed, the total number of vendors observed seated on the market floor ranged from several

⁵ Detailed descriptions of the markets are in the project report, which is available from the authors.

dozen in Mandiakuy to perhaps 1,000 in Dieli. By comparison, that type of vendor probably numbered less than 200 in each village fair of the Douentza marketshed. Mobile vendors were also plentiful in the fairs of the San marketshed but rarely encountered in the Douentza fairs with the exception of Dangol-Boré, which is located on the main road toward the southwest in the direction of San. Restaurants were visible only in the Dangol-Boré fair in Douentza but were less rare in the San marketshed. Motorized transport was common in the San marketplaces and largely absent in the Douentza network, with the exception of Dangol-Boré. Hundreds of horse- and donkey-drawn carts arrived in the Fangasso and Dieli markets of the San network, while at most only about a dozen were observed in each fair of the Douentza marketshed. Wells, pumps, or faucets were present in all the San marketplaces but in only two of the marketplaces in Douentza.

Table 2. Structures and vendors, by type and market, San and Douentza marketsheds, April 2007

Structures	San Marketshed						Douentza Marketshed			
	Lohan	Fangasso	Dieli	Benena	Mandiakuy	N'gono	Kiro	Petaka	Kerena	Dangol-Boré
Permanent shops	1-2	3	49	8	12	0	5	0	1	15
Permanent stalls	12	14	432	0	180	0	0	0	0	10
Semi-permanent stalls	80	500	800	240	200	5	35	0	20	80
Floor vendors	120	800	1,000	100	20-40	30	120	40	100	175
Mobile vendors	15	200	500	300	25	6	12-15	5-6	5-10	20
Restaurants	0	0	2	5	1	0	0	0	0	2
Motorized market transport	12	30	45	57	11	0	2-3	0	2-3	15
Horse- or donkey-drawn transport	10-15	200-300	200	20	40-50	1-2	12	2-3	8-10	10-15
Public toilets	0	2	0	0	2	0	0	0	0	0
Drinking water	Well, pump	Well, faucet	Well	Well	Well	0	Wells, pump	0	0	Wells

Definitions:

Permanent stores: buildings of cement or cement mixed with mud (*banco stabilisé*).

Permanent stalls: open-air stalls with tin roofs.

Semipermanent stalls: open-air stalls with straw or plastic roofs.

Floor vendors: vendors selling products spread out on the ground.

Mobile vendors: vendors selling products while walking through the market.

All markets in San were larger in scale and in range of products than those surveyed in the Douentza site. Each village market in Petaka, N'gono, and Kerena covered only several hundred square meters. The Kiro marketplace was somewhat larger, and that of Dangol-Boré stretched for about one hectare. In contrast, aside from Lohan, village fairs in the San marketshed sprawled across several hectares.

The range of products sold in village fairs was vast in the San marketshed but limited in the Douentza marketshed. More wild fruits and leaves were visible in the village markets of the Douentza site, and certain crops, such as maize and *fonio*, were entirely absent. Millet was far more frequently sold in the Douentza site than was sorghum, which dominated all the markets of San except for the city market of San. Sales of small amounts of millet and sorghum represented a much larger proportion of transactions in Douentza than in San, where the team had to actively search for vendors. In addition, the local units of measure for vendor lots are larger in size than in Douentza, and sales of grain for consumption and local beer production far outweighed the sales of local varieties that could serve for either seed or consumption.

The spatial distributions of vendors selling grain and sorghum depended on the market. In the Douentza market hub, women were scattered in small groups at various locations. In the smaller village fairs of Petaka, N'gono, and Kerena, women selling millet and sorghum, as well as other condiments and crops, were grouped under a tree. In the San market hub, women were seated along the edges of the storefronts and stalls and in the middle of the corridors between stalls, selling a variety of goods in small quantities. In Benena and Mandiakuy, women vendors formed small groups on the edges of the market. In Lohan, no vendors of sorghum and millet were found on the market floor; rather, at one side of the market, intermediaries purchased millet or sorghum from farmers, bulked it, and then resold it to dealers at the same market.

Vendors

Characteristics of millet and sorghum vendors are summarized in Table 3. Most variables were not normally distributed, and either parametric or nonparametric tests were conducted on differences, proportions, and distributions. Tests were conducted to compare marketsheds (San versus Douentza) and market type (test versus control). Data were weighted by the inverse probability of selection.

Table 3. Characteristics of vendors

	San			Douentza			All Markets	
	Control	Test	All	Control	Test	All		
N	25	20	46	23	24	58		102
Mean								
Age	45.4	40.1	44.7	34.8	43.7	31.7	a	41.9
Years in school	0.04	1.43	0.22	0	0.61	0.36	a	0.31
Years selling in this market fair	12.4	9.06	11.9	9.47	19.1	15.3	a	13.9
Fairs per year	40.9	35.1	40.2	41.1	48.4	45.5	a	43.4
Days participating in other market fairs per year	15.3	20.9	16.1	29.5	6.49	15.4	a	15.7
Hours per day selling in this market fair	7.9	7.5	7.9	6.8	8.1	7.6	a	7.7
Number of varieties or types sold at the same time	1.11	1	1.09	1	1.18	1.12		1.11
Number of qualities sold at the same time	1.05	1.13	1.06	1.18	1.08	1.11		1.09
Percentage of vendors								
Literate (including participating in adult literacy training)	10.4	19.8	11.7	11.3	5.43	7.8		9.3
Female	100	84.1	97.9	a 97.1	100	98.9		98.5
Primary occupation								
Farming	21.3	74.5	28.5	a 96.2	91.6	93.5		68.1 b
Petty commerce	64.1	8.70	56.7	a 0.00	8.35	5.0		25.1 b
Major crop sold								
Millet	39.5	24.3	37.5		84.9	81.2		82.7 b
Sorghum	19.4	75.7	26.9	a 15.1	9.74	11.9		17.7 b
Neither sorghum nor millet	41.1	0	35.6		0	9.01		5.4 b
			100			100		100

Source: Survey data, April 2007. Markets (12) listed in text.

Note: Data weighted by inverse probability of selection, which varies by market, crop, and grain type of vendor lot.

a. Statistically significant difference between control and test according to either parametric (chi-squared or t-test) or nonparametric (Kruskal-Wallis) tests, at 5%.

b. Statistically significant difference between sites according to either parametric (chi-squared or t-test) or nonparametric (Kruskal-Wallis) tests, at 5%.

At both sites, 98–99 percent of all vendors were women. Male vendors were more likely to be found in the test markets of San. Most vendors had never attended school. Less than 10 percent stated that they were literate, including those who had attended adult literacy training in their maternal language. Nonetheless, most spoke not only their maternal language but also the language needed for sales transactions (in the Douentza marketshed, Dogon, Peulh, Songhoi, and some Bambara; in the San marketshed, Bambara, Bobo, and some Peulh). One woman spoke French. Vendors were typically arranged in the market by affinity (village of origin, ethnicity).

Many vendor characteristics were similar between the two marketsheds. The average age of vendors was 40 in the Douentza site and 45 in the San site. Most vendors were unable to state their ages with certainty, and ages reported were approximations. Ages ranged from 14 to more than 70. Vendors participated in the weekly fair where they were interviewed an average of 43 times per year, which corresponds roughly to the number of weeks not included in the growing season. This finding indicates that all those interviewed, except the few intermediaries in Lohan, were farmers or contributed to the farm work of their agricultural production units during the rainy season. The average number of days vendors participated in other weekly fairs each year was 16.

Hours spent in the market are limited by hours of daylight and the time traveled to reach the market. Duration of stay is also influenced by the extent to which the vendor specializes in sales compared with other occupations. We observed that farmers often wanted to sell their millet or sorghum rapidly to make other purchases, conduct other business, and return to the village. Speedy transactions also help them avoid paying fees to sell in the markets. In contrast, vendors more specialized in commerce remained longer hours and often participated in the city markets on days other than the weekly fair, paying the required daily fees. Daily fees are lower than the fee at the weekly fair. The average of time spent per day in the weekly fair in either marketshed was around 7–8 hours.

The characteristics of the control and test markets differed significantly in the Douentza marketshed but not in the San marketshed. Compared with their counterparts in the control markets, vendors in the test markets were older, had attended more school, and had been selling for a longer period and for longer hours in the fair where they were interviewed, but they did not participate in as many other fairs. These findings suggest that test-market vendors are specialized in selling millet and sorghum among farmers in the villages targeted by the project.

Regardless of marketshed or market type, vendors typically sold one variety or type at a time and only one quality. In some cases, they mentioned that over the course of a year, they might sell more than one variety or more than one quality. Differences in millet quality, when described, represented either differences in the maturity of the grain (immature or fully mature millet from the Douentza site) or millet sold for consumption only (millet from San) compared with millet that could be either consumed or

planted. Differences in sorghum quality pertained to mixtures destined for beer production compared with varieties suitable for planting.

The distribution of primary occupations and major crops sold differed significantly by marketshed. Vendors in the Douentza marketshed reported almost unanimously that their primary occupation is farming, even when, as was the case in the Douentza town market, they are frequently present in the market and known by others as *détaillantes* (retailers selling small quantities). The explanation for this pattern is that women in villages in close proximity to Douentza town (such as Fombori) have become specialized in the sale of high-quality grain from their own villages and fields. Ninety-five percent of vendors in the Douentza marketshed reported selling millet (82.7 percent) or sorghum (11.9 percent) as their major crop.

Only slightly more than a quarter (28.5 percent) of vendors in the San marketshed listed farming as their major occupation, describing themselves instead as housekeepers who help their husbands farm. More than half (56.7 percent) of the San vendors reported petty commerce as their primary occupation compared with only 5 percent in the Douentza marketshed. More than a third (35.6 percent) of vendors in the San marketshed reported a major crop that was neither sorghum nor millet, reflecting the wider range of crops produced in this site as well as the broader range of products sold in the markets.

In the San marketshed, but not in the Douentza marketshed, significant differences were found in the primary occupations of vendors in the test and control markets. In the test markets, which are nearer the project site, vendors were more likely to be farmers, while in the control markets closer to the city of San, vendors specialized in petty commerce. This finding is a function of the location of test villages compared with control villages.

Table 4 lists occupations that vendors cited as secondary, excluding farming, petty commerce, and housekeeping. Spinning, processing, dying, and weaving cotton were common among vendors in the Douentza site, followed by mat making and fattening livestock. Vendors in the San site most often reported beer brewing.

Table 4. Frequency of occupations other than farming, housekeeping, and petty commerce

	San	Douentza	All Markets
Spinning cotton	0	11	11
Beer brewing	7	0	7
Mat making	0	6	6
Fattening livestock	0	3	3
Dying cotton	0	2	2
Fan making	1	0	2
Collecting manure	0	1	2
Selling homemade cookies	1	1	2
Weaving cotton	0	1	1
Processing cotton	1		1
Trading livestock	1	0	1
Selling wood	1	0	1
Knitting	1	0	1

Source: Survey data, April 2007. Markets (12) listed in Table 1.

Notes: Data not weighted by probability because vendors cited multiple occupations.

Data not disaggregated for test and control markets because observations are few.

The frequency of other crops and items sold by vendors is shown in Table 5. Among other crops, groundnut, cowpea, and rice (*Oryza glaberrima*, West African rice) were most common in the Douentza site. Groundnut, *fonio*, maize, and rice were most common in the San site. By far the most common other item sold was referred to as “condiments,” which are the ingredients of sauces to accompany staple dishes. Baobab leaves were common in the lower rainfall site. Sorghum beer, sold in the village, was common in the San site. Handmade items, such as soap, shea butter, fans, and mats were also cited.

Table 5. Frequency of other crops and items sold by vendors

	San	Douentza	All Markets
Crops sold other than sorghum or millet			
Groundnut	7	6	13
Rice (including <i>Oryza glaberrima</i>)	4	3	7
Cowpea	2	5	7
<i>Fonio</i>	6	0	6
Maize	5	1	6
Okra	1	3	4
Bambara groundnut	2	0	2
Hibiscus or sorrel	1	2	2
Onions	1	1	2
Tobacco	1	1	2
Cotton	0	1	1
Hot pepper	0	1	1
Other items			
Condiments	6	16	22
Baobab leaves	1	8	9
Local beer (in the village)	5	0	5
Handmade soap	0	5	5
Livestock	1	3	4
Shea butter	2	2	4
Fish	2	1	3
Handmade mats	0	3	3
Cookies	1	1	2
Salt	1	1	2
Handmade fans	1	0	1
Wood	1	0	1
<i>Nere</i> (African locust bean)	1	0	1

Source: Survey data, April 2007. Markets (12) shown in Table 1.

Notes: Data not weighted by probability because vendors cited multiple crops and products.

Data not disaggregated by control and test markets because observations are few.

Vendor Lots

While many characteristics of vendors are similar between the two marketsheds, characteristics of what they sell generally differ. On the other hand, apparent differences in vendor lots between test and control markets within marketsheds are not statistically significant except for the units of sale. Characteristics of vendor lots are presented in Table 6, by marketshed and market type.

Table 6. Characteristics of vendor lots

	San			Douentza			All Markets	
	Control	Test	All	Control	Test	All		
N	25	20	46	23	24	58		102
Mean								
Kilograms per unit	0.804	3.85	1.2 a	0.66	0.66	0.7		0.9 b
Kilograms sold since April 1	91.0	253	112.0	1.56	63.6	34.3	a	61.3 b
Expected price since April 1								
Sorghum	85.7	92.9	88.9	94.2	103.3	98.7		93.1 b
Millet	95.3	85.9	95.7	119.7	124.2	123.3		113.3 b
Years first variety / type sold by vendor	11.64	8.74	11.2	9.46	17.6	14.4		13.2 b
Percentage of lots								
Millet	60.1	34.7	56.7	78.3	75.9	76.9		69.0 b
Sorghum	39.9	65.2	43.3	21.7	24.1	23.1		30.9 b
Varieties or types deliberately mixed by vendor	20.2	36.8	22.5	0	0	0		8.7 b
Identity of variety/type known	80.9	78.3	80.0	100	100	100.0		92.5 b
Of these,								
Known because all local people know it	17.3	31.5	19.2	21.7	21.1	21.3		21.9
Known because it has been grown by vendor or vendor's production unit	49.6	42.3	48.7	78.3	74.4	76.5		65.7 b
Known because it has been grown by farmers from the same village as the vendor	13.9	0	12.1	0	3.58	2.16		6.04 b
			100.0		100.0	100.0		

Source: Survey data, April 2007. Markets (12) listed in Table 1.

a Statistically significant difference between control and test according to either parametric (chi-squared or t-test).

b Statistically significant difference between sites according to either parametric (chi-squared or t-test) or nonparametric (Kruskal-Wallis) tests, at 5%.

All lots in the Douentza marketshed were sold by the bowl, weighing 0.66 kg on average. Units of sale were larger in the San marketshed, particularly in the test markets. Outside the San city market, vendors sold in empty tins of processed tomatoes (approximately 2 kg per tin) or a larger bowl (about 4.5 kg per unit). Total quantities sold in April 2007 were difficult for vendors to estimate. Mean total quantities sold per vendor in April 2007 in the San marketshed were nearly four times as great as those sold in the Douentza marketshed.⁶ Prices had varied little since the beginning of the month, especially among vendors who only participated in weekly markets. Nevertheless, the expected price calculated from the minimum, maximum, and most frequently quoted was higher for both millet and sorghum in the Douentza marketshed than in the San marketshed, which is not surprising given that Douentza is a more challenging agroecology and its market infrastructure is less developed.

As suggested by anecdotes, secondary information, and other data already reported, millet represents a higher percentage of lots sampled in the Douentza marketshed, and sorghum is more common in the San marketshed. Differences in distributions are statistically significant. About 22.5 percent of vendors reported that they mixed varieties or types deliberately in the San marketshed (particularly in the Lohan markets, and particularly sorghum). The most frequently cited reasons for mixing sorghum varieties were that mixtures are suitable for local beer and that buyers demand mixtures. One vendor said that she had too little to sell and thus needed to bulk varieties from several farmers in her village. In a few cases recorded in San, mixtures were sold alongside varieties. Vendors explained that varieties belonged to their production units and were sold to make other purchases, while the mixtures were purchases they had made for resale to earn extra money.

Not only were mixtures more common in the San marketshed, but also vendors in the San marketshed knew less about the grain they sold, suggesting that it is less likely to be suitable for seed than the grain sold in the Douentza marketshed. All respondents in the Douentza marketshed reported that they knew the identities of the varieties or types they were selling compared with only 80 percent in the San marketshed. Of vendors who knew the identities of the varieties or types they were selling, 76.5 percent in Douentza and only 48.7 percent in San reported that their knowledge was the result of their having grown the grain (or family members on the same production unit grew it). About 20 percent in both Douentza and San explained that all local people know the varieties they sell (one paraphrase would be that they describe the grain as “our” millet or sorghum). The remainder knew the varieties because other farmers in their villages grew the grain. In San, this category of response was larger than in Douentza.

Frequencies of named types and varieties sold, their villages of origin, and the markets where they were sold are shown in Tables 7a (millet) and 7b (sorghum). Where feasible, some additional description or interpretation of the name is provided. Many of the names mean millet or sorghum “of the

⁶ Vendors in San were interviewed a week later than in Douentza, which explains part of the difference.

people” in various languages or dialects spoken (Dogon, Peulh, Bobo, Bambara, and Songhoi). Only one lot was the grain of a modern variety (sorghum, variety CSM 63E). Some names include grain color or size, or a description of the panicle (“horse’s tail”). Most often the lot originated in a village that was located in the same commune where it was sold. One name refers to a variety retrieved when returning by land from Mecca long ago—perhaps from Chad. A cluster of vendors from a nearby village in Burkina Faso participated in the Benena market. Proximity of origin to point of sale has implications for the suitability of the variety for use as seed, given the importance of local adaptation.

Table 7a. Frequency of named types and varieties of millet sold, village of origin, and market where sold

Named Identity of Lot	Description (Language)	Origin of Vendor Lot			Location of Market Where Lot Sold		
		Frequency	Village	Commune	Village	Commune	Region
Sanion	Millet in Bambara	5	N'gogolo, Boré, N'togosso, Teneni	Dangol-Boré, Diakorouna Teneni	Dangol-Boré, Dieli, San city	Dangol-Boré, San	Mopti, Ségou
<i>Sie darra (medji)</i>	Thin-grained millet (Dogon)	4	Tondifere, Koranga	Dangol-Boré	Dangol-Boré, Kiro	Dangol-Boré	Mopti
<i>Dogo sie</i>	Millet of the Dogon (Dogon)	2	Kouwebel-Koundia	Douentza town	Douentza town	Douentza town	Mopti
<i>Dogon yogue</i>	Millet of the Dogon (Dogon)	1	Kouwebel-Koundia	Douentza town	Douentza town	Douentza town	Mopti
<i>Djon nion</i>	Millet of the Songhoi	1	Alabengouma	Petaka	Douentza town	Douentza town	Mopti
<i>Toronion</i>	Millet of the Dogon (Dogon), Millet of the cliffs	8	Panga, Fombori, Kouwebel-Koundia	Tiedie, Douentza town, Petaka, Borko	Douentza town	Douentza town	Mopti
<i>Chibra</i>	Mixture of wild millet and Toronion)	1	Fombori	Douentza town	Douentza town	Douentza town	Mopti
<i>Gaouri maire</i>	Millet of the hills (Peulh)	5	Kerena, Dansa, Tebi-Diadie, Petaka	Kerena, Petaka	Kerena	Kerena	Mopti
<i>Dogon nion</i>	Millet of the Dogon (Dogon)	4	Tebi-Diadie, N'gono	Kerena, Petaka	Kerena	Kerena	Mopti
<i>Sie bini</i>	Large-grained millet (Dogon)	2	Tete-Ompto, Korenga	Dangol-Boré	Kiro	Dangol-Boré	Mopti
<i>Tondi haine</i>	Millet of the hills (Songhoi)	2	Alabengouma	Petaka	N'gono	Petaka	Mopti
<i>Gnoudougou</i>	Millet of the Dogon (Dogon)	3	N'gono	Petaka	N'gono	Petaka	Mopti

Table 7a. Continued

Named Identity of Lot	Description (Language)	Origin of Vendor Lot			Location of Market Where Lot Sold		
		Frequency	Village	Commune	Village	Commune	Region
<i>Haine kasso</i>	Large-grained millet (Songhoi)	2	N'gono, Alamina	Petaka	N'gono, Petaka	Petaka	Mopti
<i>Atem nion</i>	Millet of the ancestors (Dogon)	3	Petaka	Petaka	Petaka	Petaka	Mopti
<i>Bouefoue</i>	Variety of millet (Bobo)	3	Porode	Burkina Faso	Benena	Burkina Faso	Ségou, Burkina Faso
<i>Sanionba</i>	Large-grained millet (Bambara)	4	N'togosso, Korolo, Teneni	Diakorouna, Fangasso, Teneni	Dieli, Fangasso, San city	Dieli, Fangasso, San	Ségou
<i>Nionba</i>	Large-grained millet	1	Korolo	Fangasso	Fangasso	Fangasso	Ségou
<i>Sanioteli</i>	Early-maturing variety (Bambara)	1	N'togosso	Diakorouna	Dieli	Dieli	Ségou
<i>Korofing</i>	Variety of millet with black panicle (Bambara)	1	Kondala	Tominian	Fangasso	Fangasso	Ségou
<i>Oumahara duo</i>	Chameleon (Bobo)	1	Konkwana	Fangasso	Fangasso	Fangasso	Ségou
<i>Doutete</i>	Real millet (Bobo)	1	Sokoura	Fangasso	Fangasso	Fangasso	Ségou
<i>Doufoua</i>	Variety of millet (Bobo)	3	Villages around Lohan, Seguekuy, Porode	Mandiakuy, Benena, Burkina Faso	Lohan, Mandiakuy, Benena	Mandiakuy, Benena, Burkina Faso	Ségou, Burkina Faso
<i>Mil bobo</i>	Millet of the Bobo	1	Villages around San	San	San	San	Ségou

Table 7b. Frequency of named types and varieties of sorghum sold, village of origin, and market where sold

Named Identity of Lot	Description (Language)	Frequency	Origin of Vendor Lot		Location of Market Where Lot Sold		
			Village	Commune	Village	Commune	Region
<i>Emba boyori</i>	Sorghum (Dogon, Peulh)	3	Tondifere, N'gono, Gorodogon	Dangol-Boré, Petaka	Dangol-Boré, N'gono	Dangol-Boré, Petaka	Mopti
<i>Eme piru</i>	White sorghum (Dogon)	7	Kouwebel-Koundia, Borko, Petaka	Douentza town, Petaka, Borko	Douentza town, Kiro, Petaka	Douentza town	Mopti
<i>Eme boyori</i>	Sorghum (Dogon, Peulh)	3	Kouwebel-Koundia, N'gono	Petaka, Douentza town	Douentza town, Kerena, N'gono	Petaka, Kerena, Douentza town	Mopti
<i>Eme Maka</i>	Sorghum variety collected when returning from Mecca (Dogon)	1	Variety from route to Mecca	Toguimourari	Douentza town	Douentza town	Mopti
<i>Eme di gre</i>	Sorghum variety that resists too much water (Dogon)	1	Madina	Douentza town	Douentza town	Douentza town	Mopti
<i>Emba dogon</i>	Sorghum of the Dogon (Dogon)	1	Ennatioki	Dangol-Boré	Kiro	Dangol-Boré	Mopti
<i>Emba bounalo</i>	(Dogon)	1	Ennatioki	Dangol-Boré	Kiro	Dangol-Boré	Mopti
<i>Eme doumo</i>	Sorghum variety with a short panicle (Dogon)	1	Gorodogon	Petaka	N'gono	Petaka	Mopti
<i>Eme Djoulouna</i>	Sorghum of Djoulouna (Dogon)	1	Petaka	Petaka	Petaka	Petaka	Mopti
<i>Bibri</i>	Sorghum (Bambara)	1	Porode	Burkina Faso	Benena	Benena	Ségou, Burkina Faso
<i>Sequetana</i>	Resistant to striga (Bambara)	3	Diakorouna	Diakorouna	Dieli	Dieli	Ségou
<i>Koranga</i>	Variety of white sorghum (Bambara)	1	Diakorouna	Diakorouna	Dieli	Dieli	Ségou

Table 7b. Continued

Named Identity of Lot	Description (Language)	Origin of Vendor Lot			Location of Market Where Lot Sold		
		Frequency	Village	Commune	Village	Commune	Region
<i>Nion gueynin</i>	White sorghum (Bambara)	1	Diakorouna	Diakorouna	Dieli	Dieli	Ségou
<i>Keninke</i>	Sorghum (Bambara)	3	Korolo, Sinzana, San	Fangasso, Toridagako, San	Fangasso, San	Fangasso, San	Ségou
<i>Kende</i>	Early-maturing variety of sorghum (Bambara)	1	Ton	Fangasso	Fangasso	Fangasso	Ségou
<i>Nion guey</i>	White sorghum (Bambara)	1	Korolo	Fangasso	Fangasso	Fangasso	Ségou
<i>Keninke Sokou</i>	Sorghum “horse’s tail” (Bambara)	1	Korolo	Fangasso	Fangasso	Mandiakuy	Ségou
<i>Dalabanion</i>	Millet of the lake (Bambara)	1	Korolo	Fangasso	Fangasso	Mandiakuy	Ségou
<i>Hamboro</i>	Sorghum (Bobo)	3	Perakuy, Konkorona	Mandiakuy	Lohan, Mandiakuy	Mandiakuy	Ségou
<i>Tiekado</i>	High-yielding (Bambara)	3	Lanekuy, Doui	Sanekuy	Mandiakuy	Mandiakuy	Ségou
<i>Banehe</i>	Red and white sorghum variety, planted as a mixture (Bobo)	2	Lanekuy	Sanekuy	Mandiakuy	Mandiakuy	Ségou
<i>Jakumbe</i>	CSM 63E, improved variety	1	Lanekuy	Sanekuy	Mandiakuy	Mandiakuy	Ségou
<i>Da</i>		1	Somo	Somo	San city	San city	Ségou

Transactions

Estimating the amount or share of grain sold as seed, even within a fixed period, was extremely difficult for respondents. Asking for an estimate in terms of number of seed buyers out of 10 customers during the planting season did little to simplify the task, but a common response for a year after a good harvest was 2 or 3 seed buyers. As shown in Table 8, more variation was reported for years following poor harvests, with a slightly higher number in the Douentza marketshed than in San (4.7 compared with 2.9 seed buyers). In all except three cases, vendors reported that sales of grain for seed were more frequent after poor harvests than after good harvests, consistent with expectations. In those cases, they stated simply that “everyone is looking for food.”

Table 8. Characteristics of market transactions

	San			Douentza			All Markets
	Control	Test	All	Control	Test	All	
N	25	20	46	23	24	58	102
Number of buyers out of 10							
Purchasing grain for seed during the planting season							
After a good harvest	2.23	3.09	2.33	3.87	2.13	2.39	2.48
After a poor harvest	2.62	4.82	2.87	4.01	5.10	4.72	a 4.24
Percentage of vendors							
Selling at fixed prices	88.7	75.8	86.9	100	90.5	94.2	91.4
Providing discounts	7.20	19.5	8.90	13.8	22.5	19.1	15.1
Storing grain at the market	0	4.3	0.58	a 3.78	24.5	16.3	a 10.2 b
Paying a market fee	100	51.5	93.5	a 0	61.4	37.1	a 59.1 b
Providing no explicit information about the seed/grain lot to buyer	79.5	78.8	79.4	41.5	35.6	37.9	54.1 b
Stating that quantities sold vary a lot from season to season	88.6	90.5	88.8	96.0	73.4	82.5	a 84.8
Stating that prices vary a lot from season to season	100	100	100	95.6	85.7	89.6	93.5
Procuring lots from							
Own fields or production unit	41.4	82.6	46.9	93.4	77.9	84.1	69.6 b
Other farmers	40.8	17.4	37.7	6.60	11.9	9.80	20.1 b
Traders	17.8	0	15.4	0	10.1	6.10	9.80 b
			100.0			100.0	100.0
Mean							
Market fee (FCFA)	50	34.2	47.9	a 0	61.45	37.2	a 41.3

Source: Survey data, April 2007. Markets (12) listed in Table 1.

a Statistically significant difference between control and test according to either parametric (chi-squared or t-test) or nonparametric (Kruskal-Wallis) tests, at 5%.

In both marketsheds, more than four-fifths of vendors stated that the quantities they sold in the market varied significantly from year to year, depending primarily on the harvests. Among the remaining one-fifth of vendors, the typical explanation was that they decided to bring, or were given by the head of the production unit, fixed quantities to sell in the market to purchase other food or necessary items for the family. An even higher proportion stated that prices varied by season inversely with the quantities available on the market.

More than 90 percent of vendors reported that prices were fixed on the day of the fair and variation occurred only in the larger markets. Discounts were said to be rare and granted only to close relatives or friends or when large purchases were made. It was rare for a vendor to have purchased the lot she was selling when interviewed. In even fewer cases could vendors tell us the amount they paid per unit for the lot. The average markup in 17 cases was 0.83 CFA franc per kilogram.⁷ In 13 of the 17 cases, the source was known by the vendor and was trusted or a client.

The characteristics that differ significantly by marketshed are related to payment of market fees, storing grain at the market, the source of the vendor's lot, and information provided by the vendor to the purchaser. The first two characteristics also differ between test and control markets. Vendors in the San marketshed, which is larger in scale and scope and more formally regulated than the Douentza marketshed, are more likely to pay a market fee but less likely to store their grain at the market than are those in the Douentza marketshed, although grain storage was reported primarily in the test markets of Lohan (in San) and the town of Douentza. Generally, storage at the market was rare. In the smaller village fairs of the Douentza marketshed, no fees are charged. The mean market fee paid in Douentza city was higher, however, than that reported in the San markets.

As can be expected given the data reported in Table 6, only 6.0 percent of lots originated with other traders in the Douentza site compared with 15.4 percent in the San site. In the Douentza site, 84.1 percent originated from the fields of the vendor or the granary of the production unit compared with 46.9 percent in the San site. More of those lots in the San site were procured from other farmers. These findings are consistent with the hypothesis that grain sold in the San marketshed is less likely to be suitable for seed than that sold in the Douentza marketshed.

Nearly 80 percent of vendors in the San markets stated that they generally provided no explicit information about the grain lot to the buyer compared with only 37.9 percent in the markets of the Douentza site. Many vendors typically provide no information at all unless asked because they do not know the final use that will be made of the seed. Vendors reported that buyers asking about the characteristics of grain are likely to be new to the area or farmers purchasing for seed. Still, even in the

⁷ Conversion rates on April 15, 2007 from Banque Centrale de l'Afrique de l'Ouest: US\$1 = 485.078 CFA franc; 1 CFA franc = US\$0.002062.

case of seed purchases, about one-fifth of vendors told us that buyers know the variety or type by its physical appearance and do not necessarily ask for much information. Often the village of origin is the sole piece of information requested by buyers, or a confirmation that the source of the lot is the village or granary of the vendor.

The frequencies of other lot characteristics that vendors or buyers appreciated are shown in Table 9. The two most frequently cited characteristics were early maturity and quality of food. Quality of food was described in terms of taste, color, texture, nourishment, and suitability for preparation of local dishes. The same was true for both millet and sorghum. Yield, adaptation to the local growing environment, storability, and ease of processing were also mentioned, but infrequently. Grain size and cleanliness were cited in a few cases. Suitability for local beer preparation was noted in the case of sorghum sold in the San marketshed. The lack of variability in responses concerning these two traits does not imply that there is no variation in maturity or food quality among varieties sold but that these are the traits figure strongly in the demand for seed attributes. This makes sense given the generally low levels of rainfall in the zones of study, the frequency of the need to replant, and the reliance on millet and sorghum as starchy staples.

Table 9. Frequency of lot characteristics reported by vendors or demanded by farmers

	San	Douentza	All Markets
Millet			
Quality of food (taste, color, texture, nourishment)	13	36	49
Early maturity	5	32	37
Yield	6	0	6
Well adapted	1	5	6
Stores well	0	1	1
Clean grain	1	1	2
Ease of processing	2	0	2
Grain size	0	1	1
Medium maturity	1	0	1
N lots of varieties or types	20	38	58
Sorghum			
Early maturity	12	14	26
Quality of food (taste, color, texture, nourishment)	18	21	39
Stores well	1	1	2
Well adapted	1	1	2
Yield	4	1	5
Good for local beer	3		3
Ease of processing	1		1
N lots of varieties or types	25	19	44

Source: Survey data, April 2007. Markets (12) listed in Table 1.

Notes: Date not weighted by probability because vendors often cited multiple characteristics.

Traits described for the few second varieties sold were inferiority with respect to taste or processing

Category of early maturity includes one observation on drought tolerance.

Data not disaggregated by control and test markets because observations were few by subcategory.

Overall, we observed considerable variation in knowledge of seed varieties and variety traits. In some markets of the San site, women who had brought grain given to them from their husbands' fields or by the heads of their production units appeared to be ignorant of variety names. In other instances, women not only knew the names but also were knowledgeable about unique characteristics. It was the most knowledgeable who were more likely to say that farmers purchased seed from them and asked about the characteristics of the seed. Note, however, that the average period selling a named variety type was 14 years among vendors in the Douentza site and 11 years in the San site (Table 6). Those figures are close to the mean numbers of years participating in the weekly fair (Table 3).

Regression Analysis

The caveats already mentioned with respect to the data mean that any econometric analysis will be indicative of general patterns but imprecise in terms of measurement. Many variables represent rough estimates that vendors had difficulty reporting, most are categorical, and many are interrelated. Nevertheless, the descriptive findings lead to several testable hypotheses concerning the behavior of petty vendors in marketsheds. Sales of grain cannot be distinguished from sales of seed, but we know that any seed sales in local markets would occur through the channels analyzed here.

The first hypothesis concerns the marketshed. Although the role of seed in the grain markets of Douentza appears to be far more important than in San, the total quantities sold during April 2007 were greater in the San marketshed than in the Douentza marketshed and greater in the test markets of Douentza than in control markets. The structure of crops sold and the ethnic identity of vendors are also distinct between the two marketsheds. The second hypothesis concerns market hubs, which serve a function different from that of village fairs. More purchasers in the market hubs are consumers of grain than are consumers of seed. Third, economic theory predicts that quantities sold will respond to price signals. Fourth, we hypothesize that the characteristics of vendors themselves explain a lot about their behavior in the marketplace.

Factors affecting the total quantities of grain sold by vendors in April 2007 are reported in Table 10. Marketshed is significantly correlated with crop sold as well as ethnicity and therefore represents a combination of those factors. Other variables are not significantly correlated. As expected, the total quantities of grain sold in the Douentza marketshed are lower than in the San marketshed. Surprisingly, location of the vendor in the market hub instead of a village fair does not have an effect on quantities sold. More grain was sold in test markets than in control markets. All vendor characteristics are statistically significant. The total time spent selling in the marketshed, a measure of specialization in commerce rather than farming, positively affects quantities sold. Older women sell a bit less, though the amount (about 2 kg) is negligible. Years in school are associated with larger amounts sold. Thus, younger

and more-educated women appear to be more successful as vendors. Quantities sold are not responsive to expected prices during the period, which is consistent with the evidence that most prices are fixed and determined by a combination of social norms among market participants and institutional norms in any given market.

Table 10. Factors affecting total quantities sold by vendors in April 2007

Variable	Definition	Coefficient	Standard Error	t-value	P> t
Constant	Regression intercept	176.79	97.37	1.82	0.0730
Market hub	San city or Douentza town = 1, else 0	-17.32	33.99	-0.51	0.6120
Marketshed	San site = 1, Douentza site = 2	-171.12	37.43	-4.57	0.0000
Test market	Marketed frequented by farmers sampled in test villages	98.96	30.36	3.26	0.0020
Time selling	Hours per day multiplied by number of days vendor sells in this market fair and others	0.30	0.06	5.24	0.0000
Expected price	Calculated as the mean of a triangular distribution elicited from vendor (minimum, maximum, mode)	0.81	1.02	0.79	0.4310
Age	Estimated age of vendor	-1.94	1.00	-1.95	0.0550
Education	Number of years vendor attended school	14.84	8.49	1.75	0.0840
Number of observations =	88				
F(7, 80)	12.76	Prob > F		0	
R-squared	0.5275	Adj R-squared		0.4862	

Note: Site, dominant ethnic group and crop sold are significantly correlated and only the site variable was included to represent the three variables. Whether the crop sold was sorghum or millet is not statistically significant.

The finding that vendor characteristics are significant determinants of quantities sold suggests that sociological information, and reference to data about farming communities, can improve our ability to interpret the data collected about markets. For example, in several villages in the Douentza site, farm data indicate that married women are allocated fields on which they can grow millet or other crops. The millet lots sold by vendors we interviewed in those villages may be those harvested from their own fields. That practice is far less typical in San. Women in the San site do not tend to have fields of millet and sorghum allocated to them for their own management. Instead, women help men in the cultivation of millet or sorghum on fields managed by the patriarch of the extended family based on consultation with other members of the production unit. Key informants described several patterns of allocation of grain. In some cases, the head of household allocates a share of the millet or sorghum harvested to women household members for their own management. In other cases, women may be given a specific amount on the day of the weekly fair to sell for condiments. They may be given larger quantities to meet special

needs. Reflecting our findings, we conjecture that the quantities women vendors bring to market are fixed by social and economic rules within the production unit. These rules can be complex in the case of production units with multiple households.

While vendors who sell millet and sorghum grain that can be used as seed are typically women, this does not imply that it is women who typically procure millet and sorghum seed. Earlier project documents describe millet and sorghum seed procurement as primarily the responsibility of men or heads of production units, with some exceptions. Even in Douentza, women appear to be more likely to procure the seed of leguminous crops that they produce on plots allocated to them (cowpea, *Bambara* groundnut). In the San site, project reports mention that women do procure sorghum seed to produce grain suitable for local beer.

Casual observation also suggests that, in some cases, vendors may purchase and sell other lots aside from the lots they brought with them. Here again, transactions are probably influenced by social norms. For example, vendors were spatially arranged by ethnicity and village. They also engaged in trade of other goods and in social activities while vending in the market. On several occasions, we observed that women bartered bowls of millet or sorghum grain for other goods.

6. CONCLUSIONS

Seed trade in local markets is more prominent in the site that has greater agro-ecological heterogeneity and abiotic stress, and where market infrastructure is generally less developed. In the more highly developed marketshed of the more favorable growing environment, the grain trade heavily dominated the seed trade. Although these findings cannot be generalized to other contexts, they make sense: Village fairs ensure a supply of seed of identifiable local varieties as a final recourse in a risky environment where as yet no reliable alternative channels exist. Seed flows on markets are still thin, while those of grain are great, especially following the successful liberalization of grain markets. The zone with the better-developed market infrastructure that also produces grain known for its high quality in consumption will have relatively active grain markets.

We found that the social structure of communities, which depends on ethnicity and cultural norms, has a lot to do with the behavior of female vendors. A high degree of socially prescribed behavior was apparent within markets in terms of fixed prices, when and how discounts are made, the procurement of lots, and the spatial organization of vendors. Though the quantitative data are limited in scope, both the quantitative and qualitative information reveal major differences between marketsheds in terms of structure and function. We also found some measurable differences between test and control markets, such as estimated quantities sold of grain and seed. Without other analysis, these findings cannot be attributed to project activities, but they do suggest that project activities are conducted in a nexus of villages and markets where they are most likely to have an impact on farmers' access to crop genetic resources.

Market participation by women as petty vendors of grain appears to serve other important livelihood functions. This was confirmed by the dietary diversity data we began collecting. In particular, in Douentza, key ingredients of the sauces that accompany the starchy staple, such as baobab leaves, shea butter, *neré* (African locust bean) seeds, and dried fish, provide important nutrients and vitamins to a diet based largely on millet. Many of the vendors interviewed stated that they were selling millet to purchase the ingredients for their sauces, which it is their responsibility to provide for the main meals of the agricultural production unit.

At the same time, unwittingly, women vendors may be providing important genetic diversity to other farmers when the grain they sell is planted as seed. The data suggest that much of the grain sold by petty vendors is recognized as a variety, is brought straight from the granary, and has not been mixed. Further, these vendors are providing seed that not only has a high probability of variety integrity but also can be obtained at the price of grain, in a transaction that is free of social stigma. Weekly fairs are a place where farmers can obtain seed if the village-based seed system fails.

There was no apparent interface between formal and informal channels. Seed of modern varieties is never sold on the market. We found only one vendor among the more than 100 interviewed who was selling a modern variety and knew its name (*Jakumbe*, the sorghum variety CSM 63E). This is disturbing given the emphasis that the Malian government has placed on liberalizing the formal seed channel, combined with progress in breeding modern varieties adapted to various agroclimatic zones. In some of the more developed markets of the San study site in particular, scope for seed sales by vendors of other farm inputs was apparent.

Policy implications of the study findings are tentative at best and will depend on other findings generated by this project and other research currently in progress in Mali. “Formalizing” the informal markets described here may not have the desired impact. If money is to be earned where money is scarce, it is likely that women would lose the control they now exert over a few resources. Instead, it is obvious that seed sector reform should permit the sale of local seed varieties. Mechanisms could be developed to ensure that the minimum quality standards are met, although the assumption that local seed is of lower quality than certified seed is not always borne out in germination rates. It is also clear that certified seed should be made available on local markets. Either the seed distribution channel should be expanded to include agrodealers and full-time traders, such as through the provision of small seed packs, or farmers’ associations that experiment with and multiply seed should be trained in marketing, or both.

The question of whether it is demand or supply that currently inhibits the development of retail seed markets remains unresolved. Seeking ways to encourage the monetized flow of seed among farmers in such a way that the social norms can be respected may be a first step in some of these communities. Current efforts by nongovernmental organizations and farmers’ associations to host seed auctions for local and modern varieties are examples. Either way, public and voluntary actors are likely to continue to be needed in the supply of millet and sorghum seed, given the reproductive system of these crops, their importance as food staples, and the spatial dispersion and poverty of Mali’s producers.

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