Seed Interventions and Cultivar Diversity in Pigeon Pea: A Farmer Based Assessment in Eastern Kenya

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ABSTRACT. We have assessed the impact of three seed-based intervention programs on crop diversity levels of pigeon pea (*Cajanus cajun*) in the semi-arid districts of Kitui and Makueni in eastern Kenya. We adopted four-cell analysis along with focus-group discussions to determine the cultivar diversity of pigeon pea. Often intercropped with maize (*Zea mays* L.), pigeon pea is widely adapted to drought conditions and has multiple uses — as green vegetable and as food grain. It was evident that the existing local crop diversity also had an impact on local foods in the communities. The food preferences of the local population underlined the value attached to maize, pigeonpea, beans, and cowpea. All three seed interventions, producer-marketing groups (PMGs), community-based seed production programs (CBSP) and seed vouchers and fairs (SV&F) have had an impact on the overall crop diversity as well as on the pigeon pea crop diversity in

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the region. However, the cultivar diversity of pigeonpea was significantly higher in PMG sites than in CBSP and SV&F areas. Farmers located in PMG areas, had increased access to improved and quality planting materials of pigeonpea during normal and distress periods. The seed prices were more stable in the PMG sites than in the other intervention sites, due to proper marketing tie-ups for seeds and the grain. The results from our study further indicate that seed-based interventions, such as PMGs, are effective in providing improved seeds of dry-land crops like pigeon pea during normal and disaster periods. However, it was not clear if the improved varieties had displaced the existing local or land races of pigeon pea in the system, which requires a more rigorous study. This also calls for an effective and sustainable, seed-based initiative that provides quality seeds on time as well in improving the cultivar diversity during normal and distress periods in the semi-arid regions of eastern Kenya.

KEYWORDS. Cultivar diversity, pigeon pea, seed intervention, seed supply

INTRODUCTION

Pigeon pea *(Cajanus cajan)*, a grain legume, is grown widely in the semi-arid districts of eastern Kenya. Ninety percent of the total pigeon pea production in Kenya is contributed by eastern Kenya region. Of this, nearly 50 % of the production is concentrated mainly in two eastern districts of Kitui and Makueni (District Annual Agricultural Reports, 2005). The grain legume is utilized as dry grains as well as green vegetable. While more than 70% of dry grain produced is traded for cash, the bulk of green peas from local landraces are consumed by the households as vegetable. Most of the cultivars grown by farm households are local, long-duration cultivars, native to the region, intercropped with maize, sorghum or millet. Recently, increased adoption of improved varieties released by national and international research institutions is evident in many parts of the eastern province (Sutherland et al., 1999; Jones et al., 2001). The post-harvest products of pigeon pea are used as fodder, firewood and as a thatching/fencing material. The pigeon plant, being a leguminous crop, also fixes soil nitrogen and replenishes the soil fertility across time.

The pigeon pea growers in eastern Kenya often face unreliable rainfall distribution, coupled with increased pest attacks and repeated crop failures. Most of these stresses also have resulted in non-availability of

quality planting materials (seed) on time and the poor marketing facilities available for their harvested produce. Farmers in semi-arid, eastern Kenya depend on their own saved seeds or seeds purchased from local markets for planting. However, in the event of drought, farmers mostly seek seeds from community-level local markets. The local markets and farmer's seed sources also are in short supply, especially after recurrent droughts. Seeds of newly introduced, improved varieties become even scarcer than local cultivar seeds after drought, as in most cases, the farmers rely heavily on their own sources for improved varieties (Jones et al, 2001). To reduce the incidence of seed insecurity faced by farmers in these marginal environments, many intervention programs were implemented during the last two decades in Kenya. They were designed and jointly implemented by public as well non-governmental agencies in eastern Kenya.

Table 1 summarizes some of the key seed-intervention strategies that have been implemented during the last few years in eastern Kenya, especially in two major pigeon pea growing regions of Kitui and Makueni. They were implemented to improve the access and availability of quality seeds to vulnerable as well as small farmers during normal and disaster periods. Each intervention had its own strengths and weaknesses in terms of access, availability and sustainability of the program.

The existing literature on the impact of seed interventions have dealt mainly with evaluating the effectiveness of various programs in terms of supply and farmer-access issues, especially during or after disaster periods (Friis-Hansen and Rohrbach, 1993; Longley et al., 2001; Remington et al., 2002; Sperling et al., 2004 and Makokha, et al., 2004). Not many studies have focused on the impact of seed interventions on local inter- or intra-crop diversity levels. Here, we have assessed the impact of three seed-based intervention programs on crop diversity levels of pigeon pea in eastern Kenya. Specifically, do the seed intervention programs implemented in Kitui and Makueni districts of eastern Kenya have had any impact on the on-farm diversity levels of pigeon pea? If so, does it have any effect on farmers' access to quality, improved materials? The impact of seed-supply interventions on crop diversity will depend not only on the nature of the intervention (e.g., whether it is aimed at increasing the variety choice or reducing access costs), but also on the features of the local seed system, and farmer demand for genetic services from the crops (Lipper et al., 2006). Tripp (2001) noted that any seed-intervention programs must be assessed on the basis of their impact on local seed market systems and farm-household welfare. However, here we restrict the scope of the study to assess the impact of

TABLE 1. Summary of past pigeonpea seed interventions in Makueni and Kitui districts, eastern Kenya.

District/type of pigeonpea intervention	Characteristics of the seed interventions
A. Makueni	
1. Producer Marketing group (PMG)	1. Implemented by ICRISAT in 2002. 2. 10 tons of improved pigeonpea seed were produced and provided to farmer groups in 4 divisions between 2002–2006 3. Three kinds of pigeonpea seeds (short, medium and long duration types) were provided 4. The grain and seed shops owned by the groups, sold seed on cash and credit basis 5. The group members were trained to produce good quality seeds of improved pigeon pea varieties and in grain marketing. 6. The groups were also linked to major pigeonpea grain buyers in urban centres 7. Each group also selected farmers within the community for further multiplication and sales to other farmers in the subsequent seasons.
2. Community-based seed production (CBSP)	1. Implemented by DANIDA funded Makueni Agricultural Project (MAP) 2. 5 tons of foundation seeds of pigeonpea, beans, green grams, cowpea and maize were bought from KARI.seed unit between 1998–2004 3. The seed was passed to Focal Development Area (FDA)Committees based at sub-location level in 5 divisions. 4. FDA committees selected individual farmers who paid for 25% of market price for the seed to be bulked 5. During 1998–2004, 100 tons of seed of pigeonpea, beans, green gram, cowpea and maize were produced by farmers, who in turn sold to other farmers and traders.
B. Kitui	
1. Community-based seed production (CBSP)	1. Implemented by DANIDA funded Kitui Agricultural Project (KAP) 2. 3 tons of foundation seeds of pigeonpea, beans, cowpea, green grams and sorghum were bought from KARI seed unit from 2002–2005. 3. The seed production and distribution structure was similar to CBSP operated in Makueni District
2. Seed Vouchers and Fairs (SV&F)	1. Implemented by Catholic Relief Services (CRS), Kenya and Catholic Diocese of Kitui from 2003–06. 2. Seed needy households were identified in Mutomo and Mutha Divisions of Kitui and were given vouchers to purchase seeds from local traders participated in fairs.

(Continued,

TABLE 1. *(Continued).*

District/type of pigeonpea intervention	Characteristics of the seed interventions
	3. Seeds purchased through vouchers were redeemed by CRS-Kenya. 4. 10 tons of assorted seeds were purchased by farmers during the 2003–2006 cropping seasons

Source: Personal communication with Njoroge Goro, District Crops Officer, Makueni District; Phestus Gikunga, District Crops Officer, Kitui District; E. B. Muga and Sam Nguta of MAP-Makueni; and Emmanuel Kisangau, Catholic Diocese of Kitui, May-June, 2006.

interventions on crop/varietal diversity that have sufficient effects on household welfare and local seed systems.

The paper is organized as follows. We first present the methodology adopted to assess the farmers' perceptions. This is followed by a detailed discussion on the results from the farmers' focus-group discussions conducted at different locations and seed-intervention sites in eastern Kenya. Conclusions are derived based on the results and are presented in the context of existing seed policies in Kenya.

METHODS

Makueni and Kitui districts from Eastern Kenya were selected based on the pigeon pea acreage and production levels and their benefiting from past seed-intervention programs. The Makueni district benefited from two of the key seed-intervention strategies, namely, International Crop Research Institute for Semi-Arid Tropics (ICRISAT)-led producer marketing groups (PMGs) and Danida-sponsored community-based seed production program (CBSP). Four out of the 17 divisions had benefited from the PMG seed initiatives and the rest of the divisions had benefited from mainly CBSP interventions. In Kitui district, there were two main seed initiatives, namely, community-based seed production program and an emergency seed intervention in the form of seed vouchers and fairs (SV&F) sponsored by Catholic Relief Services (CRS). We did not include any control groups in our sample, as all the divisions in both the districts benefited from one seed intervention or the other. Subsequently, four sites in each district, represented by both locations and sub-locations, were selected to conduct the farmers' focus discussion groups. For

instance, in Makueni, two sites were selected to represent PMG and CBSP seed interventions, respectively; whereas in Kitui district, two sites each represented CBSP and SV&F interventions. Further, the divisions were also selected to represent various agro-ecological zones, namely, wetter (Zone 4) and drier (Zone 5), the two most predominant agro-ecological zones in semi-arid eastern Kenya. Table 2 summarizes the characteristics of the selected sites along with number of participants in each location during the conduct of the study.

From the eight administrative sub-locations, farmers were selected to participate in focus group discussions (FGDs), in consultation with local extension and administrative officials. The farmers were all pigeon pea growers and represented their village from each discussion site. The group had an optimal mix of men and women, belonging to all groups of wealth status, represented both young and old-age farmers. The final groups selected at each site did not exceed 20 members. A checklist was used to determine the existing crop diversity patterns in the respective locations, with specific reference to the focus crop, namely, pigeon pea. The study was conducted during May-June, 2006 in the selected districts and locations.

In addition, a four-cell participatory technique was employed to assess inter-crop and intra-pigeonpea diversity (Rana et al., 2005; Grum et al., 2006). By the four-cell method, one could classify all the varieties grown

TABLE 2. Selected study sites in Makueni and Kitui districts of eastern Kenya.

District/ Focus group discussion sites	Agro-ecological zone	Pigeonpea intervention type	Number of discussants/group
Makueni:			
1. Iteta, Mbitini Division	4	PMG	15
2. Muani, Kasikeu Division	4	CBSP	15
3. Thavu, Kathonzweni Division	5	PMG	15
4. Malunda, Kalawa Division	5	CBSP	15
Kitui:			
1. Kathungu, Mutomo Division	4	SV&F	20
2. Chuluni, Central Division	4	CBSP	18
3. Kyatune, Mutomo Division	5	SV&F	20
4. Nyanyaa, Yatta Division	5	CBSP	18

Source: PMG- Producer Marketing Group; CBSP- Community Based Seed Production; SV&F- Seed Fairs and Vouchers. The sites were selected in consultation with District Crop Officers in Makueni and Kitui districts, Food Security Coordinator and Catholic Diocese of Kitui.

by the farm households in a community into a 2×2 matrix, by distributing them in four different cells. The cells are classified based on the crops/varieties grown by: many households, large area; many households, small area; few households, large area; and few households, small area. After the varieties are assigned to different cells, in subsequent steps, the characteristics of varieties are analyzed in the context of their distribution within and between different cell categories. Verifying with the participants of the discussion by simple, probing questions on the existing crop diversity patterns could further extend this analysis. Some responses were recorded on an individual basis to get the precise nature of the operations. For example, individual responses regarding the number of crop varieties planted during long-rains season in 2006 were recorded individually for each participant, as the responses were anticipated ones and cannot be generalized for the whole group. For some responses, group consensus was sought, such as details on market prices between seasons. This was done to explain the differences among the intervention types and the beneficiaries with respect to various agro-ecological zones and crop diversity levels.

RESULTS

For this study, we used the four-cell analysis, along with focus group discussions, to determine the impact of seed interventions on the cultivar diversity of pigeon pea in the semi-arid regions of eastern Kenya. From our analysis, it was evident that the three seed interventions, namely, PMGS, CBSP, and SV&F, have had an impact on the overall diversity of major crops grown in the region as well as on the pigeon pea crop diversity levels and other seed-related issues, such as seed access and affordability.

Diversity Among Major Crops Grown

Farmers in the survey sites included multiple crops in their cropping system, often grown in mixed stands of cereals and legumes. The major cereals and legumes grown in the region were maize, pigeonpea, cowpea, and beans, along with minor crops, such as green gram, black gram, dolichos, sorghum, finger millet, pearl millet, cassava, sweet potato, pumpkins, water melon, cotton and castor. We used focus group discussions, along with the four-cell analysis, to determine the distribution of local crop diversity among the farming communities. Accordingly, we classified the existing crop diversity levels

in the local communities based on their presence as common, *unique* and *rare* crops. They are further distributed into four different categories adopted by the households in these communities, as follows:

i. grown by many households in large plots – *common* crops (maize, pigeon pea)
ii. grown by many households in small plots – *unique* but safe crops with certain limitations (beans, cowpea and sorghum)
iii. grown by few households in large plots – *unique* crops with certain limitations (cotton)
iv. grown by few households in small plots – *rare* and could be vulnerable crops (dolichos, vegetables, sweet potato, millets, cassava)

The results of the 4-cell analysis are summarized in Table 3. It could be seen that the crop distribution patterns among the households in all the three seed-intervention sites were similar. Pigeonpea and maize were the most common crops grown by almost all the farmers in big plots. Maize is often intercropped with pigeonpea in eastern Kenya as both these crops

TABLE 3. Common, unique and rare crops in PMG, CBSP and SV&F sites of Makueni and Kitui districts, eastern Kenya.

Type of seed intervention[a]	Common crops-many households in large plots	Unique crops-many households in small plots	Unique crops- few households in big plots	Rare crops-few households in small plots
PMG (2)	Maize, pigeonpea	Cowpea, beans, sorghum, green grams, fruit trees, pumpkins	Cotton	Finger millet, pearl millet, cassava, sweet potato
CBSP (4)	Maize, pigeonpea,	Cowpea, beans, fruit trees, sorghum, pumpkins	Cotton	Green grams, finger millet, cassava, sweet potato, pearl millet
SV&F (2)	Maize, pigeonpea, cowpea	Beans, green gram, pumpkin, sorghum, fruit trees	Cotton	Pearl millet, finger millet, cassava, sweet potato

Source: FGD study in Makueni and Kitui Districts.
[a]Numbers in brackets represent the number of groups reported.

contribute towards household food and income security. Further, pigeon pea and cowpea are widely adapted to drought conditions and have multiple uses - as green vegetable and as food grain.

Many farm households also preferred crops that were unique but profitable on small plots. Some of the constraints faced by farmers growing these unique but safe crops were higher seed costs (e.g., beans and green gram, cowpea); pest and diseases (e.g., cowpea); limited market opportunities (e.g., sorghum) and highly susceptible to drought conditions (e.g., cassava, beans and sweet potato). Cotton was grown by a few farmers on big plots (unique crop) as it required intensive crop management. Rare and vulnerable crops (in terms of biodiversity) were grown by very few households in very small plots. For instance, finger millet, a rare crop, was considered very labor-intensive and due to change in consumption habits across years, very few households preferred it.

Participants were further asked to list the local culinary preparations that were consumed every day in the community. This was done to relate the diversity in local foods to the local availability of crop diversity in the village communities. "Ugali" (stiff porridge made of maize), "Githeri" (cereal-legume mixture made of maize, pigeon pea, beans and cowpea) and "Uji" (porridge made of sorghum, finger millet and maize flour), were the three most popular preparations consumed mostly by the local population. The food preferences of the local population clearly underline the value attached to maize (although not the most well adapted cereal to the agro-ecology), beans, pigeonpea and cowpea. Pearl millet, which is well adapted to the semi-arid weather conditions of eastern Kenya but highly bird-prone, had virtually disappeared from the local farming systems (reported by all 8 FGD sites).

Besides, it was evident that the common or rare occurrence of any crops in these marginal environments was directly related to seed availability of these crops in the nearby local markets. In the existing cropping system, maize, pigeon pea and cowpea are highly preferred by farmers. Therefore, one would expect correspondingly higher number of seed sources and varieties of these crops in local markets. However, the farmers felt that after a prolonged drought, availability of seeds was very low and the prices were very high, especially for crops like pigeon pea and cowpea. In the case of maize, the seed sourcing and availability was not a problem, as many private and public agencies are actively engaged in providing the same.

The participants of the discussion were also asked to list the number of major crops and varieties (both improved and landraces) grown per each of the farm households. Maize, pigeon pea, cowpea and beans are

considered to be major crops in the surveyed regions. The summary of results on the average number of crop varieties grown in each of the seed intervention sites is given in Table 4.

Each discussant, representing a household, cultivated more varieties per major crop in PMG seed-intervention sites than in other seed-intervention areas. The farms located in PMG-assisted areas also had higher pigeon pea diversity. The farmers felt that their close association with ICRISAT through PMGs had helped them acquire more information on pigeon pea and other major crops in the region. Collective action efforts through PMGs also increased farmers' chances of accessing seeds more effectively and on time. The PMG seed stores in the local communities also sold other crops and varieties, apart from pigeon pea. It was evident that while CBSP and PMG initiatives introduced new, early-maturing pigeon pea and other crop varieties, SV&F approach generally sourced local seeds through local traders and farmers and distributed back to the same communities.

However, it was not possible to show any significant differences in diversity between number of varieties and total number of crops grown in different agro-ecological zones within the regions. To certain extent, it

TABLE 4. Average number of crop varieties in the seed intervention sites of Makueni and Kitui districts, eastern Kenya.

Types of seed intervention	Number of crop varieties per household				Number of crops per household
	Pigeon pea	Maize	Cowpea	Beans	
PMG					
Mean	2.5	2.5	2.3	2.0	9.3
N	30	28	28	29	28
Min	1	1	1	1	6
Max	4	4	4	3	13
CBSP					
Mean	1.5	2.0	1.9	2.0	7.4
N	59	55	54	47	46
Min	1	1	1	1	5
Max	3	4	3	2	11
SV&F					
Mean	1.6	1.3	2.2	1.3	6.9
N	30	36	34	8	30
Min	1	1	1	1	5
Max	3	2	4	2	9
Mean (Total)	1.8	1.9	2.1	1.9	8.0

Source: FGDs conducted in Makueni and Kitui Districts; N = number of discussants reporting.

could be evidenced that in drier zones, where PMG and CBSP initiatives were undertaken, both the crop and variety diversity were higher compared with wetter zones. This could be due to the greater efforts undertaken by the organizations involved in drier areas in seed provision or it could indicate the higher demand for relief seed in these zones after drought. In the case of SV&F intervention sites in wetter zones, each household had significantly higher number of crops and varieties compared with drier zones.

Pigeonpea Crop Diversity

It was evident from our earlier discussions that the farm households located in PMG sites had greater pigeon pea diversity compared with other seed-intervention types. It was revealed in further analysis that farmers in PMG sites grew a higher number of improved cultivars of pigeonpea than in non-PMG sites (Table 5). In the case of SV&F intervention sites, very few pigeon pea varieties, mostly landraces, were found. The results indicate that the households located in PMG sites had increased access to improved seeds compared with non-PMG intervention areas.

In addition, we used the four-cell analysis technique to determine the diversity of pigeon pea varieties used among the households in the surveyed communities. The results are presented in Table 6. Farming communities in and around PMG serving areas had grown one local variety (Kionza) and three improved varieties (Katoli, # 777, Syombonge) of pigeon pea; whereas in CBSP areas, farmers grew three common types (Kikomo, Kionza and Mwikuyu), along with two improved varieties (Katheke and Syombonge) that were often rated as 'rare' occurrence. In

TABLE 5. Pigeonpea variety diversity in the seed intervention sites.

Seed interventions	No. of landraces	No. of improved varieties	Total varieties
PMG (2)	6	5	11
CBSP (4)	6	2	8
SV&F(2)	3	1	4

Source: Focus group discussions (FGD) in Makueni and Kitui districts. Figures in brackets indicate the number of FGD groups for each intervention type.

TABLE 6. Pigeonpea diversity indicators in the seed intervention sites of Makueni and Kitui districts, eastern Kenya.

Seed intervention	Qualitative indicators for crop diversity			
	Many households in large plots	Many households in small plots	Few households in big plots	Few households in small plots
PMG (2)	Katoli/40(2) Kionza (1) #777(1)	Syombonge(1) Kionza(1)	–	#557(1) Mwiyumbi(2) Munovi(1) Katheke(1) Mukuni(1) Musungu (1)
CBSP-Makueni (2)	Kikomo(1)	Kionza (1)	Kionza(1)	Katheke(1), Mwiyumbi(1) Syombonge(1)
CBSP-Kitui (2)	Kionza(1), Mwikuyu(1)	–	Mkolokolo(1)	Mwiyumbi(1) Kanyai(1)
SV&F (2)	Muthoila(1), Kanyai(1)	Nguyu(1)	–	–

Source: FGDs in Makueni and Kitui Districts; Numbers in brackets represent number of groups reported.

SV&F intervention sites, three local landraces (Muthoila, Kanyai and Nguyu) were extensively grown by the farm households. The farm households in PMG areas could identify the improved varieties of pigeon pea with little difficulty. However, the farmers in CBSP and SV&F areas classified the improved pigeon pea varieties as 'rare'. It is evident that in the PMG sites, the introduction of improved varieties has improved the pigeon pea variety diversity, i.e., richness of pigeon pea crop. However, it was not clear if the improved varieties have displaced the existing local or landraces of pigeon pea in the system, which requires a more rigorous study.

The relatively higher use of improved pigeon pea varieties in PMG and CBSP areas compared with seed-fair sites was attributed to higher yields, quality seeds and improved marketing facilities provided by the implementing agencies. Farmers preferred modern or improved varieties of pigeon pea for certain agronomic traits like maturity/duration of the crop, ratoon capability of the crops, resistance to pest and diseases and food and processing qualities. Farmers in the PMG intervention sites benefited mostly from the short- and medium-duration varieties compared with CBSP and SV&F sites. In many ways, introduction of improved early-maturing

varieties of pigeon pea reduced the food insecurity in the semi-arid regions of eastern Kenya. They provided green peas for home consumption and sales for an extended period of time (nearly six months in a year) compared with traditional varieties, which provided green peas for only two months. Reported incidences of increased green pea sales from improved pea varieties and their adoption was evident in PMG areas compared with CBSP and SV&F sites. Almost in all the PMG intervention sites, farmers produced surplus dry pigeon pea grains for cash sales, from the improved varieties. In general, the PMG intervention sites had higher pigeon pea diversity levels compared with CBSP and SV&F sites, apart from improved production and marketing facilities.

Access to Seed Sources

Have the seed intervention programs had any impact on improving the access to pigeon pea seeds and varieties in the semi-arid regions of eastern Kenya? This question could be measured by certain indicators like the presence of local markets that sell seeds periodically; distance to these markets; varieties handled by them; improved sources of quality seeds at affordable prices and the amount of information available on various seed-related products. The focus group participants felt that the number of local seed markets and their distance to villages did not vary significantly across the seed-intervention areas. The average distances of the location of markets vary from 5 to 15 kms. However, it was evident that PMG sites had better access to on-farm sources, such as farmers' own seeds or from other farmers during normal and drought seasons than farmers located in CBSP and SV&F site (Table 7). The farmers in PMG sites have better access to quality seeds either from their own reserves or from other group members or PMG shops within the communities; whereas in other CBSP and SV&F sites, farmers relied more on off-farm sources, such as local markets and grain shops for seeds.

Among the intervention sites, the farmers located in PMG areas realized higher prices for their pigeon pea seeds during good season compared with CBSP and SV&F areas. The seeds sold in PMG sites were good quality seeds and farmers also felt that seed mixtures were more common in the local markets situated in SV&F and CBSP sites than in PMG sites. However, the price of seeds was lower in PMG sites, especially after droughts, whereas in CBSP and SV&F areas, after the drought season, seed prices had more than doubled (Table 8).

TABLE 7. Seed sourcing in the intervention sites after good and poor agricultural seasons, Makueni and Kitui districts, eastern Kenya.

Seed sources	Percentage after normal season			Percent after drought season		
	PMG (N=23)	CBSP (N=17)	SV&F (N=13)	PMG (N=13)	CBSP (N=10)	SV&F (N=7)
Own saved seed	52	59	46	10	0	0
Other farmers	48	35	46	35	10	0
Shopkeepers	0	6	0	39	70	71
None	0	0	8	16	20	29

Source: FGD in Makueni and Kitui Districts

TABLE 8. Average prices of cereals and legumes in intervention sites after good and poor agricultural seasons, Makueni and Kitui districts, eastern Kenya.

Major crop	Mean seed prices in Ksh per kg after:							
	PMG (2 groups)		CBSP(4 groups)		SV&F (2 groups)		Crop	
	Good season	Poor season	Good season	Poor season	Good season	Poor season	Good season	Poor season
Pigeonpea	30	40	25	52	20	58	26	50
Maize	17	24	20	33	24	25	20	29
Sorghum	9	25	13	23	20	25	13	24
Cowpea	33	110	42	78	25	70	36	80
All crops	22	41	25	46	22	44	24	45

Source: FGD in Makueni and Kitui Districts

The higher seed prices in CBSP and SV&F areas, especially after drought, are synonymous with the increase in grain or food prices in the local markets. The pigeon pea seed prices were more stable in the PMG sites than in the other two seed-intervention sites, due to proper marketing tie-ups with seed sourcing as well as output markets. Thus, in the PMG areas, both local and improved seeds of pigeon pea were accessible and the prices were affordable during good and bad seasons compared with other intervention sites. In CBSP and SV&F sites, the local and improved varieties of pigeon pea were available only during good season (Table 9).

TABLE 9. Affordability of pigeonpea seed in good and bad seasons in the intervention areas, Makueni and Kitui Districts, eastern Kenya.

Type of seed intervention	Mean prices (Kshs/kg) of pigeonpea seed after:		Highest affordable pigeonpea seed price (Kshs/kg)		Affordability or accessibility of pigeonpea seed after	
	Good season	Poor season	Local	Improved	Good season	Poor season
PMG	30	40	30	40	Local and improved	Local and improved
CBSP	25	52	38	48	Local and improved	None
SV&F	20	58	30	38	Local and improved	None

Source: FGD in Makueni and Kitui Districts

Hence, the pigeon pea seed supply was much more reliable in PMG areas, especially after a prolonged or recurrent drought season.

CONCLUSIONS

Did the seed intervention programs implemented in Kitui and Makueni districts of eastern Kenya have any impact on the on-farm diversity levels of pigeon pea? If so, did it improve farmers' access to improved, quality, seed materials? To answer these questions, we conducted a preliminary research study in eight village communities in two of the semi-arid districts in eastern Kenya, namely, Kitui and Makueni, during the months of May-June, 2006. We adopted the four-cell analysis, along with a series of focus group discussions with the farm households in these communities, to determine the possible association of pigeon pea crop diversity and seed interventions, including PMG, CBSP, and SV&F that had operated in the two districts. The four-cell analysis methodology was used to evaluate the distribution of local crop diversity, particularly pigeon pea diversity, among the farming communities in eastern Kenya.

The results from the four-cell analysis explained that the overall (inter-) crop diversity patterns among the households in these communities were similar in all three seed program sites. Besides, it was evident that the farm households located in PMG sites have had significantly higher

inter-crop as well pigeon pea diversity compared with CBSP and SV&F sites. Further in PMG sites, the farmers had access to improved pigeon pea varieties with positive attributes, such as early maturity, high yield, good culinary qualities, and pest and disease tolerance, compared with other intervention areas. Farmers felt that the introduction of improved, early-maturing pigeon pea types reduced the food-insecurity months by providing green peas for an extended period of time compared with traditional cultivars. They also generated surplus dry grains for increased cash sales.

The seed-intervention programs also have impacted farmers' access to quality seeds, in turn the diversity of pigeon pea varieties available to farmers. The farmers located in PMG sites, had relied more on their own on-farm sources in the villages compared with other intervention areas, especially after or during bad seasons. The price of seeds was also relatively lower and stable in PMG areas due to proper marketing tie-ups for seeds and grains.

The assessment on these seed-based programs revealed that producer-marketing groups initiated by ICRISAT were much effective in providing more cultivars, and also improved access to quality seeds compared with community-based initiatives and seed fairs mechanisms. The community-based seed initiatives were less effective in seed provision, partly, because individual seed producers after drought were not obligated to sell it as seed to other seed-needy farmers in the communities. Seed provision through seed fairs was often a one-time event and occurred during or after disaster periods. More often, the seed fairs resulted in exchanging local cultivars than any additional, improved cultivars from the research system.

The producer-marketing-based seed initiatives proven to be successful in terms of increased cultivar usage and improved access of quality seeds. However, it was not clear if the improved varieties had displaced the existing local varieties or landraces of pigeon pea in the system, which requires a more rigorous study. This also calls for an effective and sustainable, seed-based initiative that provides quality seeds on time as well in improving the cultivar diversity during normal and distress periods in the semi-arid regions of eastern Kenya.

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