Beyond a unitary household measure: Does Gender matter in Legume Seed Systems among Smallholder Farmers?

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Beyond a unitary household measure: Does Gender matter in Legume Seed Systems among Smallholder Farmers?

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Abstract

We employ a non-unitary household model to analyze the main Pigeonpea seed channels for in Kenya. The paper is based on a household survey conducted on a 500 randomly selected households within three counties of Eastern Kenya. The study sites are based on the distance from the main trading center (county headquarters) which informs agro business infrastructure. We assess the participation in seed channels with regards to joint plots, women plots and male plots for Pigeonpeas legumes. More than half of the Pigeonpea plots (>50 %) in the sample are managed jointly by men and women; while around 10% are managed entirely by women. There were very few plots (<1%) managed by men alone. The main legumes seed sources are own saved seeds and cereal stockists. There is very limited sourcing from the certified seed channel (<10%), the certified seeds from agrovets are only acquired for joint plots. Using a multinomial logistic regression, we analyze the factors influencing the choice of Pigeonpea seed channels, encompassing characteristics of the wife of the household head. Literate wives and wives with high exposure to extension services were more likely to access seed from the agrovets, these variables were however not significant for the male head. Other significant determinants were total livestock unit, distance to the source of seed, amount of seed required, location of the household, and occupation. We conclude that targeting women farmers with knowledge and capacity building on the advantages of using certified seeds for legumes has the potential to enhance adoption of legumes in Eastern Kenya, education levels notwithstanding.

Introduction

Legumes also referred to as pulses are the 'poor man's meat', a main source of protein for more than a billion people in the developing world. Grain legumes are widely grown by smallholder farmers in many semi-arid areas of the tropics. They provide protein-rich supplementary food to many poor families that do not afford costly animal-based foods. This is especially important for growing children who cannot consume sufficient quantities of staple cereals to meet their protein requirements. Legume crops particularly pigeon peas, cowpeas and beans are almost entirely a small-holder crop and commonly an inter-crop with cereals crops like maize or sorghum.

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Intercropping helps in maximizing labour utilisation and land use, spreading economic risk and improving soil productivity through nitrogen fixation (Høgh-Jensen *et al.*, 2007). In areas of intensive legume production, studies have shown that high volumes of legume crops are mainly for sale (Mponda *et al*., 2013; Shiferaw *et al.*, 2005). However at household level, most legumes can either be prepared dry, as vegetable or as dhal. Their leaves are likewise prepared as green vegetables. The global production of pulses in the year 2014 according to FAO statistics[2] was 163.3 million MT, Africa's production accounted for 12% of the total global production.

Pigeonpea (*Cajanus Cajun*) are major legume crops in Kenya particularly in Eastern Kenya. FAOSTAT estimates Kenyan annual production for pigeonpeas at 274,523 MT in the year 2014. Despite high investments in breeding research, the rate of adoption in sub-Saharan Africa still remains below 5% (Setimela et al., 2004). Access to seed varieties has been a major hindrance to adoption of particularly improved Pigeonpea varieties; lack of efficient seed systems impedes adoption of new, higher-yielding varieties (Amare *et al.*, 2012; Shiferaw *et al.*, 2007; Jones *et al.*, 2000). Pigeonpeas have therefore not achieved their production potential due to among other factors poor input use and crop management practises (Smith et al. 2001). Simtowe *et al.*, 2009 found that exposure to improved pigeonpea varieties could potentially quadruple the adoption rates of pigeonpeas.

Until recently, many countries have relied on a single parastatal seed company for legumes and cereal seed supply, resulting in inefficiencies in seed supply chain. Introduction of liberalization policies in most African countries led to emergence of private seed companies; however, most of them focus on a few crop types and a limited number of varieties (e.g hybrid maize). Guided by profit maximizing objectives, most companies prefer seeds with a high turnover each season, especially the hybrids because of the consistence and reliability of demand. Most of them therefore shy away from investing in open pollinated varieties (OPVs) where the farmers recycle the seed for more than 3 seasons. This has led to an industry that has failed to create retail channels in most crops other than hybrid. Similarly, seed companies' working environment as related to production, processing and policy and regulatory environment pose greater challenges to their existence (Langyintuo *et al.*, 2008) .These bottlenecks in the formal seed system call for innovative strategies in order to ensure efficient delivery of improved legumes seeds to the poor and marginalized farmers in the dryland areas.

Women account contribute about 50 percent of agriculture labour directly and indirectly playing a key role in food security. Women however, have less access to productive land, improved seeds, extension services, fertilizer, market and training. These impacts on women farmers' rates of adoption of agricultural technologies and their productivity compared to men (FAO, 2011). Studies that empirically estimate gender gaps in improved technology adoption have found that differences in access to productive assets and technologies largely explain the gaps (Doss *et al.*, 2001) notwithstanding that bridging gender gaps in farm productivity may improve household

[2] http://faostat3.fao.org/download/Q/QC/E

food security (Udry, 1996). Closing the gender gaps with women empowerment in agricultural sector becomes key, as they remain critical to the development of agriculture particularly in Sub Sahara Africa (SSA). There is need to strengthen the capacity of youths and women farmers in the value chain with training in entrepreneurship and facilitate their connection to key service providers in the agribusiness sector (input suppliers, financial institutions (Maïga, 2013). Gender-related decision-making, which is linked to intra-household resource allocation, is an important determinant of the adoption of technologies by both men and women.

In analyzing cross sectional survey data, a unitary household model has commonly been used with the assumption that 'a household' has same choices, decision making processes and pool their resources together. Households are often modelled as male headed or female headed and analysis conducted in the same line. However, there is a growing body of literature that has disagreed with this notion (Rode, 2011; Doss, 2013; Behrman *et al.*, 2014). Individual household members have been shown to have different preferences and pursue different goals and objectives within the household. With this understanding, modelling a household as a unitary system can be misleading and most often give the views of the household head only. There is therefore need to consider perceptions of other household members particularly women and youth. "Male-headed" households generally include all households in which women are married to men while "female-headed" households are usually those households lacking a male head. Unless a survey asks questions about individuals within a household, we'll miss important data on women living in male-headed households – the majority of the world's women (Doss & Kieran, 2011). In this paper, we use sex-disaggregated data and move beyond male headed and female headed households to encompassing information on the wife of the male head who plays a key role in agricultural production. We likewise gather information on joint legume plots which both husband and wife manage; male legume plots managed by the male and women plots managed by either a female head or a wife to a male head.

This paper aims to evaluate legume seed systems in Kenya from a gender perspective with a focus on Pigeonpeas. We assess participation of households in the five main seed channels identified through focused group discussions; own saved seed, cereal stockist/open market, agrovets, Government and 'another farmer'. 'Another farmer' channel encompasses local seed exchanges between farmers including buying seed from other farmers or receiving seed as gifts. We aim to understand the different seed channels as used in joint plots, male plots and female plots. We use a multinomial logistic regression to analyze the factors that influence participation in the five seed channels. The subsequent sections are organized as follows; data and methods, presentation of the results and the discussions, conclusion and policy recommendations.

Data and Methods

Study area

The study was conducted in three counties of Eastern Kenya; Machakos, Makueni and Kitui. Eastern Kenya receives a bimodal rainfall with short rains between October-December and long rains in the months of March to May. The short rains (October to December rains) are considered more reliable than the long rains (March to May rains). This is because the short rains fall over a much longer period and are fairly distributed to support crop development for most early maturing and drought resistant or tolerant varieties (Gachangi *et al.,* 2015*).* The long rains usually fall within very few days such that a crop does not grow to maturity. Machakos County is located southeast of Nairobi, Kenyan capital city. The main economic activities/industries in Eastern Kenya include livestock keeping, food crops farming like maize, peas, beans, pigeon peas, cowpeas and green grams, tobacco farming, cotton, mangoes and commercial businesses. Machakos town is a major urban center, the headquarters of Machakos County and its situated 63 kilometers from Nairobi. There are more than 15 agrovet shops in Machakos town that sell agricultural related inputs like seeds, fertilizers, farm chemicals and implements. Kola and Miu are trading centres within Machakos County. Kola is 30km away from Machakos while Miu is approximately 60 km away, accessed on marram road. They both have one or two agrovet shops that are not well stocked but have an open air market that is frequented by farmers and traders once a week. Kitui town which headquarters Kitui County is 180 kilometres east of Nairobi and 105 kilometres east of Machakos. Tulia is a rural trading centre located 30km north of Kitui. Ikutha is a remote trading centre 60km south of Kitui town. The largest town in and headquarters of Makueni County is Wote. Kalii is a trading centre, 30 km southeast of Wote. It is small with only one agrovet shop. Nunguni/Kikoko is 60km away from Wote on the Southwest; it is on a hilly area and as such much cooler than Wote. There a number of agrovet shops in this town, mainly serving the horticultural farmers who irrigate farms along the rivers.

Cross Sectional Household Survey

This paper is based on a cross sectional household survey conducted in Eastern Kenya in May and June 2014. Random sampling was applied to select a set of 500 households. 50 households were selected randomly around 10 trading centres that were identified as study sites, they include; Machakos, Kikoko, Wote, Miu, Kitui, Ikutha, Tulia, Mukuyuni, Kola and Kalii. The sites were based on the state of seed input infrastructure. The study sites were selected to represent diversity in access to the agro trading centres. Three sites were selected to represent major trading centres (Machakos, Makueni and Kitui, which are county headquarters and main business hubs), three sites were selected to represent villages 30km away from the major trading centres (Tulia, Kalii and Kola) and three sites were selected to represent villages 60km away from the major trading centres (Ikutha, Kikoko and Miu). A tenth market (Mukuyuni) was added because of observed seed buying transactions in the agrovet shops in the long rains of 2014. The ward agricultural officers in the respective selected sites provided the list of all villages in sub-location and five villages were randomly selected from the list of each site. In the villages, a random starting point was identified with the assistance of the village elders, and on a transect, every 3^{rd} household was sampled until 10 households were sampled in the village. The survey covered a period of two seasons; October-November 2013 (short rains) and March - May 2014 (long rains).

Three semi structured questionnaires were used to collect household data on household characteristics, socio-demographic characteristics, land and plot allocations, seed source channels and perceptions, asset ownership among other information. The first questionnaire was directed to both the husband and wife and was based on joint legume plots; the second questionnaire was for women plots and the main woman in the house was interviewed; either the wife to a male head or a female head. The third and final questionnaire was for the male plots and was directed to male heads as respondents. Ten enumerators were hired to manage data collection in the 10 sites distributed in the counties of Machakos, Makueni and Kitui. The enumerators were continuing university or college graduates students from the community, who understood the norms, the culture and the language of the community. Training was carried out to ensure that the enumerators harmonized the translation of questions from the English language into 'Kamba', the local language.

Data collected was coded, entered and cleaned in SPSS. Descriptive analysis was carried out in SPSS and EXCEL while econometric analysis was performed in STATA. The multinomial logistic regression is based on data for the joint portions.

Specification of the Econometric Model

We use a multinomial logit (MNL) regression to empirically investigate the drivers of farmers' choice of seed channels. MNL models assume that the error terms are independently and identically distributed (Greene, 2003). MNL models are used to model relationships between a dependent polytomous response variable (variable with more than two outcomes) and a set of regressor variables. These polytomous response models can either be ordered or unordered. In this study, the responses are unordered and distinct as the farmer chooses the most important seed channel among the five categorised seed channels; 1. cereal stockist/open market 2. agrovets 3. own saved seed 4. government 5. another farmer. Drawing from the discrete choice theory of utility maximization (McFadden, 1976), the choice of the seed channel is based on the option that maximises utility subject to the inherent cost. These costs (both financial and non-financial) are determined by socioeconomic and input market characteristics, hence, we specify an unordered MNL model as follows (Greene, 2003)

$$\Pr(Y = j) = \frac{e^{\beta'_j X_i}}{\sum e^{\beta'_k X_i}}, \quad j = 0,1,2,3,4 \qquad (1)$$

The estimated equation (1) leads to a set of probabilities for J^{th} choices of seed channel for a farmer, in our case, the channels are five (cereal stockist/open market, agrovets, own saved seed, government and another farmer). Vector X_i describes individual socioeconomic and input market characteristics. $ß_j$ describes the vector coefficients of X_i associated with the j^{th} seed channel (Greene, 2003).

$$\Pr(Y = 0) = \frac{1}{1 + e\sum e^{\beta'_k X_i}} \qquad (2)$$

Normalization is achieved by setting $ß_0 = 0$ as presented in equation 2. We thus obtain a vector $ß_j$ for each probability except for the one which is a normalized alternative (a reference or base outcome). The estimated coefficients of the model can therefore be interpreted as the effect of the characteristics x_i on the probability of a seed channel j relative to the seed channel which is a base outcome. In our case, the reference/base outcome was 'own saved seed'.

Table 1 provides a description of the variables used in the multinomial logistic regression majorly drawn from literature and prior focused group discussions.

Table 1: Description of variables used in the multinomial logit model

Variables	**Description**	**Units**
Dependent variable		
Seedsource	Choice of the seed channel	0. Own saved seed (Base outcome)
		1.Cereal stockist/open market
		2. Agrovets
		3. Government
		4. Another farmer
Independent variable		
Sex	Sex of the respondent	1= Male 2=Female

Hhsize	Household size	Number of household members
AgeMale	Age of the male head	Number of years
AgeWife	Age of the wife to the male head	Number of years
EducationMale	Education of the male head	Number of years
EducationWife	Education of the wife to male head	Number of years
TotalLandSize	Total land size	acres
LogTotalassetvalue	Log of Total asset value	Amount in KES
Total_TLU	Total livestock unit	units
AmountSeed	Amount of seed planted	Amount in kgs
DistSource	Distance to source of seed	Distance in KM
GrpmemberWifeHH	Whether the wife of the male head is farmer group member	1. Yes 0. No
GrpmemberMaleHH	Whether the male head is a group member	1. Yes 0. No
FreqExtensWifeHH	Frequency of contact to extension officer by wife of the household head	Number of contacts
FreqExtensMaleHH	Frequency of contact to extension officer by the household head	Number of contacts
CreditAccessMaleHH	Access to credit by the male head	1. Yes 0. No
CreditAccessWifeHH	Access to credit by wife of the male head	1. Yes 0. No
HHType	Household type	1. Male headed & managed (base) 2. Male headed female managed 3. Female headed & managed
County	County name	1. Machakos (base) 2. Makueni 3. Kitui

Km_tradcentre	Distance to the nearest trading center from the household	1. 0 km (base) 2. 30 km 3. 60 km

Results and Discussion

Descriptive analysis

The average age of the respondents was 56 years for the men and 57 years for the women. The distance to the nearest trading centre was statistically longer for women (*p*-value=0.05), at an average of 4.2 km among the male respondent and 5.8 km for the female respondents. The average time to the trading centre was likewise statistically significant (*p*-value=0.05) with women taking more time (44 minutes) than men (37minutes) to get to the nearest trading centre. 90% of the women reported farming as their main occupation with 78% of the men reporting the same.

Table 2: Number of households with Joint, Female and Male plots for Pigeonpeas (n=500)

	Joint plots	Female plots	Male plots
Number of households	269 (53.8%)	53 (10.6%)	1 (0.2%)

More than half of the households grew pigeonpeas on joint plots (table 2); slightly more than 53% of the households had joint plots for pigeonpeas. 10.6% of the households had pigeonpeas on women plots. Only one household (<0.2%) had pigeonpea crops on male plots.

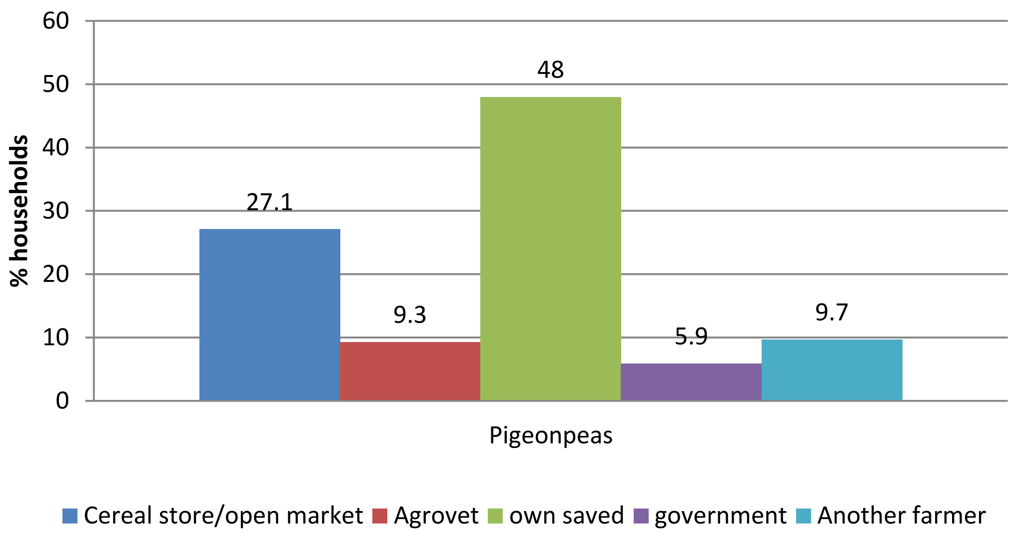

Fig. 1: Pigeonpea seed channels for joint plots

Figures 1 and 2 presents the main seed channels for pigeonpea on joint and women plots respectively. Similar analysis could not be done for the male plots because it was only one (see table 3). As presented in figure 1, the main seed channel for all the three legumes was own saved seeds with almost half of households (48%) using own saved of pigeonpea. Cereal store/open market was the second most important seed channel with over 27% of the households acquiring pigeonpeas legume seeds from this channel. Agrovets channel from which we expect farmers to access certified seed was not a common seed channel for most of the households, less than 10% of the households accessed pigeonpeas seeds from the agrovets. Likewise, there was minimal access of bean seed from other farmers either through borrowing, exchange or gift. Its only 2; 10% of the households who acquired pigeonpea seeds from other farmers.

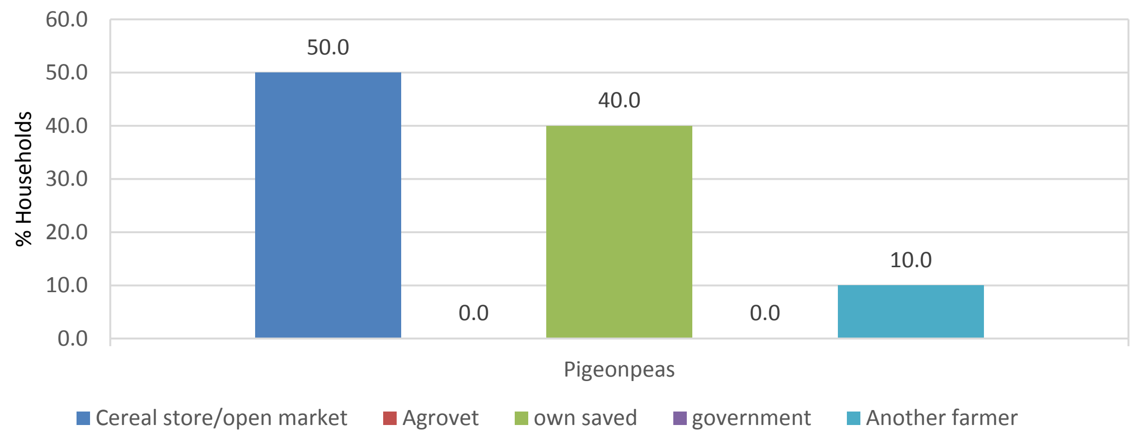

Fig. 2: Pigeonpea seed channels for women plots

Figure 2 presents results for households accessing Pigeonpea seeds for women plots through the five main channels. Cereal store/open air market was the main pigeonpea seed channel used by half of households with women plots. Most of the cereal stockists in the study area act as 'seed banks' where immediately after harvest, farmers sell their grain harvest to the stockist. This is usually as a risk mitigation where farmers don't want to lose a whole crop to storage pests as well as an income generating exercise. When it rains, households purchase the same grain for planting. The farmers are comfortable purchasing from the cereal stockist because they trust the variety sold by the stockist is adapted to their regions. Challenges of varietal mixture and contamination occur as the stockists buy grain from different farmers. Cereal stockist play a crucial role in enabling access of legume seed access in the semi-arid areas as the formal seed system is underdeveloped, particularly for legumes. Own saved seed was the second most important seed channel with 40% of the households acquiring seed from this channel. The study observes very low use of certified pigeonpea seeds on women plots from agrovets. None of the household accessed any pigeonpea seeds from the agrovet channel, this was also the case for the government seed channel. 10% of the households accessed pigeonpea seeds from other farmers.

Table 3: Multinomial logit estimates for pigeonpea joint plots

	Cereal stockists		Agrovet		Government		Another farmer	
	Coefficient	P>z	Coefficient	P>z	Coefficient	P>z	Coefficient	P>z
Sex	.22959	0.691	-.83321	0.606	-1.1271	0.470	-4.5816**	0.034
AgeMaleHH	.16371**	0.014	-.26211	0.131	-.09785	0.458	-.35477**	0.036
AgeWifeHH	-.18305**	0.010	.22775	0.175	-.01304	0.924	.45050**	0.022
EducationMaleHH	.46606	0.164	-.71935	0.265	.07485	0.902	.03846	0.960
EducationWifeHH	-.80386**	0.032	1.7212**	0.063	-.85185	0.263	-.49591	0.546
TotalLandSize	-.06382	0.142	.20943**	0.013	.07755	0.294	.06339	0.298
LogTotalAssetValue	-.23608	0.676	-1.3881	0.249	.08952	0.933	.34543	0.728
AmountSeed	.00071	0.906	-.00856	0.210	.00574	0.610	-.015270*	0.096
DistSeedSource	.19282*	0.057	.03822	0.325	.14500	0.338	-.07005 **	0.046
Total_TLU	.04267	0.569	-.87184**	0.040	-.08363	0.604	.087341	0.446
HHSize	-.11032	0.452	-.44972	0.233	.07377	0.771	.64451	0.732
GrpmemberWifeHH	1.1174	0.147	-1.360	0.263	-2.0545	0.223	.63878	0.132
GrpmemberMaleHH	-1.1996	0.103	-2.31924	0.157	1.05029	0.509	2.4158	0.201
FreqExtensWifeHH	.08467	0.413	.532619**	0.010	-.10410	0.704	-.01411	0.969
FreqExtensMaleHH	-.17820	0.218	-.41426**	0.039	.06347	0.750	.06849	0.650
CreditAccessMaleHH	2.1601	0.109	1.0075	0.556	1.7910	0.355	1.50448	0.495
CreditAccessWifeHH	1.5344	0.238	-3.1127	0.125	-1.6089	0.386	-4.3666	0.108
County								
Makueni	.70837	0.334	-1.0701	0.510	-1.2351	0.444	-3.3786**	0.033
Kitui	.32579	0.700	-4.5152*	0.066	-.08979	0.968	-20.3700	0.983
HHType								

Male headed female managed	17.241	0.997	2.4765	1.000	17.239	0.999	1.8670	1.000
KmTradeCentre								
30 km	.30704	0.695	-.01371	0.993	.82569	0.727	-1.62180	0.301
60 km	-.00684	0.993	-1.62135	0.411	2.1368	0.316	-2.2392	0.153
OccupationMaleHH								
Employed	2.1248	0.145	.49754	0.830	-14.310	0.997	7.219 **	0.016
Business within the community	-17.518	0.997	6.2770	0.155	-18.50728	0.999	-19.434	0.998
Business out of the community	3.3488*	0.084	-21.490	0.996	-18.46964	0.995	-15.672	0.997
_cons	-7.190321	0.110	20.8523	0.048	5.852926	0.382	-.57186	0.946
Number of observations = 138		Prob > chi2 = 0.0000						
Log likelihood = -104.46		Pseudo R2 = 0.4200						

Table 3 presents logistic estimates for the determinants of pigeonpeas seed channels on 'joint plots' managed by both husband and wife. Similar analysis could not be done for women and male plots as their representation was insignificant. Male plots were few (<30) while in the female plots, some seed channels (agrovets, government) were not represented (see fig. 2). However, this analysis still sheds light on gender differences in seed acquisition, as important variables on both the male head and main woman (the wife) are included in the analysis. The presented multinomial logistic model was statistically significant at a *p*-value=0.000 and explained 42% of the variation (pseudo R2 of 0.42).

Sex of the respondent was a key variable in influencing the choice of pigeonpea seed channel. Female respondents were less likely to source seed from another farmer as compared to using their own saved seed (base outcome); male farmers were more likely to source pigeon peas seeds from another farmer. The probability that a male farmer would source seed from another farmer rather than use their own saved seed was 458%. This could mean that men are aggressive to seek for better performing pigeonpea variety from among their peers while women are comfortable in the 'own seed saving' role in the household.

Households with older male heads were more likely to source pigeonpea seed from cereal stockists while those with younger male heads were likely to source from other farmers. Every additional year in the age of the male head increased the probability of the household purchasing pigeon pea seed from a cereal stockist by 16.4% *(p*-value=0.014) and reduced the probability of sourcing seed from another farmer by 35.5% (*p*-value=0.036). This could be related to purchasing power of older male heads and their vast experience in farming. The relationship was exactly opposite with women: younger women were more likely to purchase pigeonpea seed from the cereal stockists while older women preferred to source seed from another farmer. A year increase in the age of the woman reduced the probability of sourcing seed from cereal stockists by 18.3% (*p*-value=0.010) and increased the probability of sourcing seed from another farmer by 45% (*p*-value=0.022) *ceteris paribus*.

The schooling level attained by a male household head was not significant in influencing the choice of pigeonpea seed channel but that of the wife was significant. Wives with more years of schooling were more likely to source seed from the agrovets while those with less years of schooling were more likely to source pigeonpea seed from cereal stockists as compared to using own saved seed. An additional year of schooling of the wife would increase the probability of sourcing seed from an agrovet by 172% (*p*-value=0.063) and reduce the probability of sourcing seed from cereal stockists by 80.4% (*p*-value=0.032). Capturing the age of the wife into the regression has clearly shown importance of women's education and its potential in influencing the women's choice of improved pigeonpea varieties vis-à-vis use of own saved seed.

Households with big land sizes were more likely to opt sourcing pigeonpea seeds from the agrovets. An additional acre of land would increase the probability of a household sourcing pigeonpea seeds from the agrovets by 20.9% other than using own saved seeds. Households with large land sizes are more commercially oriented and would therefore prefer to use certified seeds from the agrovets. Households are more likely to source from another famer when the amounts of pigeonpea seeds required are smaller as compared to amounts of own saved seed. For every additional kilogram of seed required, the probability that the household would source from another farmer other than use own saved seed reduces by 1.5% at 90% confidence level. Distance to the seed source was also significant in influencing the type of seed channel used for obtaining pigeonpea seed. An additional kilometer to the source of seed increases the probability of a household sourcing seed from the cereal stockists by 19.3% (*p*-value) and reduces the probability of sourcing from another farmer by 7% (*p*-value=0.046). This implies that farmers are more willing to go for longer distances when sourcing seed from cereal stockists; however. They are more likely to ask for seed from farmers who are close to them as neighbors or friends and don't have the social capital to allow them to borrow far from home.

The total livestock unit was significant and negative (*p*-value=0.040) for the agrovet seed channel: a unit increase in the total livestock unit of the household reduces the probability of sourcing seed from an agrovet by 87.2%. We would have expected a positive correlation assuming that farmers with more animals would have an income source to buy pigeonpea seed from an agrovet. The data we have doesn't allow us to make a conclusion that those farmers who sources pigeonpeas from agrovets are oriented to more commercial pigeonpea farming, but it is our guess; households with high total livestock units are more oriented towards mixed crop livestock farming and pigeonpea production is essentially for subsistence. Contact with extension officers for both the male head and wife of the female head was significant in influencing farmers to source their pigeonpea seeds from an agrovet However, this relationship was opposite for the male head and the wife. While frequent contacts with the extension officer by the wife of the household head would increase the likelihood of sourcing pigeonpea seed from the agrovets, frequent contacts with the male head would reduce this likelihood. An additional contact to the extension officer by the wife would increase the probability of using the agrovet channel by 53.3%, while an additional contact by the male head will reduce the probability of sourcing seed from the agrovets by 41.4%. Women are more receptive to extension services and would likely apply what has been learnt in choosing certified seed channel which is not the case for men. Second, pigeonpea might largely be a woman crop and their contact to extension officers translates into implementing seed system decisions.

County had a significant relationship with the choice of seed channel. Households in Makueni County were less likely to access pigeonpea seeds from other farmers as compared to households in Machakos County (base category); the probability reduces by 337.9%. On the other hand, households in Kitui County were less likely to access seed from agrovets as compared to households in Machakos County; the probability reducing by 451.5%. Kitui County is the farthest from Nairobi, the capital city, and it seems farmers have the least experience with improved pigeonpea seeds as compared to Machakos which host the National Research Center in Dryland Farming (KALRO-Katumani).

Households with employed male heads had a higher probability (721.9%) of accessing seed from other farmers as compared to male heads whose main occupation was farming. Majority of those employed in the study areas are teachers and civil servants, from the interaction and social networks in their workplaces, they are able to get seeds from other farmers which could probably be higher yielding seed varieties. The probability of a household head with a business accessing seed from a cereal stockist increased by 334.9% compared to a household with a male head whose main occupation is farming. Besides the purchasing power being for such households with business, they also are also more exposed to the cereal stockists, who also form part of the business people's network.

The multinomial regression estimates indicate that socioeconomic, demographic and input market characteristics influenced the choice of pigeonpea seed channels. Age, education, land size, distance to the seed source, contact with extension officer, household location (county), and occupation were found to be significant variables. Women's years of schooling as well as constant interaction with the extension people significantly increased their probability of using improved pigeon peas varieties by sourcing from the agrovet shops.

Conclusion and recommendations

The role of legumes or otherwise known as pulses in food and nutritional security and supplementing cash income particularly for ASAL areas with low potential for other high value crops cannot be underscored. Pigeonpea which is one of the main legume crops in Kenya play a critical role as in intercrop for most cereals by assisting in soil nitrogen fixation. Despite the potential of pigeonpeas as food and cash crop, the adoption of high yielding varieties has been low, most importantly due to weak seed systems of availing high quality seeds to farmers. Farmers therefore use various seed channels besides the formal seed company channel (agrovets) to access seeds. This study explores the differenct seed channels that farmers use to acquire Pigeonpea seeds.

Beyond the unitary household approach where the household head is the key respondent, this paper incorporates responses from both male head and the wife of the household head. The paper analyzes the various seed channels applied on joint Pigeonpea plots, women plots and male plots. The findings reveal that slightly more than half of the households have joint Pigeonpea plots. The main seed channel for joint plots was own saved seed; almost half of the households used their own saved seed. The second main seed channel for the joint plots was cereal stockists/open air markets with almost a quarter of the households accessing from this channel. Interestingly, for women plots, the main source of pigeonpea seeds was cereal stockists; Women tend to easily establish a social network which makes it easy for them to know the type and quality of seeds in the cereal stockist. While many can think of the seed in the cereal stockists as grain, farmers bear more trust on this type of seed as they are the ones who sell the grain harvest to the cereal stockist after harvesting. They therefore consider this seed as their own. Very few farmers seem to purchase certified Pigeonpea seeds from the agrovets, and this was only for joint plots with no certified seeds being used in the women plots.

In most studies, focus is only given to the household head who more than often in the rural set up is male, with the other members particularly the wife who plays a major role in small holder agricultural production being neglected. In this study, we do not assume a unitary household model but encompass the characteristics of the wife of the household head in our econometric analysis. The results of the multinomial regression reveal important findings on women and their role in sourcing of certified seed through agrovets. Wives with higher schooling levels were more likely to purchase seed from the agrovets; the results were however not significant for the male head. Additionally, contact to the extension officer by the wife of the household increased the probability of accessing seed from the agrovets; surprisingly contact to extension officer by the male head reduced this probability. This underscores the role of women in small holder legume production. Women accessing extension services easily translate into adoption and use of certified seeds. We therefore recommend that extension services should not only be targeted to household heads but their spouses too, as it will translate to possibly higher adoption. Distance to the source of seed, amount of seed required, total livestock unit, location of the household, and occupation were other factors that determined the choice of seed channel.

From these findings, we recommend that there is need to engage all the stakeholders in creating a robust legume seed system that will ensure quality improved seeds are availed to the farmers. Targeting the cereal stockists in dissemination of improved seed varieties by researchers and the government can be a more efficient method that will ensure improved seed varieties is accessed by more farmers.

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