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FACTORS INFLUENCING SMALLHOLDER FARMERS' INPUTS USE IN MAJOR BEAN PRODUCTION CORRIDORS IN KENYA

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ABSTRACT

This study analysed socio-economic determinants for inputs use in major bean corridors in Kenya. It comprised 417 respondents sampled from four major bean corridors. A structured questionnaire was used in data collection. Probit model was used to assess determinants of input use among the bean-farming households. From the results, 74% of respondents were male with a mean age of 48.6 years. The probability of using agricultural inputs increased with education level and income from crop sales. Fertilizer was mainly used in Bomet (73%) and Narok (74%) counties. Eighty-five percent planted recycled seeds. Education level and Income from crops positively influenced inputs use. It was concluded that education level, incomes from sale of crops, livestock and livestock products, and farm income influenced use of inputs. As a recommendation, Capacity building on merits of input use and promotion of public-private partnerships to strengthen input supply system would enhance increased input use by smallholder farmers.

Keywords: Bean, inputs, determinants, Kenya

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INTRODUCTION

Smallholder farmers continue to dominate the agricultural sector in sub-Saharan Africa. In Kenya, smallholders produce most of their own food and contribute about 70 per cent of all marketed agricultural produce (Wikipedia) making them an important group for the country's GDP as well as food security. One of the most important crops among smallholder farmers is common bean.

Common bean (*Phaseolus vulgaris* L.) is an important grain legume for the direct human consumption in the World (CIAT, 2010; Wortmann *et al.*, 1998). It is a staple food for more than 100 million people in Africa with per capita consumption of 60 kg/person/year (CTA, 2010).

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Being high in nutrients and commercial potential, common bean holds great promise for fighting hunger, increasing income and improving soil fertility in Sub Saharan Africa (Katungi, 2010). It provides dietary protein for over 100 million people in rural and poor urban communities, with an annual per capita bean consumption in Eastern Africa (50 - 60 kg) being the highest in the world (ISAR, 2011). Beans provide a steady and lucrative source of income for many rural households, with the value of bean sales now exceeding US$ 500 million annually (FAO, 2011).

However, to be able to generate outputs that can meet both food and market needs, use of agricultural inputs is paramount. The use of productivity enhancing inputs is still a major challenge among smallholder farmers. Agricultural inputs such as seeds and fertilisers are very significant in improving agricultural yield. Hence, smallholder farmers should be able to achieve higher yields and margins if they adopt recommended agricultural practices and have access to inputs. Inputs play a fundamental role in Agricultural production and productivity the world over, as they constitute the basal segment of the agricultural value chain. This is particularly so when we talk of productivity enhancing technologies or inputs such as improved seed, agro-chemicals among others.

It is widely accepted that increased use of production inputs (seeds, chemicals, and fertilizers) has a critical role to play in the technical change needed for sustained smallholder agricultural growth in Africa, However production inputs use is very low, with particular low usage in smallholder food crop production where constraints on expanded purchased inputs affects both the supply and demand sides (Mare and Barret, 2009).

Farmers are also constrained by lack of information on for example price, appropriate time to apply inputs, yield responses, appropriate input etc. Even assuming that the information exists, it may not be within reach of farmers because extension services has been severely affected by public sector budgetary constraints leaving many workers with their salaries paid but without funds to visit farmers . Farmers' willingness to purchase inputs is also affected by risks and uncertainties..Studies have been done use of inputs on maize production using different methodologies. Studies such as Nkonya et al., (1997); Becerril and Abdulai, (2010); Kassie et al., (2011) have studied adoption and use of improved seed varieties in maize production. Other studies such as Nkonya et al. (1997) and Cavan and Donovan (2011) have studied adoption and use of chemical fertilizers in Maize production. Limited research has been done on nature of input use in bean production particularly in Kenya; this constrains understanding and decisions on optimal input use in bean production. This is critical in the sense that more focus has most of the times been placed on maize and other arable crops while ignoring the role inputs can play in bean production. This paper explores how bean producers use inputs and what determines the extent and incidence of use in Kenya. The study evaluated use of improved seed, fertilizer and agrochemicals used in bean production. The paper focuses providing information on the existing resource use patterns, productive inputs, farmer preferred bean varieties that can benefit stakeholders including extension and other development partners working with beans.

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Materials and methods

Sampling Procedures and Sample Size

Multistage sampling technique was employed in the selection of Counties, Sub-counties and respondents. The first stage involved purposive selection of four (4) bean-growing counties namely Machakos, Bomet, Narok, and Homabay. The second stage involved the selection of two sub-counties from Narok, three from Homabay, one from Bomet and Narok. The sample size was determined using precision criterion, which assumes that the dominant characteristics of a population would occur if the confidence interval is set at 95%. In total, the sample size selected for detailed household survey was 417 households from Bomet, Narok, Machakos and Homabay Counties in Kenya. Data collection took place between June and August 2015.

Method of Data Analysis

Data analysis methods used were descriptive statistics and probit model. Descriptive statistics were used as a investigation preliminary investigation procedure to gain an understanding of inherent significant socio- economic characteristics of the smallholder farmers. The Probit model represents another type of widely used statistical model for studying data with binomial distributions.

The study used descriptive analyses such as table, graphs, means and standard deviation to describe distribution of farmers' households according to farm and farmer characteristics. The study applied a probit model to determine factors that influence input use, assuming that bean inputs use follow the same path as farmer's decision to use or adopt any other agricultural technology. This study adopted a methodology similar to that used by Yuan et al., (2010) which applied the probit model in assessing the factors of use of agro-chemicals. The explanatory variables used in the paper included age, household size, gender, education, size of land owned, livestock ownership, farm income and non-farm income to analyse smallholder farmers' socio-economic determinants for inputs use as presented in the following model.

$$\Pr(y=1/x) = \beta_0+\beta_1 x_{age} + \beta_2 x_{hsize} + \beta_1 x_{gender} + \beta_1 x_{education} + \beta_1 x_{landowned} + \beta_1 x_{livestockown} + \beta_1 x_{landunderbeans} + \beta_1 x_{farm\ income} + \beta_1 x_{non\text{-}farmincome} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Equation 1 represents the probit model used in this study. The dependent variable is INPUTUSE, which represents the aggregation of all responses from the survey questioning current use of farming inputs in selected counties for bean production.

RESULTS

Descriptive Statistics of Sampled Smallholder Farmers and Apriori Expectations

The mean age of the head of household (HH) was 48.6, with a mean of 45.8 (Bomet), 40.5 (Narok), 57.9 (Machakos) and 49.5 (Homabay) years. The maximum age was 92 years, with a

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maximum of 82 (Bomet), 62 (Narok), 92 (Machakos) and 88 (Homabay) years (Table 1), Machakos County had the oldest respondents with a maximum age of about 80years. Age of the household head is used as a proxy for experience in farming. This is expected to improve the intensity of market participation hence indicating they are old and are generally experienced in their farming practices. Age has implications on the availability of family labour and their productivity because age has a direct bearing on the availability of farm labour and the ease with which improved agricultural practices are adopted (Rauf,2010).

From the results (Table1), about 76% of the head of households were male where 73%, 86%, 91% and 68% of the house hold head in Homabay, Machakos, Narok and Homabay counties respectively were male. Gender represents differences in market orientation between male and female heads of households. Cunningham *et al*. (2008) found that men are likely to sell more grain early in the season when prices are still high, while women prefer to store more output for household self-sufficiency.

Inputs Used In Bean Production

Availability of seed is important as it influences increased productivity in bean production. It also influences the time of planting and the acreage under production and therefore yield. The results indicated that majority of the interviewed farmers (94%), used bean seeds. Since bean is considered primarily as a cash crop for some households, it is expected that fertilizer use among the bean farmers would be relatively common. About 33.1% of the sample used fertilizers, with 72.5% (Bomet), 73.5% (Narok), 32.8% (Machakos) and 8.2% (Homabay) stating that they usually used fertilizers (Table 2).

Pesticide and fertilizer use was more common in Bomet and Narok compared to other counties (Table 2). Irrigation was not a common practice in all the sampled counties. Manure was also not used for crop production in these counties.

As shown in Figure 1, agro-dealer were the main source of inputs for the majority of the respondents apart from bean seed which was mainly recycled and manure which was sourced mainly from other farmers. These results are in line with results by Sperling *et al.,* (1996); David and Sperling, (1999) and Rubyogo (2010) which showed that the bulk of bean seed used by farmers is supplied through local sources, farmer saved/traded seed and local seed markets. Unfortunately, these local sources are often disconnected from the innovations of new bean varieties.

Various types of bean varieties were used in the study areas. It is revealed in Table 3 that on an average, 40% farmers in Narok sowed Nyayo variety of bean and Machakos followed with 32.0 %. Wairimu (43%) was the most preferred bean variety in the Bomet County, while KATB1 was more preferred in the Machakos and Homabay Counties with 37 and 10 percent respectively

Wairimu(small red bean) variety was very popular in Bomet county, while *Nyayo* variety was popular in Machakos and Narok. KAT B1 was very popular in the Machakos County (Table 3).

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The other varieties were not very popular. It was observed during the survey that farmers grew beans that are demanded by the consumers (Table 3).

Distance to Input Suppliers

The mean distances to input suppliers Highest in Narok and Machakos counties 13.7 and 13.8 km, respectively. While Homabay had the least distance of 2.08 km (Table 4). From this study finding Table 4, there were large differences in the mean distances to the market between the sampled counties. On average, Narok County were faced with longer distance of about 16.4 to the Agro-dealers who were a major source of pesticides and fertilizers which was 19.57kms more than for Bomet county (5.47kms), 5.41kms more than Machakos, and 11.98kms more than Homabay County. Key et al. (2000) and Makhura et al. (2001) found that distance to the market negatively influences both the decision to participate in markets and the proportion of output sold. Thus, the variable transport costs per unit of distance increases with the potential marketable load size. For farmers in very remote rural areas, geographic isolation through distance creates a wedge between farm gate and market prices.

Results of the Probit Model of Input Use: **Determinants of Input Use by Smallholder Farmers**

With reference to the results in Table 5, the Probit model is significant at $p<0.01$ level of probability. The coefficients estimated revealed that there are some factors such as age, total land holding, livestock and their products, and income from crops , influence use of production inputs by smallholder bean farmers in the study counties. Coefficients that were estimated to be statistically significant imply that use of production inputs by smallholders' bean farmers may decrease or increase as the response of the explanatory variable increases/decreases.

From the results on Table 5, the coefficient for education level has the expected positive sign and is statistically significant at $p<0.10$. Explain/interpret that the coefficient positively influencing smallholder's farmer's use of inputs in bean production. These findings confirm that education has an impact on smallholder farmers' production inputs use. These results are consistent with those reported by Mary at el (2014) supporting the hypothesis that materials promoting technological change typically favour literate farmers. The results also indicate that, the coefficient for income from crops has a positive sign and is statistically significant at $p<0.01$ and positively influencing smallholder's farmer's use of inputs in bean production. Hence, an increase of 1000 Kenya shillings in income from crop sales increase the probability of farmers using input by 0.01% for bean farmers.

Furthermore, the results indicate that farm income has a positive effect on utilization of production inputs by smallholder farmers and is statistically significant at $p<0.05$ on bean farmers. Increases in farm income by 1000 Kenya shillings raise the probability of farmers using inputs by 1.9% for beans. This results support Abdulai and Binder (2006) who suggest that gross farm income from sale of produce is the major source of funds for most farmers. The results also indicate that total number of livestock has a negative effect on the utilization of agricultural

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inputs by smallholder's farmers and is statistically significant at $p<0.10$ for bean farmers. Increase in total number of livestock owned by a household decrease the probability of farmers using inputs 0.08% for bean production. This shows that intensive animal husbandry may reduce demand for agricultural technologies because crop production is a secondary enterprise hence low investment priority in the study area. The direct effect of livestock is that farmers can sell their livestock and get cash to buy inputs and indirect one is that livestock can serve as collateral for fertilizer credit. Therefore, number of livestock such as cattle may have a positive or negative effect on use of these technologies.

Furthermore, in assessing the effect of farmers' location on the use of agricultural input, the findings suggests that among the four regions Narok county has a positive and significant effect at $p<0.05$ on bean input use. These results indicate that increase in number of farmers located in Narok County raise the probability of farmers to use input on bean production by 3.80 %. The geographical location of the farm determines the land potential and thus the expected returns from a given technology (Chirwa, 2005; Doss, 2006). Prevailing agro-ecological conditions capture the potential risk of crop failure associated with rainfall dependency and soil quality, which affects adoption decisions. Researchers have shown that households located in zones where rainfall is high and erratic are likely to use fertilizers than those in zones with less reliable rainfall (Chianu & Tsujii, 2004).

CONCLUSION

The study used data collected at household level to identify factors that influence input use in bean production in selected bean corridors of Kenya. The factors influencing input use was evaluated using probit model estimation. From the study it is noted that decision to use improved seed and agrochemical inputs depends on education level of the farmer, incomes from sale of crops livestock and livestock products, farm income and location of the farmer. Based on the study findings , it can be concluded that the gross farm income from sale of crop produce is the major source of funds for most farmers, hence the higher income accrued from crop sales the more likely farmers can re-invest part in innovations. The total number of livestock had a negative effect on the utilization of agricultural inputs by smallholder's farmers. An increase in total number of livestock owned by a household decreased the probability of farmers using inputs for bean production. This shows that intensive animal husbandry may reduce demand for agricultural technologies because crop production is viewed as secondary enterprise hence low investment priority. Also livestock ownership can have positive effect in use of inputs. Farmers can sell their livestock and get cash to buy inputs and indirect one is that livestock can serve as collateral for fertilizer credit. Therefore, number of livestock such as cattle may have a positive or negative effect on use of these technologies.

A key recommendation is to build capacity of smallholder farmers to appreciate the merits of using improved inputs and agro-chemicals. Strengthen the link between scientific/ modern seed

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and traditional/indigenous knowledge. And promote the public private partnership to strengthen and build sustainable supply systems for agricultural inputs.

Further research would be required to find out how best the smallholder farmers' agricultural production could be enhanced in areas where arable land is increasingly been scarce and degraded making it difficult for generating sufficient food crop production by using existing improved production methods and use of improved inputs..

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Table 1: Demographic Characteristics of the sampled H/Hold head

	Sample size	Gender (%)		Mean age (Years)			Marital Status		
		Male	Female	Mean	Min.	Max.	Married	Single	Widowed
Bomet	69	73.9	26.1	45.8	25	82	88.4	1.4	10.1
Narok	68	86.8	13.2	40.5	23	62	86.8	7.4	5.9
Machakos	61	91.8	8.2	57.9	36	92	91.7	1.7	6.7
Homabay	219	68.0	32.0	49.5	21	88	76.4	3.6	23.6
Total	417	75.5	24.5	48.6	21	92	82.2	1.7	15.8

Source: Farm survey, 2015

Table 2: Percent of respondents in various counties who used various inputs

Inputs	Bomet n=69	Narok n=68	Machakos n=61	Homabay n=219	Total n=417
Improved Bean seed	98.6	92.6	96.7	91.8	93.8
Fertilizers	72.5	73.5	32.8	8.2	33.1
Fungicides	47.8	77.9	13.1	0.0	22.5
Herbicides	13.0	2.9	0.0	1.4	3.4
Field Pesticides	94.2	86.8	31.1	0.3	34.5
Storage Pesticides	49.3	14.7	13.1	3.2	14.1
Irrigation water	1.4	0.0	1.6	0.0	0.5
Manure	0.0	1.5	0.0	2.3	1.4

Source: Survey, 2015

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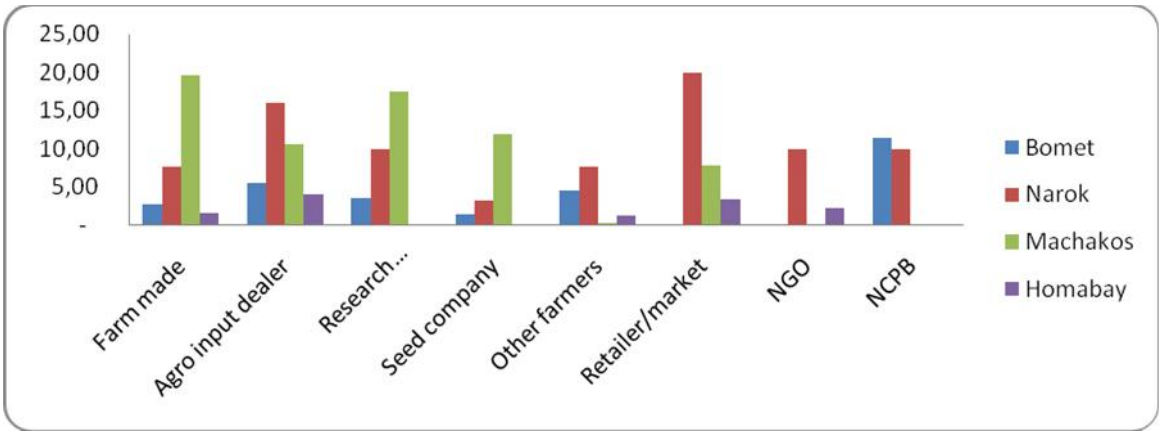

Figure 1: Percentage Sources of various inputs by households
Source: Survey 2015

Key: NGO- non Governmental Organization; NCPB – National Cereals and Produce Board

Table 3: Distribution of varieties among the sampled farmers

	Nyayo	Wairimu	Mwitamania	KATB1	KATX56	KATB9
Narok (n= 69)	40.1	0.5	0.5	0.5	0.0	0.0
Bomet (n=68)	8.1	42.6	0.2	0.0	9.1	0.1
Machakos	32.1	0.2	15.0	33.6	0.5	0.1
Homabay (n=219)	0.3	0.1	0.0	10.2	0.3	0.3

Table 4 : Mean distance (km) to input supplier

Type of supplier of input supplier	**Name of county**				
	Bomet (n=69)	Narok (n= 68)	Machakos (n=61)	Homabay (n=219)	Total (n=417)
Farm made	2.76	7.74	19.64	1.56	6.04
Agro input dealer	5.47	16.04	10.63	4.06	10.10
Research organizations	3.67	10.00	17.50		9.33
Seed company	1.50	3.33	12.00		4.17

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Other farmers	4.55	7.66	0.30	1.38	3.09
Retailer/market		20.00	7.89	3.38	4.74
NGO		10.00		2.21	2.92
NCPB	11.50	10.00			11.33

Source: Survey results (2015)

Table 5: Results of Probit model estimation

Dependants Variables	**Determinants of inputs use in Bean production**		
	Coefficient	P-Values	Marginal effects
Head/H age	-0.002	0.8000	-0.0001
Head/H gender	-0.220	0.370	-0.0180
Household size	0.033	0.110	0.0031
Head /H education	0.0001	0.096	0.0001*
Head/H marital status	0.0670	0.190	0.0062
Incomes from crops	0.0003	0.000	0.0001***
Total land	-0.0040	0.810	-0.0004
Livestock and their products	-0.0082	0.070	-0.0008*
Farm income	-0.0094	0.500	-0.0009
Dummy Homabay	0.254	0.260	0 .0211
Dummy Bomet	0.2970	0.170	0 .0331
Dummy Machakos	-0.2277	0.342	-0.0190
Dummy Narok	-0.504	0.040	0.0380**
Cons	-2.410	0.000	
LR chi2	55.70		
Log likelihood	-172.30		
Pseudo R2	0.1390		
Prob > chi2	0.0000		

Note: ***significant at p<0.01, ** significant at p<0.05 and * significant at p<0.10