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Farmers Preference and Willingness to Pay for Sugarcane Seed Attributes in Kenya

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Abstract:- Over the years, Sustainable production of sugarcane has been impeded by scarcity of high-quality seeds, this has been mainly attributed by dominancy use of recycled planting materials which are often sourced from local social networks. To help reverse this trend, a number of organizations have been involved in the development of improved and clean seed cane planting material. However, a sustainable seed-system has not yet been actualized largely due to limited development of improved cane seed systems. In order to inform the improved cane seed development efforts, it is important to understand farmer's preference toward different attributes attached to sugarcane seed varieties. It's due to the above insistence to identify these preferences that this article has been developed, the data used was collected in Kakamega and Kisumu Counties which occupies the large sugarcane production zone. 284 sugarcane farmers and Value chain actors were interviewed. Choice experiment approach was used in assessment of farmers preferences for sugarcane seeds attributes . The findings of the study revealed that mean age of the farmers was approximately 50 years (49.96 yrs.) with average of 14 years in sugarcane production and average land size of 2 acres with most of farmers having just basic education (Primary school level). The findings indicated that, in general, sugarcane farmers mostly preferred to purchase seed cane planting material with high adaptability to the environment, high yielding, disease resistance, early maturity and Sucrose level in that respective order of importance. The marginal willingness to pay for each attribute show that adaptability had the highest WTP of 3970 followed yields (KES.1316), resistance (KES.608), maturity (KES. 379), and level of Sucrose content (KES.238)respectively. The study therefore recommends that awareness creation on improved cane seeds should be done, and an efficient distribution system for improved seed cane should be established.

Keywords:- *Willingness to Pay, Attributes, Preferences*

I. INTRODUCTION

The sugar sector has a notable impact on Kenya's economy, making up around 15% of the country's agricultural GDP (KSI, 2019) and 3% of the overall national GDP. According to the KSI (2019) and KSB (2010), sugar businesses receive over 92% of their processed sugarcane from more over 250,000 smallholder farmers. The remaining supply comes from factory-owned nucleus estates. The sector generates job opportunities for more than 500,000 workers across the whole value chain, both directly and indirectly. Despite its contribution and relative importance to the national economy, the Kenyan sugar industry faces many challenges that include among others: poor access to improved seed cane, low productivity, Production inefficiencies and high cost of production with industry estimates showing that Kenya's production cost is about 40% above the other COMESA producing countries (Monroy, et al, 2012), lack of supportive institutional, policy, legal and regulatory environment, underutilization of processing capacity due to high competition for cane. As a result of these challenges, Kenya is continuing to be a net importer of sugar (Republic of Kenya, 2018a; United States Department of Agriculture, USDA, 2019). Among these constraints, lack of access to quality seed is one of the most limiting factors in smallholder sugarcane production (KSB, 2010; Monroy, et al., 2012). This is because cane seeds have an important influence on plant growth,productivity and sugar quality in terms of sucrose content which in turn impacts on household income, industry profitability and competitiveness (PASGR, 2016). The majority of Kenyan farmers (90%) mostly obtain their seed cane from previous crops or borrow it from social networks through local farmer-to-farmer channels (Monroy et al, 2012). As a result, most farmers use planting materials that are low yielding, of low quality, and contaminated with pests and diseases. Recycling locally sourced planting materials causes diseases and pests to proliferate and reduces production (Republic of Kenya, 2018b). The other drawback of local farmer to farmer seed systems is that availability of planting materials at the onset of rains is not guaranteed leading to late planting, reduced planted area or even failure to plant in a whole season (KSB, 2010).

Sugarcane seed systems in sub-Saharan Africa have over the years been dominated by supply of planting material from sugar millers and the Sugar Research Institute (formerly, the Kenya Sugar Research Foundation). However, since 2016, the Sugar Development Levey which used to support seed cane development was discontinued. As a result, the sugar cane development including multiplication has been severely affected. The result has been farmers' reliance on the informal sector, mainly from borrowing from social networks. This has in turn affected yield levels of the sugarcane, as recycling of seed cane leads to spread of diseases and pests. Kenya, has been affected by this trend, with the country having the lowest production levels when compared with its COMESA counterparts, Uganda, Zambia and Egypt (FAOSTAT, 2018). The country's productivity is

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at 50-60 tons/ha against a potential of 100-120 tons/ha. The consequence is that Kenya has continued to be a net importer of sugar with the quantities of imported sugar increasing significantly rising in recent years.

While the draft sugar policy (Republic of Kenya, 2018) seeks to promote private sector participation in seed cane development and distribution, understanding of what would support this intention is lacking. This remains a key knowledge gap considering that most studies in the sugar sector have focused increasing productivity and welfare and food security implications. Equally, studies on private seed systems have largely been done on cereals and pulses but the application would be limited to bulk seed system such as sugarcane. The paper aims to provide key information to sugarcane seed development sector and it starts off by characterizing the sugarcane seed systems and farmers preferences and willingness to pay for the attributes for the improved seed cane varieties.

II. MATERIALS AND METHODS

- *Study Area*

The study was done in Western part of Kenya specifically Kisumu and Kakamega due to their status as prominent sugarcane-producing locations in the country (AFA, Sugar Directorate, 2018). The distinct geographical regions in which the two counties are situated enabled the examination of regional disparities and the testing of hypotheses regarding differences within each county.

- *Survey Methodology*

A purposive random sampling of 284 respondents: The researchers selected 33% from each strata (wards) ensured a well representative sample, based on Kothar and Garg's recommendation of a sample size ranging from 10% to 30% of the total population. 284 respondents in total from the two counties 142 respondents in each County, 72 respondents from each sub county and 24 respondents from each ward. In Kisumu the data was collected in two sub counties namely Muhoroni and Nyando and in each sub-county 3 wards were identified and that is Koru,Chemelil,Wawitha (East Kano),Awasi,Kobura and Miwani while for Kakamega the two sub counties are Mumias East and Mumias west with the six wards being Lusheya/Lubinu,Malaha/Isongo/Makunga, East Wanga,Mumias Central,Mumias North and Etenje. The study tool was administered through face-to-face interviews with Sugarcane farmers, Focus Group Discussions (FGDs) and key informant interviews (KIIs) were also conducted.

- *Data Collection*

Data collection was conducted using a pre-tested, structured questionnaire which was administered to each farmer. The study was mainly quantitative and adopted the use of quantitative approaches to collect primary data. Primarily, the study used questionnaires, FGDs and KII's especially sugarcane producers and other actors along the sugarcane seeds value chain. A total of six FGDs were held to understand the nature of sugarcane production, inputs sources, preferred sugarcane seed varieties, motivation for growing sugarcane, marketing channels used, institutional support and overall challenges faced by sugarcane producers. Ten KIIs were held among county agricultural and extension officers, research institutions and development partners supporting sugarcane production.

- *Empirical Specification for Assessment of Farmers Preference on Seed Attributes (Choice Experiment Approach)*

Selection of the Crop variety's desired attributes was the first in designing the choice experiment, after deep review of secondary sources of data, Companies, Farmer groups/saccos, Key informants and FGD's the following attributes were identified as the most considered attributes when choosing a new sugarcane seed variety; Yield, Maturity period, Resistance to disease, price of the seeds and Sucrose content.

Table 1 Description of Seed Attributes and levels as used in the Choice Experiment

Attribute	Description	Levels
Disease-resistance	Disease is a challenge in sugarcane production, more than 30% of the yield is lost through attack by diseases. The use of disease resistant varieties solves the issues hence improving the yield.	Resistant Not resistant
Sucrose Content	Sucrose content is the level of sugar in different varieties of sugarcane, mainly this component is determined by sugar companies since it mostly benefits them and not the farmer. According to many secondary sources of Data most farmers don't care much about sucrose content of Sugarcane variety.	High Low
Yield (Tones per acre)	Yield is simply the total amount of sugarcane that a farmer harvests from a unit of land (Acre) in this case tones per acre. Companies, key informants and secondary data have shown that sugarcane production ranges between 18-25 tones and 40tonnes for farmers who have used improved varieties.	18 Tones 20 Tones 25 Tones 40 Tones
Maturity period	Maturity Duration is the duration between planting and harvesting of the Sugarcane. Some varieties take long to mature while others take very short duration to mature. Many farmers prefer short-term maturity varieties meaning they harvest frequently hence more income. The duration ranges from 18-24 Months for old varieties and 12-16 months for improved varieties	12months 16months 18months 24months

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Price (one ton)	Price is the money that a farmer will exchange for 1tone of seeds in return. Secondary data shows that the price ranges from KSH3500 per ton for farm-farm exchange to a Maximum of KSH5000 per ton for Company-Farm price.	KES. 3500 KES. 4000 KES. 4500 KES. 5000
Environmental adaptability	This is the ability of the new seed varieties to adapt and succeed in the new environmental or the environment in which they will be planted in.	Yes no

Choice sets are generated using a software known as Ngene software (Choice Metrics, 2018). The full block generated consists of 16 choice sets which are divided into two blocks with each block consisting of 8 choice sets each, only one is administered to one farmer to avoid the confusion, saliation and fatigue which can occurs to a farmer if the whole block of 16 choice set is administered to a farmer (Savage & Waldman, 2008).

The choice cards will be tested during the piloting period of the study where 5% participants of the sample size will be interviewed and presented with the choice in order to identify any errors and gaps in the sets. This will help us to come up with a more efficient design for final data collection exercise. The order of presentation will such that every presented with 8 choice sets with different attributes in any order randomly to avoid ordering effect (Loureiro & Umberger, 2007). Each set will have three option columns to choose from, the first two options in each raw they contain the same attribute but with different Table for the farmer to choose from while option three is also called a no choice and the farmer only chooses it when he can't find a favorable option in the first two. Below is a sample of choice card.

➢ *Sample Card*

Table 2 Sample Choice Card

CHOICE SET NO:			
Options	**Option 1**	**Option 2**	**Option 3**
Maturity			No choice
Yield			No choice
Sucrose Content			No choice
Disease Resistance			No choice
Environmental Adaptability			No choice
Price			No choice

In choosing the alternatives in each choice set every farmer were expected to choose an alternative which could give them full satisfaction, an act where consumer or farmer gets a full satisfaction or a value from using a product is known as Utility. The utility each sugarcane farmer k attains from each alternative j within a choice set s is given by:

$$U_{kjs} = \beta_k X_{kjs} + \varepsilon_{kjs} \quad (1)$$

Where:

X_{kjs} ; observed variables

β_k; vector of coefficients of different seed cane attributes

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ε_{kjs}; stochastic error term to capture unobservable factors which affects decision making of the farmers.

This study seeks to estimate farmer's utility for yield, Maturity duration, price of improved seeds, Disease resistance, Environmental adaptability and sucrose content

Equation 2 below shows attributes of the study in the model:

$$U_{kjs} = \beta_1 yield_{kjs} + \beta_2 Sucrose\ content_{kjs} + \beta_3 maturity_{kjs} + \beta_4 price_{kjs} + \beta_5 disease\ resistance_{kjs} + \beta_5 environmental\ adaptability_{kjs} + \beta_6 none_{kjs} + \varepsilon_{kjs} \quad (2)$$

From the equation above yield, maturity and price were represent as Continuous variable while Sucrose content, environmental adaptability and disease resistance were represented as dummy variable which is equal to one if positive and zero otherwise. None was a dummy variable of value one since the only an option of 'no choice' for farmers. The assumption is that farmers only chose an option if the utility derived from that option j is greater than the utility which could have been derived from choosing other options since U_{kjs} is not directly observable.

A representative utility was constructed with assumption that there is linearity in the seed cane attributes observed for the alternative options as seen in the equation above.

$$W_{kj} = X_{kj}\beta + \varepsilon_{kj} \quad (3)$$

Conditional logit (CL) model was be used in this study since it utilizes the alternatives inside the choice sets as the primary focus for estimate (Hoffman & Duncan, 1988). The probability that a farmer k chooses alternative j for the CL was specified as:

$$p_{kj} = \frac{\exp(\beta X_{kj})}{\sum_{i=1}^{j} \exp(\beta X_{ki})} \quad (4)$$

Where;

p_{kj} : probability of farmer k choosing alternative j,

X_{kj} : characteristics of alternative j for farmer k,

β: vector of parameter for attribute characteristics.

The MWTP for each of the sugarcane seed attribute was estimated using the function below;

$$\text{MWTP} = -1 * \left(\frac{\beta_i}{\beta_{price}}\right) \quad (5)$$

➢ *Statistical Analysis*

The first step involved selection of desirable characteristics based on farmer preferences; the attributes that were considered include: yield (tonnage), maturity period, sucrose content, disease resistance, pest resistance, drought tolerance, financing mechanism and price (Oluoch-Kosura, *et al*, 2019). The study considered sugarcane farmer's preference for an alternative in a choice set, assuming that the utility farmers derive from a choice set consists of attributes related to that option. The utility function was specified as;

$$HI = \sum_{i=1}^{n} (AE_i)^2$$

$$U_{kj} = V(Z_{kj}, S_k) + \varepsilon_k \quad (6)$$

Where for any k farmers, the level of utility derived from a certain choice is linked to another choice set. Z represents the attributes in a choice set j from which the farmer k derives utility from. S_k are socio-economic characteristics of a farmer k and ε_k is the error term which captures all external factors from the model. It is assumed that a farmer chooses an option which gives the highest level of utility. The probability that a farmer chooses an alternative j among other alternatives in a choice set was given as;

$$P_k(j) = \Pr(U_{kj} \geq U_{km}) \quad (7)$$

The two (1 and 2) yield:

$$P_k(j) = \Pr[V(Z_{kj}, S_k) + \varepsilon_{kj} \geq V(Z_{km}, S_k) + \varepsilon_{km}] \quad (8)$$

Since the choice set contains more than two values, a multinomial logit model will be used as specified in equation 4;

$$P_k(j) = \frac{\exp(V_{ti})}{\sum_t exp(V_{to})} \quad (9)$$

Where V_{ti} is an indirect utility function before usage of choice set selected and V_{to} is an indirect utility P.

III. RESULTS AND DISCUSSION

➢ *Descriptive analysis of Respondents' Demographic and Household Characteristics*

As presented in Table 3 and 4 below, the average age of farmers was 47yrs with both respondents from Kisumu and Kakamega recording an almost similar average of 46.6 and 47.2 years respectively. The household size showed a significant difference (p=0.002) with an average size of 6 members per household and with an average of one member in household being 14 yrs and below. 78.5% of the farmers (respondents) were male while only 21.5% were female. Furthermore, Male respondents had substantial power in heading decision making processes (73.6%) whereas, 16.9% were headed by a female, 8.8% had both a male and female as the head and decision makers and only 0.7% were headed by other family members.

In terms of educational attainment, it was found that 108 (38%) of the household heads had only attained primary level of education while 99 (34.9%) attained secondary education, 37 (13%) attained vocational level of education, 23 (8.1%) attained tertiary level and only 17 (6%) went through

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informal education. Revealing significant difference (p = 0.008) in educational attainment between farmers in Kisumu and Kakamega.

The average total size of the land was 2.002 hectares, from which an average of 1.42 hectares was allocated for sugarcane production. Further analysis revealed that there was a significant difference (p = 0.001) in the total land size owned by households in Kisumu and Kakamega counties, however, there wasn't a significant difference (p =0.097) on the land size allocated for sugarcane production in the two counties.

The study findings revealed that the farmers in this study had an average of 14.31 years of experience in sugarcane production. Furthermore, the findings revealed that there wasn't a significant difference (p = 0.967) in the years of sugarcane production between farmers from the two regions.

According to the study findings, on average, the nearest market to the farmers' homesteads was 4.267 Km away whereas their proximity to a tarmac road was 4.487 Km. This finding suggested that the farmers' proximity to the market was slightly closer than to a tarmac road implying that most farmers in the two regions access the market through non-tarmac roads.

Majority of the farmers 248 (87.3%) didn't have access to extension services while only a few 36 (12.7%) did. This finding underscores the challenges that farmers in the study area have in regards to access to professional agricultural help and knowledge which may negatively impact their adoption of improved sugarcane seeds. Furthermore, the findings also revealed that most of the farmers 191 (67.3%) didn't have membership to any farmers' group.

In the study, majority of the farmers 204 (71.6%) didn't have access to credit facilities. Only 80 (28.4%) indicated to have access to credit. This implied that most of the farmers in the study area could be struggling with liquidity constraints which may subsequently have an implication on their willingness to pay for improved sugarcane seeds.

Table 3 Descriptive Statistics for Continuous Household Characteristics

	Total Sample N = 284		**Kakamega (0) N = 150**		**Kisumu (1) N = 134**		**Mean Diff' (1 – 0)**	**P**
	Mean	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**		
Demographics								
Age	46.96	13.502	47.23	13.888	46.66	13.103	-.569	0.724
Household size	5.92	3.188	6.47	3.942	5.23	1.599	-1.153	0.002
Farm characteristics								
Land size (Ha)	2.002	2.890	1.484	2.002	2.581	3.556	1.096	0.001
Sugarcane land size (Ha)	1.42	.722	1.35	0.706	1.50	0.735	0.143	0.097
Sugarcane production years	14.31	11.292	14.34	11.790	14.28	10.750	-.056	0.967
Institutional factors (Mkt Access)								
Market distance (km)	4.267	29.662	4.899	40.715	3.560	3.748	-1.3393	0.705
Tarmac distance (km)	4.487	4.361	4.556	3.958	4.409	4.787	-.14738	0.777
N = number of observations; S.D = standard deviation; P = statistical significance of independent samples t-test used to compare characteristics difference between respondents from Kisumu and Kakamega								

Table 4 Descriptive Statistics for Categorical Household Characteristics

	Measurement	**Total Sample N = 284**	**Kakamega (0) N = 150**	**Kisumu (1) N = 134**	**Mean Diff' (1 – 0)**	**P**
Demographics factors						
Gender	Female	61 (21.5%)	45 (30%)	25 (18.7%)	- 11.3	0.312
	Male	223 (78.5%)	105 (70%)	109 (81.3%)	11.3	
Education Level	Informal	17 (6%)	13 (8.7%)	4 (3%)	- 5.7	0.008
	Primary	108 (38%)	68 (45.3%)	40 (29.9%)	- 15.4	
	Secondary	99 (34.9%)	42 (28%)	57 (42.5 %)	- 14.5	
	Vocational	37 (13%)	17 (11.3%)	20 (14.9%)	3.6	
	Tertiary	23 (8.1%)	10 (6.7%)	13 (9.7%)	3	
Institutional factors						
Farmers group	No	191 (67.3%)	120 (80%)	71 (53%)	- 27	<0.001
	Yes	93 (32.7%)	30 (20%)	63 (47%)	27	
Credit access	No	204 (71.6%)	117 (78%)	87 (64.9%)	- 13.1	0.017
	Yes	80 (28.4%)	33 (22%)	47 (35.1%)	13.1	
Extension access	No	248 (87.3%)	120 (80%)	128 (95.5%)	15.5	<0.001
	Yes	36 (12.7%)	30 (20%)	6 (4.5%)	- 15.5	

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➢ *Assessment of Farmers' Preferences for Sugarcane Seed Attributes*

To assess the farmers' preferences for sugarcane seed attributes, the researcher conducted a choice experiment which was later analyzed by use of conditional logit model to identify the most significant attributes to the farmers. The results are presented in Table 5 below.

Table 5 Farmers' Preferences for Sugarcane Attributes

Attribute	**Total Sample**			**Kisumu County**			**Kakamega County**		
	Coeff.	SE	P	Coeff.	SE	P	Coeff.	SE	P
Price	-.00018	.000	0.000	-.00024	.000	0.000	-.00015	.000	0.000
Yield	.236	.065	0.000	.359	.117	0.002	.174	.078	0.025
Resistance	.109	.069	0.119	.188	.122	0.122	.018	.098	0.852
Adaptability	.712	.077	0.000	1.020	.155	0.000	.535	.088	0.000
Maturity	-.068	.010	0.000	-.076	.021	0.000	-.065	.011	0.000
Sucrose	-.043	.011	0.000	-.077	.017	0.000	-.021	.014	0.148
No. of Obs.	2644			1154			1490		
Log- Pseudo likelihood	-758.60			-301.69			-446.38		
Wald chi2(6)	105.36			52.90			58.13		
Prob > chi2	0.000			0.0000			0.0000		

The data in Table 5 above presents the results of a conditional logit regression analysis that examined farmers' preferences for various sugarcane attributes. The estimated log-pseudo likelihood values indicated the robustness of the models, with a high level of significance across all samples (Prob > chi2 = 0.000). The Wald chi2 values of 105.36 confirmed that the model's overall statistical significance and good fit, reinforcing the reliability of these findings.

The negative coefficient for price across all samples indicated that as the price of sugarcane seeds increased, the farmers' preference for purchasing those seeds decreases. This is consistent with basic economic theory that states that higher costs generally reduce demand. Price was estimated to have a coefficient of -0.00018 ($p < 0.000$) for the total sample, Kisumu County had a coefficient of -0.00024 ($p < 0.000$), and Kakamega County showed a coefficient of -0.00015 ($p < 0.000$). The observed significant negative relationship aligned with findings in agricultural economics literature where price sensitivity is considered a critical factor when making choice of a seed (Morris, 1998).

Yield had a positive and significant effect on farmers' preferences in all groups. The total sample had a coefficient of 0.236 ($p < 0.000$), indicating that higher yield potential is highly valued by farmers. In Kisumu County, the coefficient is 0.359 ($p = 0.002$), suggesting an even stronger preference for yield, while in Kakamega County, the coefficient is 0.174 ($p = 0.025$). This supports the idea that yield is a primary consideration for farmers, as higher yields typically translate to higher profitability (Fischer et al., 2014).

The coefficient for resistance is positive but not statistically significant in the total sample (0.109, $p = 0.119$) and in Kisumu County (0.188, $p = 0.122$). In Kakamega County, the coefficient is notably lower and insignificant (0.018, $p = 0.852$). This indicates that resistance is not a major driver of seed preference among the surveyed farmers, possibly due to other more pressing concerns such as yield and adaptability. Literature suggests that while disease resistance is important, it may not be prioritized if farmers do not perceive immediate threats or have effective management practices in place (Jones, 2002).

Adaptability has the highest positive coefficients across all samples, indicating a strong preference. The total sample shows a coefficient of 0.712 ($p < 0.000$), Kisumu County has 1.020 ($p < 0.000$), and Kakamega County has 0.535 ($p < 0.000$). This underscores the critical importance of seeds that can thrive under local environmental conditions, which is a well-documented priority among farmers in diverse agricultural settings (Sperling & McGuire, 2010).

The negative coefficient for maturity in all samples suggests that farmers prefer varieties that mature more quickly. The total sample has a coefficient of -0.068 ($p < 0.000$), Kisumu County shows -0.076 ($p < 0.000$), and Kakamega County has -0.065 ($p < 0.000$). This preference likely stems from the need for faster returns on investment and the ability to harvest multiple crops within a growing season (Almekinders et al., 1994).

The coefficient for sucrose is negative in the total sample (-0.043, $p < 0.000$) and in Kisumu County (-0.077, $p < 0.000$), but it is not significant in Kakamega County (-0.021, $p = 0.148$). This suggests that higher sucrose content is not a priority for most farmers, possibly due to the focus on other agronomic traits like yield and adaptability. Previous studies have noted that while sucrose content is important for processing, farmers may prioritize attributes that directly affect their immediate agricultural productivity (Borrell et al., 2000).

➢ *Farmer's Marginal Willingness to Pay for Each Sugarcane Seed Attribute*

Farmers' preferences for sugarcane seed traits were evaluated by analyzing their Marginal Willingness to Pay (MWTP), as presented in Table 6 below. MWTP represents the trade-off between non-monetary factors such as; (adaptability, yield, resistance, maturity, and sucrose levels) and the monetary factor (price). Essentially, it indicates how much money farmers are willing to spend to obtain seeds with

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a particular desirable trait, such as adaptability, compared to seeds without that trait. Therefore, a higher Marginal Willingness to Pay for a particular trait suggests that the trait is more highly valued by farmers.

Table 6 Farmer's Marginal Willingness to Pay for Each Sugarcane Seed Attribute

Attribute	Total sample	Kisumu County	Kakamega County
Adaptability	KES.3970.54***	KES.4279.58***	KES.3476.31***
Yield	KES.1316.16**	KES.1509.93**	KES.1131.00**
Resistance	KES.608.03	KES.790.51	KES.118.67
Maturity	KES.379.32***	KES.319.02***	KES.424.51***
Sucrose	KES.238.21**	KES.321.79***	KES.133.43**

The results in the Table 6 highlights the farmers marginal willingness to pay for various attributes of sugarcane seeds in the total sample surveyed and among farmers in Kisumu and Kakamega. The findings revealed that the farmers in the study area were willing to pay the highest premium (Ksh. 3,970.54) for adaptability. However, farmers in Kisumu County were willing to pay more (Ksh. 4279.58) as compared to their counterparts who were willing to pay a lesser amount (Ksh. 3476.31) for the same attribute. This suggested that farmers in Kisumu County were more concerned with adaptability of a sugarcane seed slightly more than those in Kakamega. Also, the results revealed that yield was the second most valued attribute across the study area as farmers were willing to pay Ksh. 1,316.16 for this attribute. Similar to the trait of adaptability, farmers were willing to also pay more (Ksh. 1,509.93) for yield, as compared to those in Kakamega who were willing to pay Ksh. 1,131.00. This finding suggest that yield was also an important attribute considered by Kisumu County farmers.

The attribute of resistance to disease was also evaluated, revealing that relative to adaptability and yield, resistance attribute was valued lower. Farmers across the study area were willing to pay Ksh. 608.03 for this attribute. Similar to adaptability and yield, Kisumu County farmers placed a higher value on resistance, willing to pay Ksh. 790.51 whereas farmers in Kakamega showed a significantly lower WTP of Ksh. 118.67 for the resistance attribute. This finding underscored a significant disparity in the value and importance of disease resistance trait between the two regions. However, farmers generally placed a moderate value on the attribute of maturity with a WTP of Ksh. 379.02. County comparison revealed that farmers in Kakamega County valued maturity period more with a WTP of Ksh. 424.51 as compared to farmers in Kisumu County who were willing to pay Ksh. 319.02, highlighting a distinct preference for maturity attribute in Kakamega.

Finally, sucrose content was found to be the least valued attribute by the total sample. Farmers across the study area were only willing to pay Ksh. 238.21 for this attribute. However, farmers in Kisumu were willing to pay more (Ksh. 321.79) for this attribute whereas farmers in Kakamega were willing to pay even lesser (Ksh. 133.43) for this attribute. These findings underscore the fact that, despite sucrose being generally undervalued, it held more value to farmers in Kisumu as compared to those in Kakamega. Generally, these findings highlight the inherent variations in the importance and value placed on the multiple traits of sugarcane seed by farmers from the study area, with those from Kisumu willing placing more value and importance to most of the attributes hence willing to pay more as compared to farmers in Kakamega County.

IV. CONCLUSION

Based on the findings of this study,it can be concluded that Kenya in general has a sugarcane seed system that is not well developed and it's characterized by relatively mild seed insecurity, self-production of seeds, low awareness and uptake of improved seeds, and a high dependency on local farmers for sourcing of seeds and agricultural knowledge. This underscores the need for interventions that are aimed at improving the level of seed security in the country, improving the accessibility and availability of adaptable seeds, increasing the level of awareness of improved seeds and improving accessibility to agricultural information. Furthermore, it is important for farmers in Kenya to be empowered to adopt innovative methods and improve their productivity.

Based on the study findings on the farmers' preferences for sugarcane seed attributes, the study conclude that farmers had a higher consideration for a seed's adaptability, yield, maturity, sucrose content, and resistance in order of their importance to them. Implying that it is important that these attributes be highly considered as per the farmers preferences during seed breeding programs.

RECOMMENDATIONS

Based on the findings, various recommendations can be drawn to assist sugarcane farmers in Kenya. Firstly, it is necessary to enhance farmers access to agricultural education and training so as to provide farmers with the necessary knowledge that would enable them to adopt modern methods of farming. Secondly, it is important to ensure that there is adequate development and strengthening of private to ensure adequate production, improvisation and implementation of new technologies and in this case improved seed varieties with highly desirable attributes by farmers.

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REFERENCES

[1]. Agossou, A. C. O., N'Danikou, S., Fassinou Hotègni, V. N., Kakpo, T. A., Coulibaly, M., Oselebe, H. O., & Achigan-Dako, E. G. (2023, August 2). Determinants of farmers' willingness to pay for improved cultivars of Macrotyloma geocarpum (harms) Maréchal and Baudet in Benin and Togo. *Frontiers in Sustainable Food Systems*, *7*. https://doi.org/10.3389/fsufs.2023.1180961

[2]. Ahmed, U. I., Ying, L., Bashir, M. K., Abid, M., Elahi, E., & Iqbal, M. A. (2016). Access to output market by small farmers: The case of Punjab, Pakistan. Journal of Animal and Plant Sciences, 26(3), 787–793.

[3]. Almekinders, C. J., Louwaars, N. P., & De Bruijn, G. H. (1994). Local seed systems and their importance for an improved seed supply in developing countries. *Euphytica*, *78*, 207-216.

[4]. Ambetsa, F. L., Ndirangu, S. N., & Mwangi, S. C. (2021, May 5). Smallholder Sugarcane Farmers' Participation and Profitability of Factory Contracted Services in Malava Sub-County, Kenya. *Journal of Agricultural Extension*, *25*(2), 54–65. https://doi.org/10.4314/jae.v25i2.5

[5]. Anugwa, I. Q., Onwubuya, E. A., Chah, J. M., Abonyi, C. C., & Nduka, E. K. (2021, July 26). Farmers' preferences and willingness to pay for climate-smart agricultural technologies on rice production in Nigeria. *Climate Policy*, *22*(1), 112–131. https://doi.org/10.1080/14693062.2021.1953435

[6]. Ateka, J., & Mbeche, R. M. (2022). To Sell or Store? Assessing Smallholder Farmers' Willingness to Pay for Potato Cold Storage in Kenya. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4035594

[7]. Ayinde, J., Torimiro, D., & Koledoye, G. (2014). Youth Migration and Agricultural Production: Analysis of Farming Communities of Osun State, Nigeria. Journal of Agricultural Extension, 18(1), 121. https://doi.org/10.4314/jae.v18i1.11

[8]. Bucheyeki, T. L., Shenkalwa, E., Kadadi, D., & Lobulu, J. (n.d.). *Assessment of Rice Production Constraints and Farmers Preferences in Nzega and Igunga Districts*. ResearchGate. https://www.researchgate.net/publication/267384305

[9]. Duflo, E., Kremer, M., & Robinson, J. (2008). How high are rates of return to fertilizer? Evidence from field experiments in Kenya. *American economic review*, *98*(2), 482-488.

[10]. FAO (2019)

[11]. Grimm, M., Luck, N., & Steinhübel, F. (2023, January). Consumers' willingness to pay for organic rice: Insights from a non-hypothetical experiment in Indonesia. *Australian Journal of Agricultural and Resource Economics*, *67*(1), 83–103. https://doi.org/10.1111/1467-8489.12501

[12]. Jones, A. (2002). An environmental assessment of food supply chains: a case study on dessert apples. *Environmental management*, *30*, 560-576.

[13]. Khainga, D. N., Obare, G., & Nyangena, J. (2018). Estimating pastoralists willingness to pay for artificial insemination in arid and semi-arid lands of Kenya. Journal of Development and Agricultural Economics, 10(8), 262–270. https://doi.org/10.5897/jdae2018.0920

[14]. Martey, E., Etwire, P. M., Adombilla, R., & Abebrese, S. O. (2023, February). Information constraint and farmers' willingness to pay for an irrigation scheduling tool. *Agricultural Water Management*, *276*, 108043. https://doi.org/10.1016/j.agwat.2022.108043

[15]. McGuire, S., & Sperling, L. (2016). Seed systems smallholder farmers use. Food Security, 8(1), 179–195. https://doi.org/10.1007/s12571-015-0528-8

[16]. Morris, M., & Byerlee, D. (1998). Maintaining productivity gains in post-Green Revolution Asian agriculture. *International agricultural development.*, (Ed. 3), 458-473.Fischer et al., (2014)

[17]. Mwangi, C. W., Ateka, J., Mbeche, R., Oyugi, L., & Ateka, E. (2022, May 17). Comparing farmers' willingness to pay with costs of clean sweet potato seed multiplication in Kenya. *Food Security*, *14*(5), 1279–1293. https://doi.org/10.1007/s12571-022-01293-w

[18]. Mwangi, M., & Kariuki, S. (2015). Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries. Journal of Economics and Sustainable Development, 6(5), 208–216. www.iiste.org

[19]. Nawi, N., Basri, H., Kamarulzaman, N., & Shamsudin, M. (2023, January 11). Consumers' preferences and willingness-to-pay for traceability systems in purchasing meat and meat products. *Food Research*, *7*(1), 1–10. https://doi.org/10.26656/fr.2017.7(1).646

[20]. Nawi, N., Basri, H., Kamarulzaman, N., & Shamsudin, M. (2023, January 11). Consumers' preferences and willingness-to-pay for traceability systems in purchasing meat and meat products. *Food Research*, *7*(1), 1–10. https://doi.org/10.26656/fr.2017.7(1).646

[21]. Ntshangase, N. L., Muroyiwa, B., & Sibanda, M. (2018). Farmers' perceptions and factors influencing the adoption of no-till conservation agriculture by small-scale farmers in Zashuke, KwaZulu-Natal province. Sustainability (Switzerland), 10(2). https://doi.org/10.3390/su10020555

[22]. Ortiz, C., Avila, J., & Martinez-Cruz, A. L. (2022). Dairy Farmers' Willingness to Adopt Cleaner Production Practices for Water Conservation: A Discrete Choice Experiment in Mejia, Ecuador. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4250950

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT1827

[23]. Perman, R., Ma, Y., McGilvray, J., & Common, M. (2002). Natural Resource and Environmental Economics Database. In Marine Resource Economics (Vol. 7, Issue 4). https://doi.org/10.1086/mre.7.4.42629040
[24]. Sperling, L., Cooper, H. D., & Remington, T. (2008). Moving towards more effective seed aid. *The Journal of Development Studies*, *44*(4), 586-612.
[25]. World Bank (2022). *Poverty*. https://www.worldbank.org/en/topic/poverty.