Research Article

International Journal of Agriculture and Technology

Factors Related to Farmers' Acceptance of Improved Technologies: A Case Study of Small-scale Sugar Cane Farmers in Kakamega County, Kenya.

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Received: 21 Sep 2022; **Accepted:** 27 Oct 2022; **Published:** 01 Nov 2022

Citation: Thuo CM, Ombati JM, Nkurumwa AO. Factors Related to Farmers' Acceptance of Improved Technologies: A Case Study of Small-scale Sugar Cane Farmers in Kakamega County, Kenya.. Int J Agriculture Technology. 2022; 2(1): 1-11.

ABSTRACT

Improvement of agricultural technologies has been a global focus, aimed at enhancing agricultural productivity for economic growth and improved livelihood. Through research, many agricultural technologies, loaded with potential benefits have been produced but their acceptance by the intended users has been a global challenge. This calls for need to develop effective mechanism to enhance technology acceptance so that their potential benefits may be realised. This study focused on these phenomena through establishment of various factors related to acceptance of improved sugar cane varieties among small-scale sugar cane farmers in Kakamega County. Understanding of these factors was critical, as it would pin point critical conditions that would facillitate wider acceptance of improved technologies by the targeted users. The study was built on Unified Theory of Acceptance and Use of Technology (UTAUT); and the theory of Diffusion of Innovations (DOI). A Cross-Sectional Survey research design was used. The target population was 137,355 sugar cane farmers from Kakamega County, from which a sample of 384 farmers was randomly selected. Questionnaires were used to collect data. Statistical analysis was done using chi-square at 0.05 significance level. The study findings established significant relationships between gender, age, education, land ownership, experience in farming, source of income, sugar cane varietal attributes, variety choice, seed sources, availability of advisory services and marketing of sugar cane, with farmers' acceptance of improved varieties. Addressing these factors is of great importance to technology developers and promoters as they would facilitate acceptance of the improved technologies produced by farmers. The study recommended extension service providers and sugar millers to provide farmers with adequate information on improved sugar cane varieties, required facilitating resources and supportive services in effort to enhance production of these varieties by farmers. The study has also contributed valuable information to the existing literature in agricultural extension.

Keywords

Farmers, Sugar cane, Improved Varieties, Acceptance, Technologies.

Introduction

Utilization of improved technologies is one of the critical ways of enhancing agricultural productivity for economic growth and improved rural livelihood [1-3]. Many improved technologies have been developed by various agricultural research systems [4]. However, acceptance of these technologies by intended users has been a global challenge, often faced with change resistance and therefore their intended benefits are never realised [4-8]. According to Mwangi and Kariuki [6], majority of smallholder farmers prefer to use traditional methods of production, which has lowered agricultural productivity. The greatest challenge is therefore designing an effective mechanism for enhancing technology acceptance by end-users and subsequent use of innovations [7,9].

Improvement of crop varieties has been identified as a key approach towards enhancing agricultural productivity [6]. The

sugar industry among many global agricultural sectors, have engaged in research to improve crop varieties. According to Chaku [10], major sugar cane growing countries of the world such as Brazil, Australia and India have continuously invested heavily in genetic improvement to develop improved sugar cane varieties for farmers and millers. In Kenya, the sugar sector has similar variety improvement programmes, for producing improved sugarcane varieties to address threatening challenges [11]. Decline in sugar cane productivity is one of the major threats facing the Kenyan sugar sector. According to Mwanga, Ong'ala and Orwa [12], yields dropped from 74 TCH to 61 TCH between 2004 to 2014; and from 61TCH to 55TCH between 2014 to 2018 [13]. This was attributed to the widespread use of low-quality sugar cane varieties [13,14]. These varieties include CO421, CO617 and CO945, and occupies 39, 22 and 17 percent of the total area under sugar cane in Kenya [15]. They are prone to diseases like smut, low yielding in sucrose content and late maturing, taking 20 to 24 months to mature. By contrast Sudan grows early maturing varieties that mature within 14 months [13]. Their continued production has resulted to unprofitable sugar cane farming and insufficient sugar production that cannot fully address Kenyan sugar domestic needs. The Country is therefore forced to import approximately 240,000 metric tons of sugar annually to bridge the gap [16].

In effort to increase productivity, high yielding, early maturing; pest and disease resistant sugar cane varieties have been developed and promoted for adoption by farmers since 2002 [11]. They include six varieties released in 2002 (KEN82-808, KEN82-216, KEN82-219, KEN83-737, KEN82-401, KEN82-247); four varieties released in 2007 (KEN82-472, KEN82-62, D84-84, EAK73-335); three varieties released in 2011 (KEN82-601, KEN82-121, KEN82-493 and eight varieties released in 2014 (KEN98-530, KEN98-533, KEN98-551, KEN00-13, KEN00-3811, KEN00-3548, KEN98-367 and KEN00-5873). However, despite the efforts made and the aforementioned advantages, acceptance of these improved varieties by farmers remain a serious challenge. The varieties account for approximately 9 percent of sugar cane varieties under production in Kenya [15]. KEN83-737, EAK73-335 and D84-84 are the most widely produced improved varieties and occupies 6.3, 1.8 and 1.3 percent of total area under sugar cane production in Kenya [15]. Low acceptance of these varieties is a significant impediment to their success in Kenya and therefore need to identify factors that can enhance their wider acceptance by farmers.

According to Lima, Hopkins, Gurney, Shortall, Lovatt and Davies [17], Talukder [7], technology acceptance is influenced by socio-demographics factors (gender, age, education), financial resources and farm sizes. Gender-linked factors that affect farmers' access to key resources like land, credit and contact with extension agents affect technology acceptance [18]. Age has been identified to play an important role in the dissemination and adoption of innovations [19]. Younger farmers are known to be more willing to accept new technologies while older farmers are better innovation evaluators [6]. Education is critical in technology acceptance as it enables farmers to read, write and follow technical recommendations [18,20] enhances decision-making process and farmers innovativeness [21]. Source of income is also critical in technology acceptance as it demonstrates farmer's ability to acquire necessary farm inputs [18]. Land ownership widely encourage technology acceptance as more land holdings indicate more potential to increase productivity and efficiency to adopt innovations [6,19]. Farmers also require sufficient information and exposure to the latest technologies to improve their skills and knowledge about modern agricultural technologies [1,19,22,23]. Jack [22], further identifies that absence of facilitating resources represents barriers to technology usage and may hinder its acceptance. Lack of improved seeds, fertilizers, poor infrastructure, inefficient input and output markets are impediments to acceptance of profitable innovations [18,22]. Involvement of farmers in technology development activities has been identified to enable greater acceptance of technologies generated. It ensures production of appropriate technologies, compatible with farmers perceived needs, values, beliefs and preferences [4,9,24,25]. According to Dimitra, Adam, Peggy and Man Fung [5], overlooking the farmer may result to production of technology that will never match with planned goals. Kaihura [26], further identifies that active participation of farmers in technology dissemination facilitate and fasten the process of information exchange, dissemination and adoption. Farmers act as grass-roots promoters of technologies, as they are certain about the technology performance and are able to use it. They also have an in-depth knowledge of local conditions, culture, and practices and are known by other farmers and hence have their trust [27].

This study was built on the theory of Diffusion of Innovations (DOI) by Rogers [28] and the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh, Thong & Xu [29], which identifies factors associated with technology acceptance. Relationship between these factors and acceptance of improved sugar cane varieties was established to identify conditions that would facillitate their acceptance by farmers. DOI theory has identified innovation characteristics as a key element that influence rate of innovation diffusion [21]. Ghane, Samah, Ahmad & Idris [30] acknowledged that innovations, which are perceived as having greater relative advantage, compatibility, observability, trialability and less complex, have greater acceptance rate. In this study, improved sugar cane varieties with attributes compatible with farmers need were expected to be highly acceptable by farmers. DOI also emphasizes on use of effective communication channels for enhanced innovation acceptance. Use of farmer participatory approaches in development and dissemination of improved varieties was expected to enhance their acceptance by farmers. UTAUT model by Venkatesh, Thong & Xu, [29] explains the user's behavior of accepting a technology [31]. The model identifies performance expectancy, effort expectancy, social influence, facilitating conditions, gender, age, experience and voluntariness of use, as key factors that influence technology acceptance and use [29]. According to Sa'ari, Jabar, Tahir and Mahpoth [32], performance expectancy indicates benefits of a technology in performing certain activities. Technology perceived as beneficial is easily accepted. Production of improved varieties is expected to enhance productivity in sugar cane farming. Effort expectancy is the ease of use of technology. A technology perceived

by people as easy to use is expected to be more acceptable. Improved sugar cane varieties with attributes compatible with the traditional commercial varieties under production are expected to be produced with ease by farmers. Social influence is the extent to which consumers perceive that important others should use a particular technology. It was expected that membership in research groups can influence farmers in production of improved sugar cane varieties. Facilitating conditions are the resources and support available to perform a behavior. It is expected that availability of critical resources required in production of improved varieties would enhance their acceptance. This UTAUT model has identified innovation characteristics, facilitation condition and farmers' characteristics that need to be considered to enhance acceptance of improved technologies generated.

Figure 1 is a conceptual framework illustrating the interaction between factors related to acceptance of improved sugar cane varieties. The term acceptance refers to the extent to which sugar cane farmers had engaged in production of improved varieties on their farms. The indicators of acceptance were size of land under improved varieties and number of years a farmer had produced them. Factors studied includes farmers' characteristics (age, gender, education level, experience), sugar cane varietal attributes (Innovation characteristics), facilitating conditions (income sources, land availability, transportation, harvesting and marketing of sugar cane), farmers participation in the development of improved varieties and farmers participation in the dissemination processes of improved varieties.

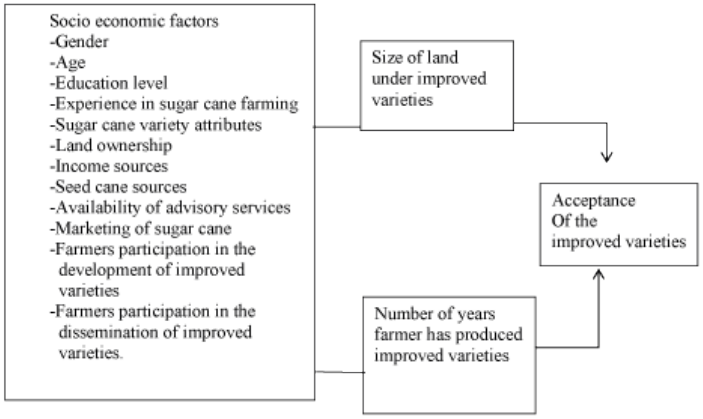

Figure 1: A conceptual frame work illustrating the interaction between factors related to acceptance of improved sugar cane varieties.

Research Methodology

A cross-sectional survey research design was used. The study was conducted in Kakamega County, Kenya. Figure 2 shows map of Kakamega County and its' location in Kenya. The study population comprised of 137,355 small scale sugar cane farmers from three sugar zones of Mumias, West Kenya and Butali in Kakamega County. A sample size of 384 sugar cane farmers was selected using the table for determining sample size from the Research Advisors [33], which is shown as Table 1. It is recommended that if the exact population size of the study is not listed, the next highest value of population size may be used from the table. Therefore, since the exact population size of 137,355 was not represented in the table, a population size of 250,000 was used as the next highest value. With a specific margin error of 5 percent and 95 percent confidence interval, a sample size of 384 farmers was used. Proportional sampling was used to determine the number of farmers to be selected from each sugar zone. Then for each zone, random sampling was done. Questionnaires were used to collect the required information from farmers and were administered orally, as the researcher recorded the responses. Collected data was analyzed using statistical package for social sciences (SPSS) version 20.0. Both descriptive and inferential statistics were used to analyze the data. Descriptive statistics were used to summarize data generated from the research using percentages and frequencies. Cross tabulations were done to establish the relationship between the variables. For the hypotheses seeking relationships, Spearman rank-order correlation coefficient (r) was calculated to show the strength and direction of the linear relationship between the independent and the dependant variables. Hypothesis testing was done using chi-square at 5% level of significance.

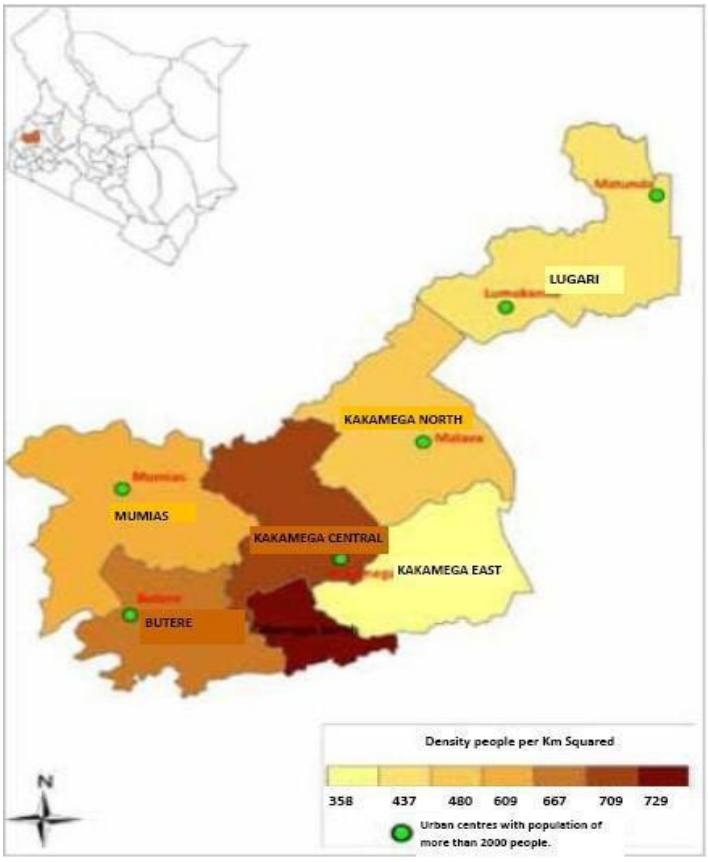

Figure 2: A map of Kakamega County and its' location in Kenya.

Results

Factors Related to Farmers' Acceptance of Improved Sugar Cane Varieties

Table 2 shows statistical analysis of factors related to acceptance of improved varieties based on land sizes under their production and number of years of production.

Required Sample Size†

Population Size	Confidence = 95% Margin of Error				Confidence = 99% Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295
400	196	265	318	384	250	309	348	391
500	217	306	377	475	285	365	421	485
600	234	340	432	565	315	416	490	579
700	248	370	481	653	341	462	554	672
800	260	396	526	739	363	503	615	763
1,000	278	440	606	906	399	575	727	943
1,200	291	474	674	1067	427	636	827	1119
1,500	306	515	759	1297	460	712	959	1376
2,000	322	563	869	1655	498	808	1141	1785
2,500	333	597	952	1984	524	879	1288	2173
3,500	346	641	1068	2565	558	977	1510	2890
5,000	357	678	1176	3288	586	1066	1734	3842
7,500	365	710	1275	4211	610	1147	1960	5165
10,000	370	727	1332	4899	622	1193	2098	6239
25,000	378	760	1448	6939	646	1285	2399	9972
50,000	381	772	1491	8056	655	1318	2520	12455
75,000	382	776	1506	8514	658	1330	2563	13583
100,000	383	778	1513	8762	659	1336	2585	14227
250,000	384	782	1527	9248	662	1347	2626	15555
500,000	384	783	1532	9423	663	1350	2640	16055
1,000,000	384	783	1534	9512	663	1352	2647	16317
2,500,000	384	784	1536	9567	663	1353	2651	16478
10,000,000	384	784	1536	9594	663	1354	2653	16560
100,000,000	384	784	1537	9603	663	1354	2654	16584
300,000,000	384	784	1537	9603	663	1354	2654	16586

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Table 1: Sample Size Table.

Table 2: Factors associated with acceptance of the improved sugar cane varieties.

Factors associated with acceptance of improved varieties	Statistical analysis								
				Based on years of variety production			Based on size of land under the variety		
	Critical value	df	α	*X*	*P*- value	Phi	*X*	*P*- value	Phi
Gender	9.488	4	0.05	4.525	0.340	0.169	9.223	0.056	0.242
Age	31.410	20	0.05	61.333	0.000	0.623	61.072	0.000	0.622
Education level	26.296	16	0.05	76.571	0.000	0.696	46.243	0.000	0.541
Experience	41.337	28	0.05	85.928	0.000	0.737	93.823	0.000	0.771
Variety attributes	26.296	16	0.05	13.573	0.631	0.271	31.079	0.013	0.410
Land availability	26.296	16	0.05	45.808	0.000	0.538	-	-	-
Income sources	15.507	8	0.05	85.722	0.000	0.723	43.883	0.000	0.517
Advisory services	21.026	12	0.05	29.105	0.004	0.427	58.981	0.000	0.607
Input (seed) sources	9.488	4	0.05	11.032	0.026	0.264	52.930	0.000	0.579
Harvesting challenges	31.140	20	0.05	34.904	0.021	0.460	56.986	0.000	0.588
Transportation	36.415	24	0.05	52.384	0.01	0.663	69.622	0.000	0.765
Cane payment	21.026	12	0.05	42.328	0.000	0.486	61.482	0.000	0.586
Participation in tech-nology development	21.026	12	0.05	37.785	0.000	0.648	12.838	0.381	0.378
Participation in tech-nology dissemination	26.296	16	0.05	48.455	0.000	0.764	8.075	0.947	0.312

Gender of the Respondents and Acceptance of Improved Varieties

According to the study results, 88 percent of the respondents were male while 12 percent were female. No significant relationship was established between genders, acceptance of the improved varieties based both on size of land under their production, and number of year's farmer had produced them. Despite this observation, 90 percent of male respondents were found producing the improved varieties, which was likely to be related with the large land ownership by male farmer (88 percent of land under sugar cane).

Age of the Respondents and Acceptance of Improved Varieties

The respondents age ranged from 21 to 80 years and 54 percent of respondents were over 51 years old. Table 3 shows improved varieties under production by the respondents based on their age. The study established significant relationship between age of the respondent and acceptance of improved varieties, based on land sizes under their production. A Phi of 0.623 indicated a strong effect of age on varieties acceptance. This was likely to be associated with increased land size with respondents age as shown in Figure 3. A significant relationship was also established between age of the respondent and acceptance of improved varieties based on the number of years under variety production. A Phi of 0.622 indicated a very strong effect of age on varieties acceptance.

Size of Land and Acceptance of Improved Varieties.

Land ownership status revealed that majority of the respondents were small landholders. Table 4 shows size of land of the respondents and improved varieties under production. Results revealed that majority of the respondents were small landholders and land size available was not a hindrance to production of improved varieties. Findings indicate that majority of the respondents produced their preferred improved varieties on small portions of land owned of between 0.1 to 1 acre.

Farmers Education Level and Acceptance of the Improved Varieties

The overall literacy level of the respondents was quite impressive. Table 5 shows education level of the respondents and the improved varieties under production. A significant relationship was established between respondents' education levels and improved varieties acceptance based on land sizes under production. A Phi of 0.696 indicated a very strong effect of education on varieties acceptance. A significant relationship was also established between farmers education levels and varieties acceptance based on years under production. A Phi of 0.541 also indicated a very strong effect of education on varieties acceptance.

Table 3: Age of the respondents and improved sugar cane varieties under production.

		Improved varieties under production					Total
		EAK73-335	KEN83-737	KEN83-493	KEN82-472	D84-84	
Age of farmers in Years	21-30	0.6	4.4	0.0	0.0	0.0	5.1
	31-40	1.9	12.7	0.0	0.0	0.6	15.2
	41-50	10.1	15.2	1.9	0.0	4.4	31.6
	51-60	0.0	10.8	0.0	0.0	2.5	13.3
	61-70	0.0	10.8	0.0	0.6	2.5	13.9
	71-80	0.0	13.3	0.0	0.0	7.6	20.9
Total		12.7	67.1	1.9	0.6	17.7	100.0

Table 4: Size of land and improved sugar cane varieties under production in Kakamega County.

		Improved sugar cane varieties under production					Total
		EAK73-335	KEN83-737	KEN83-493	KEN82-472	D84-84	
Size of land under sugar cane	0.1-2.0	1.9	48.7	1.9	0.0	8.2	60.8
	2.1-4.0	7.0	13.9	0.0	0.0	3.2	24.1
	4.1-6.0	3.8	2.5	0.0	0.0	1.3	7.6
	6.1-8.0	0.0	1.3	0.0	0.6	5.1	7.0
	8.1-10.0	0.0	0.6	0.0	0.0	0.0	0.6
Total		12.7	67.1	1.9	0.6	17.7	100.0

Table 5: Education level of the respondents and improved varieties under duction.

		Improved varieties under production					Total
		EAK73-335	KEN83-737	KEN83-493	KEN82-472	D84-84	
Education level	None	0	8	0	0	2	10
	Lower primary	0	6	0	0	1	7
	Upper primary	0	30	0	0	8	39
	Secondary school	0	15	2	0	4	21
	Post -secondary	13	8	0	1	2	23
Total		13	67	2	1	17	100

Experience in Sugar Cane Production and Acceptance of Improved Varieties

The number of years a farmer had engaged in sugar cane production was used in the study to indicate farmers experience in cane production. More years indicated more experience and vice versa. Table 6 shows farmers experience in sugar cane production and improved varieties under production. The study established a significant relationship between experience in sugar cane production and acceptance of improved varieties based on land size under their production. A Phi of 0.737 indicated a very strong effect of experience on varieties acceptance. A significant relationship was also established between farmers experience in sugar cane production and improved varieties acceptance based on years of production. A Phi of 0.771 indicated a very strong effect of experience on varieties acceptance.

Sugar Cane Varietal Attributes and Acceptance of Improved Varieties

The most preferred attributes identified by the respondents included high tonnage, early maturity, ratoonability, high tillering and high vigour as shown in figure 4. A significant relationship was established between farmer preferred sugar cane varietal attributes and acceptance of improved varieties based on years of production. A Phi value of 0.410 indicated a moderate effect of farmer preferred attributes on varieties acceptance. Results further established no significant relationship between farmers preferred varietal attributes and variety acceptance based on land sizes under their production. According to the results, majority of the respondents produced their preferred varieties on small portions of land owned of between 0.1 to 1 acre. Land size was not a hindrance towards production of preferred varieties.

Advisory Services and Acceptance of Improved Varieties

According to the findings, 50 percent of the respondents made their own choice on varieties to produce while 44 percent were advised by the miller; 5 percent by researchers and one (1) percent by other farmers. Table 7 shows the relationship between advisory on variety choice and varieties under production. A significant relationship was established between advisory on variety choice and the acceptance of the improved varieties based on land size under them. A Phi value of 0.427 indicated a moderate effect of advisory on variety choice varieties acceptance. A significant relationship was also established between advisory on variety choice and varieties acceptance based on years under production. A Phi value of 0.607 also indicated a strong effect of advisory on variety choice and varieties acceptance.

Sources of Seed and Acceptance of the Improved Varieties

Figure 5 shows a comparison between seed cane sources and varieties under production. A significant relationship was

Table 6: Experience in sugar cane production and improved sugar cane varieties under production in Kakamega County.

		Improved sugar cane varieties under production					Total
		EAK73-335	KEN83-737	KEN83-493	KEN82-472	D84-84	
Years of sugar cane production (Experience)	1-5	1	6	2	0.	0	8
	6-10	10	27	0	1	6	44
	11-15	1	8	0	0	1	10
	16-20	1	6	0	0	1	6
	21-25	0	4	0	0	0	4
	26-30	0	1	0	0	2	3
	31-35	0	3	0	0	2	5
	Over 36	0	12		0.	7	19
Total		13	67	2	1	18	100

Table 7: Sugar Cane Varieties under Production and Advisory on the Varieties to be produced.

		Sugarcane varieties under production							Total
		CO 421	CO 945	EAK 73-335	KEN83-737	KEN82-493	KEN82-472	D84-84	
Advisory on variety to produce	Sugar company	13.3	9.2	3.8	16.8	0.0	0.0	5.5	44.0
	Other farmers	0.0	0.9	0.0	0.0	0.7	0.0	0.0	1.5
	Self decision	26.7	3.3	0.8	9.6	0.0	0.0	4.6	49.9
	Researcher	0.0	0.4	0.2	1.8	0.0	0.2	1.8	4.4
Total		40.0	13.8	4.8	28.2	0.7	0.2	11.8	100.0

Table 8: Farmers Role in the Development of the Improved Sugar Cane Varieties and Improved Varieties under Production.

		Improved sugar cane varieties under production					Total
		EAK73-335	KEN83-737	KEN83-493	KEN82-472	D84-84	
Farmers role in the development of the improved sugar cane varieties	Group leader	3.3	3.3	0.0	0.0	3.3	10.0
	Farmer Research Group member	0.0	10.0	3.3	0.0	3.3	16.7
	Research plot owner	0.0	10.0	0.0	0.0	4.4	14.4
	Seed cane production	3.3	36.7	0.0	1.1	17.8	58.9
Total		6.7	60.0	3.3	1.1	28.9	100.0

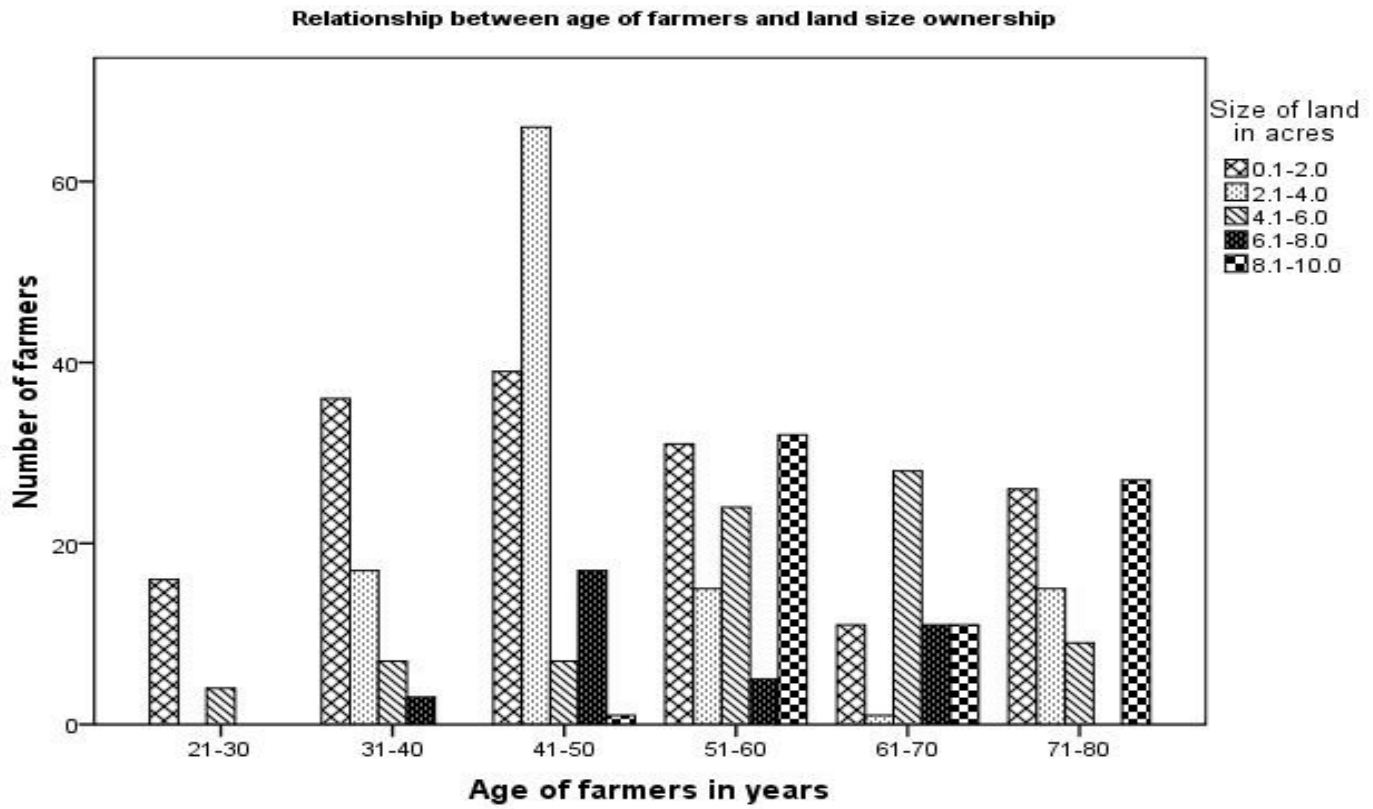

Figure 3: Relationship between age of sugar cane farmers and sizes of land ownership.

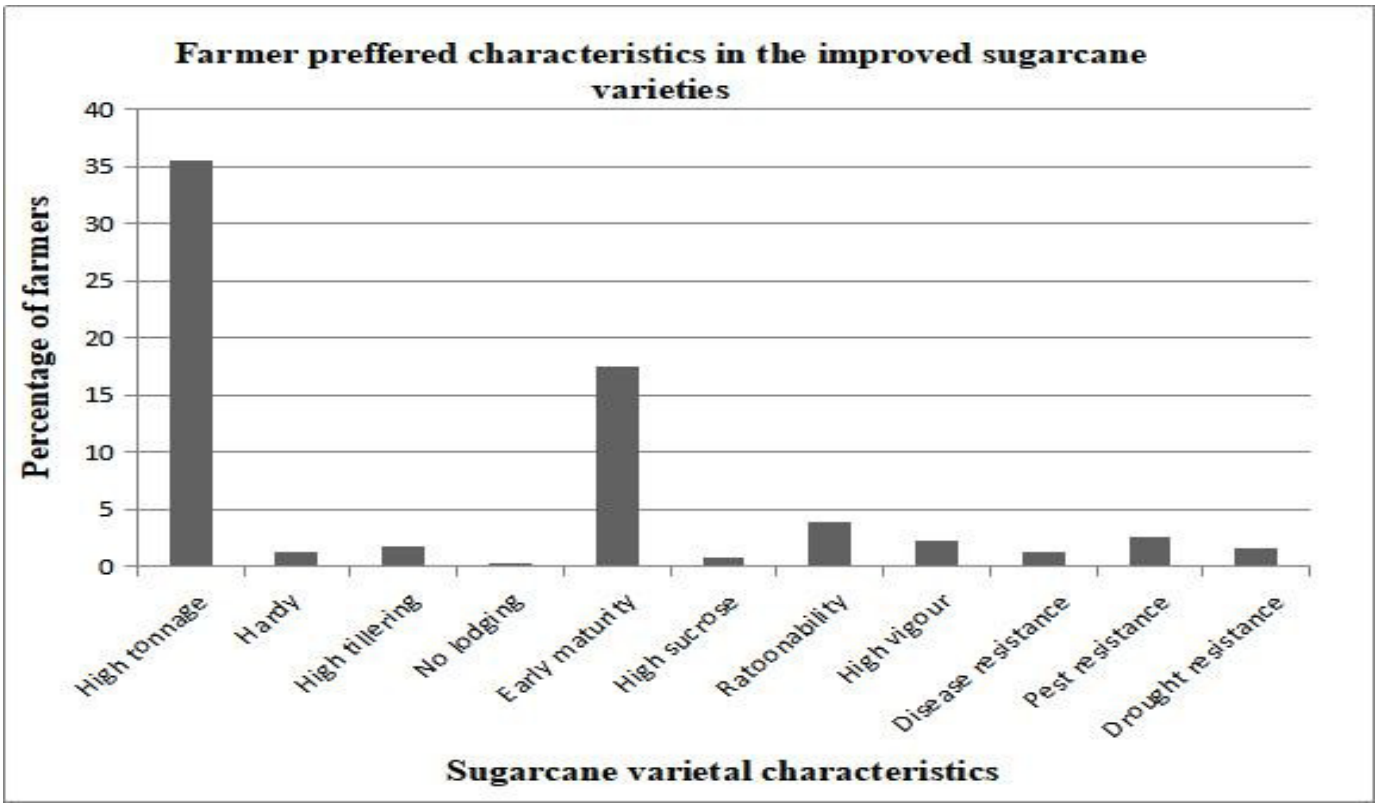

Figure 4: Characteristics of the improved sugar cane varieties preferred by farmers.

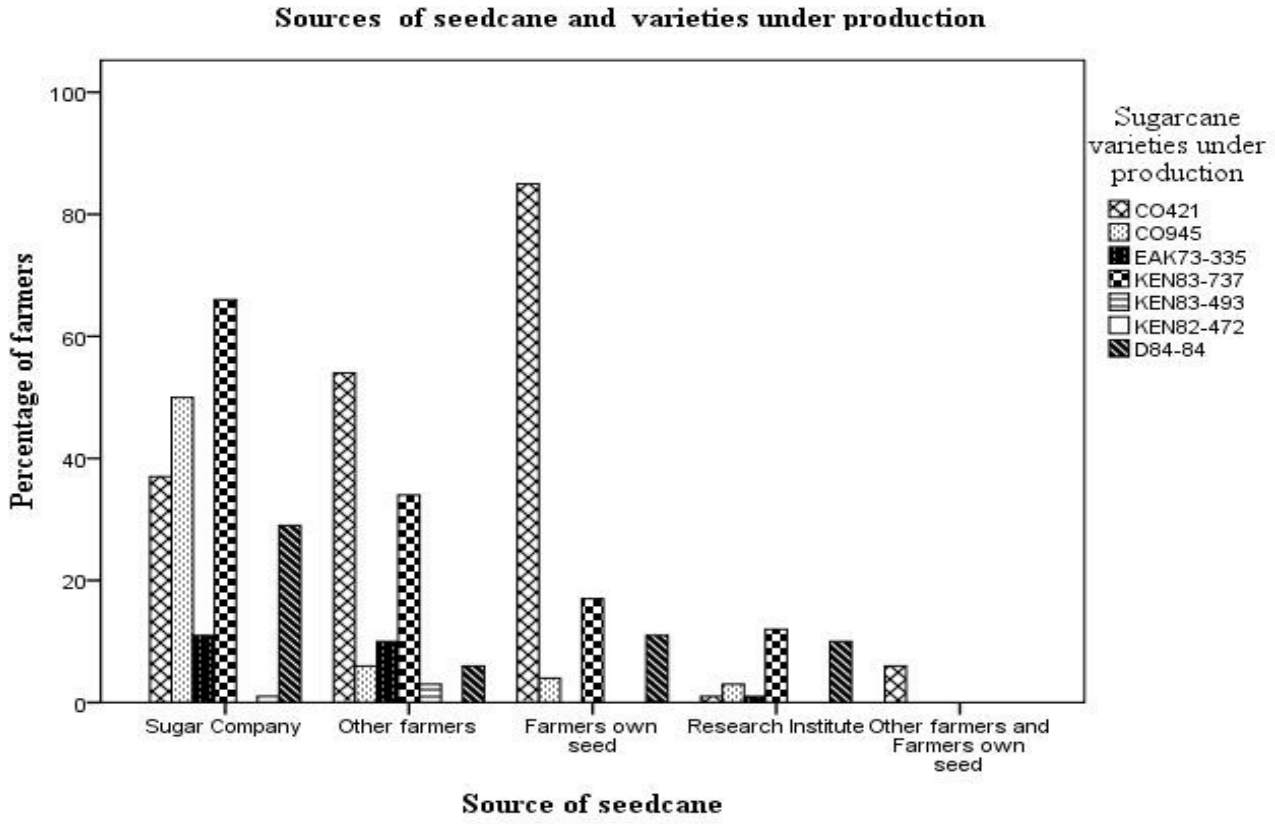

Figure 5: Comparison between seed cane sources and varieties under production.

established between sources of seed cane and the acceptance of the improved varieties based on the number of years under production. A Phi value of 0.579 indicated a strong effect of seed sources on varieties acceptance.

Farmers Income Sources and Acceptance of Improved Varieties

According to the research findings, 81 percent of the respondents were farming only as a source of income; 15 percent had formal employment while 4 percent had businesses. A significant relationship was established between farmers' income sources and varieties acceptance based on years of production. A Phi value of 0.517 indicated a strong effect of source of income on varieties acceptance. A significant relationship was also established between farmers' income sources and varieties acceptance based on land sizes under their production. A Phi value of 0.723 indicated a very strong effect of farmers' income sources on varieties acceptance.

Sugar Cane Marketing and Acceptance of the Improved Varieties

In sugar cane marketing, relationship between acceptance of improved varieties and challenges experienced by respondents during harvesting, transportation and cane payment were considered. During cane harvesting, findings depict that 68 percent of respondents experienced delayed cane harvesting (23%); poor cane harvesting standards (44%); bribery for cane to be harvested (5%); stool destruction due to trampling (5%) and lack of harvesting labour (1%). A significant relationship was established between these challenges and acceptance of improved varieties based on the land sizes under their production. A Phi value of 0.460 indicated a moderate effect of these challenges on varieties acceptance. A significant relationship was also established between the challenges in cane harvesting and the varities acceptance based on the number of years under production. A Phi value of 0.588 indicated strong effect of these challenges on varieties acceptance.

In cane transportation, challenges experienced included transport inadequacy (18%); poor roads (8%); cane spillage on transit (12%); corruption by transporters i.e bribery to transport farmers cane and cane theft during transit (12%); cane left on the ground uncollected (18%); faking of farmers tonnages at the weighing bridge (22%) and high transport cost (7%). A significant relationship was established between these challenges and improved varieties acceptance based on land size under their production. A Phi value of 0.663 indicated a strong effect of transportation challenges and varieties acceptance. A significant relationship between these challenges and acceptance of improved varieties based on the number of years under production was also established. A Phi value of 0.765 indicated a strong effect of these challenges on acceptance of improved varieties.

Challenges in cane payments included delayed cane payment (37 percent), wrong deductions from sugar cane proceeds (11 percent), debit returns (8 percent) and low payments (1percent). A significant relationship was established between challenges in cane payments and acceptance of improved varieties based on size of

land under them. A Phi value of 0.486 indicated a moderate effect of challenges in cane payments on the acceptance of improved varieties. A significant relationship was also established between challenges in cane payments and the varieties acceptance based on number of years under production. A Phi value of 0.586 indicated a strong effect of these challenges on the variety's acceptance.

Farmers' Participation in the Development of Improved Varieties and Their Acceptance

Findings show that the respondents participated in seed production, membership in various farmer research groups, donation of research plots and as group leaders during the development of the improved sugar cane varieties. Table 8 shows the relationship between these roles and improved varieties under production. A significant relationship was established between farmers' role in the development of the improved varieties and variety acceptance based on years of production. A Phi value of 0.648 indicated a strong effect of farmers' role in the development of the improved varieties and their acceptance.

Farmers' Participation in Technology Dissemination and Acceptance of Improved Varieties

Results depicts that the respondents participated in the dissemination of improved sugar cane varieties through training of other farmers, hosting of field days, formation of other farmer research groups (FRGs), participation in the establishment of demonstration plots and in seed cane sales. Table 9 shows the relationship between these roles and improved varieties under production. A significant relationship was established between farmers' role in the dissemination of improved varieties and their acceptance based on years of production. A Phi value of 0.764 indicated a strong effect of farmers' role in the dissemination of these varieties and their acceptance.

Discussion

The study identified gender, age, education level, experience in sugar cane farming, variety attributes, land ownership, income sources, seed sources, availability of advisory services, marketing of sugar cane, farmers participation in the development and dissemination of improved varieties as factors related to acceptance of improved sugar cane varieties. Findings demonstrated that male farmers dominated in sugar cane production and had more potential to produce improved varieties due to much land ownership. This is a gender-linked factor and was likely to be a hindrance towards wider acceptance of improved varieties by female farmers. According to Mwangi & Kariuki [6]; Rousan [34]; Morris et al. [18] observations, less access of land by women farmers affects their acceptance of improved technologies. Results established that majority of farmers were over 51 years, which is consistent with Katchova and Ahearn [35], who identified that farmers' age peaks between ages 50s and early 60s. Increased acceptance of the improved varieties with respondents' age was noted and was likely to be related to increased land ownership with age. According to Katchova and Ahearn [35], younger farmers tend to own less agricultural land than older farmers. Therefore, older farmers being better innovation evaluators [6], and having gained more experience and knowledge are likely to accept improved varieties for production more readily than younger farmers. Research findings confirmed that education has great potential to enhance acceptance of improved varieties among farmers, which is likely to be related with the improved farmers ability to understand and evaluate improved technologies [1]. Experience in cane production was also noted to enhance acceptance of improved varieties. This was associated with the knowledge and understanding gained about these varieties as farmers produced them for many years. The study identified need to expose and provide sufficient information about the improved varieties to farmers, which is a key factor that influence technology acceptance [1]. Findings indicate that sugar companies and individual farmers made a significant impact on choice of varieties under production. Sugar companies' advisory services on variety choice and seed supply enhanced production of improved varieties more in relation to the other service providers. Ability of farmers to produce their own seed and supply to other farmers confirmed their potential in seed production if the necessary support is availed. Research Institute was found to supply very limited amount of seed cane to farmers. Its' role is to provide the breeder seed to farmers and millers for multiplication purpose, which is later availed to other farmers for production [36]. Source of income demonstrated farmers' ability to acquire necessary inputs [18]. Results portrayed that those farmers who had extra sources of income through formal employment demonstrated higher acceptance of the improved varieties having produced them for many years. The study further established that respondents who experienced challenges in sugar cane marketing had a low acceptance of the improved varieties. Farmers' participation in the development of improved varieties was found to enhance acceptance of improved varieties based on the number of years farmers had continuously produced them. This is due to the gained knowledge, experience and understanding about the varieties as farmers participated in their development process. Cavane [20]; Rogers [28]; Kaihura [26] and Morris et al. [18] identified that participation of farmers in technology development

Table 9: Farmers' Roles in Dissemination activities and Improved Varieties under Production.

		Improved sugar cane varieties under production					Total
		EAK73-335	KEN83-737	KEN83-493	KEN82-472	D84-84	
Farmers roles in the dissemination of improved varieties	Training of other farmers	3.6	2.4	0.0	0.0	1.2	7.2
	Hosting of field day	2.4	20.5	3.6	1.2	15.7	43.4
	Formation of other farmer research groups	0.0	1.2	0.0	0.0	1.2	2.4
	Establishment of demonstration plots	0.0	13.3	0.0	0.0	2.4	15.7
	Seed cane sale	3.6	18.1	0.0	0.0	9.6	31.3
Total		9.6	55.4	3.6	1.2	30.1	100.0

enhances technology acceptance as it equips farmers with adequate knowledge on technology use and detailed accurate technical information. Research findings confirmed farmers participation in the dissemination activities of improved varieties through hosting of field days, selling of seed to other farmers, establishment of field demonstrations and training of other farmers. Farmers' involvement enabled them to familiarize with the varieties, acquire necessary knowledge and technical information about them, gain certainty about their performance, which enhanced acceptance of the improved varieties.

Conclusion

The study concludes that:

i. Factors related to farmers' acceptance of the improved sugar cane varieties in Kakamega County include farmers age, education, land ownership, experience in farming, source of income, sugar cane varietal attributes, seed sources, availability of advisory services, marketing of sugar cane, farmers participation in production and dissemination activities of improved sugar cane varieties.

ii. Gender is not related with acceptance of improved varieties. However, land ownership, which is a gender linked factor is likely to have affected farmers' acceptance of the improved varieties. Male farmers who own much of available land for sugar cane production have more potential to produce improved varieties.

iii. Land size is not a hindrance towards production of the improved sugar cane varieties. Farmers produce improved varieties of their own choice based on the preffered attributes on the portions of land owned.

Recommendation

Based on the research findings, the following need to be implemented to enhance acceptance of the improved sugar cane technologies by farmers.

i. Extension service providers to provide sugar cane farmers with more technical information on improved sugar cane varieties, improved varieties seeds and necessary support services to facilitate production of improved varieties.

ii. Sugar millers to provide adequate supportive services through well coordinated harvesting programmes, efficiency in cane transportation to the factory and prompt cane payments as it encourages farmers to produce improved sugar cane varieties.

iii. Researchers and extension personnels to involve farmers more in the production and dissemination activities related to improved sugar cane varieties as it enables them familiarize with the varieties, gain adequate knowledge, understanding, and detailed technical information about them, which facilitates their acceptance by farmers. Field days and seed production by farmers need to be enhanced due to their great potential to facilitate acceptance of improved varieties.

iv. Factors identified related to farmers' acceptance of the improved sugar cane varieties need to be addressed by technology developers and promoters to enhance acceptance of the improved technologies generated.

Acknowledgement

I am grateful to National Commission for Science, Technology and Innovation (NACOSTI) for granting me permission to undertake this research study. I wish to extend my sincere gratitude and appreciation to Kenya Agricultural and Livestock Research Organization (KALRO) for its support in my studies. This article is an extract from my Ph.D thesis, which was prepared under the supervision of Dr Justus M. Ombati and Dr Agnes O. Nkurumwa both of Egerton University. I would like to express my special gratitude and thank to them for their great contribution, encouragement, counsel, and direction. Thanks and appreciation go to all who assisted me during data collection and the respondents who gave valuable data without which the study would not have happened. I am extremely grateful to all other people whose assistance was a milestone in the completion of this study.

Statement of Interest Declaration

I hereby declare that this article is my original work and has not been submitted to any other research journal for publication. I have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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