Technical Knowledge and Information Gaps among Smallholder Farmers in the Production of Sugarcane in Kakamega County, Kenya

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The purpose of the study was to identify and document technical knowledge and information gaps that can inform development of appropriate training programs for cane farmers. The study employed a survey research design; involving 105 small scale farmers in selected from eight Sub-counties of Kakamega County. Data was analyzed using both descriptive and inferential statistics. Pearson's product moment correlation coefficient was used to test for significance of relationships between access to information regarding cane production and the productivity of the crop. The results show that there was a strong positive correlation (r =0.722) between the firm size and the acreage under cane crop. The technical knowledge and information gaps varied on the basis of growth stages of the cane crop; 60% of the small scale farmers did not prepare land at the right time, 48% of the farmers did not know how to propagate cane, 34% did not know the cane planting spacing, 48% cultivated uncertified materials due to lack of capital and poor access to the suitable materials as the reasons. Majority of the farmers (92%) confirmed that they knew how to gap, although a few (8%) didn't, 48% did not remove tillers from their crop, the number of times that the crop was weeded ranged from once (2%) to 8 times (2%), and 64% of the farmers applied organic manure while 87% applied inorganic fertilizers. The results show that majority of the smallholder farmers were unable to apply the recommended crop management practices due to lack of capital and lack knowledge and skills. For instance 38% of the respondents were unable to practice crop rotation due to lack of practical skills. Access to agricultural information regarding cane crop agronomy was rated as low by most of the respondents (58%).There was a positive correlation between access to knowledge and productivity of cane crop with a coefficient of 0.283. The productivity of sugarcane crop in Kakamega County was low and this was contributed by among other factors; lack of capital and inadequate knowledge and skills regarding the crop's agronomy. The study recommends that strategies should be designed to disseminate practices that require technical knowledge and skills.

Key words: Knowledge &Information Gaps, Smallholder Farmers, Sugarcane Production, information dissemination

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1. Introduction

The sugar industry plays a significant role in Kenya's economy, contributing about 15 percent to the country's agricultural GDP (KSI, 2009). The sector consists of more than 250,000 smallholder farmers, who supply over 92% of the sugar cane processed by sugar companies while the remainder is supplied by factory owned nucleus estates (KSI, 2009; KSB, 2010). An estimated 25 percent of the country's population depends directly or indirectly on the sugar industry for their livelihood (Odenya et al. 2007). Kenya's annual sugar production ranges from 450,000 to 550,000 tons of sugar. This does not meet the country's annual demand of 760,000 tones necessitating importation of sugar (MSC, 2008). Increased regional trade and the opening up of borders to allow sugar imports from both the East African Community and the Common Market for Eastern and Southern Africa (COMESA) have hurt Kenyan sugar producers. In July 2008, the Kenyan government cancelled the licenses of all its 55 sugar importers citing miss-use of import licenses, tax evasion and that imports were hurting local farmers (Odenya et al, 2007).

There has been a decline in cane production per given unit area and hence an increase in poverty for approximately 6 million people who depend on sugarcane farming either directly or indirectly (KSB, 2008). The sugarcane yield in Kenya stands at 65tons of cane per hectare, which is way below the potential yield of 100 tons of cane per hectare under rain-fed conditions (KESREF, 2009). Potential reasons for

this reduction in productivity include the widespread use of low quality sugar cane varieties, poor agricultural and land management practices and delayed harvesting of mature sugarcane (KSB, 2010). Moreover, most farmers grow cane varieties that are susceptible to the major diseases such as smut, mosaic and ratoon stunting disease. These factors coupled with poor crop management practices leads to low yields.

In view of the complex nature of the small-scale production systems most cost effective technological intervention to increase sugarcane productivity in Kenya is cultivation of improved varieties and appropriate crop management practices. Although, there has been continuous dissemination of sugarcane production knowledge by both public and sugar company's extensionists, some small scale farmers do not access the right knowledge and skills needed to address the farm specific problems that they encounter in their farms. This paper is the outcome of a farmer survey undertaken to contribute towards the understanding of the gaps and information needs among smallholder farmers in the sugar industry in the country.

2. Materials and methods

Study Area:

Kakamega County borders the following Counties: Bungoma to the North and North West, Uasin Gishu to the North East and East, Nandi to the South East, Vihiga to the South, Siaya to the South West and Busia to the West. The County is classified as moist mid-altitude zone (MM) (Lynam and Hassan, 1998). The MM zone forms a belt around Lake Victoria, from its shores at an altitude of 1110 meters, up to an altitude of about 1500 meters above sea level. These zones largely follow an altitude gradient, with higher elevation areas receiving more rainfall. Kakamega County is largely comprised of the Lower Highland (LH), Upper Highland (UH), Lower Midland (LM) and Upper Midland (UM) Agro-ecological zones (AEZ). Jaetzold and Schimdt (1982) divided the temperature belts of this zone in sub-categories ranging from humid 1; to less humid 6; and differentiated by altitude, soil type and fertility, rainfall and the range of crops growing in the respective areas. According to the FAO (1978) classification scheme, Kakamega is classified as humid Forest agro-ecological zone with a length of growing period.

Study Design and Data Analysis

The study used survey method; involving 105 small scale farmers in selected from eight Sub-counties of Kakamega County namely Kakamega Central, Butere, Malava, Matungu, Navakholo, Mumias, Lurambi and Lugari. Data for this study was obtained mainly from primary source collected using structured questionnaires. The study used stratified random sampling method to select the smallholder cane farmers. Robson (1993) tells us that sampling theory supports stratified randomsampling as an efficient choice because the means of the stratified samples are likely tobe closer to the mean of the population overall. The smallholder farmers were startified on the basis of Districts (Sub-counties) they belong to. Then, 15 smallholder cane farmers were randomly selected from the identified Sub-counties. The data was analyzed using descriptive and inferential statistics. Pearson's product moment correlation coefficient was used to test for significant relationship between access to information regarding cane production and the productivity of the crop.

3. Results and discussion

Farmer and Farm Characteristics:

The study engaged a total of 105 smallholder sugarcane farmers where 66% were male and 34% were female. Approximately, 7% of the respondents were aged between 18 and 27 years, 23% were aged between 28 and 37 years, 33% were aged between 38 and 47 years, 20% were aged between 48 and 57 years and 18% were aged over 58 years. Regarding their educational levels; 28% had primary education, 36% had secondary education, 25% had college education and 12% had university education. This shows that majority of the farmers were literate. Education contributes to general awareness and exposure of information which should favor the farmers to adopt improved sugar cane technologies.

Various farm characteristics were assessed namely; type of land ownership farm size, acreage under cane crop, annual income and experience in crop production. A comparison of the characteristics was done across the Sub-Counties covered by the study as shown in Table 1.

Regarding the type of land ownership, 10% had leased land, 28% were cultivating family owned land and 62% were cultivating their own land. The mean farm size ranged from 2.0333to 4.5636acres where Kakamega Central had the lowest mean farm size while Mumias had the highest mean. Mumias Sub County (3.12) reported highest mean acreage under cane crop in acres while Kakamega Central (0.8827) was the lowest. The highest mean annual income from sugarcane was reported in Malava Sub County (107066.67) while farmers in Butere were the most experienced (14.7 years) with regards to number of years they have been producing the cane crop.

Relationship between farm size and level of cane production:

Pearson's correlation coefficient was run to establish whether the level of cane cultivation was

determined by the size of the farm. The results in Table 2 show that there is a strong correlation (0.722) between the firm size and the acreage under cane crop. The p-value was 0.00 less than the significance level of 0.01 establishing a significant relationship between the two variables. This implies that the bigger the farm size the bigger the acreage under cane cultivation.

Access to agricultural information on cane production:

As illustrated in Figure 1, access to agricultural information regarding cane crop agronomy was rated as low by most of the respondents (58%). This implies that most of the sugarcane small holder farmers in the County did not access cane crop production information. This means that most of the farmers had very few or no contact with extension officers either from the County Agricultural Office, KESREF (Kenya Sugar Research Foundation) or from the sugar milling companies; the institutions that provide extension services to farmers.

Table 1. Farm Characteristics

Sub County	Farm size (Acres)	Mean acreage under cane (Acres)	Annual mean income (kshs)	Experience in cane production (years)
Lurambi	2.3800	1.42	60000.00	8.40
Butere	3.8769	1.97	45307.69	14.77
Malava	3.0667	1.98	107066.67	9.00
matungu	3.0000	1.95	24692.31	3.92
Kakamega Central	2.0333	0.88	38066.67	12.00
Mumias	4.5636	3.12	63636.36	10.27
Lugari	4.1538	1.35	103076.92	4.42
Navakholo	2.3000	1.46	83200.00	8.10
Total	3.1314	1.73	65323.81	8.91

Table 2. Correlation analysis between farm sizes and level of cane production

		Farm size	Land under sugarcane in Acres
Farm size	Pearson Correlation	1	0.722**
	Sig. (2-tailed)		0.000
	N	105	105
Land under sugarcane in Acres	Pearson Correlation	0.722**	1
	Sig. (2-tailed)	0.000	
	N	105	105

***. Correlation is significant at the 0.01 level (2-tailed).*

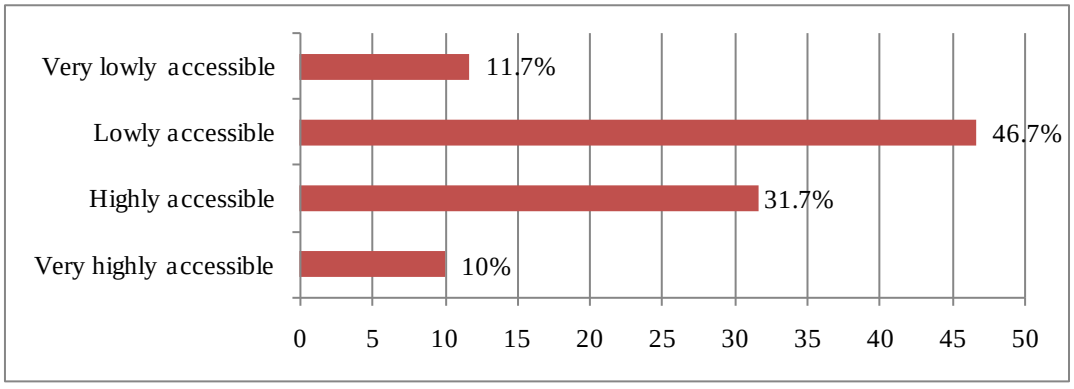

Figure 1. Access to agricultural information regarding cane production

Knowledge and Information gaps:

The study aimed at unveiling the knowledge and information gaps that exist at various stages of cane crop production. The stages covered included land preparation, propagation, planting, gapping, weeding, and pest and disease control.

Land Preparation:

For higher sugarcane yields, providing optimum soil environment is an essential pre-requisite since the crop remains in the field for about 5 to 6 years due to the practice of raising several ratoon crops and this therefore calls for proper and adequate land preparation. When asked to indicate the period within which you undertake land preparation, 5% indicated that they did it a few days before planting, 2% undertook the practice two weeks before planting, 40% prepared their land one month before planting and majority did it two months before planting as illustrated in Figure 2.

The results further indicated that 84% cleared the vegetation before ploughing, 44% leveled the land after ploughing, 55% practiced sub-soiling, 93% undertook ploughing, 88% undertook harrowing of the land, 84% dug furrows and 73% did land surveying as presented in Table 3. This shows that although majority of the smallholder farmers were undertaking the land preparation practices, challenges still exist among some farmers towards practicing recommended land preparation practices.

Propagation:

The results further indicate that 52% of the respondents knew how to propagate cane while 48% did not as shown in Table 4. Only 14% of the respondent knew how to establish cane sett nursery. This show that some farmers lacked knowledge and skills in cane propagation and nursery establishment.

Planting:

The study also assessed the cane setts spacing, source and planting materials used by the smallholder farmers in the County.

Cane Setts Spacing

The respondents were asked to indicate the cane setts' spacing they applied during planting. The results (Figure 2) shows that majority of the farmers (66%) used a spacing of 1.2 metres. The results indicate that the planting spaces ranged from 0.25 to 4 metres. This is a clear indication that most of the farmers did not know the most appropriate spacing to use when planting the cane crop. Although there is no standardized (control) inter-row spacing for sugarcane seedlings (Olweny&Jamoza, 2008) the spacing should range between 0.1m to 1.5 to maximize the yields. According to Verma, (2004), high density planting reduces the number of tillers produced per each planting material due to mutual shading and competition for light, nutrients, and water. On the other hand, sub-optimal density planting results in a loss of yield due to inefficient use of the land space (Azhar*et al.*, 2007).

Sources and Kind of Planting Materials

The smallholder farmers got planting materials from various sources. The main source of sugarcane seedlings was own farm.KESREF which is supposed to be the major source (Odenya *et al*. 2008) only provided seed cane to 16.7% of the farmers. About 17% of the respondents sourced planting materials from milling companies, 27% prepared cane setts from the crops in their farms and 11% got planting materials from neighbours as presented in Table 5. The results further indicate that 52% grew certified planting materials while 48% cultivated uncertified materials. Those who grew uncertified seed cane cited lack of capital and poor access to the suitable materials as the reasons.

Gapping:

Majority of the respondents (92%) confirmed that they knew how to gap, although a few (8%) didn't as shown in Table 6.

The result (Table 6) also indicates that 78% knew the right time to gap the cane crop however, 22% did not. Majority of the respondents (52%) removed tillers from their crop while 48% did not. This shows that although majority of the respondents knew when and how to gap, a significant number of smallholder farmers in the County did not know. It is advisable to remove water shoots as and when they arise because water shoots affects the growth of adjacent stalks. They harbor insect-pests and when they are harvested and sent to mill for crushing, lead to reduced juice quality and affect sugar recoveries. Despite the importance of removing tillers a significant number of farmers did not undertake the practice.

Weeding Management:

In sugarcane weeds have been estimated to cause 12 to 72% reduction in cane yield depending upon the severity of infestation. As depicted in Figure 3, most of the respondents (23%) weeded their crops 5 times before harvesting. The number of times that the crop was weeded ranged from once (2%) to 8 times (2%). This shows that most farmers did not know the recommended number of times (8 times) to weed the crop, lacked labour or machinery to undertake the practice. The study found that most of the farmers (85%) were using manual methods to control weeds. Other farmers used chemical (10%) and mechanical (5%).

Fertilization:

Sugarcane being a giant crop producing huge quantity of biomass generally demands higher amounts of nutrient elements.

The results (Table 7) indicate that 64% of the respondents applied organic manure while 87% applied inorganic fertilizers. This means that some farmers did not apply organic or inorganic fertilizer to their crops. Further, 82% of the respondents were applying the right amount of fertilizer while 18% were not.

Pest and diseases:

There is wide spectrum of pests and diseases that affects cane crop (Table 8) most of which if not controlled can cause huge losses. The susceptibility of the variety to the diseases and pests aggravates the situation and creates additive problems. The most common pest was termite as indicated by 87% of the respondents. On the other hand the most common disease was ratoon stunting disease (73%).

Reasons for not applying the Recommended Practices:

The study also investigated the reasons why some farmers were not applying the recommended cane crop management practices. According to the results in Table 9, most of the respondents (42%) were not practicing mulching due to lack of capital or labour. Fertilizer/manure application was hindered by lack of capital as noted by 53%, 53% did not apply soil conservation measures due to lack of capital. In general majority of the smallholder farmers were unable to apply the recommended crop management practices due to lack of capital; however, a significant number also lacked the required knowledge and skills. For instance 38% of the respondents were unable to practice crop rotation due to lack of practical skills.

Productivity of the Cane Crop in the County:

An analysis of the productivity of cane crop in the County revealed that although the its production levels were low as indicated by majority of the respondents (63%) as illustrated in Figure 4. The low production levels had been contributed by among other factors; lack of capital and inadequate knowledge and skills regarding the crop's agronomy.

Access to Knowledge and Information and Productivity of Cane Crop:

The study further assessed the relationship between access to knowledge and information, and the productivity of the cane crop. The results in Table 10 indicate that there is a positive correlation between access to knowledge and productivity of cane crop with a coefficient of 0.283 which was significant at alpha level of 0.05. This means that an increase in farmers' access to information and skills regarding cane crop agronomic practices leads to an increase in the productivity of the crop.

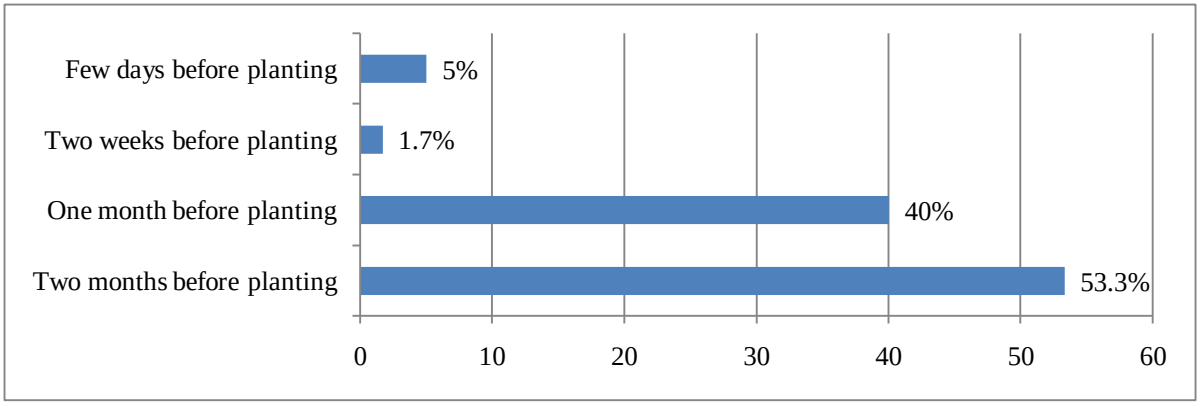

Figure 2: Land preparation

Table 3. Land preparation activities

Practiced or not	Field clearing	Levelling	Ripping	Ploughing	Harrowing	Furrowing	Land surveying
	%	%	%	%	%	%	%
Yes	84.5	44.4	55.4	93.2	88.1	84.7	72.9
No	15.5	55.2	44.6	6.8	11.1	15.3	27.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

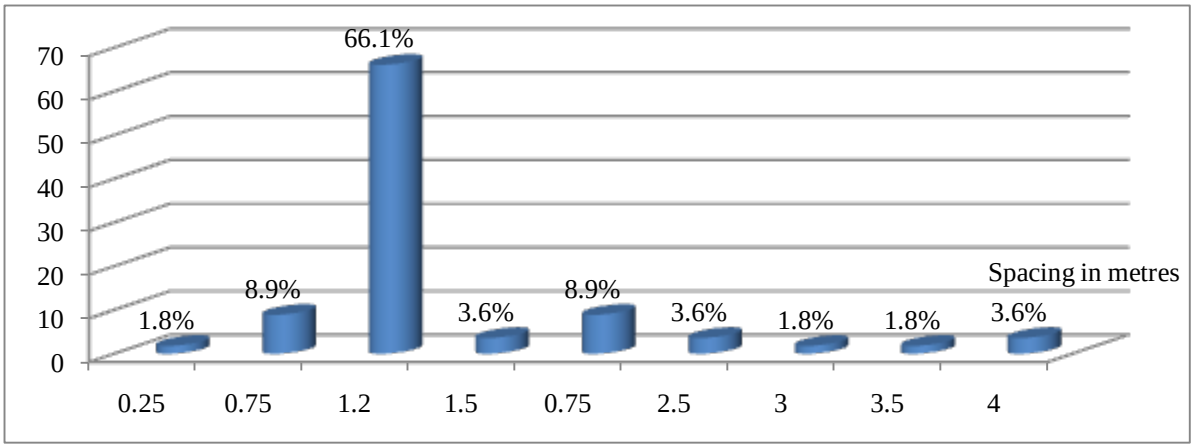

Figure 3. Planting space

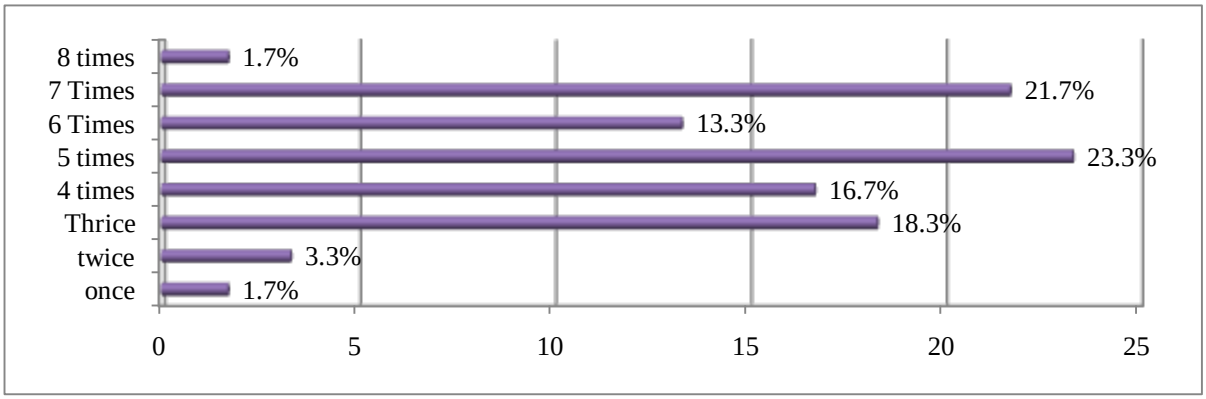

Figure 4. Number of times of cane crop weeding

Table 4. Knowledge of cane propagation and sett nursery establishment

Activity	Know how to propagate cane (%)	Know how to establish cane sett nursery(%)
Yes	51.7	14.3
No	48.3	85.7
Total	100.0	100.0

Table 5. Source and kind of planting material

Source	Frequency	Percent	Kind of planting materials	Frequency	Percent
KESREF	10	16.7	Certified	31	51.7
Sugar companies	27	25.0	Uncertified	29	48.3
Own farm	16	26.7	Total	60	100.0
Neighbour	7	11.7			
Total	60	100.0			

Table 6. Gapping

	Do you know how to gap?		Do you know the right time to undertake gapping?		Do you remove tillers (side shoots)?	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Yes	55	91.7	47	78.3	31	51.7
No	5	8.3	13	21.7	29	48.3
Total	60	100.0	60	100.0	60	100.0

Table 7. Application of manure

Application of manure	Organic manure (%)	Inorganic fertilizers (%)
Yes	63.6	87.2
No	36.4	12.8
Total	100.0	100.0

Table 8. Pests and diseases

Pest and disease	Yes (%)	No
White flies	34.6	65.4
Termites	86.7	13.3
Stalk borer	63.8	36.2
Yellow leaf spot	56.1	43.9
Nematodes	53.6	46.4
Ratoon stunting disease	72.9	27.1
Wilt	54.5	45.5
Smut	70.2	29.8
Pineapple disease	35.5	64.8

Table 9: Reasons for not applying the recommended practices

Practice	Never heard of it (%)	Lack of practical skills(%)	Lack of capital(%)	Lack of labor (%)	Total
Mulching	1.7	15.0	41.7	41.7	100.0
Application of manure	5.0	23.3	53.3	18.3	100.0
Application of soil conservation measures	3.3	31.7	53.3	11.7	100.0
Use of certified planting materials	6.7	20.0	66.7	6.7	100.0
Pest and disease control	3.3	20.0	70.0	6.7	100.0
Weed control	6.7	20.0	56.7	16.7	100.0
Crop rotation	10.0	38.3	38.3	13.3	100.0
Gapping	11.7	31.7	36.7	20.0	100.0

Table 10. Correlation analysis between access to knowledge and productivity of the crop

		Access to knowledge and information	Productivity of the cane crop
Access to knowledge and information	Pearson Correlation	1	.283*
	Sig. (2-tailed)		.029
	N	105	105
productivity of the cane crop	Pearson Correlation	.283*	1
	Sig. (2-tailed)	.029	
	N	105	105

*. Correlation is significant at the 0.05 level (2-tailed).

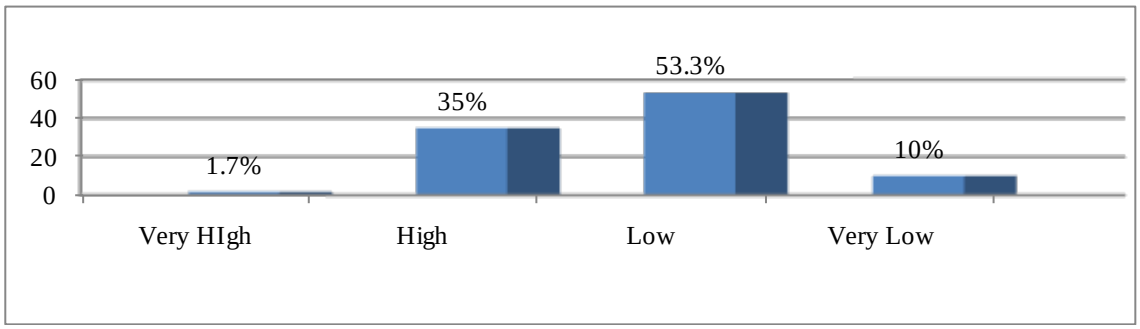

Figure 5. Productivity of cane crop in Kakamega County

4. Conclusion and Recommendations

The productivity of sugarcane crop in Kakamega County has been low and this is being contributed by among other factors; lack of capital and inadequate knowledge and skills regarding the crop's agronomy. The inadequate access to knowledge and skills; technologies and agronomic practices regarding cane crop production and management is attributable to very few or no contact with public and private extensionists who are the sole disseminators of cane crop agronomic practices and technologies. Additionally, the level of cane cultivation was determined by the size of the farm.

The technical knowledge and information gaps varied on the basis of growth stages of the crop. Some farmers had no knowledge of the right time to prepare their land for planting although there is empirical evidence to show that timely planting helps in maximizing the yields. Furthermore other farmers did not undertake the key activities associated with land preparation namely; clearance of vegetation, leveling, sub-soiling, and even ploughing. However, majority harrowed the land, dug furrows and surveyed the land as recommended. A significant number of the small holder farmers did not have the knowledge and skills required for cane propagation. Moreover, very few farmers had knowledge of how to establish cane sett nursery. Even though sub-optimal density planting results in a loss of yield due to inefficient use of the land space, some small holder farmers didn't know the recommended planting spacing for cane crop. The smallholder farmers got planting materials from various sources namely; milling companies KESREF, and neighbours with the main source of sugarcane seedlings being own farm. Hence, most of them grew uncertified cane setts and this may have been contributed to low productivity. Only a few farmers did not know when and how to undertake gapping of the crop. Almost half of the farmers did not remove tillers from their crop although it is advisable to remove tillers as and when they arise because they affect the growth of adjacent stalks.

In sugarcane, weeds have been estimated to cause 12 to 72% reduction in cane yield depending upon the severity of infestation. The number of times the farmers weeded their crops varied from 2 to 8 times; an indication that some farmers lacked knowledge regarding the recommended number of times of weeding and those who had the knowledge lacked capital to apply the practice fully. A significant number of farmers were not applying organic and inorganic fertilizers because of the aforementioned reasons. The crop was also being attacked by a wide spectrum of pests and diseases most of which huge losses. The most common pest was termite and the most disturbing disease was ratoon stunting disease.

Recommendations:

In order for farmers to realize improved cane production levels, they must access and adopt modern technologies and information.

The County agricultural extension staff, milling company extensionists and KESREF technology dissemination units as well as private sector extension should design and implement need based training programs to address the technical knowledge and skills gaps established by the study.

Farmer-to-farmer extension should be used as one strategy of up-scaling and replicating methods already in use among some farmers.

Strategies should be designed to disseminating practices that require technical knowledge and skills.

Mass extension methods should be used to ensure that the information disseminated reaches as many farmers as possible. This will address the problem of a high extension to farmer ratio.

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