

Fire Disaster Preparedness and Response among the Residents and Sugarcane Farmers in the Mumias Sugar Belt Zone in Western Kenya

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Abstract- Fire disasters have caused injuries, numerous deaths and extensive damages to homes and businesses. Despite various systems in place for household preparedness and survival, the effects of fire destruction still affect the economic and social fabric of the whole community. Preparedness and effective response reduces vulnerability from inevitable events of fire destruction. The purpose of this study was to investigate farmer's fire hazard preparedness and response in Mumias Sugar belt zone in Western Kenya. The proximity of sugarcane plantations in Mumias Sugar belt makes communities living in the zone vulnerable to fire destruction because of the dry sugarcane leaves that easily catch fire. The study adopted a cross cultural study design. 384 farmers were selected through multistage random sampling and interviewed using questionnaires. Data obtained was analyzed using descriptive statistics and ANOVA with the aid of SPSS computer software program Version 18. Study findings revealed that 92.7% (357 respondents) had low levels of knowledge and misconceptions regarding fire disaster preparedness, whereas 66% (253 respondents) had a positive attitude towards fire preparedness programs. The study concluded that gaps in knowledge, misconceptions about fire hazard preparedness and mitigation as well as negative attitudes make the communities ill prepared to deal with fire disasters. The study recommends intensive education to members of the community to fill the gaps in knowledge and to correct the misconceptions noted. The education should be tailored to help improve on attitudes towards fire disaster mitigation and fire safety.

Index Terms- Fire Disasters, preparedness, Response, Community, Knowledge, Attitudes

I. INTRODUCTION

Worldwide, fire disasters cause injuries, numerous deaths and extensive damages to homes and businesses (World Fire Statistics Bulletin, 2012). Such fires may be caused by natural forces/processes known as natural disasters or by human actions such as negligence or errors commonly referred to as 'anthropogenic disasters'. According to USAID (2012), fire destruction, as with most other natural disasters, is usually aggravated by anthropogenic activities; thus the fire hazards which are part of nature often turn into disasters due to human actions or inactions. Despite advances in knowledge and technology, vulnerability to and risks to fire disasters have been

rising in both the developed and developing countries. Risks and vulnerability to fire disasters have resulted from changes of people's lives socially, economically, culturally, politically and environmental contexts partly due to development as well as lack of development processes. However, according to Hemond & Robert (2012), sometimes man faces risks from such disasters because of lack of awareness of hazard in his environment

Aspects leading to fire destruction are present almost everywhere ranging from wildfires caused by lighting or dropping of cigarettes outside on surfaces that are flammable, industrial accidents to earthquakes which have been known to cause damage of gas leaks leading to explosions and fires (Wisner *et al*, 2012). Fire destruction can also come from acts of arson and terrorism such as the September (2011) terrorist attack in the United States of America in which terrorists crashed planes into the world Trade Centre causing jet fuel explosion which set the twin towers on fire. Recent examples of fire as natural disaster (out-of-control wildfires) which caused death and destruction have been witnessed in Australia in 2009, in Russia in 2010, and virtually every year through different southern and western states of the United States and Mediterranean Europe. However, among the developed countries, USA has had a bigger share of fire disaster destruction.

The United States of America (USA) and Canada have recorded the highest absolute number of fire-related deaths in the world and fire death rates, generally 2 to 4 times those in Europe (Euro Fire Protection, 2012). The United States also has also recorded one of the highest per capita fire rate losses (Coppola, 2015). The cause of accidental death in the United States of America by fire is exceeded only by automobile collisions, falls and drowning (Coppola, 2015). Wildfire affecting urban and semi-urban areas is a phenomenon which deserves much greater attention than it has been given because of the dense population of people in these areas (ADPC, 2007).

In Africa, fire disasters have occurred virtually in all the Sub Saharan countries and several key sectors of the economy have been affected negatively. Kenya faces a rising degree of vulnerability to fire disaster risks ranging from loss of property worth billions of dollars to loss of lives. The frequency and magnitude of fires in Kenya has increased over the last few years making communities also more vulnerable (UNISDR, 2013). Several cases of fire incidences have previously occurred in Kenya with most of them being fatal. The more recent tragic cases include the 2009 fire in Nakumatt stores downtown

(Nairobi) on the 28th January 2009, Sachangwan Molo oil tank explosion fire on 31st January, 2009 (The Daily Standard, 2009).

Majority of fires in Kenya are started by people (Republic of Kenya, 2009). Of these fires, 40% were classified as due to arson, 20% are caused by negligence and carelessness, and 40% due to unknown causes (Republic of Kenya, 2009). Most cases of fire outbreak disaster in the communities are never reported. Communities in Kenya are predisposed to fire disaster destruction by a combination of factors such as poverty, settlement in areas prone to perennial fire outbreaks, areas with poor infrastructure and services such as the informal urban settlements, or even poorly constructed buildings.

This study sought to investigate community preparedness and response to fire disaster in the Mumias sugar Belt Zone. The Mumias sugar belt zone is an area concentrated with sugarcane plantations and human settlement. Majority of the people in the Mumias Sugar belt zone are cane farmers. Both the farmers and nearby premises were included in the study. Fire outbreaks are among the greatest risks faced in this zone; such outbreaks may occur as a result of lightning strikes, accidents or arson. The numerous sugarcane plantations make communities living in this zone vulnerable to fire destruction because of the dry sugarcane leaves that easily catch fire. On several occasions, large hectares of cane plantations have been razed down and reduced to ashes in the Mumias Sugar-belt zone (G.o.K, 2011). The economic losses suffered by the residents, farmers and sugar millers are enormous. The sugar milling companies are forced to harvest premature burnt cane which has a smaller than normal yield, and in the process, disrupt harvesting operations and disrupting livelihoods. As a result, farmers and sugar factories incur huge economic losses. These fire disasters predispose community members to risks of poverty, injuries and even deaths.

Responses to these fire disasters have been disheartening. People appear to lack basic standards of professionalism; furthermore, the fire brigade units operate independently, without a coherent strategy or any central command (Kiveu, 2015). This situation is worsened by the fact that there are no standardized training programs in the country and that the National Disaster Operations Centre (NDOC) doesn't have its own resources (G.o.K, 2012). This leaves communities vulnerable to fire disaster destruction. With so many accidental and non-accidental fires occurring in the zone, and the risks of large fire plantations which easily catch fire, safety from fire disasters is a concern.

It is still not clear how prepared people in the sugar belt zones are in dealing with the problem of fire hazards. Despite various systems in place for household preparedness and survival, the effects of fire destruction still affect the economic and social fabric of the whole community. Community preparedness and response to fire disasters is invaluable since the burden of care and support for affected people lies more on the community than any other agency. Community preparedness reduces vulnerability to losses that may result from inevitable events of fire destruction. Community participation and capacity are therefore critical in preparedness (Nelson, 2014). Moreover, Disaster Risk Reduction (DRR) also recognizes social and adaptive capacities of communities as critical components to successful preparedness against disasters. Knowledge of fire safety precautions, knowledge of what should be done in case of fire outbreaks are invaluable for planning the development of this

area and for taking steps to protect individuals and their property from fire disaster destruction. The rationale here is that community preparedness, mitigation and management of fire hazards would minimize losses incurred from fire disasters and also save human lives.

II. MATERIALS AND METHODS

The study adopted a Cross-cultural research design that used both quantitative and qualitative data collection methods. Structured questionnaires and interview schedules were developed and validated in consultation with professionals from the Center for Disaster Management and Humanitarian Assistance of Masinde Muliro University. These instruments were pretested and necessary corrections made before embarking on actual data collection. The sample size was determined using the Fischer *et al* formula $n = Z^2pq/d^2$ (Creswell, 2013) and a sample size of 384 obtained was used. 384 House Hold heads were randomly selected from the study area; in addition, 11 key informants were purposively selected for the study. The study proposal received approval of the National Commission of Science and Technology (NACOSTI).

The study site (Shibinga) was randomly selected by multistage random sampling from the three divisions of Mumias Sub County. Lists of all the Cane farmers contracted to Mumias Sugar Company within shibinga zone were obtained from the respective farmer zonal cane supervisors of the Mumias sugar company. The researcher then mapped and assigned numbers to the farmers list creating a complete list of all the farmers in Shibinga. This was done with the assistance of the various Zonal cane farmer supervisors and four research assistants. Ballot sheets were then assigned numbers corresponding to each farmer, from the first to the last in shibinga. Using the numbered ballot sheets, cane farmers were randomly selected and the selected farmer was interviewed. In situations where the farmer could not be reached (such as those who were in employment far away from their homes), the spouse of the farmer was considered as his representative and was subsequently interviewed. And in situations where the farmer or their representatives were available but not present at the time of the visit by the research team, appointments were booked and two follow up visits made to meet the respondent. Fortunately, upon the two revisits, these respondents were traced and interviewed. Using this procedure, 301 male and 83 female respondents were interviewed. In addition, 11 Key informants and 11 observation checklists were also used to collect data. A summary of data collection methods adopted in the study are presented in Table 1 below.

Table 1: Data collection Methods adopted for a study on fire disaster preparedness and response in the Mumias Sugar Belt Zone, Kenya

Study population Unit	Sampling Method	Sample Size	Data collection Instruments
Farmers	Multistage Random sampling	384	Questionnaire
Key Informants	Purposive	11	Interview Guide
Buildings	Purposive	11	Observation checklist

Data for this study was collected during the month of August, 2012.

SPSS for windows version 18.0 -Computer software program was used for coding, entering, and cleaning of quantitative data obtained from questionnaire respondents. Coding was done using the data editor in SPSS to allocate each variable a numerical value, for example, 1 for male and 2 for female. The data was then sequentially entered for each respondent. Cleaning of the data involved cross checking each answer for any inconsistency and running through the SPSS data viewer for any gaps and inconsistencies. Frequency distributions and descriptive statistics of scores were then obtained and their meanings derived. Chi-square tests of independence and Analysis of Variance (ANOVA) were used to check for any significant differences between variables of interest. Spearman's rho correlation coefficients between the different variables with attitude were also determined. This particular statistic was used because it does not assume a linear relationship between variables and is indicated for ordinal data.

To determine the level of Knowledge on fire preparedness, respondents were asked a series of specific questions on fire preparedness. These questions tested on the cause of fire disasters, Fire safety precautions, knowledge different types of extinguishers, knowledge of how to use different types of extinguishers, knowledge of practices used to prevent fire out breaks, knowledge of where and how to report fire outbreaks. Responses to these question items were scored. A correct response was assigned a score value of 2, while an incorrect response was scored as 0. The result was a scale for knowledge on fire hazard preparedness with scores ranging from 0 (the lowest level of knowledge) to 40 (the highest level of knowledge). For the purpose of easy comparison, these scores were also expressed as percentages. Level of Knowledge on fire preparedness was determined using a scale.

Using the knowledge scale, the cumulative score for responses for each respondent was then computed. It was established that respondents attained scores ranging from 10 (25 %) to 24 (60 %) with a mean score of 12 (30 %) and a standard deviation of ± 3 . From these scores, the level of knowledge was then categorised as follows; Respondents with high level of knowledge – these were respondents who had attained a score of at least 20 i.e. $\geq 50\%$ on the scale for knowledge. Respondents with low level of knowledge - these were respondents who had

attained a score less than 20 i.e. $< 50\%$ on the scale for knowledge.

To determine the attitudes of the respondents, two sets of analysis were carried out to illicit association between attitude and key variables. First, attitude towards fire hazard preparedness and programs on fire safety was determined from respondents feelings on a 5 point Likert scale of responses i.e. 'strongly disagree', 'disagree' undecided', 'agree' and 'strongly agree'. Analysis was by determining score values for responses in agreement with the positive attitude to the question asked. Responses were scored as follows; strongly agrees or Agrees was assigned a score of 2 points; while responses in disagreement with the positive attitude were scored as follows; strongly disagree/ disagree/undecided was assigned a score value of 1 point. The result was an attitude scale with scores ranging from 10 points (very poor attitude) to 20 points (most favorable attitude). A score of 15 (60 %) was used as the cutoff point to determine the type of attitude each respondent had.

Using this scale, the cumulative score for responses for each respondent was then computed. It was established that respondents attained attitude scores in the range from 12 to 18 with the mean score at 16 points (a score of 60%). Respondents were then grouped into two categories as follows; Respondents with positive attitudes – These were respondents who had attained a score of at least 15 points on the attitude scale i.e. agreed with at least 60% of the statements of positive attitude towards fire safety and fire hazard preparedness; Respondents with negative attitude - These were respondents who attained a score less than 15 points on the attitude scale i.e. disagreed with at least 60% of the statements of positive attitude towards fire safety and fire hazard preparedness.

The last section of analysis involved scores using a checklist for preparedness of premises and buildings in the study area.

III. STUDY FINDINGS

Socio-demographic characteristics

Results showed that 301 (78%) of the respondents were male while 83 (22%) of the respondents were female. There was significant variation in the gender distribution (Pearson Chi $\chi^2_{1, 0.01}=9.00$; $P<0.01$); thus, the larger proportion of the respondents was males and therefore controlled most of the households or farms. The age of the 384 farmers was as follows; 73 (18.90%) were aged 18 -25 years; 53 (13.80%) were 26-32years; were 33 - 40 (46.80%) and 41years and above were 68 (17.70%). A chi square test of independence conducted on age distribution of the respondents showed a significant ($p>0.05$) distribution of age (Pearson Chi $\chi^2_{4, 0.05}=36.69$). A fairly large proportion (80.4%) of the respondents can be described as small scale farmers because they have 1-6 acres under cane. A chi square test of independence conducted on the distribution of acreage of land owned under cane plantation showed that there was no significant variation ($P<0.005$) in the distribution of land acreage (Pearson Chi $\chi^2_{24, 0.05}=8.57$). Ownership of acreage of land under sugar cane plantations was determined by the gender of the respondents, with 12 of the male respondents owning 12 acres and above acreage of land under canes as compared to only 1 of the females in the same.

Knowledge on fire disaster preparedness

Results showed that a majority (92.9%) of the respondents had a low Level of knowledge on Fire hazard preparedness (Table 2).

Table 2: Levels of Knowledge regarding fire disaster preparedness and response in the Mumias Sugar Belt Zone, Kenya

Levels of knowledge	Frequency	Percentage
Respondents with high levels of knowledge	357	92.9%
Respondents with low levels of knowledge	27	8.1%
TOTALS (N)	384	100%

Source, Field Data (2012)

These findings agree with study findings by Kiveu(2015) which reported poor fire preparedness knowledge levels among residents of Kisumu. Further analysis of responses on knowledge questions revealed differences and gaps in knowledge on issues related to fire hazard preparedness. Differences are noted when we compare knowledge for the variables gender, level of education and age of respondents.

Generally, both the male and female respondents displayed poor knowledge regarding Fire preparedness. These findings agree with study findings by Woodrow (2012) which reported poor no similar perceptions about fire safety among the different gender. The only observable differences on knowledge across gender are on issues of knowledge of using fire extinguishers. Table 3 below summarizes the differences noted on knowledge across the variable gender.

Table 3: Differences in Knowledge on fire disaster preparedness across gender in Mumias Sugar belt Zone in Western Kenya

Variable.	Frequency of correct responses		Level of significance on difference. (p-value at 0.05)
	Males (n=301)	Females (n=83)	
Knowledge on using Fire Extinguishers	90 (30%)	10 (12%)	.001
Action to take in case of a fire outbreak	60 (20%)	12 (13%)	.010
Knowledge on basic fire safety precautions	54 (18%)	6 (2%)	.001

Source field Data, (2015)

Table 3 revealed that male respondents were more knowledgeable than their female counterparts in the issues of fire safety, causes of fire outbreak and knowledge of using fire extinguishers. These differences are significant; however, the percentages scoring correct answers were very low.

When the average scores of knowledge were cross tabulated with level of education, it appeared that the respondents with university level of education had better knowledge levels than the rest with the highest (60%) answering correctly the knowledge questions. The respondents with secondary school level of education come second with 43% answering positively. The primary level graduates came third in the knowledge aspects (37%) while the respondents with no formal education were last with an average score of 7 %. This finding reveals that level of education is an important factor in fire preparedness. This perhaps is because some lessons are taught in school about fire safety.

The pattern observed from the results was that knowledge on fire preparedness increased with age as the oldest respondents (over 45 years old) also had the highest average of positive answers to the questions of knowledge (57%). The youngest respondents had the lowest average level of knowledge (43%). This finding agrees with study findings by Thomas (2012) which reported that older persons in rural South Africa were more knowledgeable on fire safety issues.

The study also sought to establish perceptions by cane farmers on the risk of fire disaster outbreak. Table 4 below presents a summary of the findings.

Table 4: Cane farmer Perceptions of the risk of fire outbreak in sugar cane farms in the Mumias Sugarbelt zone

Perception	High Risk%	Moderate Risk%	Low Risk%	No risk%	Total
Males	276 (71.9%)	15 (3.9%)	7 (1.8%)	3 (0.8%)	301
Females	57 (14.8%)	20 (5.2%)	5 (1.3%)	1 (0.3%)	83

Totals(N)	333 (86.7%)	35 (9.1%)	12 (3.1%)	4 (1.1%)	384
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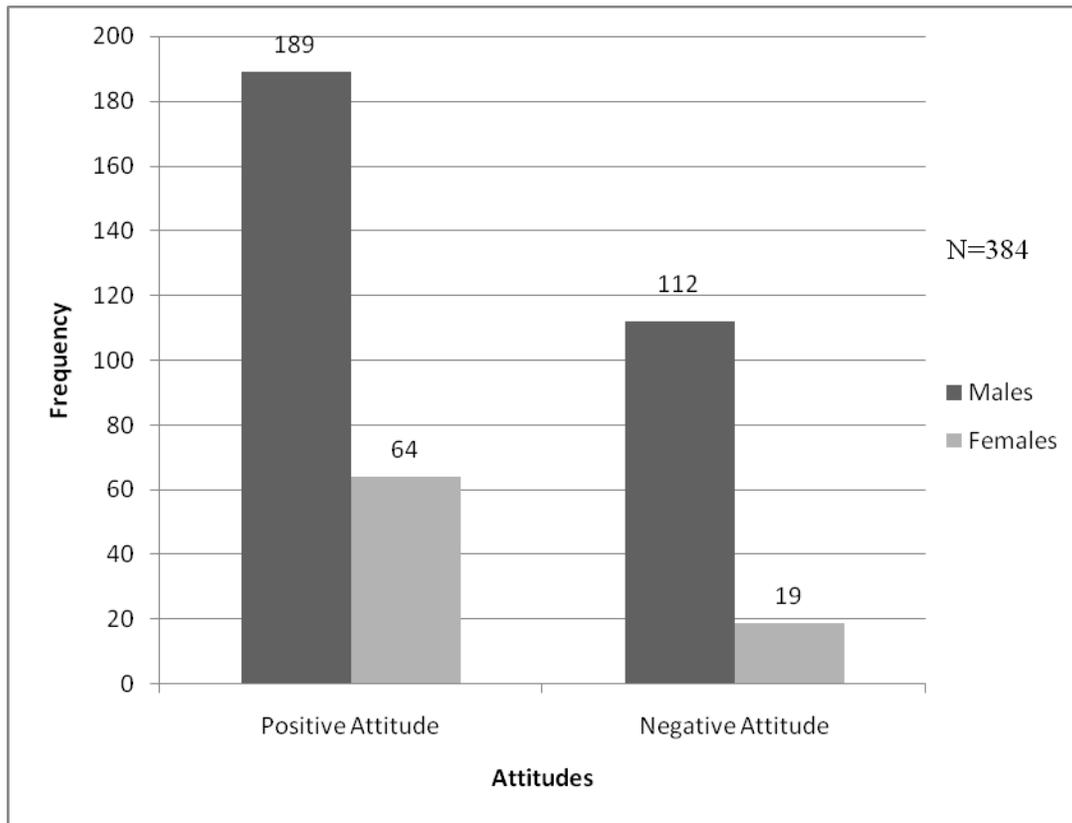
Source field Data, (2012)

Table 4 revealed that majority of the respondents (86.7 %) were well aware of the potential risk of a fire outbreak in their home environment. This finding agrees with study findings by Kiveu(2015)which reported that more people in Kisumu were well aware of the potential risks of fire outbreaks in their communities. 9.1% of the respondents perceived the risk of fire outbreak as moderate, while only 16(4.2%) respondents either perceived it as low risk or no risk at all. However, it is also

emerged from the data that male respondents perceived the risk of fire outbreak as more likely than their female counterparts.

Attitudes towards fire disaster preparedness and programs on fire safety

Results showed that two-thirds 253(66%) of the respondents held positive attitude towards fire safety and fire hazard preparedness (Figure 1).



Source field Data, (2012)

Figure 1: Attitudes towards fire safety and response in Mumias Sugar belt Zone.

Further analysis revealed varied opinions on certain issues key to fire safety and fire hazard preparedness.Both male and female respondents held similar feelings regarding fire safety and fire hazard preparedness. There were only a few differences in as

regards feelings on fire safety and fire hazard preparedness. Table 5 below summarizes the main observable differences in feelings noted.

Table 5: Differences in Attitude on fire safety and fire disaster preparedness across Gender

Variable.	Frequency of positive attitude responses		Level of significance on difference (p-value at 0.05)
	Males. (n=301)	Females. (n=83)	
Attitude statement that:-			
Everyone should create time to learn about fire safety	202 (67%)	72 (87%)	.005
Fire safety should be introduced in school as part of the curriculum	213 (71%)	72 (87%)	.013

Willingness to attend fire drills	126 (42%)	56 (68%)	.008
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Source field Data, (2012)

Table 5 reveals that male and female respondents differ in opinion about the three attitude variables regarding fire safety and fire hazard preparedness. Female respondents appeared more willing to create time to learn about fire safety and would be more willing to attend fire drills. These differences across sex are however, not strongly significant. Similar study findings were reported by Mahendra (2011) which reported that women in

agricultural rural zone were more willing to create time for lessons on disaster preparedness.

There wasn't much difference between people with a higher education and those with a lower education over some of their attitude and Perceptions about fire safety and fire hazard preparedness. Higher education here implied having at least secondary school education. The differences noted were summarized in table 6 below.

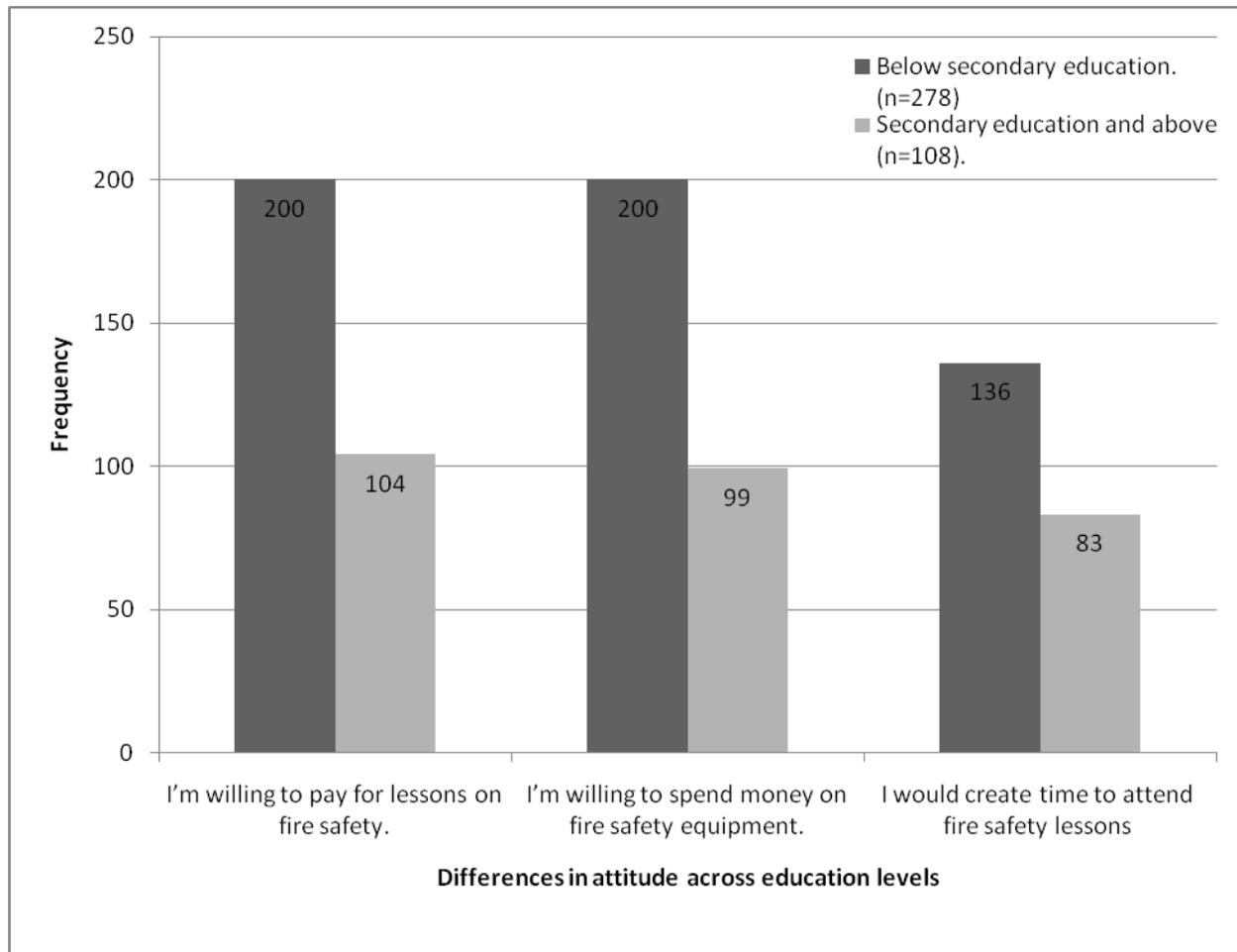
Table 6: Differences in attitude on fire safety and fire disaster preparedness across levels of education

Variable.	Frequency of positive attitude responses		Level of significance on difference <i>(p-value at 0.05)</i>
	Below secondary education. (n=278)	Secondary education and above (n=108).	
I'm willing to pay for lessons on fire safety.	200 (72 %)	104 (96 %)	.003
I'm willing to spend money on fire safety equipment.	200 (72 %)	99 (92 %)	.002
I would create time to attend fire safety lessons	136 (50 %)	83 (77 %)	.002

Source field Data, (2012)

It is notable from Table 6 above that more people with a higher education are willing to pay for lessons on fire safety.

This same pattern applies to spending money on fire safety equipment and creating time to attend fire safety lessons. These differences in feelings across education are quite significant.



Source field Data, (2012)

Figure 2: Differences in attitude on fire safety and fire disaster preparedness across different levels of Education

The second part on analysis of attitude aspects involved using Spearman's rho correlation coefficients for the different aspects of attitude with the independent variables; age, sex, level of education and employment status were determined. The highest correlation (0.191) was found in the category of employment status and creating time to learn about fire safety. People in formal employment are less likely to create time to learn about fire safety. This study finding agrees with study findings by Hemond & Benoit (2012) which reported that formal sector employees were less likely to create time to attend to fire preparedness lessons and drills. Among the demographic factors, Gender emerged as the least important with small correlation coefficients between gender and the attitude measures ($P < 0.05$).

IV. DISCUSSION AND CONCLUSION

Generally, the level of knowledge about fire disaster preparedness recorded for members of the study community was low. This low level of knowledge can be attributed to lack of awareness campaigns in this community. There is need for community members to be exposed to fire safety campaigns through the media, seminars or trainings. Gaps in knowledge and certain misconceptions about fire hazard preparedness were evident. Men were significantly more knowledgeable than

women on certain issues on fire safety (p -Knowledge on using Fire Extinguishers 001. Action to take in case of a fire outbreak) probably because men are regular attendants of social gatherings such as public Gatherings (*Baraza's*) where this information is often delivered; and also because men get more information for listening more to the Radio. Higher levels of education (secondary and tertiary) are linked to better knowledge on fire disaster preparedness this is probably because people with higher education levels can easily comprehend some 'difficult' aspects about fire safety. Gaps in knowledge and misconceptions noted could be an indicator that certain aspects about fire safety are still difficult for some community members to comprehend; but could also be a reflection of lack of related information fire disaster mitigation.

Gaps in knowledge and misconceptions such as those revealed in this study have clear negative implications and reduce the potential to mitigate fire disasters in a sizeable population of the community. For instance, community members who do not know the difference where to give information in case of a fire disaster outbreak leave the community in a vulnerable position from fire destruction. Similarly, failure by some community members to understand on basic fire safety precautions makes them vulnerable.

The study population held varied attitudes towards fire disaster preparedness and programs to prevent fire outbreaks.

Based on the study findings, attitudes towards programs on fire safety can generally be described as poor. Key issues necessary for fire preparedness and safety scored poorly.

Higher levels of education (secondary and tertiary) are linked to positive attitudes about and programs fire disaster preparedness and programs to prevent fire outbreaks. This is probably because people with higher education levels can easily comprehend some difficult aspects about fire disaster mitigation. Thus they can therefore give correct or expected views.

Attitude towards fire disaster and Programs to prevent fire outbreak has important implications because attitude has a major influence over behavior whether

This study has shown that the people living in sugar belt zone and non-industrial premises in Mumias Sugar Belt zone are ill prepared to respond to a fire hazard. Mumias Sugar Belt zone, being a fast growing region in terms of population size is fairly representative of the situation in other towns in the country. There is a general lack of awareness on fire hazards in the working environments. This leads to a poor attitude and practice among farmers. Fire safety knowledge, attitude and practice among the people are not optional, as this may be the difference between life and death in many fire incidents. Ignorance and apathy of the administrators, compounded by lack of funds constrain the enforcement of the existing legislation. Inadequate staffing and poor or no training of fire service providers make a bad situation worse.

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