*IOSR Journal Of Humanities And Social Science (IOSR-JHSS)*
*Volume 27, Issue 2, Series 7 (February. 2022) 01-09*
*e-ISSN: 2279-0837, p-ISSN: 2279-0845.*
*www.iosrjournals.org*

# Factors Affecting Small Scale Farmers Coping Strategies To Climate Change In Vihiga Sub County In Kenya.

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**ABSTRACT**
This study examines factors affecting adaptation strategies to climate change of small-scale farmers in Vihiga sub County in Kenya. Vihiga sub County is a rich agricultural area where various food and cash crops are grown. However, changes in climate coupled with declining soil fertility over the area have impacted on crop production, and hence affect food security especially among small scale farmers. The study sought to examine farmer's perceptions to climate change and factors that influenced small scale farmers in adapting to climate change. The study adopted a descriptive survey design. Data from both primary and secondary sources were used. Primary data included Focal Group Discussions (FGDs), questionnaires and interview schedules administered to farmers to gain information on farmer's perceptions to climate change, adaptation strategies to climate change if any and factors likely to influence their adaptation strategies. Despite these changes in climate, crop farmers had put in practice some adaptation strategies to cope with the changing trends, though they were faced with many challenges/ constraints in trying to implement these strategies and this was related to certain factors. Results indicated that a majority of the farmers engaged in adaptive strategies to climate change. Out of seven factors surveyed, age, education, family size, farm size, family income, gender and farming experiences were significantly related to adaptation strategies. These results provide policy makers and development service providers with important insight, which can be used to better target interventions which build promote or facilitate the adoption of coping mechanisms with potential to build resiliency to changing climate and resulting environmental impacts.
**Key Words**: Climatic Change, Adaptation Strategies, constraints, Small scale farmers.

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Date of Submission: 10-02-2022 Date of Acceptance: 25-02-2022

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## I. INTRODUCTION

Agriculture is extremely vulnerable to climate change, the agricultural sector in developing countries is particularly vulnerable to adversities of weather, not only because farmers are dependent on rain but because farming is subsistence oriented and is practiced not only with relatively basic knowledge but also using technologies on small pieces of land. The small holder farmers already practice farming under pressure from food insecurity, increased poverty and water scarcity (Oxfam 2010, CEEPA 2006, Regassa et al., 2010). The issue of climate change as witnessed in the 21st century is a major threat facing humanity. The fourth assessment report of Intergovernmental Panel on Climate Change (IPCC) of 2007 indicated that warming of climate is unequivocal and observations show an increase in global average air and ocean temperature, widespread melting of snow and rising global mean sea level. At continental and regional levels, numerous long term changes in climate have been observed and include widespread changes in precipitation amounts and distribution, ocean salinity, wind patterns and aspects of extreme weather resulting to droughts, heat waves, and intensity of tropical cyclones. These changes threaten community livelihoods, food security, economic sectors, ecosystems and social groups (Watson et al., 1998; O Brien and Leichiko, 2000). The socio-economic sectors that are adversely affected include water resources, agriculture, forestry, fisheries and human settlements, ecological and human health. Additional pressures emanate from higher air and soil temperatures which eventually reduce yields of desirable crops while encouraging weed and pest proliferation. Further changes in precipitation patterns increase the likelihood of short-run crop failures and long-run production declines. Although there will be gains in some crops in some regions of the world, the overall impacts of climate change, the focus of this study are expected to be negative, threatening global food security.(IPCC,2007).

The Inter Governmental Panel on Climate Change (IPPC, 2007) highlighted that Africa will be one of the continents that will be hard hit by the impact of climate change due to an increased temperature and water scarcity and yet Africa represents only 3.6 percent of emissions. The IPCC Report pointed out that there is "very high confidence" that agricultural production and food security in many African countries could be severely affected by climate change and variability. The Factors Affecting Small Scale Farmers Coping Strategies

projected that yields of crops in some countries could be reduced to as much as 50 percent by 2020, with small-scale farming being the most affected. Agriculture is at the forefront of shaping the concept of sustainable development for many developing countries, particularly Kenya. The renewed attention for the role of agriculture in development processes will have to take account of the vulnerabilities and risks posed by climate change. In Kenya the general observation is that impacts of climate change exist and may have affected some of the key sectors of the economy which are highly depended upon by the local communities. Agricultural production, environment, energy, forest, tourism, infrastructure and public health are bearing much of the impact. At the moment the country is facing severe drought that has resulted in extreme hunger among some parts of the population and the death of significant numbers of livestock, power rationing and increased conflicts over dwindling water resources.(Kuria,2009).Changes in climate and weather patterns particularly rainfall regimes are predicted to have severe negative impacts on crop production, food security and natural resources in East Africa. Without appropriate responses climate change, is likely to constrain economic development and poverty reduction efforts and exacerbate already pressing difficulties. Countries with economies rooted in climate sensitive sectors like agriculture, fisheries and forestry are expected to be hardest hit. (Woodhill and Terswichha, 2007). This is likely to affect livelihoods of people who are dependent on rain fed agriculture. Crop production is highly sensitive to climate variability and weather extremes, such as droughts, floods and severe storms. The forces that shape our climate are critical to farm productivity. Human activities have already changed atmospheric conditions such as temperature, rainfall, levels of carbon dioxide and ground level ozone (Thornton et. al., 2006). While food production may benefit from a warmer climate in temperate regions (IPCC 2007) the increased potential for droughts, floods and heat waves will pose challenges for farmers.

Additionally, the enduring changes in climate, water supply and soil moisture could make it less feasible to continue crop production in certain regions. Recent studies in Kenya indicate that increased frequency of heat stress, droughts and floods affect crop yields and livestock beyond the impacts of mean climate change, creating the possibility for surprises, with impacts that are larger and occurring earlier, than predicted using mean variables alone.( Kuria, 2009). This is especially the case for subsistence sectors of farming at low latitudes.

## II. RESEARCH METHODOLOGY

### 2.1 Study Area

Vihiga Sub-County is located in Vihiga County in the former Western Province. Its largest market centre is Mbale, where the County Headquatres are located. Vihiga Sub-County is located on latitude $0^0$50' north and on longitude $34^0$42' east. It falls within the high potential agricultural lands which are also associated with some of the highest rural population densities in the country, with a population of about 96,292, with 23,375 households and varying densities from 277 to 1064 persons per sq. (Population Census, 2019). The area comprises of four Wards, namely; Lugaga-Lumwamu, South Maragoli, Central Maragoli and Mungoma Wards. As shown in figure.

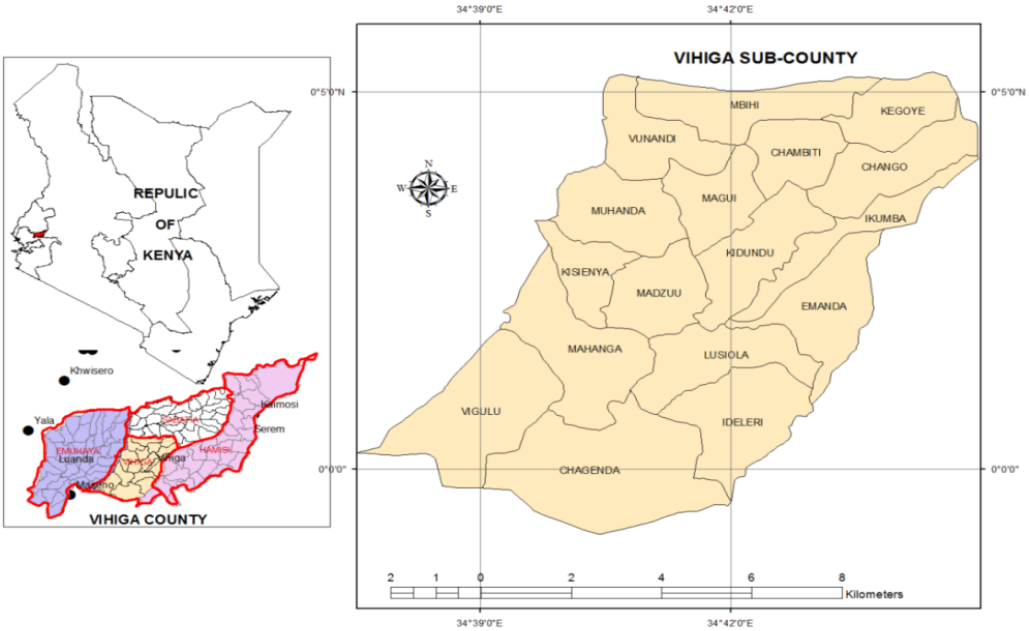



**Figure 1.0: Map of Vihiga Sub-County.**

**ESRI ArcGis 10.0**

The area experiences high Equatorial climate, rainfall is distributed throughout the year with an average annual precipitation of 1900mm. The soils in the area are mainly sedimentary in nature, which support crop production. The type of soils and climate favors two planting seasons in the year. During long rains, crops such as maize, beans, sweet potatoes and sorghum are grown for subsistence use. Yet due to various reasons , such as; poor land use practices in the community and over dependence on natural resources the area now experiences climate change impacts (Mo D&P, 2013).

**2.2 Sampling Procedure**

Vihiga Sub-County consisted of four wards, namely: Lugaga-Lumwamu, Central Maragoli, South Maragoli, and Mungoma which have clans and thus different social constructed roles and responsibilities for males and females in climate change adaptation of crop production. Today, several researchers have come up with ways to ease the calculation of sample size from a given population. This study adopted the Krejcie and Morgan table of sample size tabulation, which give the population (N) and its corresponding equivalent sample size. Therefore, out of 23,375 households in Vihiga Sub-County a sample size of 377 households was derived.

The sample size was later randomly sampled in each of the four wards in Vihiga Sub-County. Stratified sampling was then used to apportion the 377 households to the various wards in the study area according to the number of households and thereafter simple random sampling was adopted to choose the households accordingly, as shown in table 1.0.

**Table 1.0: Sample size Tabulations from Krejcie and Morgan (1970)**

| **Sub-County Wards** | **No. of households** | **No. of Households randomly picked** |
|---|---|---|
| Lugaga-Wamuluma | 7,024 | 110 |
| Central Maragoli | 6,114 | 100 |
| South Maragoli | 6,024 | 88 |
| Mungoma | 4,213 | 79 |
| TOTALS | 23 375 | 377 |

Source: KWBS (2019) population census
Adopted from Krejcie and Morgan Table (1970)

**2.3 Methods of Data Collection and Analysis**

Both primary and secondary data was collected. Secondary data on temperature and rainfall patterns for Vihiga Sub-County over the past years was obtained from the Meteorological department of Kenya. Primary data included; gender, age, levels of education, family sizes, farm sizes, family income and farming experiences of the respondents. This was collected using questionnaires which were administered to house hold heads who were the respondents. Interview schedules from key informants such as the agricultural officers and gender officers in various capacities in the Sub-County were also used. Focused group discussion with small scale farmers was used to get more information and validate the data collected from the questionnaires and interview schedules.

## III. RESULTS AND DISCUSSIONS

**3.1 Annual Rainfall Trends in Vihiga Sub-County**

Findings indicated that there was majorly a decline trend in the rainfall amounts over the years under study. Although there were some years that posted an increase in the rainfall amounts, the general outlook of the findings depicted a decrease in the rainfall amounts as years went by. Results in figure 2 indicate that there was a regression coefficient of -2.801 that clearly indicates a negative linear trend in annual rainfall amounts from 1968 to 2018. The coefficient of determination of ($R^2$) of the annual rainfall amounts is 0.016 that means there was approximately a 2%variation in rainfall amounts between the years (1968-2018).

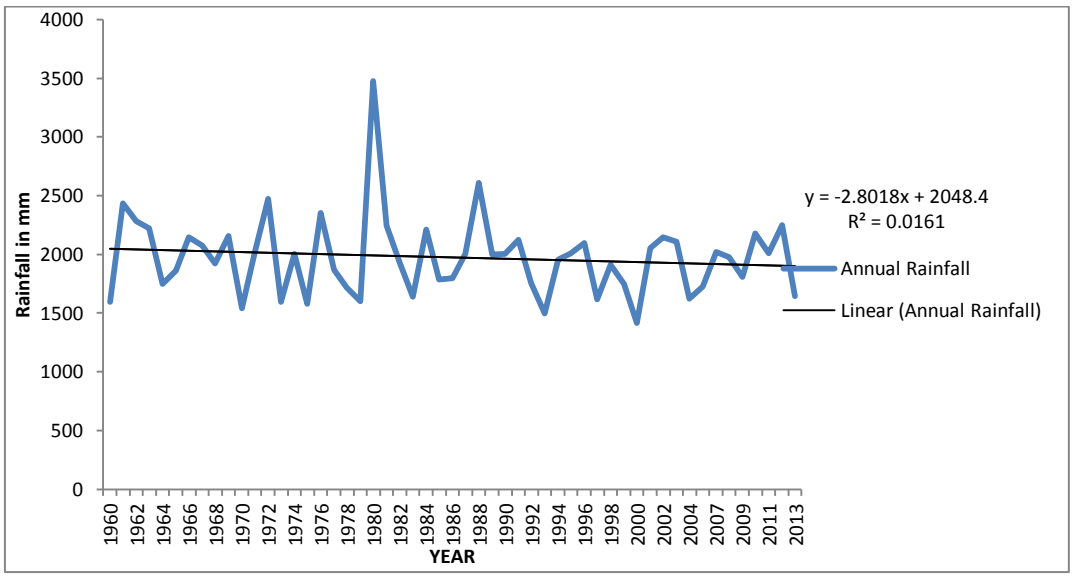



**Figure 2: Annual Rainfall Trends from 1968-2013**

### 3.1.3 Annual Temperature trends in Vihiga Sub-County

The analysis of the annual mean temperatures for Vihiga Sub-County from 1979-2018 posted a positive linear trend as shown in Figure 3 indicates that there was a regression coefficient of 0.028 while the coefficient of determination ($R^2$) of the annual mean temperatures is 0.445 which means 44.5% of variations in temperatures over a period of (1979-2018). This indicates that as years went by the annual mean temperatures increased by $0.03^0$C.

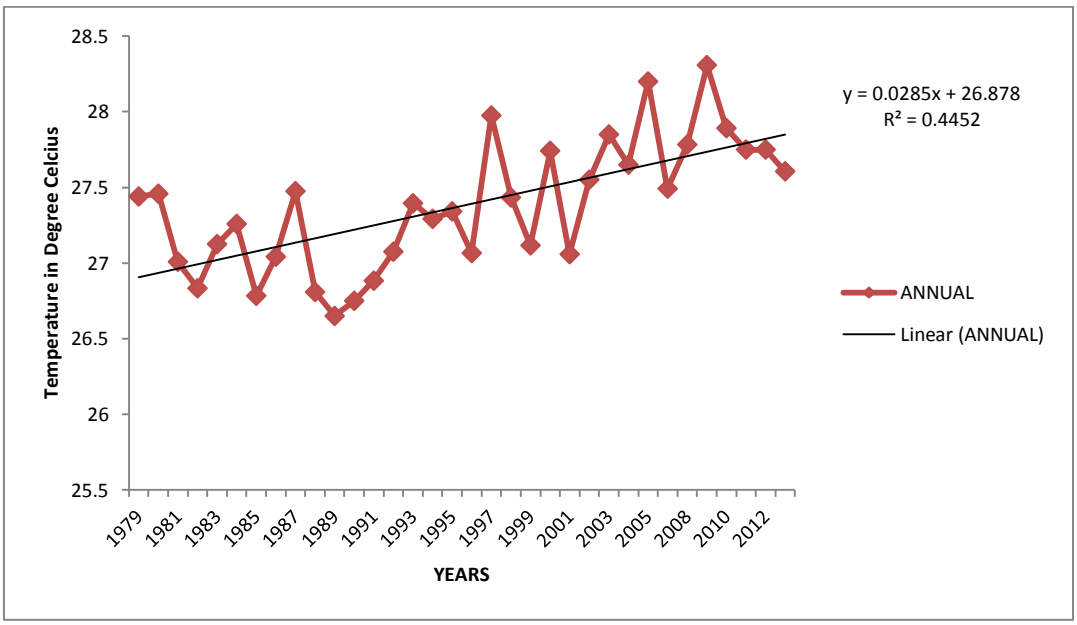



**Figure 3: Annual mean temperature trends for Vihiga Sub-County from 1979-2018**

This prediction implies that temperatures are likely to increase in the coming years. Although the rate of warming per year for the period of study overtime is small by 0.03 $^0$C the cumulative effect would damage crop productivity, particularly when interacting with declining rainfall observed in Vihiga Sub-County station recordings. This prediction shows that there is likely to be an annual increase in temperatures in the years thus the need for farmers to engage in appropriate adaptation and mitigation strategies in Agriculture.

### 3.3 Factors influencing Climate Change Adaptation

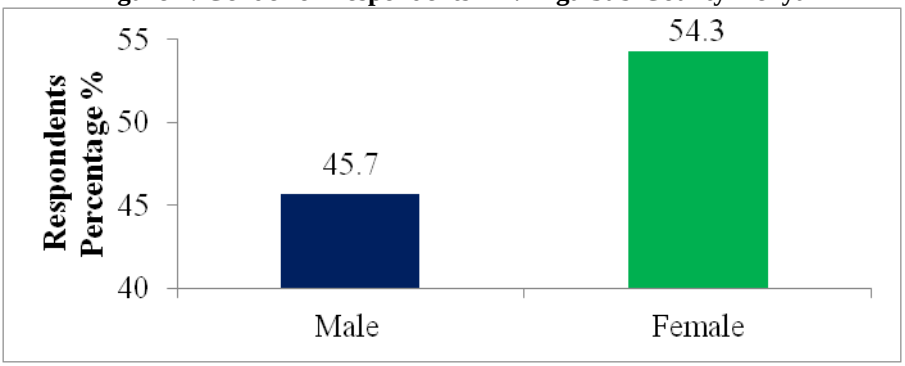
Studies done elsewhere have revealed similar findings to this study noting that adaptation strategies take on socio- economic levels and characteristics of farmers for example more literate farmers may take different

adaptive measures than the less literate ones. More over family income, farm sizes, farming experiences and contact with extension services influence the farmer's Adjustments made according to preferences.

### 3.3.1 Gender of the farmers

This study sought to establish if gender of the farmers had an impact on the adaptation strategies as shown in Figure 4. From the results a slight majority of the respondents comprised of the female which accounted for 54.3% while the males constituted the remaining 45.7%. This portrays a balanced distribution with the slightly higher number of women being attributed to their availability both at household level and in the farms during the fieldwork.

**Figure 4: Gender of Respondents in Vihiga Sub-County Kenya**




This study established the respondents' gender and notably majority of the respondents were female constituting 54.3% while females were 45.7%. It is necessary to establish the differences in roles played by males and females in climate change adaptation. Gender influences the capacity to adapt to climate change as well as their choices of climate change adaptation strategies ( IFPRI, 2015).In many households in the study area most agricultural activities are planned by men and this meant that most women apart from those single headed households were left out on issues of agricultural production, climate change and even adaptation strategies that could be suitable in the area. It worth noting that 80% of women in Kenya are involved in agricultural activities such as weeding and harvesting but when it comes to agricultural planning/calendar they are left out. In most of African countries most decision regarding agricultural activities and planning have been left as preserve for the men who mainly focus on the end products from agriculture and not the processes. It is important to involve both the gender in the agricultural calendar. In Kenya and elsewhere, male and female have different roles and responsibilities on the farm. This means that the way of coping to climate change is also likely be different. Studies done in Kenya by IFPRI in 2015 from two different scenario one from western region( Nyando) and other in Eastern region( Wote) realized that the roles of males and females in agricultural activities showed considerable differences in decision making, roles , perceptions to climate change and shocks, access to information and even adaptation strategies. This study found out that 75% of women from Nyando could make decisions on how to use crops, sell , process and consume but only 30% could decide on how to spend the the income from the crops whereas their counterparts from Wote 80% of the females could make decisions on use of crops and 75% on how to use the income from the crops. In conclusion it simply means that men mainly make decisions regarding income from agricultural activities and yet it is the women who undertake the actual farm work.

According to (IFPRI, 2015) gender differences are likely to influence males and females capacity to adapt to climate change as well influence their participation in agriculture. In this study it was realized that, although the position of the woman in rural communities has been perceived vulnerable and looked down upon however, the Maragoli woman stands out to defy the odds; she is a more courageous woman and a go getter. The Maragoli women have control over their farms produce and can make decisions with or without consultations from their husbands. This contradicts, several studies that enunciate women are always left out in decision making yet they are the most overworked on farms.

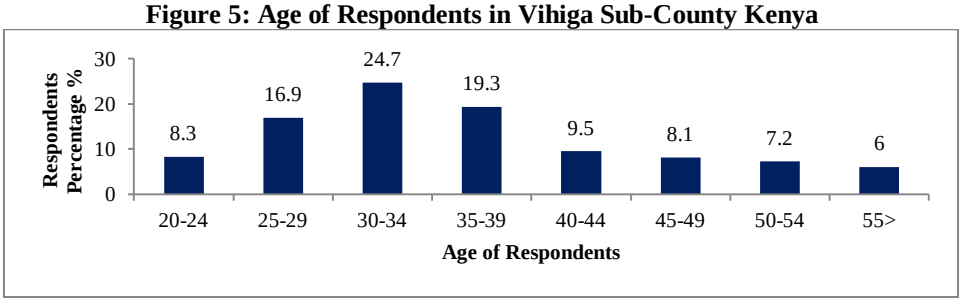
### 3.3.2 Age of Respondent

The study sought to establish the age of the respondents and the results are shown in figure 5. The age distribution for the study respondents were as follows: the study revealed that 8.3% of the respondents were between 20-24 years, 16.9% was 25-29 years, further 24.7% aged between 30-34 years, closely followed by 19.3% of respondents between 35-39 years. At the same time there were 9.5% of respondents between 40-44 years and 8.1% between 45-49 years. While another 7.2% aged between 50-54 years and finally 6.0% of the respondents were 55 years and above. From the results, it is clear that the majority of the respondents were in

the age bracket of 30-34 years followed closely by 35-39 years. This range of age bracket 30 – 39 years happens to be the most productive age in any given economy the more reason they are found to dominate the crop production sector. These are the people who are likely to understand the benefits of incorporating new ideas in climate change adaptation and likely to be more updated on current issues on gender roles and climate change adaptation unlike the older people.

Most farmers within this region are those within the ages of 30-34 years and therefore these are people who are likely to understand well the issues involved in farming and therefore are armed with necessary information regarding climate change adaptation strategies that can be well achieved and adhered to. From this study the age variable has negative correlation with adaptation strategies to climate change. This implies that the probability of adaptation significantly decreases as the age of farmer increases. This can be assumed that the farmers could be having less interest or less incentive in taking climate change issues. Moreover the older farmers could be resistant to change and thus do not see the need of employing new technologies and would prefer the traditional modes of farming that they are familiar with other than adopting to new methods. Similar outcomes have been found and explained by Fussel et al.,2008

**Figure 5: Age of Respondents in Vihiga Sub-County Kenya**




**3.3 3 Level of Education of Respondents**

The study further established the level of education of the respondents. The findings indicated that 9.6% of the respondents had attained primary education while a majority of 41.3% of the respondents had attained the secondary school level. Another 26.6 % 0f the respondents were of tertiary level and 22.5% of respondents were of university level as shown in Figure 6. There was need to establish if there were any significances in level of education of farmers and adaptions, notably from the findings there seemed to be no significant differences, even after findings of most of farmers having attained secondary level of education. This was measured using cross tabulation between levels of education and adaptation strategies adopted by farmers. Findings from this study indicate that there is positive correlation on levels of education and coping strategies to climate change. This indicates that the probability of farmers adapting to climate change seemed to be greater for those who have attained educational attainment as compared to the less educated farmers. It is obvious that educated farmers have more knowledge, greater ability to understand and respond to anticipated changes, can forecast future scenarios, have access to climate information and opportunities than the others which could encourage adaptation to climate change. Several studies elsewhere have found out that education levels of farmers also positively and significantly affect climate change adaptation such as those done in Bangladesh by Mohammed et. al., 2014).

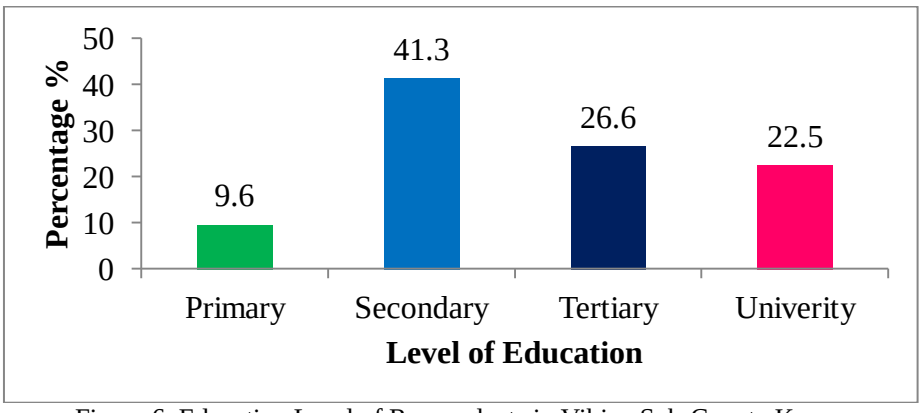



Figure 6: Education Level of Respondents in Vihiga Sub-County Kenya

**3.3.4 Farm sizes**

The study further established the respondents average farm sizes. In general the farm sizes in vihiga are too small because of the high population densities within the sub county however it had an impact on how the farmers are adapting to climate change in the area. Most farmers in the area engage in small holder subsistence farming activities.The results reveal that 75.4% of the respondents had an average farm size of between 0 – 1 hectares while 15.5% of them had a farm size of between 2–3 hectares. A further 7.2% of the respondents had average farm size of between 4 – 5 hectares while 1.8% of them had farm size for between 6 - 7 hectares. This was necessary to establish if farm sizes had an influence on the way farmers adapted to climate change as it well known that if farming is taken as business the chances of farmers being keen on production and yields will be given a priority as compared to those that take farming merely as a tradition. The findings indicated a negative correlation between farm sizes and adaptation strategies. This implies that with an increase in farm sizes the probability of farmers adapting to climate change declined. This could be attributed to large farms employing traditional methods and technologies other than modern technologies to climate change adaptation. Moreover, larger farms require a lot of investment to implement these adaptive strategies to climate change. Secondly this could be attributed to lack of proper management and supervision in relation and hence large farms tend to fail to adapt efficiently. Studies done by Mohammed et al., 2014 in Bangladesh had similar findings regarding adaptation strategies and farm sizes.

**3.3.5FARMING INCOME**

This study found it necessary to establish the farmers monthly income. Results indicate that 1.3% of the respondents had a monthly income of below Ksh. 5000 while 20.5% of them had a monthly income of between Ksh. 5,000 –10,000. A further 48.7% of the respondents had a monthly income of between Ksh. 10,000 – 20,000 while 29.5% of them had a monthly income of over Ksh. 20,000. This study revealed a positive association between family income and adaptation to climate change. It implies that farmers with high income levels are likely to adapt to climate change than farmers with lower income. These findings are in consonance with other studies which indicate that farmers that engage in off farm activities can diversify their income and continue with their agricultural operations in face of climatic uncertain activities. Kim et al., 2009 found out that household income positively and significantly influenced the adoption of adaptive climate change while Gbetibou , 2009 , explained that farmers with higher incomes are likely to embrace and will be interested in adapting by changing practice and modern methods such as irrigation to cope with the changing climate.

**3.3.6 FARMING XPERIENCE**

The study further established the respondents' farming experience and it was revealed that 16.5% of the respondents had a farming experience of between 0 – 4 years while 30.4% of them were had a farming experience of between 5 –9 years. A further 8.9% of the respondents had farmed for between 10 – 14 years while 10.1% of them had farmed for between 15 - 19 years. At the same time, 15.2% of the respondents had been involved in farming for a period of between 20 – 24 years while 16.5% of them had farmed for a period of between 25 – 29 years. Finally, 2.5% of the respondents had been farmers for a period of over 30

## IV. CONCLUSION AND RECOMMENDATIONS

Findings from this study indicated that there was majorly a decline trend in the rainfall amounts over the years under study. Results from rainfall data set showed that there was a regression coefficient of -2.801, which means every additional year rainfall reduced by approximately -3.00mm of rainfall. Temperature data set were computed and posted a positive trend line which indicates that there was a regression coefficient of 0.028 while the coefficient of determination ($R^2$) of the annual mean temperatures is 0.445 which means 44.5% of variations in temperatures over a period of (1979-2018). This indicates that as years went by the annual mean temperatures increased by approximately $0.03^0$C. Findings from this study on the distribution of the adaptation strategies among the genders showed that both men and women have a role in climate change adaptation in crop production. Although there frequencies differ, this can be attributed to differences in their exposure and socially constructed norms, age, level of education, farm sizes,gender and levels of income. The study recommends the need for designing gender-responsive software and hardware for climate change adaptation strategies in agriculture which enable females to improve the crop productivity of their farms.

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