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RESEARCH ARTICLE

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Changing Weather Patterns in Maize and Wheat Production against the Backdrop of Improved Access to Weather and Climate Information by Farmers in Uasin Gishu County, Kenya

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Abstract

With the prevailing changing climate presenting globally, regionally and locally at the farm level in most sub-Saharan countries, availability in real time and the subsequent uptake of climate information by farmers in their crop production planning and production process becomes very critical. This is because attaining improved and sustained high crop yield in a rain fed agricultural system largely depends on accurate timing of rainfall onset and cessation dates during growing and harvesting season. To bring this phenomenon into perspective, a study was conducted among maize and wheat growing farmers in Uasin Gishu County. The objective in this study was to determine the influence of climate and weather information access among maize and wheat farmers in Uasin Gishu County as a mitigating factor in the prevailing changing climate. The study was conducted in Moiben, Kesses and Soy sub counties of Uasin Gishu County selected purposively. The study adopted stratified and random sampling procedure to capture representative sample of farmers. A sample of 399 farmers participated in the study in addition to 12 key informants. A pre-tested semi-structured questionnaire and an interview schedule were the main data collection tools. Chi-square and independent sample t-test were employed in the analysis using SPSS (V.16). Results were considered significant at α=0.05. The findings showed that farmers had incurred maize and wheat crop losses due to lack of adequate rain during growing period as reported by 78.6% of the farmers. Maize and wheat yield loss due to too much rain during growing season, near harvest and harvest period was reported by 66.1% of the farmers. These findings portray a vulnerable group of farmers who have incurred losses in their farming enterprise and therefore need urgent interventional measures that include timely access and usage of advisory alerts or climate information in farming decisions. Similarly, a positive response from 79.4% of farmers reported that after utilization of information on weather and climate from the meteorological department, they were able to successfully apply fertilizers to their crop, weeding and application of agro-chemicals. They were also able to delay commencement of planting to onset of long rains season to avoid losses. Farmers have inculcated coping strategies like crop diversification to mitigate against weather related risks in their farming practice as revealed by 52.7% of the farmers. An average of 58.8% of the farmers reported that they had substituted the growing of both maize and wheat with beans when weather forecast data revealed prevalence of erratic rainfall in the growing season. This however needs to be supported through policy enhancement on crop diversification. Despite the ability to mitigate, farmers often remain vulnerable to climate variability due to the fact that their indigenous knowledge system and experience gained over time over time growing maize and wheat have a greater influence in their farm level decisions. The results *further showed that there was a significant relationship between access of climate and weather information and its usage by farmers (Chi = 87.263, P < 0.001). Therefore, the need to repackage climate information to formats that support ready access by farmers is critical if the weather forecasts have to remain relevant to farmers at the farm level and if there has to be ownership and sustainability of any kind. It is clear as explained by farmers that agro-meteorological services should target the use of available tools like mobile phones especially messaging service to disseminate their products and services to the farmers as these tools are widely accessible to farmers.*

Keywords: Changing Climate, Climate Information, Weather Forecasts, Maize and Wheat, Mitigation Measures, Agro-Weather, Farmers Access, Uasin Gishu County, Kenya

INTRODUCTION

The prevailing changing climate presenting globally, regionally and locally at the farm level in most sub-Saharan countries, it's devastating impact on various sectors have equally been felt at all levels especially in the developing countries. The changing climate is having a growing impact on the African continent, hitting the most vulnerable hardest, and contributing to food insecurity, population displacement and stress on water resources (WMO, 2019). According to information from the Ministry of Agriculture and The Kenya Meteorological Department key informant interviews conducted during this study, the changing climate has made maize and wheat farmers to constantly face greater risks throughout the growing season in the farming calendar in Kenya and more specifically Uasin Gishu County where this study was conducted. The prevailing changing climate has greatly influenced the nature and pattern of farming in Kenya and more so in Uasin Gishu County where maize and wheat growing are among the major crops grown by farmers for sustainable livelihoods (Government of Kenya, 2013). In farmer's context, the unpredictable nature of the order and seasons known to farmers, rainfall onset, frequency, intensity and cessation has led to drastic variations in yield or widespread loss of crop in Uasin Gishu County. According to FAO report, about 3.1 million people are severely food insecure, mainly located in northern and eastern areas as a result of the cumulative impact of poor 2018 October-December "short-rains" and severe dryness during most of the 2019 March-May "long-rains" season. As of January, about 393 000 individuals had been affected by floods, which were triggered by torrential rains since October (FAO, 2020).

The agricultural sector in most sub-Saharan Africa region remain dominantly a rainfall dependent system and majority of farmers work on a small-scale or subsistence level and have few financial resources, limited access to infrastructure, and disparate need for access to agronomic data and information. For the farmers, any abnormal variation in rainfall onset and cessation dates in addition to extreme temperatures result in serious crop loss or damage (Pereira, 2018). To navigate such risks, timely access to climate information and related technologies for adaptation is essential to enable actors to anticipate long–term risks and make the appropriate adjustments. This will help farmers increase their resilience at the farm and household level. The primary weather and climatic information need of a farmer is to know in advance the expected onset of seasonal rains so that they can prepare early in readiness for planting of the crops in their respective regions. Inadequate or non-access to climate and weather information to aid the farmers in their farming decisions at the farm level is a major challenge in the farming enterprise. Climate information is a valuable resource for confronting and living with an increasingly uncertain future. Availability of climate information or weather forecasts provides a basis on which people whose livelihoods are affected by climate can make forward looking and flexible plans that are adapted to a range of climate possibilities. Consequently, climate information allows us to move from strategies which react to conditions as or after they occur, to those which seek to build resilience under all possible conditions and ultimately, to proactive strategies informed by forecasts and forecast probabilities (Eilts, 2018).

According to the World Bank report guidance note 6, of 2010, in many low and middle-income countries of the world, good quality climatic and agronomic data and information are lacking. Time series of climate information may not be available to planners and farmers, either because monitoring systems do not exist or may not function properly, or information is not readily coordinated, shared or disseminated in a timely way (World Bank, 2010). The same is true for Kenya and its counties; Uasin Gishu County included. The information may be available from the Kenya Meteorological Services but farmers do not largely integrate climate and weather information in their farming decisions due to adaptability, format and timing challenges of the information. This view is supported by Hansen (2002) and Hammer *et al.* (2001) who argue that despite the availability of relatively reliable weather and climate information and products by the late 1990s, farmers seldom used them for farm level decision-making because the available information in most cases may be poorly channeled and its timing, format and modes of communication may not enhance farmers' planning and farming efficiency. There are constrains in the optimal use of seasonal climatic information by farmers generally. Some of these constraining factors include provision of information that is general and not specific to certain area thus its use is limited. Similarly, the information may be received when it is too late for use or often too difficult for the user to understand and apply (Walker, 2001).

Conceptual Framework

The conceptual framework is premised on the fact that availability of improved global observation infrastructure and meteorological services capacity by among others the World Meteorological Organization Global Telecommunication System and other global forecasting centers is crucial for the Kenya Meteorological Services as it relies on such centers together with information from Automatic Weather Stations (AWS) to provide their climate and weather information or simply weather forecasts. The observations available in a quality controlled format and distributed via the WMO Global Telecommunication System (GTS) allow the Kenya Meteorological Services to monitor the weather approaching effectively (WMO, 2011). In this paper, the researcher argues that access to weather forecasts is critical to complement the farmer's indigenous knowledge systems in weather prediction and their experience gained over time in maize and wheat cultivation. This has been necessitated by the fact that the prevailing changing climate has distorted the timing of seasons familiar to farmers through experience cultivating maize and wheat crop in the County. Farmers stand to benefit if they combine their experience and indigenous knowledge base with access to climate and weather information or simply weather forecasts for synergy forecasting. This will help farmers mitigate the impacts of the prevailing changing climate as better decisions are made at the farm level. The better decisions enable farmers navigate the risks and avoid potential crop losses that will impact negatively on the farmers' livelihood system. Such combinations have led to better and beneficial adaptation strategies that will enable farmers attain improved livelihoods as crop losses are minimized or avoided early enough. This will create a farming enterprise driven in a business-like manner with great returns on investment for farmers.

Study Area

The study was conducted in Uasin Gishu County, Kenya as shown in the map in figure 1. The county has 6 sub-counties namely: Turbo, Soy, Moiben, Anabkoi, Kesses and Kapseret. According to Uasin Gishu profile report 2013, the total area of the County is 3327.8 km^2 with arable land covering 2603.2 sq. km^2 and non-arable land covering 682.6 sq. km^2. The County extends between longitude 34° 50′ and 35° 37′ East and 0° 03′ and 0° 55′ North. It shares common borders with Trans Nzoia County to the North, the Marakwet and Keiyo County to the East, Baringo County to the southeast, Kericho County to the South, Nandi County to the West and Lugari Sub-County to the North West. The County, divided into six sub-counties has the following sizes in terms of land distribution: Kapsaret 400 km^2, Ainabkoi 383 km^2, Kesses 611 km^2, Soy 762 km^2, Turbo 324 km^2 and Moiben 738 km^2 (GoK, 2008).

The terrain of Uasin Gishu County is generally undulating highland plateau varying with altitude between 1,500 m above sea level at Kipkaren in the west to 2,600 m above sea level at Timboroa in the east. Eldoret town is at 2,085 m marking the boundary between the highest and the lowest altitude of the county. The gentle undulating terrain allows the practice of mechanized farming. The rainfall amounts and regimes are influenced by altitude and wind direction usually high, reliable and evenly distributed with some annual average of around 900 mm in the last few years. It is bimodal occurring between the months of March and September with two distinct peaks in May and August. The wettest areas are found in Ainapkoi, Kapseret and Kesses sub-counties. The other three sub-counties of Soy, Moiben and Turbo receive relatively lower amounts of rainfall (GoK, 2008). Temperatures range from 25^0 C as the highest and the lowest at 8.8^{0}C and humidity averaging 56%. February is the hottest month while July is the coldest. The variations in temperature across the county follow the same pattern as rainfall. Farmers generally prepare land for maize planting during the months of January and February and planting starts towards the end of March. Preparation for wheat farming starts in March to May and planting starts towards the end of June (GoK, 2008). Uasin Gishu County is basically an agricultural district producing more than a third of the total wheat production in the country. Similarly, maize ranks second both as food and cash crop. Uasin Gishu County was chosen as area of study because it has traditionally been considered the bread basket of Kenya but recent declines in crop production in the region calls for a better understanding of factors responsible hence enabling improvement in production of maize and wheat and ultimately ensuring a food secure nation and poverty alleviation at the community level.

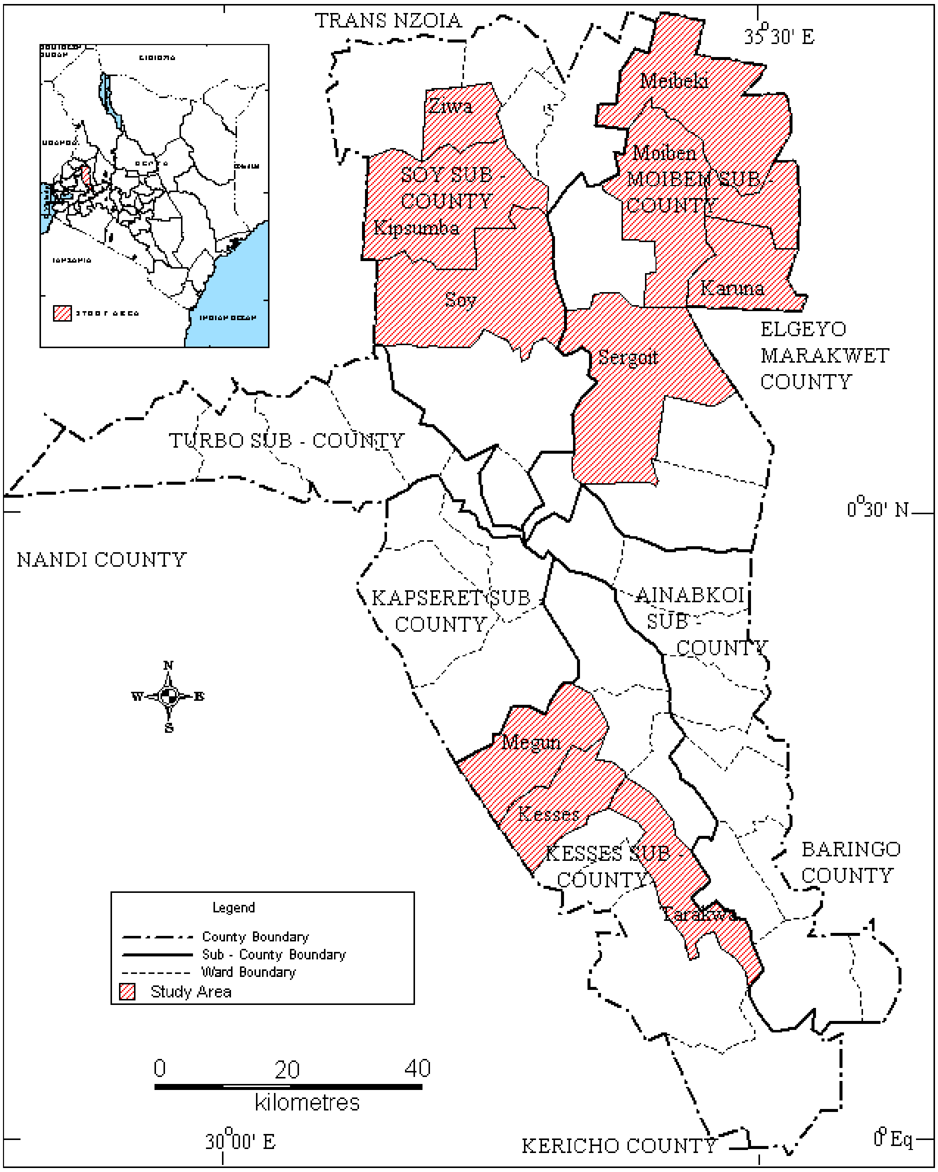

Figure 1: Map of Uasin Gishu County showing the study area.

MATERIALS AND METHODS

This paper is a result of a research conducted in three sub-county areas of Uasin Gishu County. In particular an investigation into farmers experiences in Maize and Wheat Production in a changing climate against the backdrop of improved access to climate and weather information at the farm level in Uasin Gishu County, Kenya. The investigation involved interviewing farmers selected to participate in the study and some key informants. The study adopted a mix of purposive, stratified and random sampling procedure to be able to capture a representative sample of farmers. The entire 6 sub-county areas of Uasin Gishu County were analyzed to identify sub counties exhibiting both maize and wheat production.

Based on this criterion, 3 sub-counties namely Moiben, Soy and Kesses were selected purposively. A further stratification was done at ward level. Wards that grow both maize and wheat were purposively selected again resulting to selection of Soy, Kipsomba and Ziwa wards in Soy sub-county; Moiben, Sergoit and Karuna/Meibeki wards for Moiben sub-county and finally, Kesses, Tarakwa and Megun were picked in Kesses sub-county.

A minimum of 399 farmers were included in the study. In addition, 12 key informants were interviewed; one from each ward totalling 9 and also 2 from Directorate of Agriculture and Directorate of Meteorology in Uasin Gishu County and 1 from the Kenya Meteorological Services in Nairobi. In order to determine the number of farmers to be picked in the selected wards, the use of data from households mapping done by the Kenya National Bureau of Statistics (KNBS) through the Kenya National Census and Household Surveys (KNCHS) 2009 was utilised where the randomly generated census numbers from SPSS were used to pick the households. The completed questionnaires were analyzed using both access database and SPSS V.16. For quantitative data, frequencies, mean and standard deviation were used to summarize the data. Chi-square was used to check for significant relationship between categorical variables. Independent sample t-test was used to compare means. Significance level was set at $\alpha=0.05$ while qualitative data was analyzed by use of theme generation.

RESULTS AND DISCUSSION

Impacts of Drought and High Rainfall Intensity during Crop Growing Periods in Uasin Gishu County

To understand the impact of the prevailing draught and excessive rainfall occurrence during the farming calendar, crop yield per acre were analyzed retrospectively for the last 5 years from 2014 and the results were as follows: - More than half of the farmers reported yields of between 6 and 15 bags of maize and wheat as a result of drought manifestation during the growing season (52.1% and 50.2%) respectively as indicated in Figure 2. Similarly, more than half of the farmers reported yields of between 6 and 15 bags of maize and wheat as a result of excess rainfall prevalence during the growing period (57.6% and 58%) respectively as indicated in Figure 3.

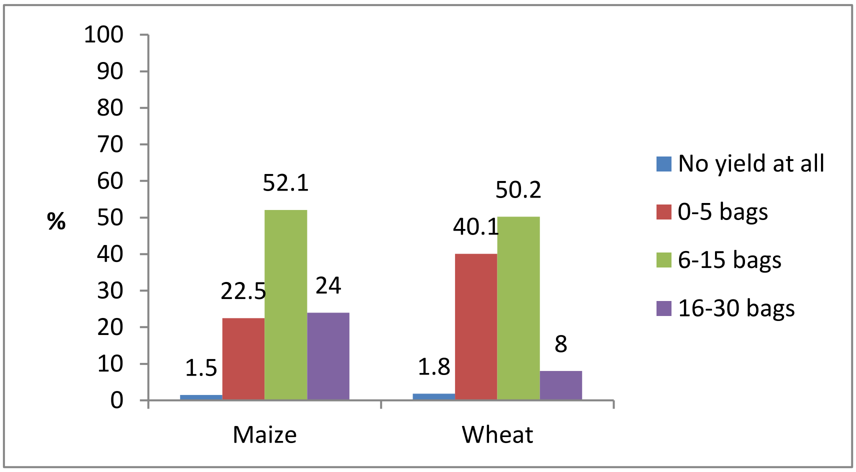

Figure 2: Impact of drought manifestation on crop yield per acre during a growing period, Uasin Gishu County, Kenya.

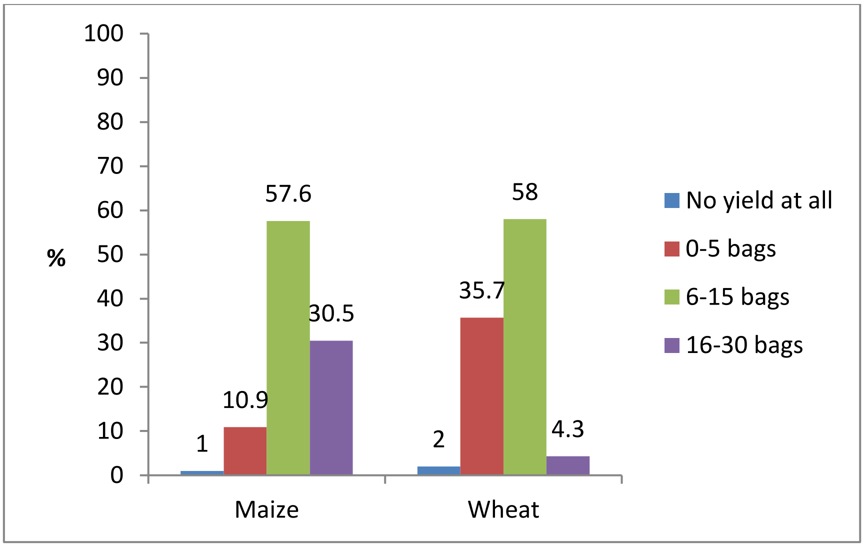

Figure 3: Impact of excessive rainfall occurrence on crop yield per acre during a growing period, Uasin Gishu County, Kenya.

According to the responses by farmers, the yield of maize and wheat remained the same (6-15 bags) of 90 kg weight each whether there was drought manifestation during growing period or whether there was too much rainfall during the same period. According to the farmers in a key informant interview and informal discussions during data collection activity they stated as follows:

> *"For some time now the yield per acre has been degreasing rapidly. In the previous years, maize production per acre averaged 30-40 bags of 90 Kgs bag and that of wheat averaged 20 - 30 bags of 90 Kgs per acre. A few farmers however still attain this level of production".*

These phenomena can be attributed to the prevailing changing climate as farmers lose their crops when there is drought manifestation or during occurrence of excessive rains during the cropping season. Similarly, the non-change in yield output per acre could be attributed to other factors at play that may include soil acidity and application of correct fertilize that does not increase the level of acidity in the farm bearing in mind that the farmers have been practicing maize and wheat crop growing for many year in the same farm land. Farmers also stated that most did not get their soils tested to determine their pH levels hence missing out on informed choice of correct fertilizer to apply on their farms. The seed variety could also play a role in production because the use of non-certified seeds may not change much the production per acre in both maize and wheat crops. These extraneous factors however were not the principal focus of this study. The findings herein however, mirror what The Consultative Group on International Agriculture (CGIAR) research programme in Climate Change and Food Security (CCAFS) report of (CGIAR, 2014; Lobell *et al*., 2007) reveal. The two findings explain that through historical studies, climate change has already had negative impacts on crop yields. Maize, wheat and other major crops have experienced significant climate-associated yield reductions of 40 mega tons per year between 1981 and 2002 at the global level. Therefore, sound mitigation measures need to be incorporated into policy to help farmers deal with the prevailing changing climate.

Benefits to Farmers Accessing and using Weather Forecasts at the Farm Level Planning

Accessing weather forecasts for planning purposes at the farm level enabled formers navigate through some inherent challenges during the crop growing season as stated in Table 1. The findings show that 44.7% of farmers reported that after utilization of weather forecasts they were able to successfully apply fertilizers, weeding and application of agro-chemicals at their respective farms. In addition, 34.7% were able to navigate through the prevailing inadequate rainfall manifestation during planting season by waiting a little longer till the onset of rains before commencement of planting of either wheat or maize hence avoiding the potential crop loss.

Table 1: Some benefit of utilization of weather forecasts by farmers in Uasin Gishu County

Benefit realized after use of climate information	**Frequency**	**Percent %)**
Ability to avoid lack of adequate rain during planting period	135	34.7
Successful application of fertilizers/top dressing	174	44.7
Avoided harvest loss due to heavy rains	67	17.2
Ability to substitute maize and wheat as per the situation	29	7.5
Information did not help	16	4.1
No information was received	74	19

Farmers acknowledge the fact that if one embraces the use of climate and weather information, it significantly enhances farming decisions at the farm level to a great extent and one is able to benefit from its application. To reiterate the fact that accessing weather forecasts or climate and weather information helps farmers navigate challenges related to the prevailing changing climate, the findings from Anuforo (2009) agrees with the findings in this study. That facilitation of access to climate and weather information reduces farmers' vulnerability to weather related risks, ensures that informed decisions are made on time, and reduces the risk of agricultural losses.

The same view by Anuforo (2009) has been echoed by Gunasekera (2009) who argue that there has been a positive effect associated with the use of climate and weather information in agricultural production as seen in some empirical studies carried out elsewhere. The examples where the use of climate information can have a positive impact has been demonstrated by various studies reported in Gunasekera (2009). They include that by Solow *et al.* (1998) who analyzed the effect of improved ENSO predictions on US agriculture. The study estimated that the value of "modest" and "high" skill ENSO forecasts is $240 M and $266 M US dollars per year respectively. Lemos *et al.* (2002) analysed the use of seasonal climate forecasts in drought mitigation strategies (including seed distribution, emergency drought relief and water reservoir management) in Northeast Brazil. This study highlighted the potential to offer considerable opportunity for National/local government level planners to undertake proactive drought relief planning using climate information. Thornton *et al.* (2004) analyzed the economic value of climate forecasts for livestock production in the Northwest Province of South Africa and the study demonstrated that, for the commercial farmers, long term average annual income could potentially be increased through using ENSO predictions (Gunasekera, 2009).

Similarly, the findings in this study are supported by other studies contained in a World Bank report of 2010. The report by World Bank on mainstreaming adaptation to climate change in agriculture and natural resources management projects guidance notes 6 states that seasonal climate forecasts and early warning systems include some of the most useful climate-related information for farmers and rural communities in general (World Bank, 2010). That the farmers usually do not know what climatic conditions to expect in the following growing season but have evolved conservative cropping strategies based on their experience. These strategies may fail to capitalize fully on beneficial conditions and also frequently buffer poorly against negative effects of climatic changes. The report further states that seasonal forecasting can greatly assist in managing climate risks in agriculture, particularly in risk-prone rain-fed environments, by providing planners and farmers with timely information, which allows them to decide upon and shift to the most suitable coping strategies over short time scales hence avoiding losses related to weather variability.

Relationship between Access and Use of Climate and Weather Information

In order to understand whether there was any relationship in the access of climate and weather information by farmers and their utilization, cross tabulation of the two variables was executed and *P value* determined as shown in Table 3.

Table 2: Relationship between access and use of climate and weather informationin in Uasin Gishu County

Responses on	**Use of Climate information**			
Access of information	**Yes**	**No**	**Chi**	**P**
Yes	116 (74.8%)	39 (25.2%)	87.263	< 0.001
No	66 (27%)	178 (73%)		

The result shows that there is a significant relationship between access of climate and weather information and its usage by farmers (*Chi = 87.263, P < 0.001*). Majority of farmers accessing the climate and weather information are using the said information to plan their crop activities. It is important therefore that access to such information by farmers should be facilitated as this will help improve their crop production by avoiding losses related to weather variations and the resultant impact. The uptake of climate and weather information may vary from country to country therefore; the level of users of such information is of outmost importance. If there is a communication mismatch, between the generators of the climate information who are the meteorological scientists and the consumers of the same information who are the farmers, the situation remains the same. This is corroborated by some field studies conducted in the Southern part of Africa that revealed the existence of a considerable gap between information needed by farmers and that provided by meteorological services. According to a study by Walker (2001) and Blench (1999) there existed a communication barrier between the information providers and its intended users. The farmers know what they want and the Meteorological services know what they need to give to the farmers, but there is no “shared meaning” (without a shared meaning in communication, the value attached to particular information availed to the user is diminished and may not serve the intended purpose. It is critical for meteorological and agricultural scientists including policy makers to understand important variables among the farmers that have to be taken into consideration. This will include farmer’s indigenous knowledge systems in weather and climate prediction, their farming experience over time, delivery mode of climate information and others. A study by Rengalakshmi (2002) explains that understanding the local people’s perception on rainfall prediction is necessary to communicate the scientific forecast, since it is learned and identified by farmers within a cultural context and the knowledge base follows specific language, belief and process. Perceiving such a knowledge base facilitates social interaction and acceptance among the farmers hence effective utilization of climate and weather information or simply weather forecasts.

Weather Information Access by Farmers Informing their Decision on Crop Substitution at the Farm Level

Farmers were asked to respond to a question where the Kenya Meteorological Services during its routine weather forecasting reveal a situation where drought would prevail during the season when farmers expect to commence the planting of maize and wheat. In their responses, more than half of the farmers (52.7%) agreed that they would substitute the growing of maize or wheat with other crops to avoid any risks involved while 35.5% could not change their activities at all regardless of the advisory. Still 10.6% of the farmers affirmed that they did not follow what the Kenya Meteorological Services say because they are never right in their predictions. The responses here reveal a group of farmers who are willing to substitute the growing of maize or wheat with other drought resistant cereal crops to mitigate climate variability.

To understand further what mitigation measures against the changing climate had farmers practiced during their farming activities, they were asked to state if at one point in time or severally during their routine maize and wheat growing season they had substituted the growing of maize with either potatoes, beans finger millet or sorghum after weather forecast report reveal drought manifestation during the cropping period. More than half (60%) reported that they had substituted maize growing with that of beans (Figure 4).

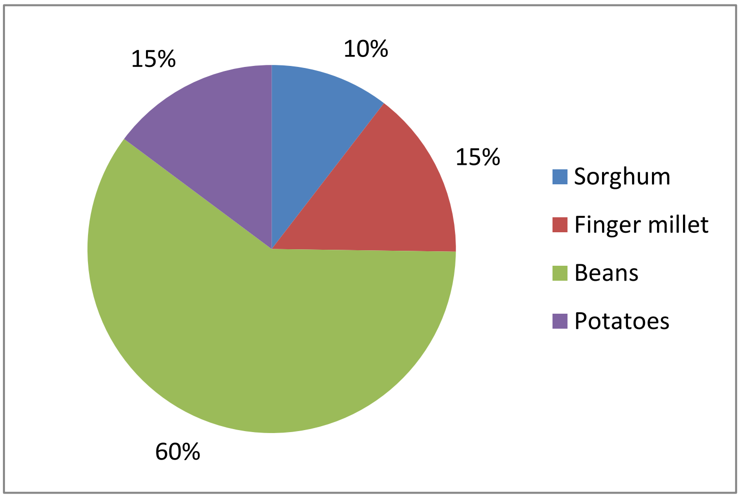

Figure 4: Maize substitution with other drought resilient crops in Uasin Gishu County.

Asked further about wheat growing and substitution of the same in the prevailing drought manifestation predicted by the Kenya Meteorological Services and communicated to farmers as climate and weather information alerts, a big number (57.6%) agreed that they had substituted wheat crop growing with the growing of beans (Figure 5). The rest of the farmers agreed that they had at some point substituted the growing of either maize or wheat with sorghum, finger millet cassava or potatoes though in small quantities.

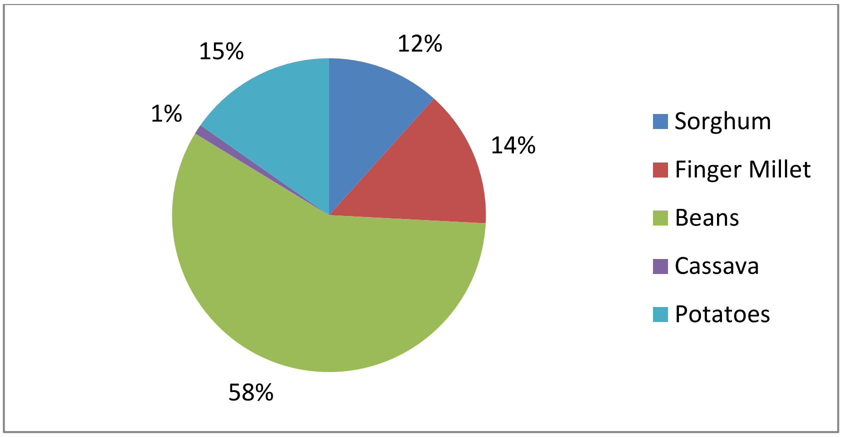

Figure 5: Wheat Substitution with other drought resilient crops in Uasin Gishu County.

When substituting for both maize and wheat growing as shown in Figure 4 and 5, farmers agreed and informed the research team that the growing of beans is the most preferred substitute for both maize and wheat growing followed by potato crop. This was after receiving an advisory from the Kenya Meteorological Services warning of an impending drought in most parts of the Rift valley including Uasin Gishu County; the area where this study was conducted. The findings herein are in agreement with those in Chu (2011) and Pettengell (2010) stating that ssuccessful adaptation means people becoming increasingly able to make informed decisions about their lives and livelihoods in a changing climate. Access to climate information is crucial in helping farmers to be well aware about the climate change and the external inputs to be able to make decisions about their future activities (adaptation strategies) otherwise, farmers have based their crop and other production decisions on local knowledge systems, developed from years of observations, experiences, and experiments and now facing challenges with the advent of the changing climate world over.

CONCLUSION

The findings in this study have shown existence of a positive influence of climate and weather information utilization by farmers as they are able to avoid inherent losses and realise the beneficial influence of climate information. Access to timely climate information thus is crucial in helping farmers to be well aware about the changing climate hence being able to plant crops that can tolerate the extreme weather conditions prevailing then as a mitigation measure. There still exists constrains however in the optimal use of seasonal weather forecasts by farmers generally and some of these constraining factors include provision of information that is general for application (not specific to any area or particular application) or may be received late by farmers.

Although access to weather advisories has been seen to support farmer decision making at the farm level especially with regard to the changing climate, other variables are important to consider that affect the production per acre in maize and wheat growing. This may include the use of correct certified seeds by farmers, use of the right fertilizer in relation to soil requirements, correct pesticides and fungicides, timely top dressing and others.

Importantly, accessing climate information without acting on it by the farmers leaves them with undesired results as they may be impacted negatively in their farming enterprise due to the prevailing changing climate. This may adversely affect farmer's livelihoods and the national food security situation.

RECOMMENDATION

A strong link, including feedback loops between scientists, advisory agents and farmers is crucial for communicating climate information and facilitating access by local communities. It is important for the meteorologists to understand farmer's needs (real and perceived) as the farmers know what they need at what point in time and not what the meteorological scientists think is needed by farmers. A policy guideline on a closer working relationship should be established between the farmers, agricultural extension officers, meteorological staff and other key stakeholders.

For effective usage of climate and weather information, farmers need support in terms of information access and the infrastructural facilitation from policy makers and scientists in both the Agricultural and Meteorological fields and other key stakeholders and role players.

The national government need to take the lead in engaging the development of a robust communication strategy at the national and county levels to ensure efficient and effective dissemination of agro-climate information to users. Appropriate means of dissemination of weather and climate information or weather forecasts that ensure that farmers are reached, and are presented in a language that farmers can understand is important. Farmers need support in terms of advisory alerts and information delivery modes. This will ensure that information produced by Kenya Meteorological Services is delivered to farmers closer to a point where they can use it especially via their mobile phones in form of SMS alerts.

Evidence based mitigation measures against farmers perceived and real threats of changing climate impacting on crop yield need to be clearly outlined by both county and national governments ministries concerned. Some of the mitigation measures include farmer's utilization of climate and weather information and also crop diversification and substitution. Substituting the growing of maize or wheat with other cereals (beans, millet, sorghum and others) that are able to do well even with poor rains or growing all these crops is important. This can be achieved through sensitization programmes to maize and wheat farmers on available mitigation measures for them and allowing them to champion such innovative approaches geared towards cushioning them against losses as this will ensure ownership and sustainability of the mitigation approaches.

It is important for policy makers and key stakeholders in the agricultural and livelihood sectors to pay attention to other salient variables that may compound productivity in a changing climate. This may include the use of correct certified seeds by farmers, use of the right fertilizer in relation to soil requirements, correct pesticides and fungicides, timely top dressing and others.

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