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Agro Climate and Weather Information Dissemination and Its Influence on Adoption of Climate Smart Practices among Small Scale Farmers of Kisii County, Kenya

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Abstract
This study examined the extent of agro climate and weather information dissemination and its impact on adoption of climate smart practices among small scale farmers in Kisii County. The study engaged 420 small scale farmers randomly sampled from Kitutu and Nyaribari Chache in Kisii County and 30 key informants, mainly technical officers of agriculture in the area. Both primary and secondary data was gathered through focus group discussions, administration of questionnaires, key informant interviews, observations and desk reviews. The data was analysed using both qualitative and quantitative techniques. The findings of this study pointed to limited outreach (23.4%), limited skill and knowledge (11%) and low utilization (8.1%) of agro weather information among small scale farmers. The low access, knowledge level and use of agro weather information was attributed to delays in forecasts, weak dissemination of advisories, and limited capacity among extension services and inadequate budgetary support for integration of this information in farming activities. The findings also indicated a positive shift towards adoption of climate smart practices in response to agro weather information among all the farmers who had access. Of the 23.4% who had received information, 22% indicated as having changed their practices. This was affirmed by chi-square test results (x^2=17.677, df. =2, P=0.000), which were within the significant level ($p < 0.05$). The study concluded that while agro weather information is crucial in enhancing adoption of climate smart practices and resilience to climate change risks, its access remains low among small scale farmers. The study therefore recommends improved and timely access of this information to small scale farmers through channels that are effective and accessible to them such as vernacular FM Radios and improved extension services. The study also recommends budgetary support, packaging of information into user friendly formats, and affirms and suggests up scaling of participatory process in interpretation and use of agro weather information in farming activities.
Keywords: Agro Weather and Climate Information, Adoption, Climate Smart Practices, Dissemination

1. Introduction

Agriculture sector is vital in eradication of extreme poverty and hunger, and supports livelihoods of over 1.5 billion people worldwide living in smallholder households in rural areas (World Bank, 2008). However, change in rainfall amounts, temperature, seasonal patterns and emergency of pests and diseases attributed to climate change has caused instability in production and decline in productivity among small scale farmers in many parts of the world including Africa and in Kenya (Perret, 2006;Fischer *et al.,* 2005; Van de Steeg *et al.,* 2009; Schlenker & Lobell, 2010; UNEP/GoK , 2000; Boko *et al.,* 2007; Ngecu *et al.,*1999; Mburu, 2013; Mburu *et al*., 2014; Mendelsohn *et al.,* 2000a).The frequency and intensity of extreme climatic events are set to increase. The effects of these climatic changes will become even more pronounced particularly among small scale farmers whose farming activities are highly sensitive and vulnerable to climate change risks (IPCC, 2007).

While over the years, farmers have developed and adapted successfully to the fluctuations in climate across and during the years through keen observation, experimentation and practice (Agrawal, 1995; Carswell & Jones, 2004; Chambers, 1989). Doubts have been expressed on the ability of farmers to accurately discern climate trends from their casual observations particularly under climate change scenario (Kempton et *al.,* 1997). Reduction in vulnerability and enhanced resilience to constantly changing climate among small scale farmers and actors therefore requires access and use of quality climate forecasts and their likely effects for coming seasons and years (WMO, 2009; WMO, 2012). This information forms the fundamental basis upon which many agricultural decisions are made e.g. what crops and variety to grow? When to grow? When to harvest? When to stock or destock? When to apply fertilizer and pesticide? This information is also useful in diversification of livelihoods and managing risks and mitigating adverse effects of climate change (FAO, 2010; FAO, 2013; FAO, 2015).Consequently integration of climate information services has gained widespread recognition in agricultural activities (WMO, 2012; Christoplos, 2009).

According to UNFCCC (2007), climate information and forecasting services is useful in understanding of the dynamics in the climate system, provide input in climate models and thus plan for adaptation options. According to World Bank (2008), appropriate climate information enhances small holder farmer's ability to mitigate the adverse effects of climate change. It is also argued that to avoid disastrous consequences, fundamental changes in agricultural operations should go hand in hand with changing climate (CGIAR, 2009). This is because, timely updated information of weather and climate scenarios helps farmers to adjust their farming plans in accordance with weather and climate patterns of the growing seasons (WMO, 2009). Apparently, access to better climate information and technical advises to small scale farmers is considered a potentially cost effective way of adapting to climate change (World Bank, 2008).

In spite of the critical role agro weather information plays in efforts towards adaptation to climate change among small scale farmers, access and use of this information has been hampered by a myriad of challenges. Chamboko *et al.*(2008), indicates existence of limitations in terms of information delivery mechanisms such as reliability, timing, infrastructural development and even language. This was supported by Cherotich *et al.* (2012) who indicated lack of readily available good quality climatic and agronomic data and *time series* of climate information to farmers & planners in most developing countries including Kenya, and more so limited capacity on the part of extension agents in terms of interpreting weather data. Murgor (2014), in his study in Uasin Gishu County, Kenya, similarly, indicated that climate & weather information is not readily coordinated, shared or disseminated in a timely way, besides the challenge of ***adaptability, format and timing*** of climate information. The weak dissemination of climate information is further compounded by lack of skills in dissemination attributed to limited knowledge with regard to the principles of extension education on the part of change agents (Mwangi, 1998).

Limited access of this information among small scale farmers has also been attributed to isolation of small scale farmers from available information and knowledge systems (Dzanku *et al.,* 2011; Roncolli *et al.,* 2009).This position was supported by Mburu (2013), who indicated low awareness in terms of climate information and lack of specific policies on climate change adaptation with regard to small scale farmers in Kenya. This was futher affirmed by Harvey *et al. (*2009), who expressed concern that information sharing among climate change actors in Africa is limited. Cherotich *et al.* (2012) further indicated the challenge posed by choice of dissemination channels and lack of services that communicate, train and help users understand how to interpret and act on the information.

On the other hand, efforts towards addressing climate change effects in agriculture and particularly among small scale farmers, have also sought to enhance innovation and improve access to technologies and practices (Howden *et al.,* 2007). And as such there have been efforts towards best practices for adapting to the effects of climate change and variability (Beddington *et al.,* 2011). One of the new approaches recommended being adoption of Climate Smart practices (CSA) (FAO, 2010; WMO, 2001; WMO, 2007; WMO, 2009). In spite of the vital role played by climate smart practices in not only enhancing resilience, but also increasing productivity, reducing greenhouse gas emissions, and addressing environmental degradation, their adoption by small scale farmers has been low (Dzanku & Sarpong, 2011; Roncoli *et al.,* 2009; Adger *et al.,* 2007; Ogada *et al.,* 2014).

In Kenya, agriculture contributes to about 24% of GDP and supports livelihoods for approximately 80% of the small scale farmers in the rural areas (IFPRI, 2004). However significant decline in crop yield and livestock production has been reported as a result of erratic weather patterns, change in rainfall and temperature for over a decade (Mburu, 2013; Osbahr & Viner, 2006). In response integration of climate information in agriculture has been undertaken by CARE Kenya, Kenya Meteorological services and ASDSP in all 47 counties including Kisii county and sub counties of Kitutu and Nyaribari Chache in the last 5 years. This has been undertaken through an innovative and all inclusive process referred to as Participatory Scenario Planning. This is where climate forecasts are shared, interpreted and advisories regarding different scenarios and appropriate climate smart practices are generated and disseminated through barazas, radio and normal extension services. However, little is known about the extent of access, knowledge and use of this information by small scale farmers, and management implications in terms of adoption of climate smart practices.

The objective of the study was to examine the extent of agro climate and weather dissemination, and its influence on adoption of climate smart practices in Kisii County.

2.0 Materials and Methods

2.1 Study Area

The study area was formerly Kisii Central District but currently divided into 3 sub counties namely Kitutu Chache North (Marani, Kegogi, Ngenyi), Kitutu Chache south (Nyakoe, Kitutu Chache and Kisii Municipality) and Nyaribari Chache (Nyaribari Kiogoro, Nyaribari Keumbu and Nyaribari Central) (Figure 1). The area is further divided into 15 wards covering a total area of 361km^2, with a population of 336,149 persons and average farm size of 0.5ha (GoK, 2009). The study area has a hilly topography and is endowed with several permanent rivers flowing from East to West into Lake Victoria. Soils in the sub counties are generally good and fertile allowing for agricultural activities. Most (75%) of the study area consists of red volcanic soils (nitosols), while the remaining area comprises of clay, red loams, sandy soils, black cotton soils (verisols) and organic peat soils (phanosols). Natural vegetation in the study area is very partial because (90%) of the total area is under cultivation (GoK, 2009).This area is characterized by three agro ecological zones; Lower Highland (LHI) Zone (Keumbu and Kiogoro), Upper Midland Zone (UMI) (Kiogoro and Marani) and Lower midland (Nyakoe and township) (Jaetzold *et al.,* 2009).

The area has a highland equatorial climate resulting into two rainy seasons, the long rains occurring between February and June, and short rains taking place between September and early December. The area receives an average annual rainfall of 1500mm. Dry spell is generally experienced in January and July**.**The maximum temperatures in the area range between 21°C–30°C, while the minimum temperatures range between 15°C–20°C(Jaetzold *et al.,* 2009).

Agriculture, though practiced on small scale, plays a crucial role in socio economic development of the area. It supports livelihood for majority of the rural dwellers and is a source of employment for a workforce of over 80% and raw materials for agro-based industries. In spite of the critical role agriculture plays, high population density coupled with high demand for food has exerted a lot of pressure on land resources. This has subsequently led to declining farm sizes and continuous cultivation without fallow periods resulting into deterioration of soil fertility and depression of productivity. While acknowledging land degradation, study by Ogechi & Hunja (2014) on land use/cover changes and main drivers of agricultural land degradation in Keumbu (Nyaribari Chache Sub County), revealed expansion of cropland, human settlement with consequent reduction in forest and grassland, exacerbation of soil erosion, decline in crop yield and upsurge in food insecurity.

The declining productivity has been aggravated further by unpredictable weather changes attributed to climate change. In spite of the challenges the area is considered suitable for growing of crops like tea, coffee, maize, beans, bananas, fish farming and livestock rearing.

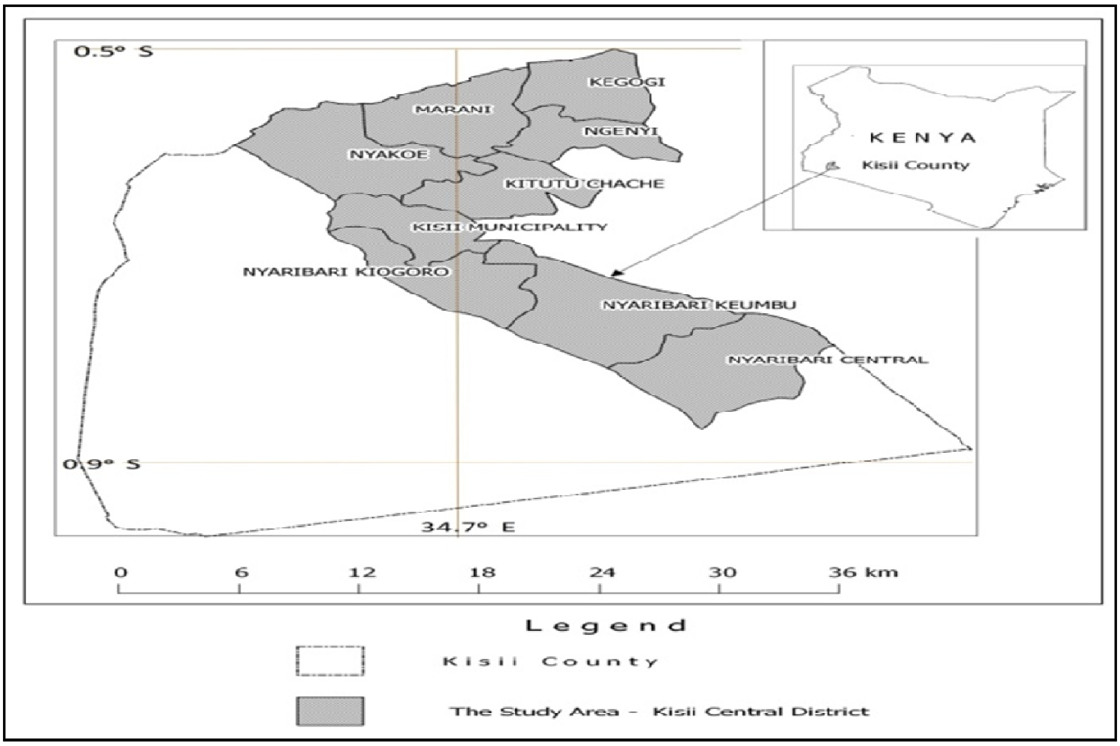

Figure 1: Map of the study area

2.2 Data collection

The research adopted a survey research design, involving both quantitative and qualitative research strategies. This research design facilitated triangulation and dovetailing of the findings and helped to offset the weaknesses of either qualitative or quantitative approach (Bryman, 2008). The study population included the entire population of Kitutu and Nyaribari Chache sub counties in Kisii County. Key informants were mainly managers and technical officers from relevant public and private institutions. Both probability and non-probability sampling techniques (simple random and purposive sampling) were used in this study. Simple random sampling technique was used in determining individuals for administration of questionnaires. Purposive sampling was on the other hand, used in identifying key informants and focus group discussions participants. The sample size for the study was arrived at by use of Krejcie & Morgan (1970) formula normally used to determine sample size(s), from fixed population (P) in such a way that the sample size is within plus or minus 0.05 of the population proportion with a 95 percent level of confidence. This formula is presented below:

$$S = \frac{X^2NP\,(1 - P)}{d^2\,(N - 1) + X^2P\,(1 - P)} \qquad (1)$$

Where: x^2 = table value of Chi-Square for 1 degree of freedom at the desired confidence level (in this case3.84), N = the population size, in this case 336 149, P = the population proportion (assumed to be 0.5 since this provides the maximum sample size), d – the degree of accuracy expressed as a proportion (0.05). The formula gave 384 as the minimum sample size for the study. However, the study adopted a sample size of 420 participants who were randomly selected from all the 15 wards of the study area based on a list of farmers provided by extension officers of agriculture, livestock and fisheries.

Data was collected using questionnaires, key informant interviews schedules, observations and focus group discussions. Before the actual data collection, pretesting of tools to determine their reliability and validity using a sample of 30 farmers and technical officers of Agriculture was conducted in June 2015.The actual data collection was conducted between June and December, 2015. During the study, four focus group discussions were undertaken; two with service providers and another two with farmers. These discussions, involved small groups of eight to twelve people who were led through open discussion guided by a trained leader (skilled moderator). The discussions were structured around a checklist of carefully predetermined questions under the two themes of the study. Apart from ensuring full participation of every participant, further probing was undertaken to ensure sufficient information is generated. On the other hand, Key informant interviews were conducted with a broad array of actors drawn from public and private agencies with specific mandate in Agriculture and climate change. In this study key informant interviewees were individuals who had competence and knowledge in the area of Agriculture and climate change by virtue of their academic qualifications and many years of work experience. The key informant interviews were aimed at validating the quantitative data on the extent of dissemination of agro weather information and its impact on adoption of climate smart practices in the study area. During the study, 30 key informant informants drawn from government departments, NGOs, CBOs and farmers organizations were interviewed. Finally, observations and desk reviews were made to confirm and gain a clear picture of the findings.

2.3 Data Analysis

Data was analysed by use of both qualitative and quantitative approaches. The quantitative data was coded and analysed using SPSS version 16, while qualitative data was analysed by establishing the categories and themes, relationships/patterns and conclusions in line with the study objectives (Gray, 2004). To test the statistical significance of the findings of this study and establish relationship between independent (**Extent of dissemination of agro weather information dissemination**) and dependent variable (**adoption of climate smart practices**), chi-square ($\times^2$) statistical test was used. This is because it allows the establishment of confidence that there is a relationship between two variables in the population. ($\times^2$) value can only be interpreted in relation to its associated level of statistical significance, which in this case is $p < 0.05$ (Bryman, 2008).

3.0 Results and Discussion

3.1 Extent of Agro Climate and Weather Information Dissemination among Small scale Farmers of Kisii County

Findings of this study revealed very low (23.4%) access to agro climate and weather information usually issued before the rainfall season immediately after weather forecast is released (see format of agro climate and weather information). Majority (76.7%) of the respondents (Table 1) were oblivious of the information that included technical advises on appropriate practices undertaken to ensure resilience to climate and seasonal weather shocks. This revealed the low extent of dissemination of agro weather advisories among the majority of small scale farmers in the study area, scenario that predisposes them to high vulnerability to climate change risks. This accounts for reported crop failure and declining productivity, production and reinforcement of food insecurity in Kisii County (MOALFD Kisii County, 2015). The low access to agro weather advisories was as a result of weak and limited dissemination (Key Informants and FGDs). These findings were consistent with Harvey *et al.* (2009), who expressed concern over inadequate sharing of climate information in Africa.

Table 1: Access to Agro Climate and Weather Information among Small Scale Farmers of Kitutu and Nyaribari Chache

Access to Agro Climate weather information	F	%
Yes	98	23.4
No	322	76.6
Total	420	100

3.2 Communication Channels used in Disseminating Agro Climate and Weather Information to Farmers in Kisii County

From these findings it was explicit, the main mode of communication that reached a wider audience among respondents who had received agro weather advisories was both electronic (TV, Radio) and print media (Newspapers) (68%) (Figure 2).

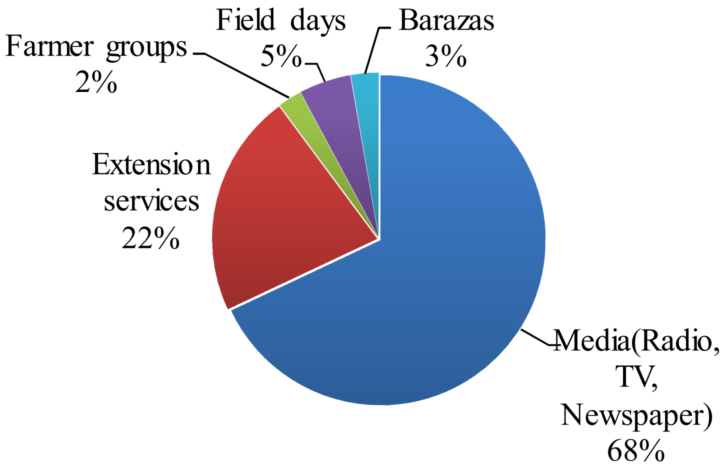

Figure 2: Channels of Communication Used During Dissemination of Climate Information in Kisii County

This revealed that the most effective way that agro weather information can be disseminated in the study area was through the media, particularly through the local vernacular FM radios, which have a wide audience among the rural farmers. This corroborated WMO (2012) and Weiss *et al.* (2000) assertion that television and radio remains the most reliable means of dissemination of agro weather information among small scale farmers, and particularly when broadcasted in the local languages. Other ways through which agro weather information was provided to farmers included barazas (3%), extension service (22%), field days (5%) and farmer groups (2%) but to a very limited extent (Figure 2). These results indicated significant shortcomings in dissemination of agro weather information through extension services and farmer organizations, which once strengthened would lead to enhanced access of agro weather information among these farmers. These results were also in agreement with a study carried out by Zendera (2011) among smallholder farmers in Perkerra and Lari-Wendani Irrigation schemes in Kenya. Where the study revealed that 98% of the farmers received agro meteorological information through radio, but to a very limited extent through bulletins, mobile, internet, extension and barazas because of inadequate extension services.

3.3 Knowledge of use of Climate and Weather Information

Climate knowledge is gained when climate information received from various sources, is contextualized, examined, interpreted for concrete use and applied in diverse circumstances (CARE Kenya, 2014). According to responses only (11%) had working knowledge of agro weather advisories. This was a sharp decline from the proportion (23.3%) that indicated access to this information (Table 2). This shows that even among the few farmers who had awareness regarding this information, majority lacked the skill and understanding to interpret and contextualize the information in their farming practices. The low knowledge level was attributed to lack of training on interpretation of the information and limited participatory sharing and interpretation of climate and weather forecasts (Key informants &Focus Group discussions). This is in congruence with Chamboko *et al.* (2008), who found similar results in his study. As recourse participatory process involving farmers, traditional forecasters, extension service and meteorological services providers has been suggested (WMO, 2012) and is currently being promoted by ASDSP in all 47 counties though to a limited extent (ASDSP. 2014). This approach referred to as Participatory Scenario Planning (PSP) ensures sharing and interpretation of weather and climate information for enhanced understanding and application by all agricultural stakeholders including farmers (CARE Kenya, 2014).

Table 2: Knowledge of Use of Climate and Weather Information among Small Scale Farmers

Knowledge	F	%
Yes	46	11
No	374	89
Total	420	100

3.4 Application of Weather and Climate Information

When the respondents were asked to indicate the application of the weather and climate information, very few (8.1%) responded affirmatively (Table 3). This was a further drop from the previous (11%) who had indicated they had practical knowledge about the use of weather and climate information (Table 2). This revealed the low utilization of weather information alongside appropriate practices to mitigate the adverse effects of weather changes attributed to climate change in the study area. The low application was as a result of lack of skill among extension services providers and farmers with regard to interpretation and application of weather forecasts, and lack of budgetary support for integration of weather/climate information and climate smart practices in farming activities (Key informants & Focus group discussions). The low uptake of the information was also attributed to delay in forecasts, development of advisories and subsequent dissemination of advisories Similar findings were established and pointed out by Chamboko *et al*. (2008) and WMO (2012) who attributed the limited use of the information to lapses in dissemination systems in terms of reliability, timing, infrastructure development, language and depth of content and lack of skill in the use of the information.

Table 3: Application of Weather and Climate Information

Application of agro weather advisories	F	%
Yes	34	8.1
No	370	91.9
Total	420	100.0

3.5 Extent of weather and climate information dissemination and adoption of climate smart practices

Adoption of climate smart practices in response to weather and climate information revealed positive correlation. However, adoption was apparently low and ranged between (1.2% to 21.9%) (Table 4). The low adoption of practices was a consequence of limited access of the information among farmers (Table 1). According to Deressa *et al.* (2009) availing climate information enhanced the adoption of appropriate crop varieties by 17.6% in the Nile basin of Ethiopia. These findings similarly showed varying levels of adoption of climate practices in response to agro weather information. For instance some practices ranked highly among farmers compared to others i.e. use of organic manure (21.9%), agroforestry (19.28%), mixed cropping (17.3%) and rain water harvesting (17.1%) were highly adopted. While adoption of index-based agricultural insurance (1.2%), silage making (2.14%), preservation of hay (2.85%), improved fallowing (3.3%, n=14) was quite low (Table 4). The difference was attributed to low awareness of practices such as index based insurance among most farmers. This shows the need for simultaneous access of agro weather information with appropriate climate smart practices among farmers.

Table 4: Climate Smart Practices Being Adopted and Intensity of Adoption in Response to weather and climate information dissemination

Climate smart practices	Frequency	Percentage
Farming drought, disease, pest and flood tolerant and early maturing varieties	54	12.85
Mixed cropping	73	17.3
Integrated crop and livestock systems	31	7.4
Improved fallowing	14	3.3
Agroforestry	81	19.28
Green house technology	24	5.71
Intercropping with legumes and fertilizer fodder crops	59	14.04
Crop rotation	62	14.76
Rain water harvesting	72	17.14
Irrigation	26	6.2
Construction of water retention structures	59	14.05
Biogas production	14	3.3
Preservation of hay	12	2.85
Planting of cover crops	36	8.5
Pasture management e.g. controlled grazing, improved forage varieties, deferment, Reseeding, control of weeds	23	5.48
Silage making	9	2.14
Use of organic manure	92	21.9
Index-based agricultural insurance	5	1.2
Feed management to reduce methane emissions	21	5
Farm-specific nutrient management & precise (micro- dose) fertilizer application	33	7.85

3.6 Relationship between use of Agro Weather Information and Adoption of Climate Smart Practices

Chi square test results on the relationship between use of agro weather information and adoption of climate smart practices was positive (Table 5). These findings were in consonant with many other studies (Thornton *et al.,* 2006; Roncoli *et al.*, 2009; Patt *et al.*, 2005). In Burkina Faso, after farmer workshops, where the interpretation and management implications of forecast information on farming was discussed, most of the participants (91%) reported changing at least one management strategy in response to forecast information (Roncoli *et al.*, 2009).

Table 5: Relationship between access to weather and climate information and Adoption of Climate Smart Practices

Climate smart practices	**Chi square test results**		
	x^2	**df.**	***P***
Mixed cropping	63.144	2	.000
integrated crop and livestock systems	17.677	2	.000
Intercropping	60.077	1	.000
Green house technology	41.968	1	.000
Irrigation	35.155	1	.000
Biogas production	16.766	1	.000
Improved fallowing	12.414	2	.002
Agroforestry	91.398	2	.000
Crop rotation	37.552	1	.000
Rainwater harvesting	88.825	1	.000
Planting cover crops	7.302	1	.007
Mulching	10.383	1	.001
Farm yard composting	1.1662	1	.000
Hay making	5.649	1	.017
Pasture rehabilitation and management	34.024	1	.000
Organic manure	1.4152	1	.000
Index based agricultural insurance	5.940	1	.015

In another study carried out in four villages of Zimbabwe, out of the (75%) farmers who received seasonal forecast information during 2002/03 and 2003/04 growing seasons, (57%) reported changing their management –primarily time of planting and cultivar selection – in response (Patt *et al.*, 2005). This affirms the hypothesis that provision of timely, reliable, easy to use and accurate climate information that includes early warning signals and weather forecasts in a language that is understood to small scale farmers, enhances farmers capacity and disaster preparedness to changing climate (Thornton *et al.,* 2009). These findings revealed that the more farmers access agro weather information, the more they are likely to adopt climate smart practices.

4.Summary of Findings, Conclusions and Recommendations

The findings of this study pointed to limited outreach, low knowledge levels and very low utilization of climate and weather information in farming activities among majority of small scale famers in Kisii County. This was against the backdrop of ongoing Participatory Scenario Planning currently being undertaken by Agriculture Sector Development Support Programme (ASDSP). The low access and knowledge of climate and weather information was attributed to delay in forecasts, development of advisories and subsequent dissemination of advisory. It was also attributed to weak dissemination of information, lack of capacity among extension services providers and lack of budgetary support for integration of weather/climate information. The findings also indicated positive correlation between access to agro climate and weather information and climate smart practices based on chi square test results.

In conclusion, while these findings affirmed the importance of access to climate and weather information in enhancing adoption of climate smart practices, its access and widespread use remains dismal among small scale farmers. To ensure effective dissemination of agro climate and weather information for enhanced adoption of climate smart practices, this study suggests the need to strengthen and enhance capacity for collection, downscaling and disseminating agro weather and climate information by meteorological services and extension service providers in a timely manner. The study recommends packaging of climate information into user friendly formats and up scaling of participatory process involving farmers, local forecasters, meteorological services and extension service providers. This will enhance skill and knowledge in the use of climate and weather information in farming activities. The study further recommends dissemination of information to small scale farmers through channels that are effective and accessible to them such as local FM radios. These findings further indicate the need for capacity building of extension services providers and small scale farmers with regard to current weather/climate changes and appropriate climate smart practices. The study finally suggests the need to set up a County climate change adaptation unit, mobilize funds and budgetary support for integration of weather/climate information and climate smart practices in farming activities by the County Government.

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Format of Agro Weather and Climate information offered to Farmers in Kitutu and Nyaribari Chache of Kisii County during the 2015 March to May (MAM) long rainfall period

Scenario: Above normal rainfall		
Type of enterprise	**Hazards and Risks**	**Opportunity and Advisory**
Livestock	- Prevalence of diseases e.g. foot rot, pneumonia, scouring, - Bloating due to consumption of rush pasture, - Washing away of acaricides after spraying, - Poor quality pasture as a result of nutrient leaching. -Prevalence of worm infestation e.g. round worms, tapeworms, flukes	- Stockists to store enough quantities of drugs & inputs, - Ensure proper and adequate housing - Use additives and concentrates - Conduct timely vaccination and deworming - Make silage and adequate feed storage arrangements - Increase the frequency of spraying, - Make hay before the rains
Crops	- Post-harvest loses due to high moisture - Soil erosion, - High disease and pest incidences, - Hail stones, - Lodging of crops and leaching of nutrients - Crop destruction	- Early land preparation and timely planting - Plant flood, pests and diseases tolerant varieties - Use of greenhouses/shade nets, - Adopt soil conservation measures e.g. terracing, cover cropping - Stake of tall tomatoes varieties and prop bananas - Avoid cultivation on steep and riparian areas - Harvest water and store - Take crop insurance - Value addition for longer storage life
Scenario : Below normal rainfall		
Livestock	- High temperature, - Water scarcity, - Increased pests and diseases, - Reduced animal feed availability and quality - Grazing in fragile areas - Low production and productivity and occasional deaths	- Routine vaccination and deworming, - Isolate and treat sick animals - Supplement feeding, - Keep manageable herds
Crops	- Dry spells & drought, - High pest and diseases incidences - Wind erosion, - Wilting and total crop failure	- Early land preparation and timely planting - Supplementary irrigation - Use of greenhouses/shade nets. - Use of mulching to conserve moisture - Control of pests using IPM - Supplementary irrigation use - Diversification of crops - Crop insurance