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The Role of ICT Tools in the Access of Climate Information by Rural Communities

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ABSTRACT

This paper, seeks to explore how rural communities especially women in Kitui county use ICT tools to access localized climate information and how Digital Capital facilitates or impedes the process. Our view is that the continued access to, and use of, ICT tools like the mobile phone and radios offer diverse opportunities for rural communities to use timely and relevant climate information to enhance their livelihood strategy. We hypothesize that rural communities' use ICT tools such as mobile phones and the community radios to access localized climate information (weather, seasonal forecasts and agro-advisories). A household survey of 419 respondents was adopted for data collection and analysis, guided by the sustainable livelihood framework. The research findings disclosed that the radios combined with the mobile phone are commonly available, accessible and cost-effective ICT tools that have played a role in improving rural women's access to real-time, relevant climate and agro-advisory information reducing information asymmetry in rural settings. The study is motivated by the increasing challenges of climate variability and climate change that are global. Kitui County has had its share of climate variability and climate change related problems such as drought which create problems such as food insecurity.

1. Introduction

The advancement in technology, for instance, the spread and use of mobile phones and community radios offer new opportunities in addressing problems associated with current challenges in climate change. As (Finlay & Adera, 2012; Tall, Davis & Guntunku, 2014a) state, "the role and the potential of ICTs in helping communities employ innovative approaches to prepare for, respond to and adapt to climate change are increasingly being recognized." This sense of innovation has transcended the earlier geographical and economic barriers that had limited their spread, to the extent that currently, even areas and people that had been considered marginal are now making innovative use of ICTs to improve their livelihoods. Similarly, (Ospina & Heeks, 2012) argue that ICTs "can enable new responses to the challenges posed by more frequent and intense unpredictable climatic events and stress."

Research and anecdotal evidence suggest that virtually every household in Kenya, even in rural areas, has a member that owns a mobile phone and/or a radio. Indeed, the current brands of mobile phones have frequency modulation (FM) radio features that enable the owners to tune to radio stations of their choice. In a sense, these FM radio stations provide portable information via mobile phones (Cherotich et al., 2012; Owusu et al., 2017; Waema & Miroro, 2014). While many Kenyans now either own or have access to ICT tools, the extent to which these tools are utilized to enhance livelihoods remains a speculative matter. Anecdotal evidence suggests that people with access to ICTs have at their disposal information on many subjects, including climate-related information. There are many other ways that people make use of ICTs, besides others like cash transfer, and social interactions, to deal with the routine challenges of their lives, including poverty (May, Waema & Bjastad, 2014; Tall et al. 2014a). It is, therefore, necessary to investigate the link between ICTs, communities, and individuals, on the basis of climate information dissemination for enhanced livelihoods. Further, how people use ICT tools to transform their lives has only been described in general terms (Marolla, 2018; Wong, 2012). As such, there was a need for a study that focuses on specific aspects related to climate change. Apgar et al. (2016) identify access to climate information as critical in the rural setting of Kitui in order to improve livelihoods and hence achieve sustainable development.

Eighty percent of Kenya is Arid and Semi-Arid Lands (ASAL) with Kitui County being part of the said lands. Farmers have experienced prolonged droughts and crop failures because of climate change and unsustainable agricultural practices (Olouko-Odingo et al., 2016).

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Changes to agricultural practices proposed by experts have been resisted by local farmers, because of cultural and lack of knowledge, which have resulted in food insecurity, poverty, and loss of livelihoods (Kitui County CIDP, 2013-2017). Additionally, women suffer disproportionately during adverse climatic conditions and for intervention measures to succeed in solving these problems, there is a need to focus on women (Carr & Onzere, 2017; Jost et al., 2016; Oluoko-Odingo, 2019). To help in solving the problem of food and nutrition insecurity in Kitui, there is an urgent need to improve access to climate information (weather, seasonal climate forecasts, and agro-advisories) to increase agricultural yields, productivity, and the farmer's livelihoods.

Thus, it is essential that scholarship focuses on how ICTs can be used to enhance the greater flow of climate information to empower the vulnerable communities' in decision-making, especially in the context of climate change.

Digital Capital

According to the International Telecommunications Union (ITU) (2009) and Peña-López (2009), access to ICTs is its availability within the home while its use is referred to operationalization by at least one individual in the household. Further, access is "not only to the physical proximity and accessibility of ICT infrastructure, tools, and services but also to their affordability" (George et al., 2011). Access to and use of ICTs in this regard is recognized as Digital Capital (May, 2010). Many remote areas have limited access to ICTs (Chapman & Slaymaker, 2002). The limited access is due to impediments such as lack of electricity or recharging facilities (ITU, 2017). Furthermore, some ICTs cannot be effectively operated without some level of technical knowledge that often comes with certain levels of education (Huyer, 2006). The implication means that where illiteracy levels are high, other factors notwithstanding, access to ICTs can be problematic.

To countermand these challenges, some people can still access ICTs and their services by invoking social networks that may allow sharing of technological tools and operational skills (Nath, 2006). Hence, even those who do not own ICTs for whatever reasons can access them by sharing (Owusu et al., 2017). Social networks involving family, friends, colleagues, and neighbors can facilitate such sharing (Alampay, 2006). However, this can only happen in situations where social capital exists and can be exploited within the communities of ICTs users in their various relationships.

2. Methodology

The study was carried out in Kitui County because over 85% of the county's population lives in rural areas and reside in semi-arid conditions highly susceptible to drought, due to reliance on rain-fed agriculture and settled pastorals. Such events place pressure on food security and water supplies (Behnke & Muthami, 2011). Explored was how climate information (weather, seasonal forecasts and agro-advisories) was accessed and utilized by rural women in Kitui. Our view is that the continued access to, and use of, ICT tools like the mobile phone and radios offer diverse opportunities for rural communities to use timely and relevant climate information to enhance their livelihoods.

The study drew from Fischer et al. (1984) exact statistical significance test cited in Mugenda and Mugenda (2003), where they argue that the ideal sample size for any population above 10,000 is 384. According to Kitui's 2009 population and housing census, the number of households was 205,491, the target population (KNBS, 2013). An actual sample size of 450 households was used to compensate for errors in data collection and of the distributed 450 questionnaires 419 were returned representing a response rate of 93.1%.

To maximize the representativeness of the sample, first, stratified sampling of livelihood zones in the study area were identified based on agro-ecological zones (AEZs) in Kitui County. Stratified sampling maximizes the inclusion of different production methods and livelihood types, ensuring the representation of livelihood variation and minimizing the possibility of bias relating to the impact of weather and climate information on particular livelihoods. Included in this AEZs are: Upper Midland Zone (UM4) which has sub-humid climate and is regarded as the sunflower, maize and pigeon pea growing zone; Lower Midland Zone (LM4) a marginal cotton growing zone; while (LM5) and Inner Lowland (IL) have arid climates, and IL5 are the main livestock-millet zones (Kitui County CIDP, 2013-2017). Second, the selection of wards within the AEZ's was purposively selected guided by various NGOs and county government offices located in Kitui that worked with villages or Women Self-help Groups (SHGs) that had projects related to climate information dissemination and food security. These were Caritas, Bio Vision Africa Trust, FAO and government agencies such as the Ministry of Agriculture and Kenya Meteorological Department. The ten wards selected were Miambani, Matinyani, Kaui, Kwa-Mutonga/Kithumula, Kyome-Thaana, Kwa-Vonza, Nguutani, Nguuni, Tseikuru, and Zombe/Mwitika as shown in Table 1.

Table 1: Wards in Livelihood Zones

AEZ	UM4	LM4	LM5	IL5
Wards	Kyangwithya east, Miambani Matinyani Township	Chuluni Kaui kwamutonga/Kithumula Kisasi Kyanguithia west, Kyome-Thaana Migwani Mbitini Mulango, Mumoni Zambani	Kanyangi Kiomo/Kyethani Kivou Kyuso KwaVonza Mutitu/Kaliku Mutonguni Mwingi Central Nguutani Tharaka Waita	Endau/Malalani Ikanga/Kyatune Mui Mutomo Ngomeni Nguuni Nuu Tseikuru Voo/Kyamatu Zombe/Mwitika

A household survey was conducted to collect data from a sample of small-scale farmers, where 83.3% were women and 16.7% were men. The whole process was interviewer-administered (face-to-face) where the researcher and research assistants asked respondents questions and recorded the responses. The questions were in the Likert format and the English language, but the research assistants were required to translate them into either Kiswahili or Kikamba, the local languages for those who did not understand English.

This study used SPSS in the analysis, interpretation, and presentation of the quantitative data. The data (filled questionnaires) was cleaned and edited to ensure that all questions were answered accurately and precisely. Questionnaires were categorized, grouped and administered according to AEZs and assigned a numerical number for easier identification. Secondly, descriptive statistics used tabulation methods to summarize the data into frequency and cross tabulation, besides the automatic generation of statistical tables with the SPSS program. The analyzed data were displayed in the form of pie charts, bar charts, and figures using the descriptive static measures of frequency distribution, central tendency and dispersions of display.

3. Results and Discussions

The results capture information on ownership of ICT tools by the respondents and digital capital, namely, accessibility, availability, and affordability of the same ICT tools. The results on awareness, access, and use of climate information and links to ICT tools by the respondents are then presented.

3.1 Use of ICTs to Access Climate Information by Rural Communities

Figure 1, displays ICT tools owned by the respondents. Out of the 419 respondents, the majority (94.1%) own mobile phones and (79.3%) own radio sets. Only 19.4% of the respondents own television sets while fewer respondents (2.1%) own computers. Notably, more than half of the respondents (53%) own both mobile phones and radios, while very few respondents (7.6%) did not own any ICT tools.

Table 2 on Digital Capital represents constructs on the response rates for accessibility, availability, and affordability. The respondents had several options in answering the above questions reflected on each row. For each question, only the highest number of response rate was selected. On the digital capital construct on accessibility to ICT tools, there were multiple sources of access to ICT tools where respondents went to neighbors and friends to access television (n=224), radio (n=109) and mobile phones (n=60), respectively, while others went to the cyber café to access computers (n=225). In regards to ICT tool operation, the respondents' ability to operate the mobile phone (n=324), and the radio (n=319) were high, with very few capable of operating the television (n=86) and computers (n=22), which is expected as depicted by the ownership of the relevant ICT tools in Figure 1. Most respondents sought assistance from their children when they were unable to operate the ICT tool (mobile n=205; radio n=166; and television, n=38). When it came to the computer, some respondents sought assistance from the cyber café (n=101). In understanding the climate information received via ICT tools, information relayed through the radio was understood the most (n=293), followed by the mobile phone (n=278). However, very few respondents could understand the climate information relayed through the television (n=87) and the computer (n=3). This response was pegged on very few respondents owning a television or a computer and the lack of skills in operating the computer. A vast number of respondents (n= 314) preferred to receive ICT based climate information in their vernacular language (Kikamba), followed by Kiswahili (n=253), and then English (n=144).

On the availability of power sources to support ICT tools, the primary source of power was solar, where the respondents (n=224) used solar to power their mobile phones and respondents (n=46) solar to power their television. A total of n=156 respondents used batteries to power their radios, while (n=9) respondents, who owned computers powered them using electricity. On how frequently the respondents used an ICT tool in the access of climate information, the mobile phone was used frequently by a majority of the respondents (n=377), followed closely by the FM radios (n=333). Through neighbors, friends and cyber café, a small number of respondents (n=104) accessed climate information through the television, and a much smaller number (n=18) accessed climate information through the computer.

Concerning affordability of ICT services, respondents (n= 179) were able to afford to maintain the use of the FM radios by using batteries, while the majority of the respondents (n=245), were able to sustain the use of the mobile phones by use of solar power. Most respondents (n=335) could afford to buy airtime, although very few (n=34) could afford to buy Internet bundles.

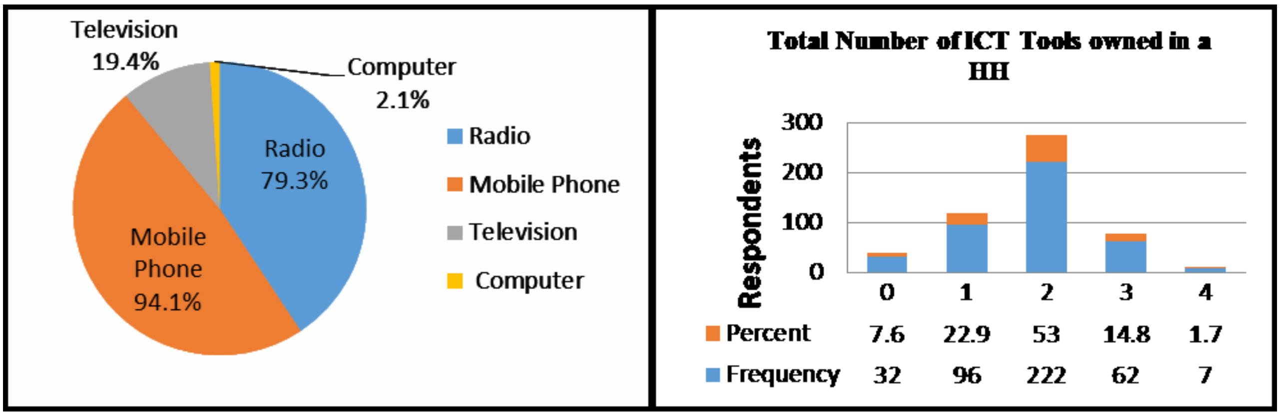

Figure 1: ICT Tools Ownership by Respondents

Table 2: Digital Capital

Digital Capital Construct	Indicator Variable	Radio	Mobile Phone	Television	Computer
Accessibility	Source of Access to ICT Tool	Neighbours/ Friends (n = 109)	Neighbours/ Friends (n = 60)	Neighbours/ Friends (n = 224)	Cyber Café (n = 225)
	ICT Tool Operation	n = 319	n = 324	n = 86	n = 22
	ICT Assistance	Child (n = 166)	Child (n = 205)	Child (n = 38)	Cyber Café (n = 101)
	Understanding Tech-nical (CI) Information	n = 293	n = 278	n = 87	n = 30
	Format of Technical (CI) Information	Kikamba (n = 314); Kiswahili (n = 253); English (n = 144)			
Availability	Charging of ICT Tool	Battery (n =156)	Solar (n =224)	Solar (n= 46)	Electricity (n = 9)
	The frequency of ICT tool use in accessing CI	n = 333	n = 377	n = 104	n = 18
Affordability	Sustaining use of ICT Tools	Battery (n = 179)	Solar (n =245); Air-time (n = 335); Internet/ Bundles (n = 34)	TV Box (n = 62); TV Monthly Charges (n = 54)	Internet (n = 15); Printing & Photocopying (n = 19)

Very few respondents (n=62) and (n=54), could afford to buy the Internet box and the monthly TV charges that go with it respectively. Overall, the respondents found the computer as the most unaffordable ICT tool, especially when it came to paying for internet access (n=15), paying for printing and photocopying (n=19) services.

3.2 Awareness and Use of Climate Information

Table 3 contains information on the respondents' awareness, and use of climate information. The source of climate information was from Kitui County Meteorological Department (KMD).

Table 3: Awareness and Use of Climate Information

Awareness and use of climate information (5 = Very Important; 4 = Important; 3 = Neutral;	Median	Mean	SD	Skewness	CV
Intensity of Rainy Season	4	4.24	0.91	-1.27	0.214
Daily Weather Forecast	4	4.25	0.94	-1.49	0.222
Length of Rainy Season	4	4.21	0.98	-1.43	0.232
Onset and cessation of rainy season	4	4.22	0.99	-1.53	0.235
Weekly Forecast	4	4.17	1.00	-1.36	0.239
Seasonal Forecast	4	4.15	1.03	-1.42	0.248
Early Warning of Extreme Weather (drought, floods, pests)	4	4.14	1.09	-1.42	0.264
Future Forecast	4	4.06	1.18	-1.34	0.291

From Table 3, the results show that awareness of climate information level is very high with a median of four for each indicator. Also provided is some information concerning the distribution of scores on awareness, and use of climate information by assessing skewness and Coefficient of Variation (CV) in normalization and ranking of the variables. The score of skewness is -> 1, which implies that the distribution of dataset is highly skewed, where most of the responses are clustered around the median number of 4. To understand the differences between these similarities, Coefficient of Variation was computed for each measured indicator and then ranked in terms of climate information awareness. Since the values of CV are very close to each other and less than 0.5, it means there is a very low dispersion of respondents around the mean. It also indicates that over 80% of the respondents are aware of climate information and hence acknowledge its importance in implementing their livelihood strategies and sustainable livelihoods.

Figure 2 indicates the results of ICT tools frequently used by respondents to access climate information. Using the median value for analysis, the respondents use mobile phones always, the radio sometimes and rarely use the computer and television (mobile phone=5, Radio=4, Computer=1, and Television=1) in accessing climate information.

3.3 ICT tools frequently used to access climate information in Kitui County

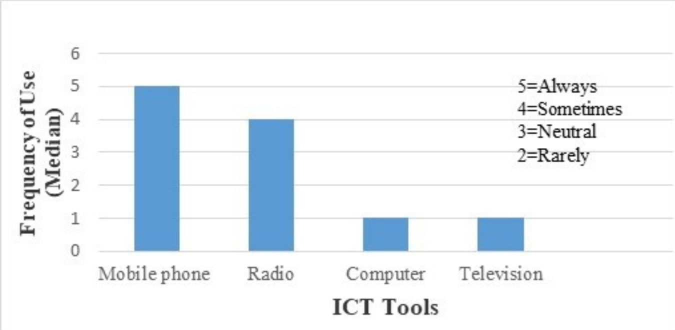

Figure 2: ICT tools frequently used to access climate information

The results show that very few respondents use televisions and radios to access climate information and again this collaborates findings of Figure 1 and Table 2 that reveal how few respondents own the said ICT tools and when required visit their neighbours, friends or the Cyber Cafés to access the ICT tools. The respondents found mobile phones and community radios to be affordable, available and easily accessible compared to the television and computers and this is because almost all households in Kitui owned at least one mobile phone with some level of disparity based on gender, technological feasibility, and financial ability.

3.4 Relevance of Climate Information Accessed through ICT Tools

Figure 3 displays results on the respondents who found climate information accessed through ICT tools to be relevant. The data was categorized into three categories: low, medium, and high. A majority (82%) of the respondents fall into the high category and find the relevance of climate information accessed through ICT tools while 13% fall in the medium category and 5% in the low category who do not find the relevance of climate information accessed through ICT tools.

3.5 Relevance of Climate Information Accessed through ICT Tools

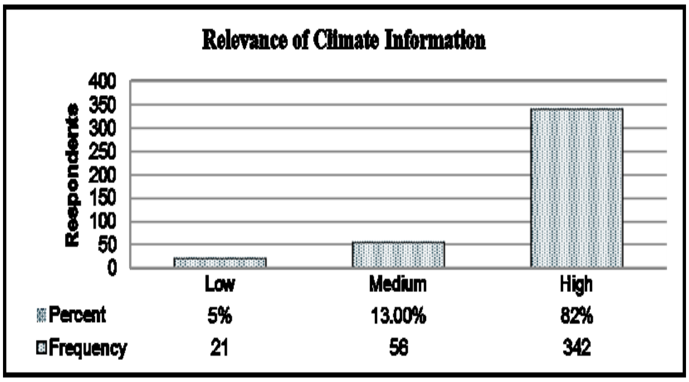

Figure 3: Relevance of Climate Information Relayed through ICT Tools

Figure 4 indicates that more than half of the respondents (69.6 % (n=104, n=143)) are willing to pay extra if the climate information that is relayed through the ICT tools is relevant, timely and accurate.

3.6 Willingness to Pay Extra for Climate Information Services

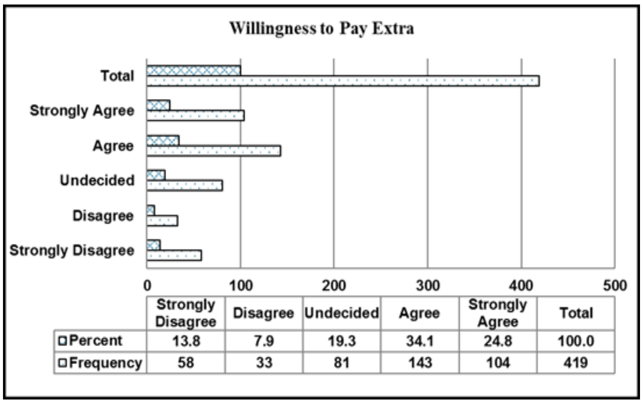

Figure 4: Willingness to Pay Extra for Climate Information Services

3.7 Utilization of Social Capital

Table 4 shows the results of the benefits the respondents have achieved by joining the social network groups. Networking and decision-making are benefits valued most by respondents with percentages of higher than 50% when they join the social network groups. More than 50% of the respondents reported that they gain respect when they are in religious organizations and savings groups. The number of respondents who are in leadership positions or who gain visibility by joining these social network groups is less than 40%.

Business Benefits

From the findings, we establish that it may be possible to build closer partnerships between ICTs manufacturers and service providers to package information in formats and languages that resonate with the needs of rural communities. For instance, the design of apps that can relay climate information on a real-time basis will go a long way in enhancing rural livelihoods, especially if such information from different stakeholders is digitized and made available on shared platforms. Secondly, mobile phone service providers and FM radio programs can be customized to meet the specific information needs of particular communities at a nominal cost. Such, when borne by development partners or government agents, will positively impact on marginalized communities and eventually lead to sustainable development.

Furthermore, the elderly and illiterate community members were not proficient in the operational skills and the technical format in which climate information is conveyed through the mobile phone. The respondents who received regular weather updates through SMS and regular radio broadcast indicated that the information was relevant and that they were willing to pay for the climate service. We acknowledge that ICTs alone cannot eradicate climate change such as drought that is prevalent in Kitui, but access to relevant and accurate information on impending droughts in a timely fashion and comprehensible formats, however, could go a long way in assisting all the stakeholders to plan for and mitigate effects of the droughts and inform farmers decision-making.

Table 4: Utilization of Social Capital

Group	n and%	Leadership Position	Networking	Visibility	Decision-Making	Respect
Farmers Groups	f	48	109	42	118	62
	%	30.8%	69.9%	26.9%	75.6%	39.7%
Self Help Groups	f	79	159	79	144	90
	%	39.3%	79.1%	39.3%	71.6%	44.8%
Religious Org.	f	36	80	47	63	85
	%	23.4%	51.9%	30.5%	40.9%	55.2%
Savings Groups	f	62	155	70	153	107
	%	30.5%	76.4%	34.5%	75.4%	52.7%
CBOs	f	19	65	36	76	40
	%	17.6%	60.2%	33.3%	70.4%	37.0%
Other Groups	f	4	14	6	20	6
	%	14.8%	51.9%	22.2%	74.1%	22.2%

ICTs supplements and to some extent transforms social capital of the individuals and communities rather than diminish it by acting as an added resource for strengthening community ties due to trust and reciprocity. The SHGs were found to be an important channel where ICT tools are used to share knowledge and experiences on a common goal. Trust levels were found to be high due to the factors of reputation, membership, rules and leadership allowing individuals to overcome barriers of limited time, distance and accessibility of climate information.

Similarly, our findings may form a basis for extended support for rural connectivity in the areas of wireless broadband connections or solar power systems. When this is done, improved livelihoods will be realized.

Conclusion and Further Work

This paper has supplied evidence in building a case to suggest the merits of the mobile phone and community radio as cost-effective ICT tools in disseminating climate information. Different authors, (Mittal, 2016; Nath, 2006; Owusu, 2017]) support these findings, as evidenced by the overwhelming access and use of mobile phones and community radios in the rural communities of Kitui County. Both tools were considered more affordable, available, and easily accessible compared to televisions and computers. Although the mobile phone is the most accessible and instantaneous method of communicating climate information, the community radio stations have a well-packaged and easily understandable language for the people in Kitui County. However, the digital capital aspect of study brought out several challenges experienced by the community in accessing ICT tools that relate to accessibility and availability due to lack of ICT infrastructure, poor network connectivity and the lack of electricity. Solar was a more affordable power source.

The central challenge for ICTs in regards to addressing climate change goes beyond the provision of information. It lays in ensuring that the knowledge and climate information can reach the appropriate stakeholders and that local audiences adopt them, and most importantly, that it is useful to the small-scale farmers and that they can apply it in order to improve their livelihoods.

The limitations of this research point to future work that, with access to greater resources, could improve understanding of the appropriate ICT tools for climate dissemination. Information services should be designed per the community needs. To make ICT interventions effective, efforts should be made to make information available in time and appropriate to the intended beneficiaries. The importance of timely and accurate weather information for farmers under local conditions has increased, predominantly because of climate change and climate variability/ extreme events. Information dissemination system for climate information forecasts data available with relevant departments should be user-friendly and easily accessible locally by small farmers. The Kenya Meteorological Department (KMD) has established good systems for the generation of weather forecasts, but dissemination system for the weather forecast is weak. While the above climate information is available on the websites and also accessible through mobile/ smartphone all over the country, small-scale farmers are unable to get full advantage of these improved systems due to their limited access to the internet, and their capacities are low to use and understand the available information. Therefore, systems should have a climate information data on the local context, for example, the agro-climatic facts, history of crop practices and diseases and availability of inputs in local markets, so that customized information could be provided as per the needs of the people in time. The role of timely and customized knowledge in climate information and agro-advisories cannot be compromised because information not coming in time is equal to 'no information.'

Secondly, there is the need to bridge the communication gap between various stakeholders and the small-scale farmers in the sharing of climate information via ICTs. The stakeholders and small-scale farmers have different backgrounds, training and experience: there are bound to be communication gaps. Information received from a particular source might not be understood in its broader context.

The use of a mobile/smartphone and engaging intermediaries or facilitators (extension workers, locally trained professionals) will complement the currently inadequate/ less effective extension services in the country. It will minimize the information and communication gap among farmers, extension services, research and traders. It can bridge the divide between scientific knowledge and technical climate change data, significantly helping the poor farmers in improving their farm efficiency, productivity and profitability.

References

Alampay, E. (2006). Analyzing socio-demographic differences in the access and use of ICTs in the Philippines using the capability approach. EJISDC, 27(5), pp, 1-39.

Apgar, M., Kniveton, D., Naess, L. O., Orindi, V., Abuya, N., & Bonaya, M. (2017). Improving the Impact of Climate Information Services in Kenya's Arid and Semi-Arid Lands.

Behnke, R. H., & Muthami, D. (2011). The contribution of livestock to the Kenyan economy, IGAD Livestock Policy Initiative Working Paper 3.

Chapman, R., & Slaymaker, T. (2002). ICTs and Rural Development: Review of the Literature, Current. London: Overseas Development Institute.

Carr, E. R., & Onzere, S. N. (2017). Really effective (for 15% of the men): Lessons in understanding and addressing user needs in climate services from Mali. Climate Risk Management, pp.1-14.

Cherotich, V. K., Saidu, O. S. E. N. I., & Bebe, B. O. (2012). Access to climate change information and support services by the vulnerable groups in semi-arid Kenya for adaptive capacity development. African Crop Science Journal, 20(2), pp.169-180.

Finlay, A., & Adera, E. (Eds.). (2012). Application of ICTS for Climate Change Adaptation in the Water Sector: Developing Country Experiences an Emerging Research Priorities. Association for Progressive Communications

George, T., Bagazonzya, H., Ballantyne, P., Belden, C., Birner, R., Del Castello, R., & Treinen, S. (2011). ICT in agriculture: connecting smallholders to knowledge, networks, and institutions. Washington, DC: World Bank.

Huyer, S. (2006). Understanding Gender Equality and Women's Empowerment in the Knowledge Society In N. Hafkin & S. Huyer, (Eds.), Cyberella or Cinderella? Empowering Women in the Knowledge Society. Bloomfield, CT: Kumarian Press.

International Telecommunications Union (ITU) (2017*)*. Telecommunications/ICTs for rural and remote areas. Final Report [Question 5/1] Doi:http://handle.itu.int/11.1002/pub/80ec6ea7-en

ITU (2009). Manual for Measuring ICT Access and Use by Households and Individuals. International Telecommunication Union.

Jost, C., Kyazze, F., Naab, J., Neelormi, S., Kinyangi, J., Zougmore, R., Kristjanson, P. (2016). Understanding gender dimensions of agriculture and climate change in smallholder farming communities. Climate and Development, 8:2, 133-144. DOI: 10.1080/17565529.2015.1050978

Kenya National Bureau of Standards (KNBS, 2013). Population and Housing Census Data.

Kitui County, First County Integrated Development Plan. (2013-2017). [Online]. Available at: <http://www.kituicountyassembly.org/userfiles/KITUI%20COUNTY%20INTEGRATED%20DEVELOPMENT%20PLAN%20July%202014(1).pdf.

Marolla, C. (2018). Information and Communication Technology for Sustainable Development. Using Information and Communication Technologies (ICTs) to Tackle Climate Variability and Change Impacts pp.11-21 CRC Press.

May, J. D. (2012). Digital and other poverties: Exploring the connection in four East African countries. Information Technologies & International Development, 8(2), pp-33.

Mugenda, O. M., & Mugenda, A. G. (2003). Qualitative and quantitative approaches. Research Methods Africa Center for Technology Studies (Acts) Press. Nairobi Kenya.

Mutunga EJ, Ndungu CK & Muendo, P. (2017). Smallholder Farmers' Perceptions and Adaptations to Climate Change and Variability in Kitui County, Kenya. J Earth Sci Clim Change 8: 389. doi: 10.4172/2157-7617.1000389.

May, J., Waema, T. M., & Bjåstad, E. (2014). Introduction: The ICT/poverty nexus in Africa. ICT pathways to poverty reduction: Empirical evidence from East and Southern Africa, pp.1-32.

Nath, V. (2006). How can ICTs positively influence the lives of disadvantaged women groups: working towards the optimum ICT-impact model. In N. Hafkin & S. Huyer, (Eds.), Cyberella or Cinderella? Empowering Women in the Knowledge Society. Bloomfield, CT: Kumarian Press.

Oluoko-Odingo A. A. (2019). Gender Mainstreaming for the Adaptation to Weather and Climate Extremes in African Cities. Vol 2, issue 1, pp. 15-27. https://doi.org/10.20987/jccs.2.02.2019

Oluoko-Odingo, A.A.; Ogallo, L.A.; Oludhe, C. & Odingo, R.S. (2016) Climate Risks, Gender Perspectives and Livelihoods in the Greater Horn of Africa (GHA), USA, Charleston, SC.

Ospina, A. V., & Heeks, R. (2012). ICT-Enabled Responses to Climate Change in Rural Agricultural Communities. Climate Change, Innova ion & ICTs Project-Strategy Brief, 2, 5

Owusu, A.B., Yankson, P.W.K., & Frimpong, S. (2017). Smallholder farmers' knowledge of mobile telephone use: Gender perspectives and implications for agricultural market development. Progress in Development Studies 18(1), pp.1-16.

Peña-López, I. (2009). Manual for measuring ICT access and use by households and individuals.

Tall, A., Davis, A., & Guntunku, D. (2014a). Reaching the Last Mile: Best practices in leveraging ICTs to communicate climate information at scale to farmers. CCAFS Working Paper no. 70. Wageningen, Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Waema, T. M., & Miroro, O. O. (2014). Access and use of ICT and its contribution to poverty reduction in Kenya. ICT pathways to poverty reduction: Empirical evidence from East and Southern Africa, pp.102-131.

Wong, S. (2012). Exploring the 'Gender-ICT-Climate Change' Nexus in Development: From digital divide to digital empowerment. University of Manchester