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RESEARCH ARTICLE

EVALUATING ACCESS AND USE OF DISSEMINATION PATHWAYS FOR DELIVERING CLIMATE INFORMATION AND SERVICES TO WOMEN FARMERS IN SEMI-ARID KENYA

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Manuscript Info

Abstract

Women living in semi-arid environments of Kenya are vulnerable to the frequent exposure to impacts of changing climate and need to access climate information and services to build their adaptive capacity. This study characterized the channels through which the women farmers in a semi- arid area of Kenya access climate information and services from data collected from randomly selected sample in cross sectional survey using structured questionnaire. Over 70% of the women perceived change in rainfall, drought, floods, human and livestock diseases to have been "severe" to "very severe" over the last five years. Majority of the women (88.5%) most preferred radio in to accessing climate information and services. Women consistently rated radio highly for delivering reliable information, explaining details and use of local language understood to them. However, Principal Component Analysis (PCA) indicated that comprehensive informing on climatic hazards and support services for adaptation to changing climate is from extension service unlike the other channels which delivered information only on climatic hazards. The study concluded that combination of extension agents, radio and local administration would be more effective for disseminating climate information and services to the women farmers in marginal areas. Capacity building for extension service is needed in interpretation of weather data to enable them effectively disseminate climate information and services to vulnerable people of arid and semi-arid environments.

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Introduction

Climate change is associated with increase in temperature and heat stress, more frequent droughts and intense flooding, windstorms and disease outbreaks (IPCC, 2001). These climatic hazards are projected that will have greatest impact on livelihoods in semi-arid environments of sub Saharan (Thornton *et al*, 2006). The vulnerability of livelihoods to impacts of climate change depends on the extent of exposure, sensitivity and adaptive capacity of the people affected (IPCC 2001). More than 70% of people living in the semi-arid areas are highly dependent on climate sensitive natural resources and agriculture for their livelihoods (Siri *et al*, 2008). The concern is that they may not be adequately empowered to respond and adapt to the magnitude of climate changes projected (Boko *et al*., 2007).

Climate information and services play a critical role in providing Early Warning Systems (EAS) as well as increasing awareness for building the capacity and disaster preparedness to a changing climate. Choice of the dissemination channels can influence access and use of climate information and service disseminated to enable the vulnerable groups exposed to climatic hazards build adequate response capacities. Climate information and services

relevant to adaptation in semi-arid areas include early warning signals, weather forecasts, food aid distributions, emergency guidelines, and financial support, medical and veterinary assistance.

Though the people living in semi-arid environments are in most need of access to climate information and services, they are yet to experience the full benefits of climate research, information and services to enable them effectively cope and build adaptive capacity to the changing climate (O'Brien *et al*., 2008). Harvey *et al*., (2009) expressed concern that information sharing among climate change actors in Africa is limited and may be worse in semi-arid environments due to barriers of poverty, lack of infrastructure, illiteracy and socio-economic factors. Limitations also exist in the information delivery mechanisms in terms of reliability, timing, infrastructural development and even language (Chamboko *et al*., 2008).

In Kenya, the Meteorological Department (KMD) disseminates climate forecasts using different channels such as mass media, print media and the internet. Arid Lands Information Networks (ALIN) on the other hand, disseminates climate related information to people in semi-arid areas through use of Information and Communication Technologies (ICTs) (Nguo *et al*., 2005). Effective access by the vulnerable people especially women farmers in semi-arid Kenya to these dissemination channels has however not been evaluated empirically. The objectives of this study were specifically to:
  i.   Determine perception of the women farmers about impacts of climate change experienced most in the last five years
 ii.   characterize the patterns of climate information and services that women farmers access,
iii.   Identify the dissemination pathways that the women farmers in a semi-arid environment perceive most useful for delivering climate information and services to them,
iv.   Determine the user-friendly attributes of those dissemination pathways for delivering climate information and services to women farmers in a semi-arid environment.

MATERIALS AND METHODS

Conceptual framework
Access to climate information and services is necessary for coping, adaptation and mitigation strategies necessary in the face of changing climate. Figure 1 presents the conceptual framework adapted for this study, illustrating the hypothesized flow of climate information and services to vulnerable people. Underlying assumption is that vulnerable people can effectively access climate information and services if disseminated through channels which are accessible and effective with user-friendly attributes. The pathways through which climate information and services are disseminated include mass media, print media, electronic media, and contact with informed people. Those employing these pathways include researchers, meteorological departments, development agencies and indigenous knowledge systems. The attributes can influence information that users access such as timeliness, accuracy, reliability, ease of use, depth of content.
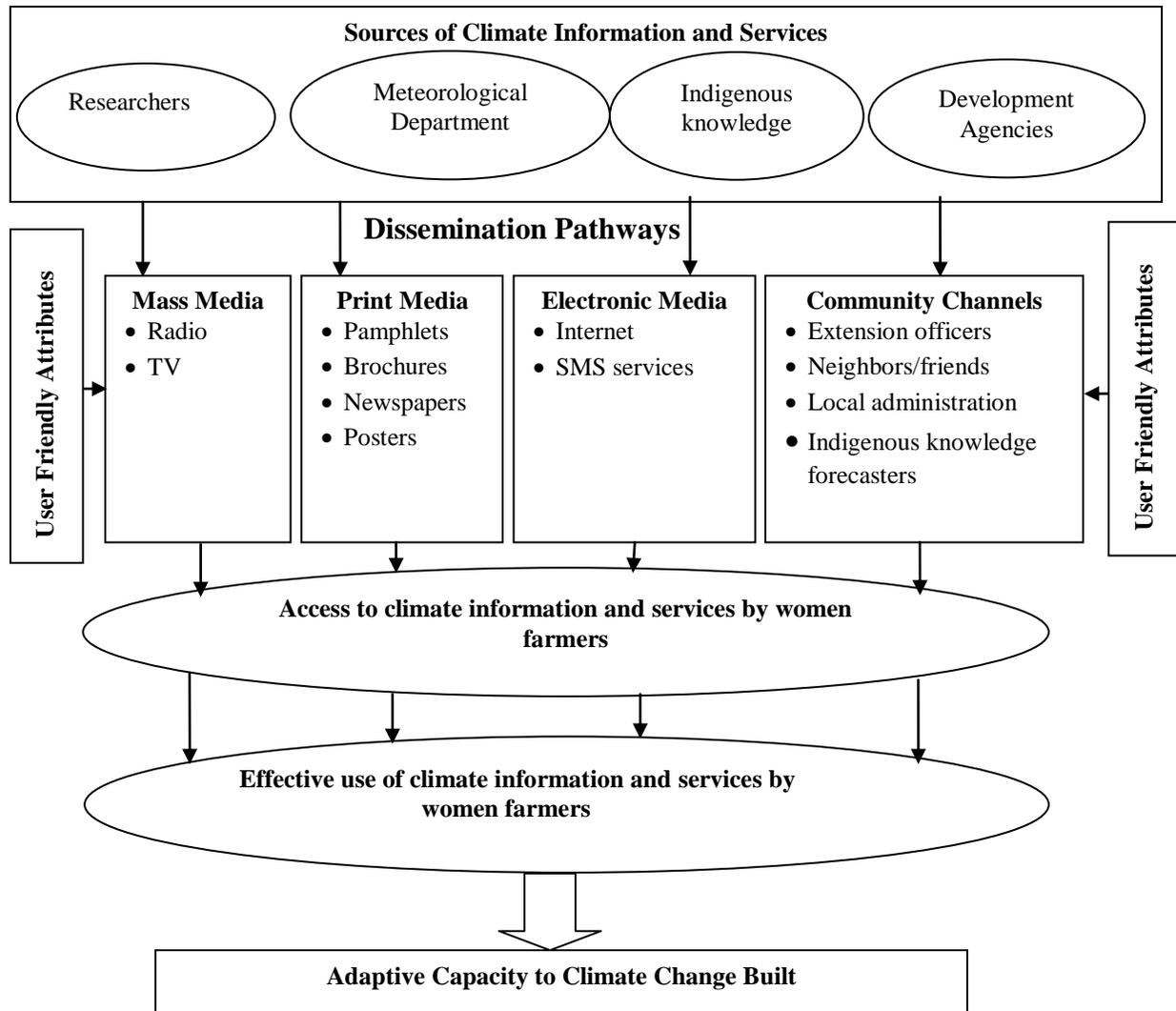
Figure 1: Conceptual framework on dissemination pathways of climate information and services to women Farmers

Study site

The study was in Marigat Division, a semi-arid environment experiencing frequent exposure to climate variability within areas identified as hotspots of climate change (Thornton *et al.,* 2006). Rainfall is highly variable which makes both livestock keeping and crop production very risky, due to water and pasture shortage. Households here are agro-pastoralists who experience prolonged droughts with frequent cases of flooding during rains and outbreaks of human and livestock diseases (GoK, 2001). Frequent exposures to climatic hazards cause famine alerts and poverty and there is competition for scarce natural resources contributing to the area being conflict-prone (Mango et al., 2004). Five locations in the area most prone to impacts of climate variability were selected for sampling the vulnerable women.

Data required was obtained in a cross-sectional survey in which simple random sampling technique was applied to obtain a sample of representative women. Women sampled were those within the age group of 24 to 60 years old considered vulnerable because they are married and shouldering household chores and have to provide food for the family under impacts of climatic hazards. The local administration chiefs and agencies involved in food assistance program within the area facilitated identification of the individual vulnerable women within their administrative areas.

A structured questionnaire was administered to the women respondents to obtain data on their experiences in the past five years about impacts of climate change, dissemination channels through which they climate change and information and services, their preferences for each of the channels and user-friendly attributes of those channels to them. For each dissemination channel accessed, respondents rated on a Likert scale of 1 to 5 (1 = low to 5 = high) the climate information and services accessed, preferences and user-friendly attributes.

 Data analysis

For each dissemination channel, Principal Component Analysis (PCA) was performed on type of climate information and services often accessed. PCA is a statistical approach (Cattell, 1978) for removing redundant information from correlated variables to represent the original variables with a smaller set of derived variables called principal components. The method was relevant for this analysis because the variables of interests were highly correlated. The derived principal components (PCs) are uncorrelated and account for most of the total variation contained in the variables fitted in the model.

Preferences of the vulnerable women farmers were evaluated through cross tabulation in order to obtain chi square statistics for detecting proportional differences. The Likert scale measures of preferences attached to specific attribute of a dissemination channel were subjected to Kruskal Wallis test and where differences were detected, Mann U Whitney test was applied for pairwise comparisons. Instead of median and mean ranks outputs from the non-parametric statistics, mean score for each attribute is presented to ease interpretation of the results.

RESULTS AND DISCUSSION

Characteristics of the sampled women farmers

The age, education, livelihood source and income levels of the sample women are summarized in Table 1. About two thirds (63.0%) of women lived in less than two dollars a day, (1 US $ = KES 80) indicating high poverty incidences. Majority (64.7%) of the women had attained only primary level of education, reflecting low literacy levels, which can be a barrier to effective access and use of early warning systems and climate forecasts disseminated through reading materials and in non- local language. The major source of livelihood was rain-fed agriculture supplemented with remittances which provides important supplemental income that vulnerable people can spend in emergencies related vulnerability to climatic variability and shocks.

Table 1: Age, education, livelihood source and income levels of the Women Farmers

Social characteristics		Statistics
Age (years)	37.7 ± 9.3	t value 828.75***
Education		χ^2 value=1.26***
Without formal education (%)	42.9	
With primary level (%)	44.8	
With secondary level (%)	7.8	
With post-secondary level (%)	4.5	
Livelihood source		χ^2 value = 3.98***
None (%)	0.6	
Farming (%)	98.7	
Remittances (%)	-	
Casual labor (%)	0.6	

Income Level		χ^2 value = 3.26***
< $ 1/ day (%)	26.6	
< 2 $ / day (%)	63.0	
< 2-5 / day (%)	10.4	

*** Significant at P= 0.000

Perception about climate change

Figure 2 illustrates perception of women farmers about impacts of climate change as having been 'severe' to 'very severe' in the last five years. Over 70% of the women perceived change in rainfall, drought, floods, human and livestock diseases to have been "severe" to "very severe" over the last five years. They associated these changes with failure and destruction of crops and property and loss of human lives and livestock and frequent famine.
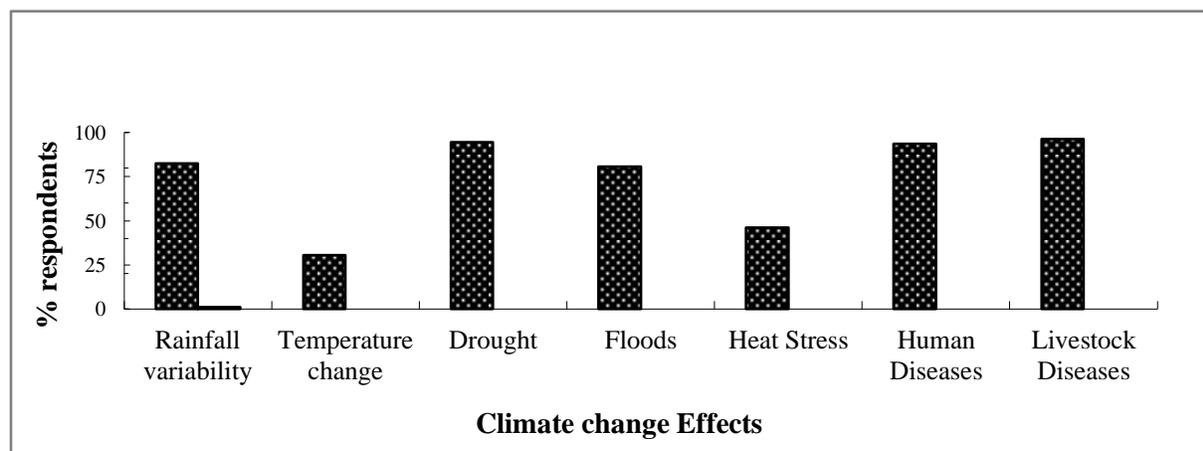
Figure 2: Perception of the women farmers about impacts of climate change as having been 'severe' to 'very severe' in the last five years

Patterns of climate information and services that women farmers access

Principal component analysis (PCA) was used to characterize climate information and services that the women farmers access through radio, extension agents, local administration and indigenous knowledge (Archer, 2003). . The rotated correlation coefficients associated with the Principal Components (PCs) extracted is explained on the basis of magnitude of the factor loading coefficients ($\geq \pm$ 0.30). The positive coefficients indicate positive association while negative coefficients indicate negative association. For each PC, variables with the largest pattern coefficient make the largest contribution in explaining the total variation there is in the data.

Climate information and services accessed through radio
Table 2 shows PCA results of the model fitted for radio. The model had goodness of fit from Bartlett's test of sphericity (Chi-square = 962.06; df =120; P value 0.000; KMO = 0.60). Seven principal components (PCs) were extracted which explained 69% of the total variance. The PC1 which explained most of the variance (17.06 %) indicate that through radio, vulnerable people mostly access information about diseases and rainfall variability and is thus labelled climate hazards information specific.

Table 2: Rotated correlation coefficients factor patterns for radio

Climate Information and services	Factor loadings						
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Climate related livestock diseases	0.92						
Climate related human diseases	0.90						

Rainfall variability	0.31						
Drought		0.88					
Floods		0.86					
Veterinary services			0.73				
Human health services			0.71				
Adaptation technologies			0.57				
Relocation to safer places			0.54				
Heat stress				0.86			
Wind storm				0.87			
Early warning signals					0.76		
Weather forecasts					0.75		
Food aid						0.81	
Temperature change						0.45	
Financial support							0.83
Variance explained (total 69%)	*17.06*	*11.22*	*10.50*	*8.92*	*7.76*	*7.06*	*6.52*

Climate information and services accessed through extension services

The PCA results of the model fitted for extension agents presented in Table 3 had goodness of fit from Bartlett's test of sphericity (Chi-square =498.550, df =28; P value = 0.000, KMO =0. 715). Four PCs accounting for 62.35% of the total variance were extracted of which PC1 explained more than half (38.91%) of total variance. The largest contribution was from climate information and services accessed on drought, floods, diseases, early warning signals, veterinary and medical services, food aid and relocation of vulnerable people to safer places. The loadings indicate that through extension service, women access comprehensive information on climatic hazards and support services. This can be labeled climate hazards with support adaptation responses. The results suggest that extension agents are very effective in reaching the women farmers with climate information and services that are necessary for building adaptation. Extension agents have regular contacts with rural farming community and in this sample, 98.7% of the women were engaged in farming activities.Though extension service can be effective in disseminating climate information and services in the semi- arid and arid areas with marginalised infrastructural development, Ziervogel and Opere (2010) has warned that the agents are unable to interpret seasonal climate forecasts presented in probabilities. Capacity building is therefore necessary to enable extension agents understand weather reports.

Table 3: Rotated correlation coefficients factor patterns for extension services

Climate Information and Services Variables	Factor Loadings			
	PC1	PC2	PC3	PC4
Climate-related human diseases	0.86			
Climate-related livestock diseases	0.83			
Adaptation technologies	0.81			
Floods	0.71			
Early warning signals	0.68			
Drought	0.67			
Relocation to safer places	0.64			
Veterinary services	0.64			
Human health services	0.58			
Food aid	0.46			
Heat stress		0.85		
Windstorm		0.82		
Rainfall variability		0.57		
Weather forecast			0.69	
Temperature change			0.01	
Financial support				0.81

Variance explained (62.35%)	*38.91*	*9.39*	*7.42*	*6.62*

Climate information and services accessed through local administration

Local administration is important in information dissemination in semi-arid and arid areas where communication infrastructure is underdeveloped. The PCA results for climate information and services that the women farmers access through the local administration extracted seven PCs (Table 4) accounting for 62.79% with a model showing goodness of fit for the data fitted (Bartlett's test of sphericity (chi-square =562.700, df =28, P=0.000 and KMO =0. 540).

Table 4: Rotated correlation coefficients factor patterns for local administration

Climate Information and Services Variables	Factor loadings						
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Climate related human diseases	0.84						
Climate related livestock diseases	0.84						
Floods		0.88					
Drought		0.85					
Temperature change			0.82				
Rainfall variability			0.80				
Food aid				0.68			
Veterinary services				0.61			
Human health services				0.60			
Early warning signals					0.66		
Relocation to safer places					0.62		
Weather forecast					0.58		
Windstorm						0.74	
Heat stress						0.72	
Financial support						0.43	
Adaptation technologies							0.84
Variance explained (62.79%)	*14.01*	*9.62*	*9.41*	*8.58*	*7.65*	*7.14*	*6.39*

The rotated correlation coefficients loading on PC1 explained 14.01% of the variation with largest contribution from information about climate-related diseases of both human and   livestock. This reflects greater concentration on disseminating disease information, hence labelled climate-induced disease information specific. Local administration includes local chiefs and village elders, often used by the government agencies to communicate with the grass root people through monthly village meetings "Baraza's".

Climate information and services accessed through indigenous knowledge informers

PCA results for climate information and services that women farmer's access through indigenous knowledge informers are represented in Table 5. Seven PCs were extracted accounting 77.11% of the total variance. The model had a goodness of fit (p=0.000) Bartlett's test of sphericity (chi-square = 3130.244, df =120 and KMO =0. 559). The factors loading on PC1 explain 19.58% of the total variance with most contribution from information on drought and floods. This is therefore labelled climatic hazards specific. Community members indicated that they were able to make predictions using various indicators while some of the elderly were recognized "experts", diviners, seers and even rainmakers.

Table 5: Rotated correlation coefficients factor patterns for indigenous knowledge informers

Climate Information and Services Variables	Factor loadings						
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Drought	0.99						
Floods	0.99						
Veterinary services		0.93					
Human health services		0.92					
Early warning signals			0.98				
Weather forecast			0.98				
Climate related livestock diseases				0.96			
Climate related human diseases				0.95			
Rainfall variability					0.84		
Temperature change					0.83		
Relocation to safer places						0.77	
Adaptation technologies						0.76	
Heat stress						0.43	
Food aid							0.80
Windstorm							0.65
Financial support							0.33
Variance explained (77.12%)	*19.58*	*13.28*	*12.41*	*9.64*	*8.45*	*7.31*	*6.46*

Preferences of women farmers for the dissemination pathways

Results in Table 6 presents respondents' preference for the channels through which women farmers access climate information and services measured as never, seldom, sometimes, often or most preferred. Only the last two measures are presented hence the proportions indicated do not add up to hundred percent. Radio was the preference of a large majority of the women (88.5%). In the study area, radio broadcast are in vernacular language so the news about climate information and services are easily understood by the vulnerable people. Extension service and indigenous knowledge were the next preferred channels for access climate information and services by the women. Hansel et al (2007) argues that radio and ICT-based communication offer immense potential to support the delivery of climate information services; but cannot replace the trust, visual communication of location-specific information, feedback and mutual learning that face-to-face interaction provides. Therefore extension service and indigenous knowledge can be utilized if key informants at the village level are identified and trained in interpreting weather data.

Table 6: Preferred Dissemination pathways by the Women farmers

Dissemination Pathway	Preference Rating (%)		Chi square Statistics
	Often Preferred	Most Preferred	
Radio	24.0	68.8	χ^2 = 72.81 **
	41.7	4.2	

Local Administration	63.7	24.7	χ^2 = 31.58**
	58.3	37.5	
Indigenous Knowledge	59.1	32.5	χ^2 = 1.83**
	16.7	83.3	
Extension Agents	85.0	5.5	χ^2 = 1.77**
	58.3	41.7	

** Significant at P = 0.00   n =154

User-friendly attributes of the dissemination pathways accessed by the Farmers

Table 7 presents means of preference rating by the women farmers on a scale of 1 (very poor) to 5 (excellent) for user-friendly attributes of the channels for delivering climate information and services in a semi-arid environment. User-friendly attributes were rated on the basis of cost, timeliness, details, reliability and language from the perspectives of the respondents. Both women (below 65 years) and the elderly(above 65 years) expressed equal preferences for the attributes of the channels through which climate information and services are disseminated, except for ($P<0.05$) radio regarding information reliability, detail and language used in which the elderly consistently rated lower than younger women.

Table 7: Mean ratings for user-friendly attributes (1=very poor 5= excellent) of the dissemination Channels by the women farmers

Channels	Group	Cost	Timeliness	Detailed	Reliability	Language
Radio	Women	3.43 ± 0.68	2.74±0.61	2.88 ± 0.62	2.66 ± 0.63	4.03 ± 0.51
Extension	Women	3.09 ± 0.97	2.73 ±0.61	3.07 ± 0.53	2.75 ± 0.56	3.33 ± 0.53
Local Administration	Women	3.97 ± 0.47	3.81 ±0.44	4.04 ± 0.61	3.99 ± 0.67	4.62 ± 0.58
Indigenous knowledge	Women	3.71 ± 0.78	3.64 ±0.51	3.96 ± 0.52	3.77± 0.59	4.56 ± 0.58

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