ACCESS TO CLIMATE CHANGE INFORMATION AND SUPPORT SERVICES BY THE VULNERABLE GROUPS IN SEMI-ARID KENYA FOR ADAPTIVE CAPACITY DEVELOPMENT

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ABSTRACT

Women and the elderly 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 support services to build their adaptive capacity. This study characterised the channels through which these vulnerable people (women aged 24 to 60 years; elderly men and women aged at least 65 years) in a semi arid area of Kenya access climate information and support services from data collected from randomly selected sample in cross sectional survey using structured questionnaire. Over 70% of both women and the elderly perceived change in rainfall, drought, floods, human and livestock diseases to have been "severe" to "very severe" over the last five years. Majority of women (68.8.5%) most preferred radio while the elderly (83%) most preferred indigenous knowledge to access climate information and support services. Women consistently rated radio higher (P<0.05) than the elderly 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 support services to vulnerable people in marginal areas. Capacity building for extension service is needed in interpretation of weather data to enable them effectively disseminate climate information and support services to vulnerable people of arid and semi-arid environments.

Key Words: Climate information, dissemination, marginal areas, vulnerable groups

RÉSUMÉ

Les femmes et les personnes âgées vivant en milieux semi-arides du Kenya sont vulnérables aux impacts du changement climatique et ont besoin d'accéder à l'information y relative et au service d'appui d'afin de renforcer leur capacité d'adaptation. Cette étude voudrait caractériser les voies par lesquels les vulnérables personnes (femmes âgés de 24 à 60 ans; vieillards et femmes âgés de moins de 65 ans) en milieux semi arides du Kenya accèdent à l'information relative au climat ainsi qu'aux services d'appui. Des données étaient collectées des échantillons aléatoirement sélectionnés, au cours d'une étude d'enquête transversale utilisant un questionnaire structuré. Plus de 70% des femmes et personnes âgées ont fait remarquer un changement sévère à plus sévère dans les précipitations, la sécheresse, les inondations, les maladies humain et du bétail au cours des cinq dernières années. La majorité des femmes (68.85%) ont généralement préféré la radio pendant que les personnes les plus âgées (83%) ont préféré l'utilisation des connaissances indigènes pour accéder à l'information sur le climat et aux services d'appui. De manière consistante, le taux des femmes par rapport aux personnes âgées était plus élevé (P<0.05), affirmant que la radio constituait une source fiable de l'information par ce qu'elle explique tout en détails et fait usage de la langue locale facile à comprendre. Cependant, l'Analyse de la Composante Principale a indiqué que l'information compréhensive sur les aléas climatiques et les services d'appui pour l'adaptation au changement climatique revient au service de vulgarisation plutôt que d'autres voies qui fournissent seulement des

informations relatives aux aléas climatiques. En conclusion, la combinaison des agents de vulgarisation, la radio et l'administration locale pourraient être plus efficace pour la dissémination des informations climatiques et services d'appui aux personnes vulnérables des milieux arides et semi arides.

Mots Clés: Dissemination, régions marginales, groupes vulnérables

INTRODUCTION

Climate change is associated with increase in temperature and heat stress, more frequent droughts and intense flooding, windstorms and disease outbreaks (IPCC, 2007). These climatic hazards are projected to have greatest impact on livelihoods in semi-arid environments of sub Saharan Africa (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, 2007). 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 projected magnitude of climate changes (Boko *et al.*, 2007).

Climate information and support 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 support 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 (Thornton *et al.*, 2006; IPCC, 2007).

Though the people living in semi-arid environments are in most need of access to climate information and support services, they are yet to experience the full benefits of climate research, information and support 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 weather 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). The people most vulnerable to impacts of climate change are the children, women and the elderly. In this study we define vulnerable people as women and the elderly. Women are those within the age group of 24 to 60 years old who are married, shouldering household chores and have to provide food for the family under impacts of climatic hazards while the elderly are both men and women aged at least 65 years, the age group being those frequently receiving food aid on exposure to climatic hazards. Effective access by these vulnerable women and the elderly in semi-arid Kenya to dissemination channels has however not been evaluated empirically. The objectives of this study were specifically to:

i. Determine perception of the vulnerable people about impacts of climate change that they have experienced most in the last five years.
ii. characterise climate information and support services that vulnerable people access,
iii. Identify the dissemination pathways that the vulnerable people in a semi-arid environment perceive most useful for delivering climate information and support services to them,
iv. Determine the user-friendly attributes of those dissemination pathways for delivering climate information and support services to vulnerable people in a semi-arid environment.

MATERIALS AND METHODS

Conceptual framework. Access to climate information and support 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 support services to vulnerable people. Underlying assumption is that vulnerable people can effectively access climate information and support services if disseminated through channels which are accessible and effective with user-friendly attributes. The attributes can influence information that users access such as timeliness, accuracy, reliability, ease of use, depth of content. Potential users of these channels include researchers, meteorological departments, development agencies and indigenous knowledge systems.

Study site. The study was in Marigat Division, a semi-arid environment in Kenya 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
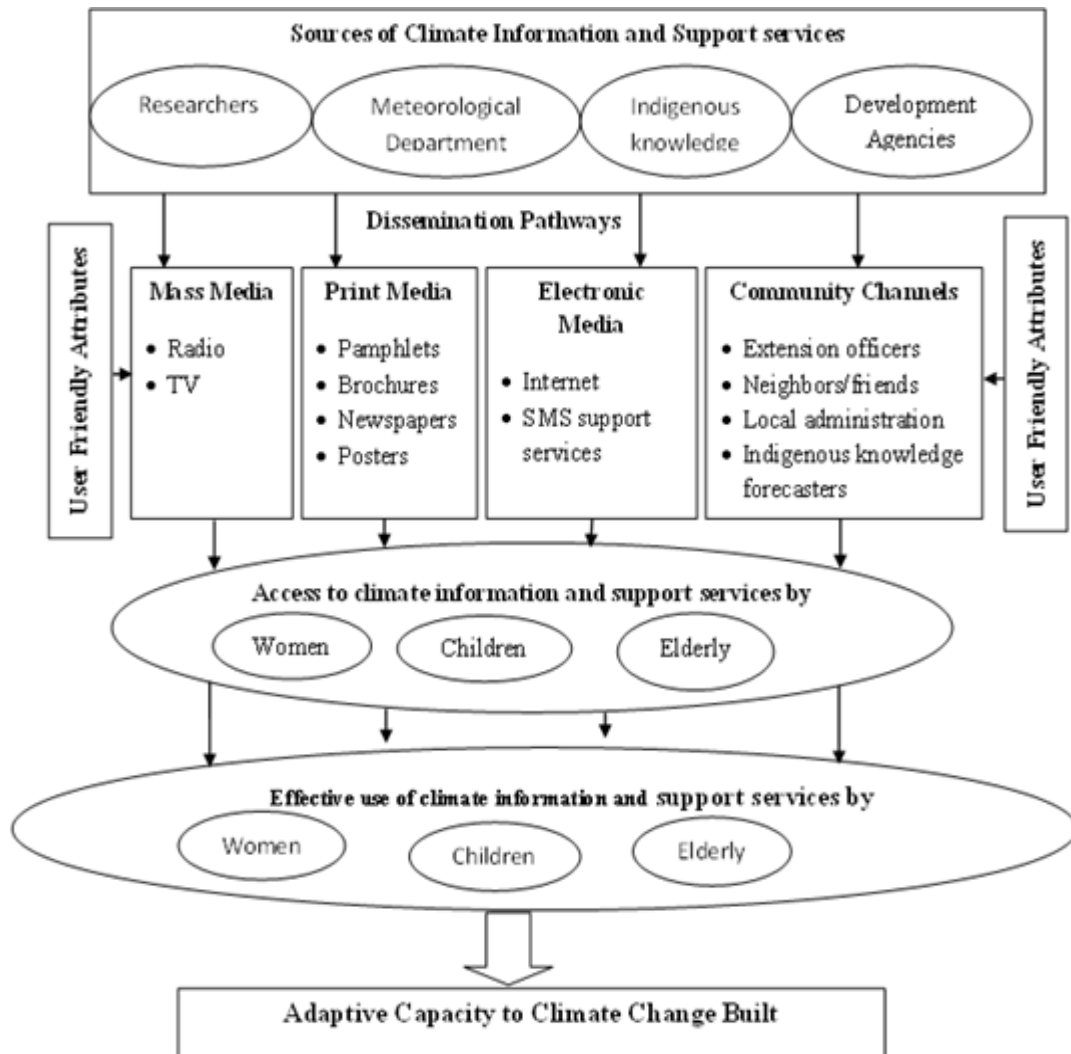

Figure 1.   Conceptual framework on dissemination pathways of climate information and services to vulnerable people.

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 and the elderly.

Sample size and sampling procedure. The characteristic of interest in this study was used mass media, print media, electronic media, and community channels for dissemination of climate information and services to vulnerable people in semi arid Kenya. Literature search did not yield previous study on these characteristics on the vulnerable people, which would have informed sample size determination. Therefore, sample size required was determined with the assumption that 50% of the study population poses the desired characteristics for the research questions (Yamane, 1973) and was computed from:

$$n= z^2pqN/ (z^2pq+Ne^2)$$

Where z is the standard deviate; p is the proportion of the population having the desired characteristics; q is 1-p; N is the total population of the vulnerable people and e is the desired degree of accuracy. The N was estimated by projecting the 1999 population census (GoK, 2001; CBS,

2000) to the year 2009 at 3% annual growth rate for the needed age groups and gender classes (Table 1). From the 2009 population estimate, a proportion of the population being women, children and the elderly was computed, which yielded 19,443. In the absence of a previous study, p was set to 50% and z = 1.96 for 95% confidence level for obtaining a degree of accuracy of 0.05 when N is 19,443. The sample size needed was computed as 377 individuals, which was proportionately distributed to women, elderly and the children. The administered questionnaire yielded a response rate of 79.6% (n=300).

The local administration chiefs and agencies involved in food assistance program within the area facilitated identification of the individual vulnerable women and the elderly people within their administrative areas. They provided a list of the names and villages from which the researcher randomly selected names within the villages. The local administration chiefs facilitated the researcher in identifying the homesteads of those selected where a structured questionnaire was administered.

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 elderly were both males and females aged at least 65 years old considered vulnerable because of they receive food aid, are of old age yet exposed to climatic hazards. Children were boys and girls of school going age, but data on children are not reported in this paper.

TABLE 1. Population estimates and projection for the study area locations and the sample size determined for each location by age and gender

Location	Total population		Sample size			Total
	Population 1999	2009 Estimates	Children	Women	Elderly	
Eldume	3467	4660	39	45	6	90
Ngambo	4047	5639	48	55	7	110
Salabani	3718	4997	42	49	6	97
Loboi	1309	1759	15	17	2	34
Sandai	1777	2388	20	23	3	46
Sample size needed			164	189	24	377
Sample obtained			122	154	24	300

Research design and data collection. Data required was obtained in a cross-sectional survey in which simple random sampling technique was applied to obtain a sample of representative vulnerable women and the elderly. The questionnaire administered to these vulnerable people was designed to capture data on their experiences in the past five years about the impacts of climate change, dissemination channels through which they receive climate change information and support 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 support services accessed, preferences and user-friendly attributes and their experience of the climate change in the past five years as: 1= no change; 2= mild change; 3=moderate change; 4= severe change; 5= very severe change.

Data analysis. For each dissemination channel, Principal Component Analysis (PCA) was performed on type of climate information and support 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 people 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 vulnerable people. The age, education, livelihood source and income levels of the sample vulnerable people are summarised in Table 2. About two thirds of (66.7%) of the elderly people lived on less than one dollar a day (1 US $ = KES 80) while about a similar proportion of women (63.3 %) lived on less than two dollars a day, indicating high poverty incidences. The majority of women (87.7%) and the elderly (91.7%) had not attained formal education past the primary level, 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.

Perception about climate change. Figure 2 illustrates perception of the vulnerable people about impacts of climate change as having been 'severe' to 'very severe' in the last five years. Over 70% of both women and the elderly 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.

Patterns of climate information and support services that vulnerable people access. Principal component analysis (PCA) was used to characterise climate information and support services that the vulnerable people 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 greater than negative or positive 0.30. The positive coefficients indicate positive

TABLE 2. Social characteristics of the climate change vulnerable groups in semi-arid Kenya

| Social characteristics	Women (n=154)	Elderly (n=24)	Statistics
Age (years)	37.7 ± 9.3	69.5 ± 5.7	t value 828.75***
Education			χ^2 value=1.26***
Without formal education (%)	42.9	79.2	
With primary level (%)	44.8	12.5	
With secondary level (%)	7.8	4.2	
With post-secondary level (%)	4.5	4.2	
Livelihood source			χ^2 value = 3.98***
None (%)	0.6	-	
Farming (%)	98.7	62.5	
Remittances (%)	-	37.5	
Casual labor (%)	0.6	-	
Income Level			χ^2 value = 3.26***
< $ 1/ day (%)	26.6	66.7	
< 2 $ / day (%)	63	29.2	
< 2-5 / day (%)	10.4	4.2	

*** Significant at P= 0.000
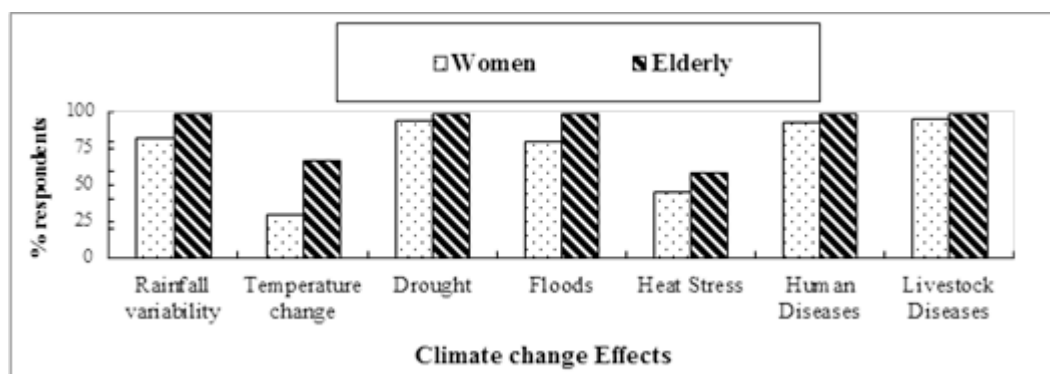
Figure 2. Perception of the vulnerable people about impacts of climate change as having been 'severe' to 'very severe' in the last five years.

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 support services accessed through radio. Table 3 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

TABLE 3. 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

about diseases and rainfall variability and is thus labelled climate hazards information specific.

Climate information and support services accessed through extension support services. The PCA results of the model fitted for extension agents presented in Table 4 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 support services accessed on drought, floods, diseases, early warning signals, veterinary and medical support services, food aid and relocation of vulnerable people to safer places. The loadings indicate that through extension service, vulnerable people access comprehensive information on climatic hazards and support services. This can be labelled climate hazards with support adaptation responses. The results suggest that extension agents are very effective in reaching the vulnerable people with climate information and support services that are necessary for building adaptation. Extension agents have regular contacts with rural farming community and in this sample, 98.7% women and 62.5% elderly people were engaged in farming activities. Though extension service can be effective in disseminating climate information and support 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.

Climate information and support 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 support services that the vulnerable people access through the local administration extracted seven PCs (Table 5) 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).

The rotated correlation coefficients loading on PC1 explained 14.01% of the variation with largest contribution from information about

TABLE 4. 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

TABLE 5. 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

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 support services accessed through indigenous knowledge informers. PCA results for climate information and support services that vulnerable people access through indigenous knowledge informers are represented in Table 6. 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 recognised "experts", diviners, seers and even rainmakers. The elderly compared to the women were more sceptical about modern information probably because they do not understand them easily.

Preferences of vulnerable people for the dissemination pathways. Results in Table 7 presents respondents' preference for the channels through which vulnerable people access climate information and support 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 women (88.5%) while indigenous knowledge was the preference of the elderly (83%). In the study area, radio broadcast are in vernacular language so the news about climate information and support services are easily understood by the vulnerable people. Extension service and indigenous knowledge were the next preferred channels for access climate information and support services by both women and the elderly.

Hansel *et al.* (2007) argues that radio and ICT-based communication offer immense potential to support the delivery of climate information

TABLE 6. 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

support 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 utilised if key informants at the village level are identified and trained in interpreting weather data.

User-friendly attributes of the dissemination pathways accessed by the vulnerable groups. Table 8 presents means of preference rating by the vulnerable people on a scale of 1 (very poor) to 5 (excellent) for user-friendly attributes of the

channels for delivering climate information and support 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 and the elderly expressed equally preferences for the attributes of the channels through which climate information and support services are disseminated, except for (P<0.05) radio regarding information reliability, detail and language used in which the elderly consistently rated lower than women.

The results of this study suggest each channel focuses on disseminating certain

TABLE 7. Preferred dissemination pathways by the vulnerable groups

Dissemination pathway	Vulnerable group	Sample (n)	Preference rating (%)		Chi square statistics
			Often preferred	Most preferred	
Radio	Women	154	24.0	68.8	$\chi^2 = 72.81$ **
	Elderly	24	41.7	4.2	
Local Administration	Women	154	63.7	24.7	$\chi^2 = 31.58$**
	Elderly	24	58.3	37.5	
Indigenous Knowledge	Women	154	59.1	32.5	$\chi^2 = 1.83$**
	Elderly	24	16.7	83.3	
Extension Agents	Women	154	85.0	5.5	$\chi^2 = 1.77$**
	Elderly	24	58.3	41.7	

** Significant at P = 0.00

TABLE 8. Mean ratings for user-friendly attributes (1=very poor 5= excellent) of the dissemination Channels by the vulnerable people

Channels	Group	Cost	Timeliness	Detailed	Reliability	Language
Radio	Women	3.43 ± 0.68^a	2.74 ± 0.61^a	2.88 ± 0.62^a	2.66 ± 0.63^a	4.03 ± 0.51^a
	Elderly	3.17 ± 038^a	2.50 ± 0.51^a	2.33 ± 0.51^b	2.21 ± 0.51^b	3.17 ± 0.38^b
Extension	Women	3.09 ± 0.97^a	2.73 ± 0.61^a	3.07 ± 0.53^a	2.75 ± 0.56^a	3.33 ± 0.53^a
	Elderly	3.46 ± 0.51^a	2.20 ± 0.68^a	3.00 ± 0.58^a	2.00 ± 0.59^a	3.67 ± 0.48^a
Local administration	Women	3.97 ± 0.47^a	3.81 ± 0.44^a	4.04 ± 0.61^a	3.99 ± 0.67^a	4.62 ± 0.58^a
	Elderly	3.79 ± 0.51^a	3.67 ± 0.48^a	3.83 ± 0.38^a	3.79 ± 0.42^a	4.58 ± 0.50^a
Indigenous knowledge	Women	3.71 ± 0.78^a	3.64 ± 0.51^a	3.96 ± 0.52^a	3.77 ± 0.59^a	4.56 ± 0.58^a
	Elderly	3.75 ± 0.68^a	3.67 ± 0.36^a	4.21 ± 0.51^a	4.25 ± 0.61^a	4.39 ± 0.41^a

^{ab} = means with different letter superscripts in a column differ significantly at α=0.05

aspects of information and support services related to climate change. Comprehensive information and support services would therefore be disseminated through combination of channels. Results suggest that combination of extension agents, radio and local administration would be more effective for disseminating climate information and support services to vulnerable people in marginal areas. Capacity building for extension service is needed in interpretation of weather data to enable extension officers effectively disseminate climate information and support services to vulnerable people of arid and semi-arid environments.

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