Flood Risk Communication within Flood Prone Communities of the Okavango Delta, Botswana

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Abstract

Floods have attracted much research attention and great improvements in forecasting them have been achieved to-date. However, the number of people affected by floods is increasing and is bound to soar as hydro-meteorological projections show that the frequency and magnitudes of floods will increase as a result of climate change. The study analyzed the factors affecting adoption of flood risk information within communities of the Okavango Delta, Botswana. The specific objectives of the study were to: 1) analyse the perception of local communities towards floods, flood risks and messages disseminated during flood risk communication; and 2) determine communities' preferred sources and channels of communicating flood risks. Employing a 3-stage sampling procedure, the study (guided by the risk perception and trust determination models) used a sample of 95 respondents from Nxamasere village. The findings show that the respondents' perception of flood risks and messages is high; that they have a neutral stance on message timing; and do trust the information sources. The results suggested that the community was aware of the floods and their associated risks and trusted the risk communicators, albeit concerns on message timing and exaggerated early warnings that raise false alarms. Recommendations for policy and practice on risk communication are offered.

Keywords: Risk communication; risk perception; adoption of risk information; floods; flood risk communication

Introduction

Natural hazards such as earthquakes, windstorms, floods, tsunamis, drought, volcanic eruptions, are increasing in frequency, magnitude and impacts. These events endanger human, animal, and plant life and their habitats. Increasing negative effects of climate change and expansion of human habitation into risk prone areas have heightened vulnerability to risks associated with natural disasters (Mitchell *et al.* 2006). Of all natural disasters, floods constitute the most common hazard worldwide (de Boer *et al.* 2014), with a high potential of causing the worst impact on humanity and economic development (Kellens *et al.* 2011). Global warming, rise in sea level as well as inadequate measures and structures for flood-control will increase the amount and severity of flood disasters in the future (Jonkman 2005).

While floods have attracted much research attention and the tremendous improvements in forecasting, the number of people affected by floods is increasing (Brilly & Polic 2005; Dale *et al.* 2014). Governments in sub-Saharan Africa (SSA) and elsewhere have established institutions and structures to mitigate the effects of natural disasters such as floods. These disaster preparedness structures came about in response to the different hydro-meteorological threats experienced by the countries (Bussell 2013). Strategies and programs were established at continental and regional level (e.g., The Africa regional strategy for disaster risk reduction and the Southern African Development Community regional platform for disaster risk reduction) for risk management and monitoring and in recognition of the fact

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that some disasters, such as floods, have transboundary effects (African Region Disaster Management Team 2010).

In Botswana, the National Policy on Disaster Management was promulgated in 1996, with consequent establishment of the National Disaster Management Office (NDMO) for the purpose of ensuring disaster preparedness, mitigation, response and rehabilitation. Over the past decade, mechanisms which facilitated decentralization of responsibilities from the NDMO were established. District Disaster Management Committees (DDMCs) were formed, which further trickled down to the micro-level structures such as the Village Development Committees (VDCs). These coordinate risk disaster management and develop community-based risk management plans within their areas of operation. Risk communication and rescue operations are the core mandates of these structures. It was envisaged that establishing these structures would enhance disaster management and improve the adoption of risk information, such as flood risk early warning messages.

Notwithstanding these developments, in 2010 the Okavango River caused destructive flooding in villages close to its banks (Mosate 2010). Some communities living in flood prone areas were evacuated in emergency and were resettled on higher grounds. This occurred in spite of the presence of structures and institutions established to deal with disasters through information dissemination and other risk mitigation strategies. The persistent risk of disaster from floods to communities living along the rivers implies a challenge to the adoption of flood-risk information in northern Botswana. There is the need to identify the impediments constraining flood risk communication among these flood-prone communities, especially as the hydro-meteorological projections show that the frequency and magnitudes of floods will increase with climate change (African Region Disaster Management Team 2010). The purpose of the study is to examine factors influencing adoption of flood risk information by communities living in the flood-prone areas of the Okavango Delta.

Flood risk perception and communication

Flood risk perception studies abound in risk analysis literature. These studies have established that risk perception about floods is shaped by multiple interacting factors such as socio-economic, cultural and demographic characteristics, experience with previous floods, residential proximity to hazard objects or phenomenon (e.g., floods), cognitive and affective factors, knowledge of the risk object or phenomenon, and other situational factors (Bradford *et al.* 2012; Bubeck *et al.* 2012; Kellens *et al.* 2013; Kellens *et al.* 2011; Lawrence *et al.* 2014). While these studies have advanced the risk analysis scholarship as it relates to floods, recent reviews have revealed limited empirical studies on flood risk communication (Bubeck *et al.* 2012; Kellens *et al.* 2013), although risk communication is regarded crucial in flood risk management. Kellens *et al.* (2013) noted that this knowledge gap exists and most risk perception studies make suggestions about risk communication practice as an area warranting dedicated empirical research.

There are limited studies in the field of flood risk communication globally, and even fewer studies in the sub-Saharan Africa (SSA) region. Of the 57 studies from 22 countries reviewed by Kellens *et al.* (2013), only two came from Africa, being South Africa and Nigeria. Another review, by Bubeck *et al.* in 2012, did not capture any studies from Africa. This under-representation of studies in SSA calls for more dedicated research to inform risk communication effectiveness. It is noteworthy that the majority of the studies reviewed were conducted in socio-cultural environments quite different from the SSA context. Literature has indicated that situational, socio-cultural, and ethnic factors tend to influence the risk response decision-making (Brilly & Polic 2005; Fessenden-Raden *et al.* 1987; O'Sullivan *et al.* 2012), thereby making it a necessity to understand risk communication environments

especially where they differ on these characteristics. Risk communication is further complicated by the fact that risk perceptions is constantly changing over time, from community to community and within communities themselves even though they may be facing similar risks and are receiving the same risk information (Fessenden-Raden *et al.* 1987). It therefore becomes necessary to embark on studies that will guide risk communication in different environments and times.

Whilst the few studies on risk communication done elsewhere may not adequately inform good practice in SSA environments, those studies do shed light on factors contributing to required responses to flood risks communication by communities at risk (i.e., getting people to take appropriate actions in view of the threat). These factors are: the channels and dissemination approaches used by communicators, the community's trust and confidence of the communicators, the risk perception by at-risk communities, the nature of interactions and engagements between and among stakeholders involved in communication, the credibility of the message and its source , and how effective the communication models are in guiding the practice of risk communication (de Boer *et al.* 2014; Kellens *et al.* 2011; O'Sullivan *et al.* 2012; Zahari & Ariffin 2013). The studies have identified these factors necessary for effective risk communication because they influence whether the communities at-risk adopt flood risk communication or not.

An exploratory study, aimed at identifying the causes of low adoption of flood risk information among local communities in Ngamiland, was conducted in some villages in 2011 (Thakadu *et al.* 2014). That preliminary, qualitative, study found a number of factors affecting adoption of flood risk information. These included history of residency in the area, myths, and beliefs, perceptions towards floods, knowledge, and socio-cultural and political factors. Issues of trust and credibility towards risk information sources were also identified as factors affecting the effectiveness of risk communication efforts. Although this exploratory study identified these factors, there is inadequate empirical evidence on the extent to which these factors influence the adoption of flood risk information in these areas. This gap highlights the importance of understanding the causes of low up-take of flood risk communication among communities living in flood prone areas.

This study aims at analyzing factors influencing adoption of flood risk information among communities living in the flood-prone areas of the Okavango Delta. The specific objectives of this paper are to: 1) analyse the perception of local communities towards floods, flood risks and the messages disseminated during flood risk communication; and 2) determine communities' preferred sources and channels of communicating flood risks.

Theoretical framework

A number of theoretical models have been suggested for risk communications, such as risk perception, mental noise, mental models, negative dominance, trust determination, and the convergence communication approach (Covello *et al.* 2001; Lundgren & McMakin 2004). The current study was guided by the risk perception and trust determination models. The two theoretical models shed light on the formation of risk perception among individuals at risk and the factors influencing the decision-making processes during risk events and its communication.

The risk perception model focuses on how risk is perceived and presents risk perception as a product of numerous risk factors. The risk factors, about 20 in total (see Covello 2009), determine how risk is perceived by individuals and their emotional response to the risk information. The emotional responses evoked by the various risk factors consequently influence an individual's attitudes and the corresponding behavior. The risk perception model suggests that

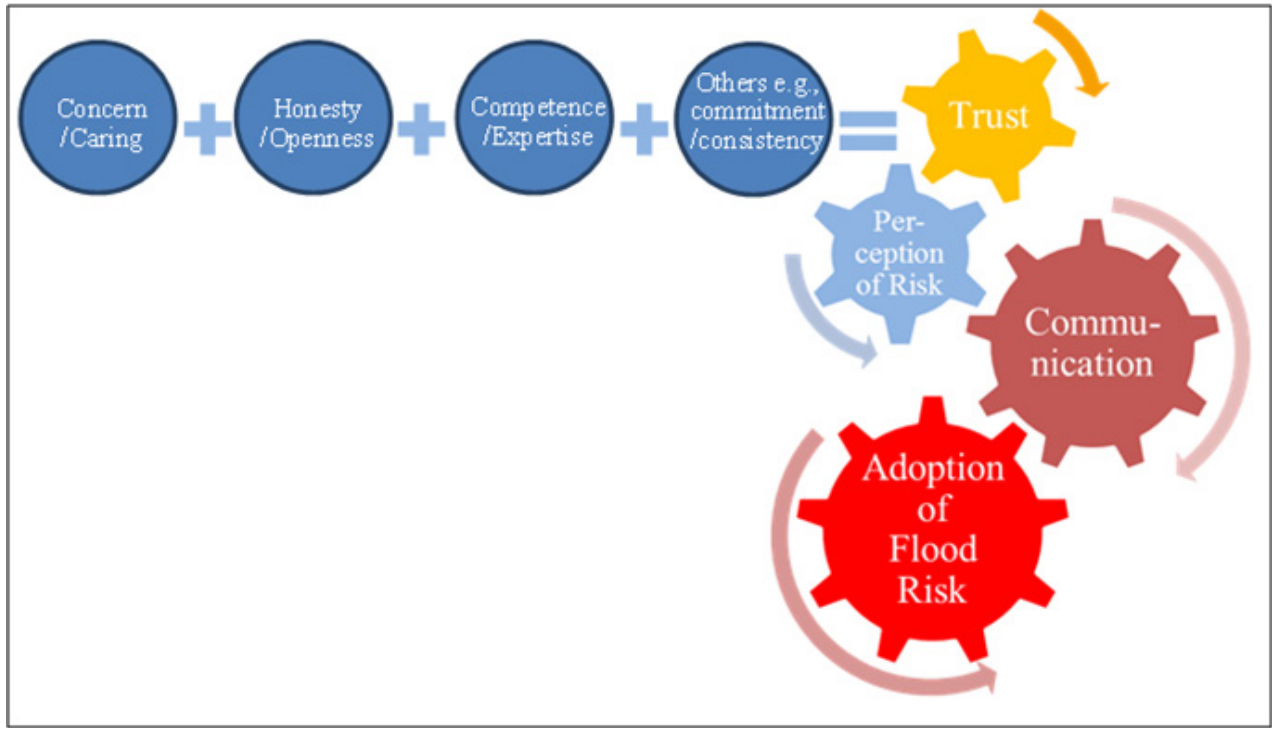
stakeholder perceptions about a risk object or phenomenon will determine the effectiveness of risk communication and management (Covello *et al.* 2001).

The Trust Determination Model (TDM) presents trust as a key determinant of risk perception as well as an essential element in risk communication (Covello 2009; Covello *et al.* 2001). Trust can be earned through a process of nurturing an enabling environment and through endorsements (Covello 2009). However, earning and maintaining trust is not a one-shot event, but a process. The at-risk public tends to assess risk information sources' attributes and their communication behaviour, and these will determine the level of trust they will have towards them. Trust, will be demonstrated through: 1) concern and caring; 2) honesty and openness; 3) competency, knowledge and expertise; and 4) other factors such as accountability, commitment, and consistency [Figure 1] (Covello 2009).

Based on the TDM, the way individuals at-risk perceive the risk information sources in terms of trust may affect communication effectiveness and success. Covello *et al.* (2001) indicate that perceptions of trust towards risk information sources may be tainted by conflicting information from experts during risk communication, inadequate disclosure of required information, untimely release of risk information and approaches used in communicating risks.

The two models are both relevant in risk communications as they present and explain key factors that must be considered during risk communication, being trust and perception of risks and their potential effects on promoting effective risk communication and adoption. The propositions of the two models are schematically shown in Figure 1, presenting how trust and perception of risks affect each other which facilitate effective risk communication and consequent adoption of risk information.

Figure 1: Research model: (Adapted from Covello, 2009; Covello *et al.* 2001; Thakadu *et al.* 2014)



Methodology

Study area

The study was conducted in the Ngamiland District, north-western Botswana (Figure 2). The District

is renowned for the Okavango Delta, the terminal end of the Okavango River. It is regarded as an oasis of water, wildlife, wealth and welfare. The Delta also provide supporting, provisioning, regulating and cultural ecosystem services (eds. Mendelsohn *et al.* 2010). The Okavango River enters Botswana at Mohembo and flows into the Delta through the panhandle (see Figure 2), being a long and wide flat-bottomed valley section of the river basin (Wolski *et al.* 2006). The level of rainfall in the headwaters of Angola determines the inflow into the Okavango River, and the extent of flooding. Most of the inhabitants, living along the margins of the panhandle and the Delta, are dependent on the natural resources of the Okavango River.

Study site

The study site was Nxamasere village in the Okavango sub-District, of Ngamiland District. The village is situated along the panhandle section of the Okavango River (Figure 2), along the expansive floodplains, which have continued to experience severe flooding in the recent times. The study site was purposively chosen for its location along the Okavango River, which is along the floodplains. The multi-ethnic village, with a population of 1584 (Central Statistics Office 2012), experienced frequent floods, causing damage to crops when inundated by water and threatening human and animal life. Livelihood activities are mainly natural resources based, such as agriculture, fishing, hunting, gathering, production and sale of crafts.

Sampling

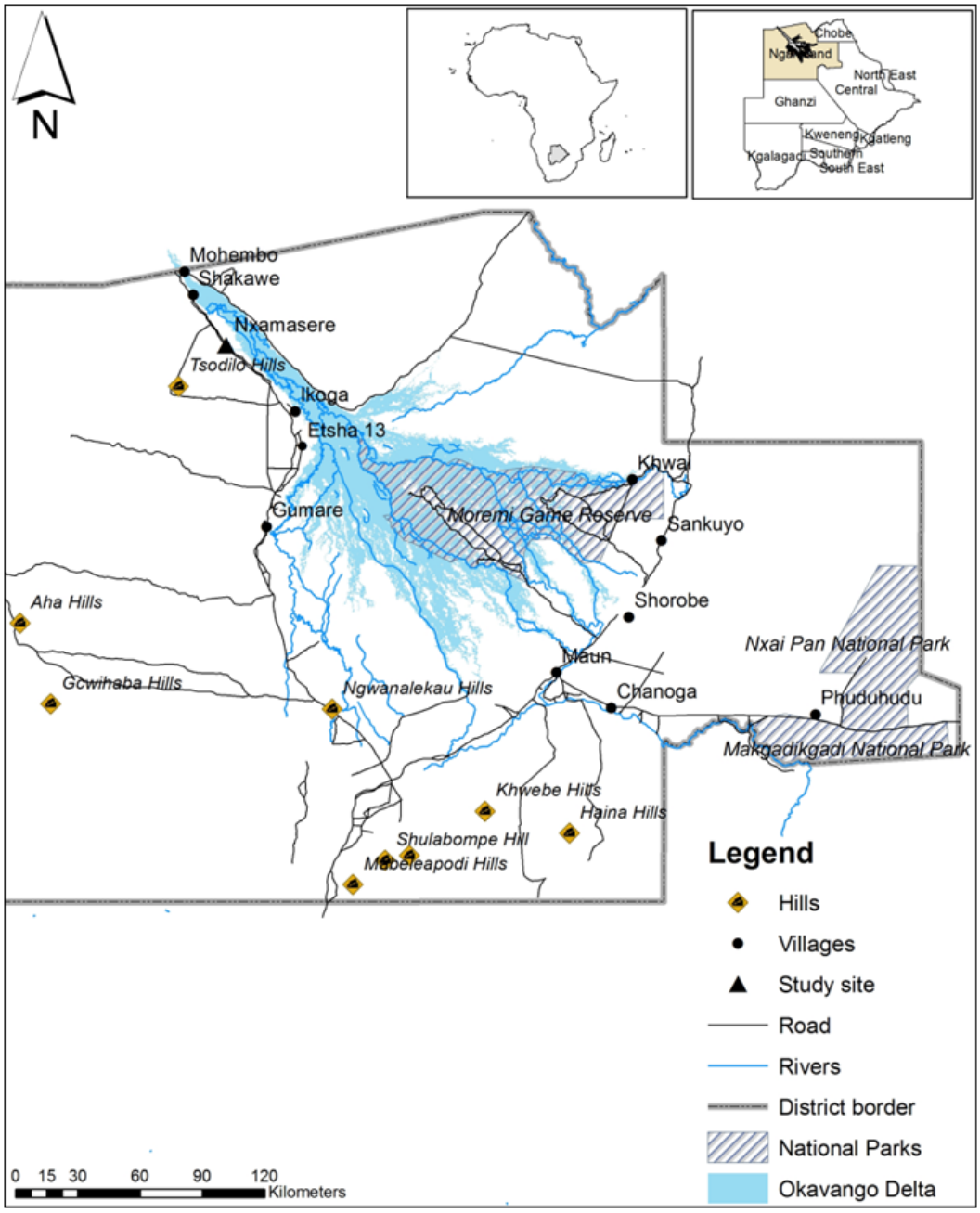
A total of 95 households were sampled for the study and four key informants were identified within the community. Household sampling followed a three staged process. First, the households were delineated into two strata, based on spatial location from the river. One stratum comprised households situated 100 m away from the river, mainly on the floodplain (high risk area), and the second stratum being households established 200 m or more away from the floodplain (low risk area). Stratifying the households based on residential proximity to hazard object or phenomenon was informed by previous studies which had indicated that location influences risk perception: people living in close proximity to hazard areas being less risk averse than those living further from the hazard (Kellens *et al.* 2011).

Secondly, from each stratum, households were randomly sampled from each of the two clusters* of households, five from clusters living within floodplains and four from clusters living away from floodplains. From the selected clusters, household heads or their representatives aged 18 years and above were sampled for interviews, making a total sample of 95 respondents.

The key informants were responsible for disaster management and implementation in the village and were purposively sampled. They included government officials and opinion leaders at the fore-front of flood risk communication in Nxamasere

**A cluster comprised of nested households*

Figure 2: Map of study area (Source: ORI GIS laboratory)



Data collection and procedure

Data were gathered from the households and key informants using semi-structured questionnaires and interview schedules respectively. The data collection instruments captured both quantitative and qualitative data in close and open-ended questions to enhance a robust analysis of issues.

The questionnaire captured data on socio-economic demographics of the respondents, perception of floods, flood risks and risk communicators, communication channels and sources. Perceptions were operationalized as the degree of the respondents' agreement or disagreement with a specified attitudinal statement, measured using a 5-point Likert scale ranging from 'strongly agree' (1) to 'strongly disagree'

(5). The instrument was pre-tested at Nxaraga, a village similar in key characteristics to Nxamasere, to determine comprehension, flow and easiness to complete. The questionnaire was administered by the researchers.

Data analysis

Quantitative and non-parametric data were analyzed using analysis of variance (ANOVA) and chi-squared tests to compare means and test for associations between variables, respectively. Results were presented using descriptive and inferential statistics, with test of significance conducted at $p = .05$. The assumptions of ANOVA and chi-square were tested and found tenable.

Qualitative data from open-ended questions were analyzed thematically. Data was organized into categories that summarized and brought meaning to the text (Ary *et al.* 2009). Thematic analysis was used to identify the major themes which came from the ideas and phrases expressed by respondents. The identification of these major themes helped in understanding the respondents' perspective regarding flood risks. Data was ultimately interpreted by considering the meaning of relationships between information within and between categories, what is important and what was learnt about the respondents (Powell & Renner 2003). Meaning from the various themes was deduced and used to explain observed results from the quantitative results.

Results and Discussions

Socio-economic and demographic characteristics

A total of 95 respondents were interviewed. The majority of the respondents were females (69.5%, n = 66). About 37% (n = 35) of the respondents had no formal education (Table 1) reflecting the illiteracy rate in Ngamiland District, estimated at 36% (eds. Mendelsohn et al. 2010). The three main ethnic groups are the Hambukushu, accounting for more than half of the respondents (57.4%, n = 54), the Bakgalagadi (19.1%, n = 18) and the WaYei (11.7%, n = 11), with the remaining balance made up of ethnic groups whose proportional representation are each less than 5%. The age of the respondents ranged from 18 to 92 years with a mean age of 37.79 (SD = 13.77, n = 95) (see Table 1).

The high proportion of females in the sample can be attributed to a high number of female-headed households (41.1%, n = 39) in the study area (Table 1). Perhaps because interviews were conducted during working hours, most of the males were away working. Regarding education, while more than 40% of respondents had secondary/tertiary level education, only 14% of adults (n = 4) in the age groups 50-59, and 60+ had primary school education. This could be attributed to the fact that there was no school in Nxamasere until the primary school was built in the late 1970s, by then most of these respondents were already grown up.

The high proportion of the Hambukushu and WaYei (69%, n = 65) is explained by the proximity of Nxamasere to the main river channels, making it the traditional type of area of residency for these ethnic groups, commonly referred to as *BaNoka* meaning: *the river people* (Tlou, 1985). More than 58% of the respondents indicated that they had experienced recent floods and the damage caused by them.

The demographic profile of the two spatial location groups differs on gender, educational and age groups. The proportion of males is relatively higher for those living close to the floodplains 35.3% (n = 18) as compared to those who live further away from the floodplain 25% (n = 11). The finding confirms earlier studies which also found that males are more likely to settle in higher risk areas than females, who are generally more risk averse (Ho *et al*. 2008; Kellens *et al.* 2011). Residents close to the river (i.e., high risk area) had a higher proportion of people who had attained secondary/tertiary

level of education (50%, n = 25) compared to those living further away: 29.5% (n = 13). This finding is consistent with previous studies demonstrating that more educated people tend to settle in flood prone areas when compared to the less educated (Ho *et al.* 2008; Nyakundi *et al.* 2010). The studies indicate that educated people generally perceive themselves to have information and knowledge about hazard phenomenon, thereby giving them a higher sense of control over their vulnerability to disaster. They are also able to trust that the structural integrity of their houses will cope with flooding. However, in this study area, those perceptions may not be so much on the structural integrity of the housing, but on the contrary, rather on the non-permanency of their housing structures. In this study most habitable structures are constructed with reeds.

The majority of those living close to the floodplains are below the age of 40 years (55%, n = 28); whilst for those living away from the floodplains, the majority are above 40 years (68.2%, n = 30). It may be that the most of those people living within the floodplains were too young to know (or remember) that these areas are prone to flooding in 'high water 'years. The previous severe floods were in the 1970s. This finding is consistent with Oruonye's (2013) findings which showed that the majority of flood victims in flood prone area in Nigeria indicated that they were not aware that they had settled on floodplains.

Table 1: Socio-demographics of the respondents by spatial location

				Strata (%)			
Variable	Category	N	M (SD)	High risk areas (n = 51)	Low risk areas (n = 44)	% of Total	n
Gender	Male			35.3	25	30.5	29
	Female			64.7	75	69.5	66
Education		94					
	None			34.0	41.0	37.2	35
	Primary			16.0	29.5	22.3	21
	Secondary/Tertiary			50.0	29.5	40.5	38
Ethnicity	Hambukushu			62.0	52.3	57.4	54
	Bakgalagadi			16.0	22.7	19.1	18
	WaYei			10.0	13.6	11.7	11
	Gxanekwe			6.0	2.3	4.3	4
	Herero			4.0	2.3	3.2	3
	Others[a]			2.0	6.8	4.3	4
Age		95	37.79 (13.77)				
	18 – 29			29.4	18.2	24.2	23
	30 – 39			25.5	13.6	20.1	19
	40 – 49			15.7	34.1	24.2	23
	50 – 59			17.6	15.9	16.8	16
	60 +			11.8	18.2	14.7	14
Head of household							
	Male			54.9	63.6	58.9	56
	Female			45.1	36.4	41.1	39

Note. [a]*includes Bugakhwe, Basarwa and Balete*

The main source of livelihood in Nxamasere is subsistence agriculture (69.5%, n = 66), both arable and pastoral. Livestock rearing in Nxamasere depends on access to water from the river, as do other livelihood activities that are associated with the resources of the Okavango ecosystem, such as craft production, basket weaving and fishing. Mbaiwa's study (2002) highlighted this dependency on the river for livelihoods, estimating that 95% of the population in the Okavango Delta directly or indirectly relied on the resources of the Delta This intimate association and dependence on riparian resources can be challenging to rescue operations during times of flood risks. Evacuation and permanent relocation elsewhere is perceived as totally alienating, as it removes one from their livelihood base, historical and cultural traditions, and interferes with social networks (Zahari & Ariffin 2013). This was indeed the perception in this case with the Nxamasere respondents in our study and may have negative implications for risk communication interventions. When livelihood concerns take the center stage the cost-benefit analysis of evacuation often clouds people's decision making processes.

Perceptions towards floods, flood risk and flood risk messages

Perception towards floods and flood risks

The mean value of the respondent's perceptions towards floods and flood risks is 1.82 (SD = .73, n = 94), with low mean values indicating high levels of risk perceptions and vice versa. The low mean value (M = 1.82) shows high perception among the respondents towards floods and flood risks. High perception of flood risks in Nxamasere indicates that people are aware of both the floods and the associated risks. Disaggregated individual responses to negatively phrased scale items had majority of respondents (≥ 54%) 'strongly agreeing' and 'strongly disagreeing' (53%) with positively phrased items such as "floods are good because they bring more food/fish, to us". This demonstrates the respondents' awareness of the risks of floods, which seems to confound what could be regarded as potential benefits. These findings are good for flood risk communication. Studies have shown that when people's perception of risk is high, there is a likelihood that they will respond responsibly to risk warning messages and increases the motivation for adopting flood risk mitigation strategies (Bubeck *et al.* 2012; Floyd *et al.* 2000). Communicating risks to people with higher levels of risk perceptions may therefore enhance communication effectiveness, as the risk perceptions and TDM posits. Key informants indicated that when they disseminated flood risk messages, they ensured that people understood the risk of floods.

Effects of socio-demographic factors on risk perceptions

The influence of selected socio-demographics on perception of flood risks among the respondents was explored using one-way ANOVA. The one-way ANOVA tested for differences in risk perception ratings among different group factors such as education, gender, age groups, ethnic affiliation, and previous experience with floods.

Effect of education: The results revealed a statistically significant difference in risk perception mean scores for the three educational groups (No formal education; Basic education; Higher education), $F(2, 91) = 3.24$, $p = .04$, $\acute{\eta} = .07$, signifying a medium effect (Table 2). Post hoc comparisons using Turkey HSD test indicated that the mean rating score for the group of respondents with basic education (M = 1.73, SD = .67) was significantly different from group of respondents with higher education (M = 1.41, SD = .51). However, respondents with no formal education did not differ significantly from the other two educational level groups. Evaluation of mean rating scores of the two significantly different educational level groups revealed that mean scores for basic education respondents, was higher than that of higher education (see Table 2) , indicating that higher education group had higher risk perception when compared to basic education group.

Findings on the effect of education on risk perceptions have often been contradictory among different studies. Some study findings are similar to the current findings (e.g., Botzen *et al.* 2009; Ho *et al*. 2008) while others produced conflicting results (e.g., Miceli *et al.* 2008; Nyakundi *et al.* 2010). The differences in the findings may be due to the sample characteristics in respect to educational attainment – which differs across the studies. This may also suggest that there are other mediating factors that affect the relationship between education and flood risk perception. For example, in the current study, respondents with higher education were mainly young, while in other studies those within the highest educational category were mostly older. Age may therefore be playing a mediating role between risk perception and education. Others have also suggested that the type and the risk characteristics may also have an effect (e.g., Ho *et al.* 2008; Kellens *et al.* 2011).

Effect of other factors: There were no statistical significant differences in the mean rating scores for gender, age, ethnic affiliation, and previous experience with floods of the respective groupings, indicating that perception towards flood risks was not influenced by either of these factors (Table 2). This contrasts with some previous studies which found that level of risk perception was affected by some of these demographic and experiential characteristics. For example, several studies found that risk perception was significantly affected by gender, age and experience with previous floods (Botzen *et al.* 2009; Brilly & Polic 2005; Ho *et al.* 2008; Kellens *et al.* 2011; Miceli *et al*. 2008), with females and older people being more risk averse than males and younger people respectively. The lack of significance among the different demographics shows that risk communication in this community may not need audience segmentation, as they have the same levels of risk perceptions. Use of group channels targeting all community members may still be appropriate within these communities.

Table 2: Results of ANOVA: risk perception by demographic characteristics.

Factor	M	SD	N	df[a]	df[b]	F	*P*
Gender	1.82[c]	0.73	94	93	1	0.07	0.80
Age			94	90	4	0.85	0.50
Education	1.82[c]	0.73	93	91	2	3.24	0.04*
None	1.73	0.67	35				
Primary	1.98	0.78	48				
Secondary/tertiary	1.41	0.51	11				
Spatial location	1.82[c]	0.72	94	93	1	2.55	0.11
Ethnicity	1.82[c]	0.73	93	88	5	1.37	0.24
Affected by floods	1.82[c]	0.73	94	93	1	0.29	0.60

Note. [a]within groups; [b]between groups; [c]Total mean value for the categories

*$p < .05$

The current study's finding indicates a high flood risk perception in Nxamasere across all demographics, and is not surprising. The majority of the respondents have experienced recent and frequent flood events, though the 2010-2011 floods were biggest in extent in 40 years. More than 58% of the sample has experienced recent floods and their resultant damages. Previous studies have buttressed the influence of experience of floods on the perception of flood risk (Bubeck *et al.* 2012; Ho *et al.* 2008; Lawrence *et al.* 2014; Siegrist & Gutscher 2006). People who have experienced floods tend to perceive them as a real threat when they are warned of the same again.

The statistically insignificant differences in the means for risk perception between those who have experienced floods (M = 1.78, SD = .71, n = 55) and those who have not been affected (M = 1.86,

SD = .76, n = 40) may be explained on the basis that those affected shared their experiences with others, thereby raising the awareness even among those who were not affected. Synthesis of open-ended questions revealed that social networks played a big role in disseminating risk information. Lindell and Perry (2004) made similar observations that neighbors or friends affected by floods tend to discuss with others who were not directly affected, thereby raising levels of risk awareness and perception among them. This demonstrates the power of social networks and interpersonal channels, which according to Rogers (2003) are important in the adoption of innovations within a social system. Furthermore, flood risk communications have been more common in Nxamasere due to the annual recurrence of floods and this may have further contributed to the high risk perception in the area.

No significant difference was found between the perceptions of those living in low risk areas and those in high risk areas. Findings from earlier studies are inconsistent and contradictory on this matter. Consistent with the current finding, for example, Lindell and Hwang (2008), found that spatial location had no effect on perceptions of risk of floods, while Brilly and Polic's (2005) findings were contrary; they found that communities living in flood prone areas had higher perception of flood risks than those living afar off.

Perceptions towards flood risk messages

Perception towards flood risk messages was categorized and analyzed in terms of perceptions about the timing, the message and the messenger. The results are shown in Table 3.

Table 3: Perceptions towards flood risk messages: message, message timing and messenger

	Message timing (%)					Message perception (%)	Trust (%)
	Spatial location		Affected by floods		Total (%)		
	Close	Far	Yes	No			
Strongly agree	3.9	34.1	14.5	22.5	17.9	30.5	39.8
Agree	23.5	27.3	16.4	37.5	25.3	41.1	43.0
Neutral	13.7	9.1	10.9	12.5	11.6	20	9.7
Disagree	19.6	13.6	16.4	17.5	16.8	6.3	3.2
Strongly disagree	39.2	15.9	41.8	10.0	28.4	2.1	4.3
n	51	44	55	40	95	95	93
M					3.13	2.04	1.89
SD					1.51	0.92	1.01
χ^2	17.60		13.23				
df	4.0		4.0				
p	0.001*		0.010*				
Cramer's V	0.43		0.37				

*p < .05

Message timing

The summated mean for the respondents' perceptions towards the timing of flood risk information was 3.13 (SD = 1.51, n = 95), suggesting a neutral position. However, the relatively high standard deviation (1.51) indicates that there was a great variation in the responses on the timing of the message

with 11.6% (n = 11) actually having no clear stance on the timing of the message (Table 3). The results should be interpreted with caution because the perception of what is 'early enough to prepare for the eminent flood' is a subjective value judgment that may vary from individual to individual. Hence, it is not surprising that there is a significant association between spatial location to the river and perception of the timing, $\chi 2$ (4, n = 95) = 17.60, p = .001, Cramer's V = .43), and being affected by the floods and the timing of the message, $\chi 2$ (4, n = 95) = 13.23, p = .01, Cramer's V = .37). Among the 43% (n = 41) who "strongly agreed" or "agreed" that the message came early enough to prepare for the flood, 66% (n = 27) lived in low risk areas, while 70% (n = 30) of the 45% (n = 43) felt that the message did not come early enough, lived in high risk areas.

The finding that respondents from households' living close to the river perceived that the timing of the message was belated is not surprising. The Okavango River and Delta is a flood pulsed system, the arrival of the flood is gradual as opposed to flash floods. While people are warned of impending floods, they tend to wait until the flood waters have 'quietly' flooded their residential areas, cutting them off from dry areas. The key informants indicated that these pulsed floods are deceptive in that *"everything else looks normal, until when properties are surrounded by water from all directions"*. It is during crisis that residents, mainly those residing in floodplains, will find it expedient to heed or recall risk warning messages which hitherto they had not taken seriously. They may later claim that the messages were not timely, even when they ignored earlier warnings.

When flood waters had engulfed residential properties, it became a crisis since in most instances response time was inadequate to salvage the property. Transport is often not readily available for an immediate rescue operation. If government does not provide motor vehicles, people rely on traditional means of transportation such as donkey carts. Since the floods reach low risk areas later than the high risk areas, residents on higher ground have more time to prepare for potential evacuation before the arrival of the floods and thereby perceive that the message warnings were sufficiently early. For those who had been affected by floods, 60% (n = 33) complained that the risk information reached them too late. There are several explanations for this discontent about timing. First, as one key informant said, *"the message could actually come late as happened in the severe floods of 2010, when many households were taken by surprise"*. Another reason might be adduced to blame-shifting. Lave and Lave (1991) indicated that people who have experienced flood damage seek to blame someone for the loss experienced. Discrediting the message as 'late' allows the flood victims to shift the blame away from themselves to someone or something else. However, it should be noted that concerns about the timing of the release and the distribution of risk information if not done judiciously, may affect trust towards the risk information sources. Trust is considered a critical factor in risk communication, as the TDM demonstrates.

Perception of message

The mean of the 'message perception' by the respondents was 2.04 (SD = .92, n = 95, see Table 3) which indicates that people in Nxamasere have a fairly positive perception of the message they receive from the risk communicators. An overwhelming majority (71.6%) perceive the message as helpful, correct, clear and easy to understand while less than 10% indicated otherwise (Table 3). This result suggests that, in the context of Nxamasere, risk communicators managed to package the information in a way that overcame the barriers of low literacy levels and multiple languages. The traditional *kgotla* meetings, which provide opportunities for two-way interactive communication, aid communication by bridging the gap between scientific jargon and common language. This has been identified by scholars as key to efficient risk communication (Fessenden-Raden *et al.* 1987; Ibrekk *et al.* 2005). Indeed, the

positive regard of the messages as comprehensible may be due to the use of locally based structures headed by local people (e.g., the *kgotla*).

The risk communicators living in Nxamasere understand their audience and they present flood risk information using common language. The concept of homophily, as noted by Rogers (2003), may also be playing a role in this context. He pointed out that effective diffusion of innovations will be promoted when sources and recipients are homophilous because they share common meanings and are similar in certain key socio-demographic attributes. Use of opinion leaders (such as village headmen (*dikgosi*) and VDC chairpersons) may be contributing positively to message perception and is a practice that should be commended as it facilitates meaningful and effective communication. The opinion leadership represents interpersonal channels and is known to be effective in risk communication even when compared to mass media channels. A study by Austin, Liu and Jin (2012) highlighted the importance of opinion leaders, in that they facilitate effective information dissemination during crisis situations.

While the majority of respondents stated that the flood risk information from the Government is usually correct, the key informants raised other concerns regarding the messages disseminated during flooding seasons. They indicated that the messages often reach them at the same time the floods arrived or even after the floods. In this case, people are already aware or "could see rising water levels" and the negative impacts of floods. Thus, the risk communicators were saying nothing new but simply validating what the villagers have either already observed or experienced for themselves. This also justifies some of the respondents' position that message comes late. Though there seems to be different perceptions on message timeliness, a take home message for stakeholders involved in risk mitigation effort at all levels, mainly forecasting agencies, is that the projections and early warnings information should be relayed to those on the ground on time, that is, before the event is an emergency. Availing early warning information may help facilitate the local structures to disseminate risk messages on time as well.

Trust towards the messenger

The mean level of the trust variable, 1.89 (SD = 1.01, n = 93), shows a high degree of trust towards the risk information sources by the respondents. A mere 7.5% (n = 7) of the respondents indicated that they do not trust the risk information sources. The high degree of trust is a result of the strong agreement with the relevance, comprehensibility and the correctness of the risk messages. This finding is not surprising as analysis of the respondents' perceptions of the risk information indicated a high positive outlook of the message. This is consistent with a previous study which found that when people trust the source as credible, they pay attention to their message, and tend to comply easily with the risk message recommendations Wray *et al.* (2006). Relying on such broad-base trust levels, the communicators are in a favorable position to effectively communicate flood risk. The TDM and studies have suggested trust and credibility between the source and recipient as crucial towards the effectiveness of the communication process (Bradford *et al.* 2012; Covello *et al.* 2001).

However, there are risks of eroding this trust in Nxamasere, and may compromise future risk communication attempts. The respondents indicated that they were informed that the 2012 floods will be of greater magnitude than any other floods they have experienced since the recurrence of floods in 2004. As it turned out, the flooding level was much lower than the 2010 floods and the flood came a little earlier than usual, but was not as heavy as predicted. These exaggerated warnings (or false alarms) may tarnish the trust and credibility of risk communicators, which negates the flood risk communication attempts because people may not respond to the alarm message. Stein and Geller (2012) have

cautioned against the risks of over-predictions and/or under-predictions as they may make the public downplay the significance of risk messages. People may ignore the warnings, thereby working against the risk communication initiative. However, over or under-predicting risk events may not be intentional, often they come from forecast models which, by design, carry some degree of uncertainties (Stein & Geller 2012; Travis & Riebsame 1979). The challenge now is whether or not risk communication should inform the risk stakeholders about these uncertainties in an attempt to fully inform the public, avert skepticism and possible embarrassment.

The uncertainties conundrum experienced and observed in the study area is not unusual, and has been a subject of debate elsewhere (e.g., Patt 2009; Ramos *et al.* 2010). It may not be out of place for risk communicators to highlight the uncertainties associated with hydro-meteorological forecasts models. Literature has suggested an honest, transparent and participatory dialogue that will communicate uncertainty to maintain user trust, credibility and appreciation of the strengths and limitations of the forecasting systems used (e.g., Kootval 2008; Patt 2009; Ramos *et al.* 2010). However, communicating uncertainties may require additional education and training in order to equip risk communicators with the requisite skills which would enable them to communicate effectively at the village level. Existing studies have already articulated and demonstrated the importance and potential of capacitating risk communicators (Patt 2009; Ramos *et al.* 2010).

Channels and sources of risk communication

The respondents were asked to indicate the communication resources they owned, and any other sources and channels they used to receive flood risk information. The overwhelming majority of the respondents owned cell phones (84.2%, n = 80), followed by the radio (54.7%, n = 52) with only about 24% (n = 23) having television sets.

Channels and sources

When asked to indicate the information sources and channels used to communicate flood risks in Nxamasere, the majority of the respondents (57.9%, n = 55) indicated the kgotla as the main channel that is always or usually used to communicate flood risk, followed by the radio (44.2%, n = 42). These results agree with the findings of other studies, in which radio was found to be among the important mass media channels and source used for floods related information (e.g., Brilly & Polic 2005). The results further substantiate claims that most of Botswana`s villages and communities regard the kgotla as the primary public meeting place and a forum for information exchange (Moumakwa 2011). The radio is widely used and is a relatively cheap medium to reach a large number of people, especially in rural areas. The study by Austin *et al.* (2012) found that respondents preferred radio as it was deemed credible. This may be the case in Botswana, given that only the state radio is broadcast in these remote areas.

The wide access to cell phones presents opportunites for message distribution use with its applications, such as SMS, in risk communication though it is currently underutilised. Even though around 84% (n = 80) of the respondents owned cell phone, the SMS got the lowest rating among the different options for channels used in receiving flood risk information. Five (5%) percent of respondents indicated having received flood risk information through the cell phone's SMS. The key informants and the report by Mosate (2010) indicated that SMS have been used to alert communities to impending floods. With an illiteracy rate of 37%, the vast majority may be receiving SMS but unable to read or understand them. An option for future practice may be the use of local language, however the communities living in the Okavango sub-District have many different languages, even within the same settlement, and often their mother-tongue is not the mainstream Setswana language. Future studies

should consider including mother-tongue language as part of demographics so that a database of languages could be mapped to inform and guide future risk communication. The widespread ownership of cell phones offers potential for the future use of social media platforms. Considering the low illiteracy rates, WhatsApp application could be applicable as it has voice/video recording capacity which can be played by the recipients.

Preferred channels of communication

The respondents were asked to rank the channels they preferred for the communication of flood risk information. The radio was the most preferred channel of communication as it has the highest mean of 3.23, closely followed by the kgotla with a mean of 3.15. Preference for the radio could be explained by respondents viewing the radio as an essential mechanism used to communicate important messages such as flood risks with an added benefit of broad-base reach within a short time. It is interesting to note that the kgotla was ranked second in preference as a medium in this study. This is in contrast to a previous study which found that people preferred kgotla forum over other channels Mutshewa (1999) although there were doubts over its effectiveness on the basis of low attendance. However, continued use of the *kgotla* is commendable as it legitimizes the sources before the communities. The use of kgotla as a platform for disseminating risk information is appropriate as it fits culturally.

Television (TV) was the third most preferred (M = 1.26) channel of communicating risk. The position of TV in terms of preference is not surprising in this study because only a few people (24%, n = 23) owned TV sets. Studies from elsewhere had indicated the utility of TV in risk communications. For example, Sabbagh (1982) indicated that TV has a great impact on raising awareness due to its ability to influence values, attitudes and perceptions. Despite of TV's potential, TV ownership is low in the study area; its use in areas like Nxamasere may be as a supplementary medium. Communication effectiveness is often enhanced through the use of multiple channels and media-mix.

While SMS was the least preferred channel of flood risk communication in the study area (M = .72), it probably will become an important channel in the future because most people will continue to own cell phones. Studies should be conducted to further develop the potential of using cell phones' social media platforms in flood risk communication. It presents itself as an accessible medium and more personalized form of communication.

Conclusions

The purpose of the current study was to analyze factors that affect adoption of flood risk information among communities living in the flood prone areas of the Okavango Delta. Specifically, the study examined the perception of communities towards floods, flood risks and the way warning messages were disseminated. This study determined local communities' preferred sources and channels of communicating flood risks. The results show that in general, the respondents' perception of flood risks is very high. This suggests that the people in Nxamasere are aware of both the floods and their associated risks. While age, gender, experience with previous floods, and ethnicity did not have an effect on risk perception, education influenced flood risk perception. The study found significant differences between individuals with basic education and higher education, people with lower education being more risk averse than those with higher education. While findings on the effect of education on risk perception differ across studies, further studies focusing specifically on assessing the effect of education on risk perceptions are recommended. The studies should examine similar risks using standardized educational categories.

Perceptions of flood risks messages, examined on the basis of timing, the message, and source

of the message, revealed a neutral stance on the question of timing, a fairly positive and high regard to the messages disseminated and a high degree of trust towards the information sources. The qualitative result suggests that people were generally not satisfied on the timing, with responses revealing that the messages came late and, at times, as crisis communication although simultaneously perceived as comprehensible, relevant and helpful. The perceived correctness and relevance of the messages also demonstrated the level of trust the respondents had towards the risk information sources. Analysis of the results based on socio-demographics revealed no differential effects of gender, education, age, ethnicity, spatial location and previous experience with floods on perception of flood risk messages, contrasting with some previous studies. However, spatial location and flood experience showed a significant association with the perception of the timing of the message. People living in low flood risk areas and those who had never experienced flood damage tend to consider the timing of messages on risk information to be adequate unlike those living in high flood risks area and who had experienced floods.

People preferred radio and the traditional group channel, the *kgotla*, as channels for receiving flood risk information. Though cell phone ownership is high in the study area, it was the least preferred form of communication, notwithstanding its potential for use through social media.

That said, the level of flood risk perception, positive perception of the flood risks information, and the high level of trust present an ideal for effective flood risks communication. The high level risk perceptions may be due to experience with frequent floods within the area, which has necessitated on-going risk communications interventions in the area. However, these risk communication interventions face threats of being undermined by exaggerated warnings. It has the potential of eroding the trust and credibility enjoyed by the risk communication sources within the area.

Implications for flood risk communication in the Okavango Delta

The findings of this study have important implications for future practice of flood risk communication in the Okavango Delta as follows:

- The need to provide early warnings about impending floods in advance and continuously is pertinent. Flood risk communication in the area should not be reactive, more so that floods recurrences in these areas have become frequent in the recent times.
- The need to make provision for communicating some uncertainty in hydro-meteorological forecasts during flood risk communication is imperative. Doing so will help promote transparency, manage expectations, facilitate improved decision-making and ensure sustained credibility and trust. Initiatives towards this will require capacity building for risk communicators and forecasts experts to enable them to effectively communicate with stakeholders.

The research of this study raises new questions about the need to explore the impediments to, and potential of tapping into cell-phone applications for social media. Social media presents an additional channel to target young people in disseminating risk/disaster information. Similar studies should be conducted in other flood risk areas, because risk perception is time and area specific.

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