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Understanding Community's Evacuation Intention Development Process in a Flood Prone Micro-hotspot, Mumbai

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Abstract During the 2005 Mumbai flood, it became apparent that the death toll and property damage could have been minimized by planned and organized evacuation. It became evident that it is not the information per se that determines whether people take actions to manage their risks, decision on evacuation reflect how people interpret and collate information to make it meaningful to them. Studies and research in pursuit of this line of knowledge are scanty in the risk management literature. In the context of mega city Mumbai flood risk management, this knowledge is non-existent. The objective of the present study is to investigate the cognitive perceptual process that households experience when faced with the decision to evacuate. The purpose of this study is to analyze integrated flood evacuation behaviour based on field evidence in order to manage the flood evacuation challenge for a Mumbai hot-spot. The present study has developed and empirically examined an integrated cognitive evacuation approach, which includes Protection Motivation Theory (PMT), Theory of Reasoned Action (TRA) and other cognitive theories. Results have shown that the intention to evacuate and avoid unacceptable loss was most pronounced with individuals when the level of critical awareness about 'outcome efficacy' and 'self-efficacy' was high. Apparently, no other factors matters as much. The present study revealed it is not always necessary that individuals' evacuation motive go through all cognitive phases or stages before it turns into genuine intention. This finding, in a way, does not run in line with the conventional cognitive theoretical approaches. Findings of the study further highlighted that emphasis needs to be made on the "how to" aspect of the diagnostic risk mitigation information rather than on the provision of information about possible risks and vulnerability. This study is particularly important in the context of improving public awareness and education programs on evacuation.

Key words Mumbai flood; Evacuation; Cognitive Approach.

1. INTRODUCTION

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On 26th July, 2005, Mumbai, the financial capital of India, experienced one of the worst floods in its history. Within a span of less than 24 hours, it had received 940mm of rainfall, which crippled transportation, telecommunications, and power services and halted the entire commercial, trading, and industrial activities for days (Government of Maharashtra, 2006). It was an urban flash flood. Water levels rose rapidly within three to four hours, submerging the roads, railway tracks and all the low-lying areas. More than 60 % of the city area was directly or partially affected due to the 2005 flood (Gupta, 2007). According to the Fact Finding Committee of Mumbai Flood (Government of Maharashtra, 2006), at least 625 persons were killed as a result of the ensuing flash floods and landslides and another 233 as a result of flood-related illness. According to one report, 100,000 residential and commercial buildings collapsed, and 30,000 vehicles were damaged (Gupta, 2007). The death toll and property damage increased mainly due to building collapses, which can be avoided or minimized by planned and organized evacuation (Tatano and Samaddar, 2010). As majority of the citizens in low lying slums areas did not evacuate in time, many of them lost their vital documents such as ration card, educational certificate, voter identity card, residential proof etc. These vital documents are critical assets in community's flood recovery and rehabilitation process (Samaddar et al., 2011). It is essential to note that the property and human loss would have been much higher if flood continued for another couple of days (Tatano and Samaddar, 2011). While most of Mumbai crept back to normalcy, the city's most poor slum populations residing in the most exposed neighborhoods of the city were still struggling to survive. Ten days following the first days of the flood, suburban and low-lying areas near the Mithi River remained waterlogged without services, appropriate shelter, potable water or food (Stecko and Barbar, 2007). This area, 70% of which is occupied by slum and pavement dwellers, received limited attention from the government both prior to and following this disaster (Samaddar et al., 2011).

The above information uphold the necessity of having realistic, hands on evacuation preparation for the city, particularly in low lying flood prone slum areas. However, city emergency management or disaster management was completely absent. Early warning systems were missing and even when floodwaters already entered into the city, the city authority or the local disaster management authority was incapable of establishing contact with the residents through any channels such as mass media, social organization or social networks to provide support (Bhagat et al., 2006). Inadequate flood evacuation information alongside the lack of proactive evacuation planning multiplied the damage and loss incurred due to the flood. Since no evacuation plan had been prepared or initiated (Samaddar et al., 2012), it is understandably clear that the local government had no idea about the community's evacuation intention, preferred shelters, risk perception, response orientation and other existing stumbling blocks sought to be annihilated to instigate the evacuation strategy.

In the post-2005 flood context, the city government instituted a few initiatives (Shinde, 2009; Pai, 2009). A fully equipped control room is now operational for 24 hours seven days to observe and regulate flood situations in the city and to receive complaints from and disseminate flood related messages to citizens. 30 state-of-the-art weather stations with tipping bucket rain gauges were installed all over the city and in addition a web portal was launched during monsoon for real time rainfall data to the citizens. In each ward, the city Government identified temporary shelters, mostly public buildings for evacuation. Short messages on weather report including date and time of high tide and bad weather, probable places of inundation, etc. have been circulated via mobile telephones during monsoon seasons. All such initiatives might be helpful to the local government and local disaster management authority to obtain and disseminate precise and timely information enhancing the evacuation plan at a certain extent. Nevertheless, the disaster mitigation approach including the evacuation plan of the city authority is by and large a top-down approach which has not paid much heed on the requirements and perception of the community. Like conventional top-down disaster management approaches, the city disaster management authority assumes that providing the public with information about the hazardous event motivates people to be prepared including motivate to evacuate. However, examples in India and across the world have showed that precise and timely dissemination of information are crucial for better preparedness, yet the provision of information alone may be insufficient to motivate people to prepare and evacuate (Paton,

2003; Baker, 1991; Haque, 1997; Tobin and Whiteford, 2002). It is not information per se that determines whether people act to manage their risks, rather, decisions to act reflect how people interpret information to make it meaningful to them (Paul, 2011; Paton 2003; Ge et al., 2011). Disaster risks evacuation studies (Baker, 1991; Haque, 1997; Paul, 2011; Paul and Dutt, 2010; Fischer-III et al., 1995) examined and identified a wide range of potential socio-economic and psychological factors or set of factors including risk perception, risk exposure, past experience, building height, and demographic characteristics behind individual's evacuation intention. Yet more importantly systematic understanding of the evacuation process, which underpins the reasoning and judgment individuals set on their evacuation action, is the key to investigate and predict individuals′evacuation behaviour.

The objective of the present study is to investigate the cognitive perceptual process that households experience when faced with the decision to evacuate in order to develop an integrated flood evacuation behaviour analysis with an evidence based means of managing the flood evacuation challenge for Mumbai slum areas. In pursuit of this line of inquiry, an integrated cognitive evacuation approach which includes Protection Motivation Theory (PMT) (Rogers, 1983), Theory of Reasoned Action (Ajzen, 1991) and other leading cognitive theories have been used and empirically examined.

2. MODEL DESCRIPTION: INTEGRATED URBAN DIAGNOSIS MODEL OF FLOOD EVACUATION

Various social cognitive models describe the relationship between motivating factors and risk preventing variables. Based on a cognitive approach of preventive measures behavior (Abraham et al., 1994; Ajzen, 1991; Rogers, 1983; Rogers and Prentice-Dunn, 1997; Lindell and Whitney, 2000; Martin et al., 2007; Bennet and Murphy, 1997; Paton and Johnston, 2001), the present study considers that the evacuation decision process goes through three phases or stages of development before the action actually takes place. Each phase or stage is influenced by a specific set of variables. We divided and termed those sequential phases as a *Risk Typification* phase followed by a *Response Orientation* stage and *Intention*. In addition, the proposed model assumes the evacuation motivation is directly or indirectly associated with the individual's background which has been divided broadly into two categories – a) S*ocio-Economic*

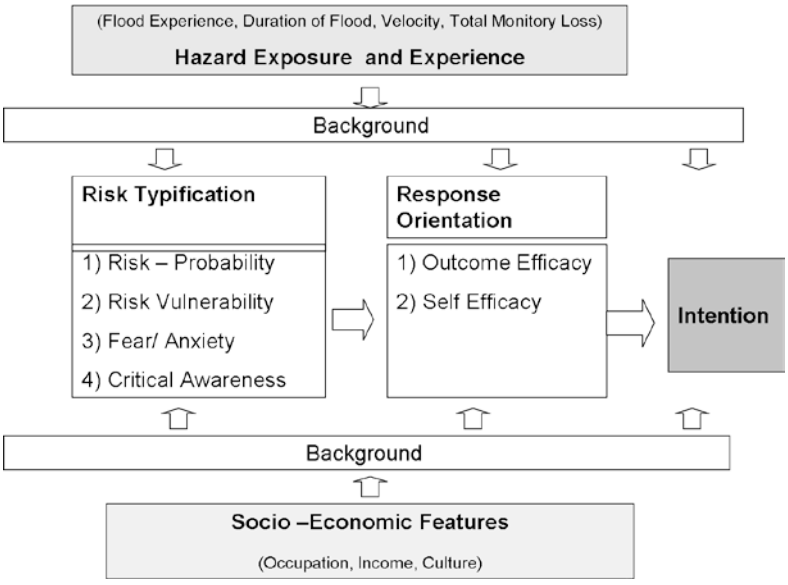

Figure 1: Integrated Urban Diagnosis Model of Flood Evacuation

Background, and 2) *Flood Exposure and Experiences Background* (See Figure 1).

Owning to the other cognitive approaches of disaster preparedness and health risk preventive behavior (Lindell and Perry, 1992; Rogers and Prentice, 1997; Paton 2003; Grothmann and Reusswig, 2006), the present evacuation model considers that the process of *Evacuation Intention* development began with the process of *Risk Typification* which can be describes as a process in which an individual assesses a risk possibility and damage potential to things he or she values, assuming no changes in his or her own behavior. Two risk perception components, *Risk Probability* and *Risk Vulnerability*, as proposed by the Protection Motivation Theory (Rogers and Prentice-Dunn, 1997; Rogers, 1983), have been considered crucial components of the *Risk Typfication* phase in the present model. *Risk Probability* is the person's expectation of being exposed to the threat, such as a flood reaching his or her house. *Risk Vulnerability* is the individual's estimate of how harmful the consequences of the threat would be to things he or she values if the threat were to actually occur (e.g., The judgment that a flood in the area would harm valued things, such as home or property).

Two others components have also been considered in the present model for assessing *Risk Typification* development. These are *Fear* or *Anxiety* and *Critical Awareness* originally introduced and proposed by Paton et al. (2001). *Fear*, the third component, plays an indirect role in threat appraisal by affecting the estimate of the severity of the danger. Neuwirth et al. (2000) found that anxiety related to a risk might slow down the motivation to prepare. He also argued fear or anxiety reduces the likelihood that people will even attend risk massages. Research into how community members respond to adverse circumstances has identified *Critical Awareness* as an important criteria variable (Paton 2001). This variable describes the extent to which people perceive hazard issues as important enough to think about and discuss with others on a regular basis. According to the present study model, the overall *Risk Typification* course can be determined by summing the above mentioned variables. Thus before considering a possible evacuation plan, an individual must first conclude that the hazard specifically affects him or her.

If an individual believes the hazard can adversely affect him or her, the individual will look forward to find out possible options, actions and measures. In this study, it is evacuation to reduce and mitigate the risks. The fear engendered by perceptions of risks cause people to assess possible coping strategies. Schwarzer (1992) said that a minimum level of threat or concern must exist before people start contemplating the benefit of possible actions and reflect on their competence to actually perform them. This process can be called *Response Orientation*. *Response Orientation* is considered as a consequence of two simultaneous judgments – *Outcome Efficacy* and *Self- Efficacy*. Both health risks and natural disaster risks research have identified *Outcome Efficacy* and *Self Efficacy* as predictors of intention formation (Rogers, 1983; Abraham et al. 1998; Bandura and Adams, 1977; Bennet and Murphy,1997; Schwarzer, 1992).

Outcome Efficacy is an individual's assessment about the effectiveness of a disaster preventive measure or action (Rogers, 1983). A positive outcome efficacy motivates an individual to adopt disaster prevention measure (Paton, 2003). It is a belief about the adequacy (will something work) of a preventive measure.

Self Efficacy has been implicated as a precursor of adjustment adoption and resiliency in natural hazard contexts (Paton, 2003; Duval and Mulilis, 1999; Bandura and Adams, 1977; Rogers, 1983). It is an assessment of one's ability to successfully initiate and complete the adaptive behavior. The number and quality of action plans, and the amount of effort and perseverance invested in risk reduction behavior is strongly dependent on self-efficacy (Bandura, 1982; Abraham et al., 1998; Bennett and Murphy, 1997; Grothmann and Reusswig 2006)). The present model considers that the individual's or household's evacuation intention formation is a function of the level of their *Self Efficacy* beliefs.

Like other cognitive theory, the present study is based on the proposition that an individual's behavior is determined by the individual's behavioral *Intention* to perform that behavior, which provides the most accurate prediction of behavior. In other words, protection motivation (here it is evacuation behavior)

itself is not observed directly but rather is an inferred mental state, indexed by behavioral intention (here it is Evacuation intention), which itself is thought to be a reasonable predictor of behavior (Ajzen, 1991; Kim and Hunter, 1993). Evacuation Intention is a function of *Risk Typification* and *Response Orientation* variables. Therefore, it is hypothesized that elevated level of risk perception and high response orientation would multiply together to produce the greatest increase in behavioral intention.

It is also hypothesized that, *Risk Typification, Response Orientation* and *Evacuation Intention*, all phases of evacuation behavior, are directly and indirectly influenced by individuals' background features which are two types – 1) *Socio-Economic Background* including income, occupation, culture, educational level etc., and 2) *Flood Exposure and Experience Background* including past flood experience, velocity of flood, damage and losses etc. Many studies have reported that socio-economic characteristics of the household (e.g., sex, age, education, religion, language, housing characteristics etc.) are correlated with disaster preventive behaviors (Lindell and Whitney, 2000; Mileti and O'Brien, 1992; Dooley et al., 1992; Russell et al., 1995) . Socio-demographic features in relation to evacuation provide useful information to planners and managers to identify and target population sectors that are most predisposed to evacuate (Paul and Dutt, 2004; Haque , 1995, Baker , 1991). Studies in disaster risk management have shown that like socio-economic background, *Hazard Exposure and Experience* plays a major role in household disaster preparedness including evacuation practice (Haque, 1995; Baker, 1991; Paul and Dutt, 2004; Grothmann and Reusswig, 2006). Mileti and Sorensen (1990) claimed that people directly affected by disaster are significantly more responsive to future hazard predictions and warning than those who have never been affected by a disaster.

3. METHODOLOGY

3.1 Case Study Area

The field survey had been conducted in a slum, called Parsi-chawl, located in Dhravi, which is one of the most flood prone areas of Mumbai, and the biggest slum of Asia. Parsi-chawl is one of the oldest settlements in Dharavi area. It began to develop 70 years ago when the area was a low lying marshy land abounded by mangrove forest on the bank of the Mithi River. There is no official record available, but local sources confirmed approximately 200 households including 1000 people live in Parsi-chawl at present. Parshi-Chawl is an amalgamation of several small clusters or settlements, namely Kalekar chawl, Patil Chawl, Parshi Chawl, Ramnath Chawl, Kalyanwari Chawl, Kishankoli Chawl, Pancham Chawl. It is mainly a residential area, though commercial activities are present along the main approach road of the settlement. In a pilot survey conducted by Kyoto University's Global Center of Excellence Program (Tatano and Samaddar, 2010), the authors reported that Parsi-chawl is much better off than other neighboring slums in terms of socio-economic development. Average household income, level of education, health condition, job security, and cleanliness of the community are reported as much better compared to other slums in the Dharavi area. Wider lanes, a better drainage system and better solid waste management, all of which are quite unusual features in Mumbai slums areas, can be observed at Parsi-chawl. The area comes under the G/North Ward municipal jurisdiction.

This low lying settlement, 2 to 3 feet below from the main road, is prone to flooding; in 2005 there was a massive flood. Though there is no government record available on the 2005 flood, the pilot survey conducted by the Kyoto University GCOE Program (Tatano and Samaddar, 2010) reported an average of 5 feet of flood waters inside houses for 2 days. 2 persons were reported killed and 3 severely injured. 40 percent of households have reported health related problems due to flood. Damage to food and household durable assets was enormous (Tatano and Samaddar, 2010).

In the post-flood context, the local municipal ward office, G/North Ward, Municipal Corporation of Greater Mumbai (MCGM), had designated four flood evacuation shelters including public schools and

Government office buildings for the entire G-North Ward. In the Dharavi area particularly, a public high school had been identified for evacuation. A public notice about the evacuation shelter can be seen hanging in front of the gate of the designated shelter. In addition, the local municipal ward office verbally claimed that they had meetings with local leaders of Dharavi, and leaders were informed about the designated evacuation shelter so that the leaders could disseminate the evacuation shelter information to the communities. No other evacuation measures had been observed or recorded in this area.

3.2 Survey Techniques

Face to face structured interviews were conducted to obtain data for the present study. The heads of the households, in view of the fact that they are the decision makers of households, were interviewed. Only those households, who had experienced the 2005 flood were selected for interview. A total of 40 respondents, 37 male and 3 female respondents were randomly selected for the interview; nevertheless, due to explanatory nature of questioners, elderly and illiterate respondents were deliberately excluded. As the heads of the households were target respondents who are usually not available in daytime, the survey was conducted either in the evening on weekdays or daytime on the weekend (Sunday).

3.3 Independent Variables

Risk Typification

The present study considered that *"Risk Typification"* is a combination of four cognitive elements including *Risk Probability*, *Risk Vulnerability* and *Fear* or *Anxiety* and *Critical Awareness*. *Risk probability* was measured by asking the respondents to report their judgment about possibility of flood occurrence: "*Do you think a flood like the one in 2005 can occur again in Mumbai?*" *Risk Vulnerability* was measured by asking the respondents to report their self judgment about their own level of vulnerability: *"Do you think flooding can be risky for you and your family?"* To measure people's *Fear* or *Anxiety*, respondents were asked to rate their level of worry about flood risks in the area: "*How worried are you personally that flood might occur and cause loss of life and property?"* All the above mentioned questions were measured with a five points scale starting from "*definitely*" = 4 to "*never*". = 0.

Critical Awareness was measured using three items. The first question was asked to know people's exposure to mass media which depicts their interest to acquire information from mass media including TV, Newspaper: "*Do you watch or read Mumbai flood related programs on television and newspaper?*" The second question was related to attendance to meetings or workshops related to the Mumbai floods "*Have you attended any workshop or meeting about Mumbai flood related issues?*" *Critical Awareness* was also considered based on individual flood related information acquiring and opinion formation tendency from their social networks including friends, relatives, neighbors etc. For this respondents were asked - *"Do you discuss about Mumbai floods with your friends / neighbors and community people"?* For the above three questions, scores were obtained from a 5 points scale varying from "*Always"= 4* to "*Not at all"* = 0. For the analysis these three questions were summed up to form one *Critical Awareness* scale.

Response Orientation

The present study considered that the *Response Orientation* stage is comprised by *Outcome Efficacy and Self Efficacy*. To measure *Outcome Efficacy* of evacuation, respondents were asked to rate the effectiveness of evacuation – *"Do you think evacuation will help to lessen the impact of flood"?* The score was anchored in a three point scale starting by "*A great deal= 2* to "Not *effective at all* = 0. The measure of *Self-efficacy* was developed based on measuring how confident respondents felt about their ability or skill to evacuate. Respondents were asked – "*How confident do you feel in your ability that you can evacuate if you wish?"* The question was measured on 3 points scale where 2 = "*Definitely*" and 0 =

"*No*", the midpoint of the score was 1 = *possibly*.

Background Data

Based on the present study model, broadly three types of *Background* data have been collected - *Socio-Economic Background* and *Hazard Exposure and Past Flood Experience*. To measure individuals' *Socio-economic Background*, respondents were asked to report their age, occupation, mother tongue, education, building height and religion. *Hazard Exposure and Past Flood Experience Background* was defined based on three variables or components – a) Flood water level inside the house, b) Duration of flood water inside the house, c) Total self-estimated monitory loss. Data on all these three aspects are self-reported and based on the 2005 flood context.

Additional Measures

Additional measures were included to obtain a better understanding of household evacuation behavior. A wide range of evacuation specific questions were asked in order to acquire data on knowledge of evacuation, source of evacuation, reasons for evacuation. At first respondents were informed by the surveyors that - *"It is prescribed or strongly recommended to evacuate to higher-story buildings or designated shelters when early warning is given"*. Given the statement, respondents were asked: *"Do you have any knowledge or information about it (evacuation)?"* Scores were obtained in 3 points scale *"A great deal"- 2 , "A little" -1," Not at all" = 0l*. This question corresponds with the level of knowledge about evacuation planning. And subsequently respondents were asked to report their source of information or knowledge such as TV, newspaper, and past experience.

Respondents were asked to report their evacuation activities in 2005: *"Did you evacuate during 2005 flood?"* and *"If yes, where did you evacuate and who asked you to evacuate?"* Respondents were also asked whether or not they were asked by local Government or any NGO to evacuate. If they did not evacuate, the reason was asked to report why not. All of these answers were collected using on open-ended interviews.

Dependent variables

The dependent variable is the degree of *Evacuation Intention* of household heads. *Evacuation Intention* was assessed by asking respondents to report the likelihood of their evacuation practice at some future date: *"Considering your own circumstances, how probable is it that you will evacuate while flood comes in the locality?"* Responses were allocated to a 3 points scale starting from *"Definitely" – 2, and "Possibly"- 1* to *"No" – 0.* .

4. RESULTS

Our field survey found that the community had no information about the flood that took place on 26th July, 2005 (see Table 1). Therefore, respondents reported that none of them evacuated until floodwaters reached inside the house. During open-ended interviews, most of respondents also reported that when floodwaters reached 2 feet inside the house, most of the respondents presumed that water had come because of the high tide and heavy rains and the floodwaters would go away soon after the high tide as it happened every year during the rainy reason. A section of respondents informed that seeing floodwaters increasing rapidly, they quickly made a decision to evacuate to nearby higher places. However, Table 1 shows only 12.5 percent of respondent could manage to evacuate when floodwater reached inside their buildings or adjacent areas. Among many factors reported for not evacuating, as shown in Table 1, the most reported one was the fear that thieves might steal belongings from their empty house. Since there was no early warnings and evacuation preparation, 15 % of the respondents reported that they could not evacuate because in their knowledge there was no good place to evacuate. 12.5 percent of respondents

reported that though they intended to evacuate, yet it was too late to evacuate as the adjacent roads and area were already submerged. As a result, they did not find any safe route to evacuate to nearby tall buildings. Other factors behind not evacuating, as shown in Table 1, are respondents (17.5%) moved to upper floor of their own houses, which were believed to be much safer place than the outside evacuation shelters; and respondents (15%) blamed absence of early warning for not evacuating.

Table: 1 Evacuation Behavior during 2005 Mumbai Flood, Parshi-Chawl, Dharavi (N= 40)

Received Early Warning or Having Flood Information	
% of people received early warning	00 %
Evacuation Nature	No. of Respondents (%)
Evacuated	05 (12.5%)
Not evacuated, because having no information or no early warning message	06 (15%)
Not evacuated, because no other place to go	06 (15%)
Not evacuated, because adjacent area was already submerged	05 (12.5%)
Not evacuated, because moved to own first floor	07 (17.5%)
Not evacuated , because there was a possibility of theft in house	14 (35%)
Not Evacuated, but did not provided not provide any information against the reason of not evacuation	07 (17.5 %)
Total	40 (100 %)

Table 2 represents the socio-economic profile of the respondents and flood related information of the settlement. In slum area context, the average education level is quite high. The study area is predominantly Marathi speaking (90%) settlement and all of them are Hindus. Majority of the populations are engaged as self-employed. The magnitude and impact of the 2005 flood was quite high. Average flood water level was 4.5 feet and it continued for almost 56 hours i.e., two and half days. The flood losses cost household on average 24000 INR (435 US $). Interestingly, Table 2 shows that all of the risk perception scores were below average (mid-point) level, which implies that people of the area perceive the chance of flood occurrence as quite low and even if it occurs, they feel they have a moderate level of vulnerability. What is more is that individuals are not worried, and their critical awareness was observed at moderate level. Evacuation intention, however, had increased compared to the actual evacuation rate in 2005. 40 percent of respondents reported they would not want evacuate in the future. However, 60 % of the respondents will possibly or definitely evacuate. Respondents' evacuation *Outcome Efficacy* was at a moderate level, but *self-efficacy* was very low. It implies that there is an average understanding of the benefit of the evacuation among the people, but only a few can see evacuation is possible to practice considering their resources and practical situation.

Table – 2: Profile of the Area (Socio-Demographic Background, Hazard Exposure, Risk Typification, Response orientation, Intention) (N= 40)

Socio Demographic Background	
Average (Mean) level of education (Std. Deviation)	10 (3.54)
Average (Mean) Age (Std. Deviation)	42 (11.48)
Average Household Size (Std. Deviation)	5 (1.71)
Language	
% of Marathi speaking people	90%
% of Hindi speaking people	10%
Religion	
% of Muslim	0%
% of Hindu	100%
Occupation	
% of Government Employees	28.2 %
% of Private Sector Employees	20.5%
% of Self-Employed	43.6%
% of Labor (daily wage labor, construction worker)	07.7 %
Building Height	
% of Ground Structure	48.1%
% of Ground plus one storied structure (G+1)	51.9%
Flood Exposure and Experience	
Average (Mean) flood water level inside the house (Std. Deviation)	4.5 feet (1.02)
Average (Mean) duration of flood inside the house (Std. Deviation)	54 hours (15.29)
Average Total Monitory loss (self-estimated) per Household (Std. Deviation)	24, 000 INR/ 435 US $ (18,180)
Risk Typification	
Average (Mean) score of Risk Probability (Std. Deviation)*	1.72 (1.27)
Average (Mean) score of Risk severity (Std. Deviation)*	2.02 (1.58)

Average (Mean) Score Fear (Std. Deviation)*	1.05 (1.33)
Average Score of Critical Awareness (Std. Deviation) **	3.5 (2.42)
Response Orientation	
Outcome Efficacy (Std. Deviation)***	.92 (.73)
Self Efficacy ***	.52 (.75)
Evacuation Intention	
Mean evacuation intention score (Std. Deviation)***	.95 (.87)
% of high evacuation intention	35 %
% of Moderate evacuation intention	25 %
% of No evocation intention	40 %

*Note : * 5 point scale; ** Combined results three scores (see methods – variable selection section) – Maximum score 9 , Minimum score – 0 ; *** 3 point scale.*

In this regard it is important to report that all the respondents had informed they had neither any knowledge about local municipality designated evacuation shelter nor they had received any information from any source. People from their past experience, hearing and observing others, had learnt that evacuation is a useful flood loss protective measure to save lives and property.

Table 3 presents the correlation matrix for the different measured variables. Spearman correlations are given due to asymmetric distribution in most variables. Unexpectedly, it was observed that none of the components, except Total Estimated Loss (self-estimated), of people's socio-economic background and hazard exposure had any correlation with their evacuation intention. Similarly, the people's risk perception or Risk Typification pattern was not correlated with their evacuation Intention. It was observed that only Critical Awareness from the Risk Typification set of variables was moderately correlated with evacuation intention. Therefore, the table indicates individuals who perceived higher flood risk were not different in their intention to evacuate from individuals who perceived low flood risk. In this regard, it is important to note again that overall a low perceived flood risk probability and vulnerability had been recorded in this area (see Table 2). Correlations among variables as represented in Table 3 also show that variables of Risk Typification were not associated with Socio-Economic Background and Hazard Exposure. Therefore, duration and level of floodwaters inside the house and self-estimated total loss did not influence people's risks perception process. Both variables of Response Orientation Category, i.e., Outcome Efficacy and self-efficacy are strongly associated with evacuation Intention. Outwardly people's Response Orientation played the instrumental role in evacuation intention development, rather than their socio-economic background and risk perception. Both the Response Orientation variables are strongly correlated with people's Socio Economic Background, Hazard Exposure and Experience but no association was found with hazard risk perception.

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Table – 3: Correlation of Variables

		Evacuation Intention	Socio-Economic Background					Hazard Exposure			Risk Typification				Response Orientation	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
EVACUATION INTENTION	(1)) Evacuation Intention	-														
Socio-Economic Background	(2) Age	.183	-													
	(3) Household Size	-.142	.308	-												
	(4) Education	-.075	-.465**	-.438*	-											
	(5) Occupation	.225	.077	.257	-.337*	-										
	(6)Building Height	-.313	-.186	-.337	.563**	-.432*	-									
Hazard Exposure	(7)Level of flood water	.257	.410**	.447*	-.405*	.177	-.439*	-								
	(8)Duration of Flood	-.155	-.008	-.248	-.080	.177	.299	-.086	-							
	(9)Total Self-Estimated loss	-.357*	-.008	.030	.077	.157	.274	.225	.227	-						
Risk Typification	(10)Risk probability	.096	.216	.208	-.087	.105	-.201	.021	-.149	-.077	-					
	(11)Risk vulnerability	.180	.168	.201	.007	.173	.045	.092	-.098	.073	.635**	-				
	(12)Fear / Anxiety	.154	-.013	-.013	-.016	.340*	.175	.009	-.099	.212	.269	.442**	-			
	(13)Critical Awareness	.431**	-.105	-.105	.256	-.050	.223	-.014	-.144	.055	-.095	.032	.143	-		
Response Orientation	(14)Outcome Efficacy	.601**	.319*	.319*	-.517**	.225	-.497 **	.395*	-.228	-.386*	.132	.071	.067	.007	-	
	(15)Self-efficacy	.717**	.226	.226	-.382*	.378*	-.556 **	.387*	-.177	-.322*	-.028	.088	.195	.116	.759**	-

**Correlation is significant at the 0.05 level (2 tailed); ** Correlation is significant at the 0.01 level (2 tailed)*

For a better understanding and systematically mapping the evacuation intention formation process, variables directly correlated with evacuation intention have been graphically presented in Figure 2. The multiple correlations (R) of the total monitory loss, critical awareness, outcome efficacy, and self-efficacy with the evacuation intention were 0.79. This means that the four variables together explained 63% of the variance of the evacuation intention. It also appeared that variables which were associated with the evacuation intention were not so much correlated among themselves. Both variables of the *Response Orientation* phase, which are strongly correlated with evacuation intention, are also strongly associated with each other. These two variables are also connected with *Critical Awareness*, otherwise no correlation was observed. It means people had higher *Self-efficacy* only when they found or sensed that the evacuation may lead towards a positive outcome against flood risk (*Outcome Efficacy*). *Critical Awareness* and *Total Monitory loss (Self-estimated)* are however solely responsible for positive flood evacuation intention formation.

Table 4 shows the final regression model to examine unique and combined effects of various variables. The significant logistic regression coefficients (Beta) and the change in R^2 (as an indicator of the

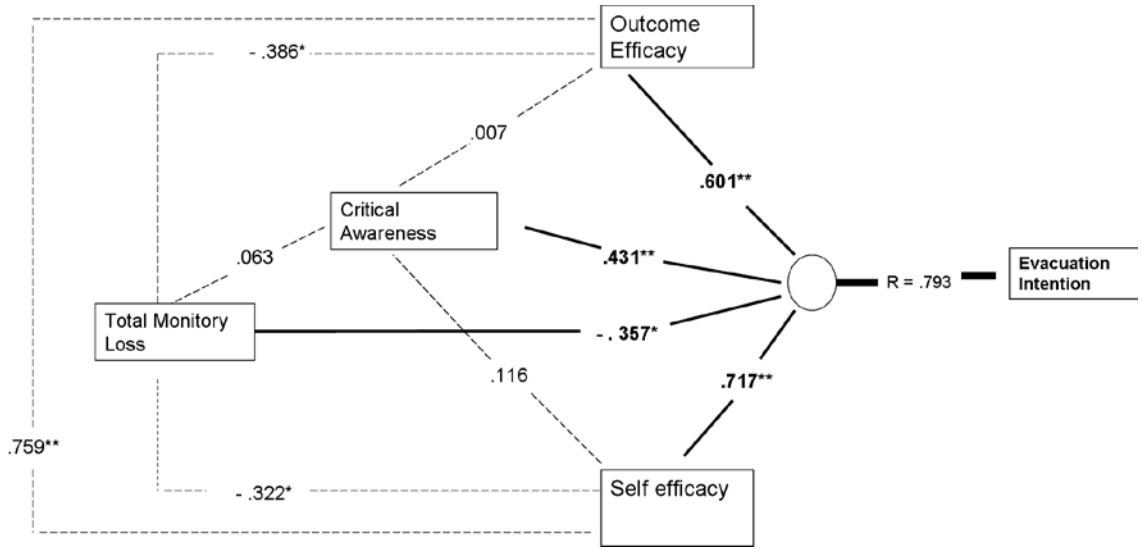

Figure – 2: Correlation of selected variables, i.e., Variables which are only correlated with Evacuation Intention,

**Correlation is significant at the 0.05 level (2 tailed); ** Correlation is significant at the 0.01 level (2 tailed)*

Note: variable which are only correlated with evacuation intention have been taken

additional variance explained with addition of additional variables) provide insights into how important each variable is. The results, as summarized in Table 4, indicate that the highest unique and direct contribution in the prediction of evacuation intention can be observed by Response orientation. *Total Monitory Loss* and *Critical Awareness* components together can only predict 25% of the variance of evacuation intention. It has received a significant leap in predicting the evacuation intention when *Response Orientation* components are included in the model. The Table - 4 shows *Response Orientation* - exclusively contributed 37% of the evacuation intention, and together with other two variables *Critical Awareness* (*Risk Typification*) and *Total Monitory Loss* (*Hazard Exposure*) the model could explain 63 % of the variance of evacuation intention. Table 4 results also show that the significant predictors of

evacuation intention were S*elf-efficacy* and *Critical Awareness*. Thus, evacuation intention will increase if *Self-Efficacy* and *Critical Awareness* will increase.

Table 4 Hierarchical Multiple Regression Analysis (N=40)

	R^2	Change in R^2	F	Sig	Standardized Coefficients Beta * (p values)
Model 1: Hazard exposure	**.132**	**.132**	**5.005**	**.032**	
Total monitory Loss					- .093 (.445)
Model 2: Risk Typfication	**.252**	**.120**	**5.386**	**.010**	
Critical Awareness					.300* (.012)
Model 3 : Response Orientation	**.629**	**.377**	**12.716**	**.005**	
Outcome Efficacy					.268 (.157)
Self efficacy					.434* (.024)

**Correlation is significant at the 0.05 level (2 tailed); ** Correlation is significant at the 0.01 level (2 tailed)*

**** Beta score is of the Model 3.*

Note: variable which are only correlated with evacuation intention have been taken.

5. DISCUSSION

The study results show that in the 2005 flood there was no information or early warning on flood. Therefore, there was no question of evacuation until the floodwaters reached people's houses. As the floodwaters reached adjacent lanes and buildings, broadly three types of evacuation behavior were observed – i) Citizens evacuated to nearby public and private higher storied buildings; ii) Citizens intended to evacuate, but it was too late to evacuate as the adjacent roads and area were already submerged and, therefore, there was no safe route to reach safer place; and iii) Citizens did not evacuate mainly due to two reasons - fear of possible theft at house and paucity of evacuation shelters. The death toll and property damage could have been high if flood continued for a long time. Fortunately, floodwaters continued for only 24 to 36 hours, therefore people could manage to stay without potable water, food, medicine, and sanitary facilities. A longer time flood would have also caused building damage and collapse, as all buildings in the slum areas do not have foundations.

Even after the 2005 flood, plans and strategies initiated by the local Government had appeared ineffective due to lack of community knowledge concerning when, how and where to evacuate; lack of designated evacuation shelters; and no involvement of NGOs in the evacuation process. All such findings indicate weak information dissemination mechanism and insensible evacuation planning by the local Government.

In comparison to the 2005 actual flood evacuation, evacuation intention as reported in the present study survey in 2011 had substantially increased. In the present study, *Critical Awareness*, *Outcome*

Efficacy, and *Self Efficacy* had an additive effect on behavioral intention or evacuation intention. The evacuation intention was most pronounced when the level of critical awareness, outcome efficacy and self-efficacy were at their highest levels – otherwise, apparently, nothing else matters.

The present study revealed it is not always necessary that individuals' evacuation motives go through all cognitive phases or stages before it turns into genuine intention, which contradicted the present hypothesis and conventional cognitive approaches (Rogers, 1983; Paton 2003; Ajzen, 1991). In the present study, except for the *Response Orientation* variables, other cognitive components could not play significant role in the evacuation intention formation process. As mentioned above, three crucial junctures in the evacuation decision process were identified: Total Monitory Loss, Critical Awareness and Response Orientation including Outcome Efficacy and Self Efficacy.

The first triggering factor was *Total Monitory Loss*, which along with positive *Critical Awareness* contributed a significant move towards individuals' evacuation intention formation. A group of individuals depending on their *Total Monitory Loss* attempted to make assessment of prevailing risks and possible mitigation measures. The present study found that flood risk severity, vulnerability and anxiety did not influence the level of evacuation, which contradicts the proposal that high risk perception proceeds towards coping appraisal or response orientation phase (Tanner et al, 1989; Neuwirth et al, 2000, Rogers, 1983). According to the derived results, two explanations can be specified behind this – 1) overall risk perception is low in the area and 2) this *Risk Typification* (perception) pattern had been quite uniformly distributed. A majority or almost a common attitude towards flood risks is that the settlement will not be affected again by flood. Therefore, uniform low risks perception trends did not induce the urge among individuals to become prepared for flood. Evacuation intention of the individuals is also not socio-economic background reliant and flood exposure or experience specific.

Critical Awareness is the only component of the *Risk Typification* phase or process, that is directly and uniquely influences the evacuation intention process. The finding, however, demands explanation. *Critical Awareness*, in the present study, was considered as an act in which people think and discuss with others on a regular basis about hazard issues depending on their risk perception level. The present study measured *Critical Awareness* by considering people's level of flood related information collection from various sources including frequency of chatting and meeting with social network partners, watching TV , attending meetings or workshops to collect flood related information and knowledge. It is simply understandable that in the information acquiring process, individuals do not confine or restrict their information collection activity to only flood vulnerability issues. Rather individuals might be seeking diagnostic information – knowledge of flood. Therefore, people were seeking more "*how to*" information about managing flood risks and they have moved beyond threat appraisal and are formulating a coping response. Deliberate or accidental exposure to coping response related information, therefore, appeared critical for the flood evacuation intention formation. Therefore, people would be motivated to prepare, even in the case of low scoring risk perception situation, only when they would have plenty of "*how to*" information about managing flood risks.

Critical Awareness positively contributed towards the evacuation decision making process, but *Critical Awareness* alone did not lead to an evacuation decision. Rather the preparedness or evacuation had become positively intended only when the potential adopters found the mechanism was effective to mitigate risks and easily applicable. The hierarchical regression analysis results showed evacuation intention would not increase unless an individual's response orientation was highly positive. This indicates that for some people a belief in both the efficacy of preparing (evacuation) and their personal capability to act (i.e. they have sufficient knowledge and resources) predicts evacuation. However, positive *Outcome Efficacy* (i.e. people believe that the benefits of evacuation to reduce flood risks outweigh the costs and perceive the desired outcomes as achievable through personal or household effort) is inevitable for flood evacuation, it has no direct influence on intentions (Beta value is not significant, table 4). Evacuation became meaningful to only those who have perceived it feasible to apply using their own resources (High *Self-Efficacy*). The rest of individuals having positive *Outcome Efficacy* did not

intend to act because they did not believe that they had sufficient knowledge and capacities to do it.

Some supplementary but important findings of the present study are:

- Building height, which is often found as significantly associated with evacuation behavior (Baker 1991, Paul, 2011) has similar established link in the present study. A negative correlation had been observed between building height and *Outcome Efficacy*. Therefore, those who live in higher storied buildings prefer to stay in their house rather than go to a public building or an officially designated evacuation shelter.
- Though the *Risk Typification* (risk perception) pattern does not directly influence evacuation intention, a possible indirect influence can be observed as the study findings showed that people who perceived a high flood probability had higher positive beliefs that evacuation would help them to reduce flood risks (positive O*utcome Efficacy*) and they could practice or implement the evacuation plan (positive *Self-efficacy*).

6. STUDY LIMITATIONS

First, there are strong grounds for questioning whether it is possible to extract an individual's actual thoughts (e.g., his or her real perception of flood risk) from answers to standardized structured questions during an interview (Bunting and Guelke, 1979).

Second, although the study aimed at testing a casual model of flood damage prevention, the non-experimental and cross sectional nature of the research design makes inappropriate to infer causality. For example, it is not clear whether Self-efficacy leads to self protective behavior against flood losses or self-protective behavior leads to self-efficacy. But it is revealing to note that several experiments have indicated that it is the former and not the latter (Flynn et al., 1995; Grothman and Reusswig, 2006)

Third, actual behavior was measured by self reports of behavior, and thus are possibly biased.

Fourth, a vital socio-economic indicator, household income, is not incorporated in this study, which may undermine the study findings. However, this study indented to incorporate household income, however, only a few respondents provided income data. Therefore, the household income parameter has been excluded from this study. A study incorporating household income and economic features could be carried out to obtain a comprehensive understanding of household flood evacuation behavior.

Fifth, the sample was relatively small and locally restricted. Therefore, it is not possible to make a generalization from this study. However, this study is a first systematic empirical investigation of Mumbai flood evacuation behavior and encourages us to conduct similar studies among a larger group of respondents.

7. CONCLUSIONS AND MANAGEMENT AND POLICY IMPLICATIONS

It is evident that human losses and property damage could have been reduced in the 2005 Mumbai flood, if the city, particularly in slum areas, would have organized and implemented a planned evacuation system. Considering the urgent need of systematic integrated evacuation plan for the city, the present study made an attempt to investigate the cognitive perceptual process that households experience when faced with the decision to evacuate. In pursuit of this line of investigation, this study analyzed an integrated flood evacuation behavior model based on field evidence from a flood prone hot-spot in Mumbai, India.

The city of Mumbai is lacking a planned evacuation system. A few initiatives have been taken by the Government to improve the community evacuation plan, but results show weak information dissemination mechanism, poor and ill-equipped evacuation shelters, inadequate early warning system, lack of understudying and importance on community's mind and heart by city Government, all are vivid in the existing disaster management and evacuation plan.

The following findings have emerged which may provide important information and allusion for planners and policymakers.

The study results show that in order to improve evacuation planning, three critical factors have to be taken into consideration: *Critical Awareness, Outcome Efficacy* and *Self-efficacy*. *Critical Awareness*, a process of an individual's information collection practice or parameter was found that it is not only important in community's evacuation decision process, but it also has a direct and unique influence on it. Therefore, to facilitate this outcome, existing information channels including mass media and informal social networks must be enhanced and rigorously exploited. Findings show public notice at signboard or pamphlets are ineffective. Also public education and risk communication strategies on evacuation must accommodate the fact that in order to develop a favorable evacuation intention, individuals opt "how to" type of diagnostic information, rather than risk and vulnerability related information. As the study results show the risk perception (probability, vulnerability and anxiety) variable had no additive effect on evacuation behavior, for that reason emphasizing vulnerability and risks in the risk communication message can make the community members become fatalist instead of proactive.

The analysis presented here suggests that evacuation behavior is a functional outcome of two interactive components, i.e. *Outcome Efficacy* and *Self Efficacy* in the *Response Orientation* phase. Information provision, as mentioned before, diagnostic information in risk communication messages and public education should accommodate *Outcome Efficacy* and *Self-efficacy* beliefs. Any risk perception condition (high or low) may not lead to evacuation unless and until the individual believes that the benefit of the evacuation will exceed the cost of it and his/her exiting skills and resources are sufficient to evacuate. Therefore, risk communication should aim to reduce negative *Outcome Efficacy* beliefs and increase positive *Outcome Efficacy* beliefs. The factors that may contribute towards growing positive *Outcome Efficacy* are improved evacuation shelter (close to settlement and better housing and infrastructure quality), involvement of community representatives in evacuation shelter management, and improved early warning systems. In many cases, individuals have low *Outcome Efficacy* because they perceive it is preferable and reasonable to evacuate to private high-rise building rather than designated shelters or public buildings. Thus, local government could indentify the durable and strong private houses or buildings and encourage individuals to evacuate there instead of to public buildings.

Self-Efficacy which is uniquely and directly contributing to evacuation intention could be increased as the results indicate by assuring safety and security during evacuation, providing special support to women headed households and elderly people, organizing training and doing mock drills, and providing adequate information on evacuation route, time, and place of evacuation.

Therefore, the present study has prescribed two determining strategies and diagnostic knowledge for successful social implementation of evacuation planning in a slum area. The first option is to improve risk communication strategies and techniques. This can be achieved by improving existing formal and informal information channels and accommodating diagnostic information ("how to") including positive *Outcome Efficacy* and *Self-efficacy* oriented messages in public education and risk communication messages. The second concern is to improve and mobilize local existing resources and capacities in order to make a favorable situation towards *Outcome Efficacy* and *Self-efficacy*.

It is important to note that the above mentioned evacuation strategies are applicable to all groups of individuals in the area because the study analysis did not find any social connotation on evacuation behavior and the same is applicable for hazard exposure and experience variance impact on evacuation behavior.

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