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Flood Risk Perception, Risk Communication and Flood Management in the Commonwealth of Dominica: A case study of Coulibistrie

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EXECUTIVE SUMMARY

The Commonwealth of Dominica is considered to be highly vulnerable to hydro-meteorological and geological hazards. Recurrent flood episodes coupled with landslides are among the most frequent hazards to affect the island. There is a concern with the level of social responsibility exhibited by the public towards warnings and mitigation measures for the hazards that they face. It is felt that disaster management must incorporate the contribution of the general public and in particular vulnerable communities. This research was done to explore flood risk perception and risk communication in Dominica with a view to inform flood policies and management. The community of Coulibistrie that was affected by Tropical Storm Erika was used as a case study. The objectives of the research are to firstly, assess the local perception of the risk of flood in Dominica with a focus on the community of Coulibistrie. Secondly, to explore the association between risk perception, risk communication and protective behavior and thirdly, to determine how the findings may help to inform flood management practices and policies.

A literature review was conducted which revealed that variables of concern or fear, likelihood of hazard occurrence, degree of hazard experience and avoidance behaviour are commonly utilized to assess risk perception. Protection Motivation Theory is the theoretical framework to underpin this research. Both quantitative and qualitative methodologies were used in data collection. Analyses of the data focused on descriptive statistics and Pearson Correlation coefficient to determine association between key variables.

Results of the analysis indicated that respondents of the survey showed a high level of risk perception. However, high risk perception does not necessarily transition to protective behaviour or at least to a significant extent. Result of the risk communication showed varying levels of awareness and understanding of flood risk information. From this research, recommendations were made on how to improve flood risk communication. Other outcomes of the research included the need to promote risk transfer and a greater level of public awareness tailored by social groups and settings.

KEY TO ABBREVIATIONS

CBD	Convention on Biological Diversity
CCRIF	Caribbean Catastrophe Risk Insurance Facility
DMS	Dominica Meteorological Service
GFDRR	Global Facility for Disaster Reduction and Recovery
IPCC	Intergovernmental Panel on Climate Change
NRC	National Research Council
PMT	Protection Motivation Theory
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
SIDS	Small Island Developing States
SPSS	Statistical Package for the Social Sciences
WMO	World Meteorological Organization
XCD	Eastern Caribbean Dollar

CHAPTER 1. INTRODUCTION

1.1 Background

The Commonwealth of Dominica is a small island of approximately 751 km^2 in the Eastern Caribbean. The island is located between the French islands of Guadeloupe and Martinique and has a population of approximately 70,000 (Central Statistical Office, 2011). The topography of Dominica is mountainous and steep with very little gentle sloping land (Convention on Biological Diversity (CBD), 2014: 5) and is characterized by many rivers and tributaries traversing down from the elevated interior to the coast. Flash floods and riverine floods where swollen rivers overflow their banks are the main types of flooding that affect Dominica. Common to the island is the scenario where floods are usually accompanied by landslides along the steep slopes which act to intensify the impact through a damming effect. The island experiences a wet season from June to November which is also the North Atlantic Hurricane Season and a dry season from December to May. With an average of over 2600mm (102 inches) of rainfall annually on the coast (Dominica Meteorological Service (DMS), 2016) and even significantly higher amounts in the elevated areas (Benson *et al*., 2001), Dominica enjoys an abundance of rainfall which makes it one of the wettest islands in the Caribbean.

Dominica is considered to be highly vulnerable to hydro-meteorological and geological hazards (CARIBSAVE, 2012: 18; Paul-Rolle, 2014: 39-40), a characteristic shared by many Small Island Developing States (SIDS). The impact of climate change is seen as another pertinent factor that will exacerbate the vulnerability of the country. Mimura *et al*., (2007: 691), in the Intergovernmental Panel on Climate Change (IPCC) report on the impact of Climate Change on SIDS, indicated that “heavy rainfall events are on the increase”. This observation supports the claim made earlier by the United Nations Framework Convention on Climate Change (UNFCCC) that “changes in seasonal rainfall patterns may take the form of more frequent and more intense droughts and floods” (UNFCCC, 2005: 18). In the case of Dominica, flood is a major concern. Recurrent flood episodes coupled with landslides are among the most frequent hazards to affect the island (Benson *et al*.,

2001: 2). Such events, at times, result in loss of lives, social displacement and significantly hamper sustainable development. The most recent event that resulted in severe damages and loss of several lives were caused by intense rainfall produced by Topical Storm Erika in August 2015.

While most of the island is susceptible to flooding and landslides due to the terrain, data indicated that the communities that are more frequently and significantly affected are located on the south and west of Dominica. The community of Coulibistrie, situated on the west coast in the parish of St. Joseph, was selected for this research on flood risk perception because it is one of the areas that was severely impacted by Tropical Storm Erika's flood rains and to a lesser degree, Tropical Storm Ophelia in 2011. Among the reasons for Coulibistrie being vulnerable to flooding is that the community was established at the mouth and generally along the banks of the Coulibistrie River. This means that the community is downstream from Morne Diablotins, the tallest mountain in Dominica standing at 4,747 feet, and is the catchment area feeding the Coulibistrie River. Field observation of dwelling units in the community highlighted a developing trend that could increase the vulnerability of the community to future flood events. It was observed that older homes were constructed on elevated pillars which could have been an indigenous effort to reduce flood impact. The more recent dwellings are, however, constructed on a flat base which will increase their likelihood of being flooded.

1.2 The Research Problem

Floods regularly create significant economic losses and social displacement to devastating levels in both developed and developing economies such as the Hurricane Katrina triggered flooding of New Orleans in 2005 (Taddonio, 2015), the 2011 Thailand flood from the Annual Monsoon (Chosun, 2011) and coastal flooding in Guyana in 2005 which affected 290,000 people and created damages equivalent to 60% of the GDP (GFDRR, 2005). The Commonwealth of Dominica, categorized as a developing country, experienced flood events in the past. However, the flood that resulted from the intense rainfall produced by Tropical Storm Erika, many have said to have never experienced flood on that scale before. The resulting damage

was “equivalent to 90% of Dominica’s GDP or approximately US$483 million” (Government of Dominica, 2015: 7). For a country whose economy is still largely dependent on agriculture production and only recently pushing purposefully toward the service industry such as tourism, the island lacks the economic and productive diversity which could help somewhat in rebounding from natural disasters (Benson *et al*., 2001: 12).

Disaster Risk Reduction is central to the sustainable development of SIDS. It is the recognition of such a need that continues to encourage the maintenance of a “global platform upon which common policies and plans for disaster preparedness, response and recovery can be streamlined and monitored” (UNISDR, 2015a). The Hyogo Framework for Action 2005 – 2015 is one such platform that is succinctly described as “…a global blueprint for disaster risk reduction efforts” (PreventionWeb, 2016). Among the strategic goals outlined under the Hyogo Framework is the need to "develop and strengthen capacities at all levels, more so at the community level that can systematically contribute to building resilience to hazards” (UNISDR, 2005: 4). The Sendai Framework for Disaster Risk Reduction 2015 - 2030, which was designed to continue the efforts that began under the Hyogo Framework, outlined four priorities deemed critical to disaster risk reduction (UNISDR, 2015a: 14). Public risk perception and risk communication are considered central components to achieving “Priority 1: Understanding disaster risk and Priority 4: Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction” (UNISDR, 2015a: 14). Kellens *et al*., (2011: 1055) showed agreement with this view by stating that “Knowledge of the public risk perception is considered a crucial aspect in modern flood risk management as it steers the development of effective and efficient flood mitigation strategies”.

The issue of adopting protective behavior is being given much attention (Bubeck *et al.*, 2012; Kirschenbaum, 2005; Siegrist and Gutsher, 2008). A longstanding concern is the level of individual and social responsibility exhibited by the population towards warnings and mitigation measures for the hazards that they face. It is felt that disaster management, in order to be effective, requires much more than the formal institutional responsibility and must incorporate contribution of the general public and, in particular, vulnerable communities. This would require individuals and the

community as a whole to take more active consideration for their personal well-being rather than depending on government to bear the financial brunt and to ‘payout’ after each flood event. Considerations of building practices, location of dwellings, land use practices and garbage disposal are all seen as vital in this process. Consequently, the research is anchored within the broad framework of disaster risk reduction and seeks to assess the public perception of flood risk and flood risk communication in the Commonwealth of Dominica and to determine how the information garnered can be used to inform flood management in the country.

1.3 Objectives of the Research

In order to explore Flood Risk Perception and Communication in Dominica, the objectives of the research are to:

I. Assess the local perception of the risk of flood in Dominica with a focus on the community of Coulibistrie
II. Explore the association between risk perception, risk communication and protective behavior (safety practices or response to flood warnings)
III. Determine how the findings may help to inform flood management practices and policies

To help achieve the above objectives, the following research questions will be utilized:

1. What is the risk perception of flooding in vulnerable communities in Dominica (Case Study of Coulibistrie)?
2. How has flood risk perception influenced response to warnings and safety practices of vulnerable persons?
3. How has flood risk communication influenced flood risk perception and protective behavior?
4. How can disaster managers incorporate flood risk perception and social practices into plans and policies to manage flooding in Dominica?

CHAPTER 2. LITERATURE REVIEW AND THEORY

This section outlines the findings of the pertinent literature reviewed on risk perception and communication with a focus on floods. Definitions are first provided for the central terms of flood in the context of the research, risk, risk perception and risk communication. Factors which influence behaviour towards protection from natural hazards, which is the main debate that was featured in the research articles and also the focus of this research, will be highlighted. The “Protection Motivation Theory (PMT)” (Rogers, 1975) revised by Maddux and Rogers (1983) will also be discussed in the literature review as it was found central to the debate on whether or not an individual is motivated to adopt protective behaviour (Bubeck *et al.*, 2012).

UNISDR (2015: 70b) declared that “Floods affect more people worldwide than any other hazard”. Given the widespread or global impact of flood hazard, there is a plethora of research on flooding to include both the physical and social aspects of this hazard (Buchecker *et al*., 2013; Shreve *et al*., 2016; White, 1945). The research seeks to delve into the social aspect of floods by looking at flood risk perception and communication in the Commonwealth of Dominica and to extract meaningful contribution toward flood management efforts.

Perusal of the literature indicates that here is a dearth of research on flooding in Dominica, both on the physical as well as the social aspects. What was found to be common are reports on particular flood events such as Tropical Storm Erika and Hurricane David which took the form of a compilation of impact details. While flood risk perception has been widely studied in other regions such as Nigeria, Adelekan and Asiyanbi (2015), Netherlands, Baan and Klijn (2010) and Terpstra (2011) and in Italy, Mysiak *et al.*, (2013), the literature review has not uncovered any research on flood risk perception or flood risk communication in the Commonwealth of Dominica. The research will therefore be seen as an entrance in this branch of work in Dominica and will seek to corroborate work already done in the flood risk perception and risk communication field particularly in relation to behaviour modification towards flood preparedness or actions to reduce impact on life and property (Brilly and Polic, 2005; Bubeck *et al.*, 2012; Whitmarsh, 2008).

2.1 Defining key concepts

2.1.1 Flash floods

The World Meteorological Organization (WMO) noted that flood has a broad range of definitions (WMO, 2011a) and is best defined within the desired context. The term flood is, however, generally defined as a “rise, usually brief, in the water level of a stream or water body to a peak from which the water level recedes at a slower rate” (WMO, 2012: 124). Flash flood on the other hand is of a “short duration with a relatively high peak discharge” (WMO, 2012: 123). Flash floods are classified among the “world’s deadliest disasters…and is responsible for approximately 85% of flood cases” (WMO, 2016). Dominica exhibits the conditions outlined by WMO that promotes flash floods including “steeply sloping highland terrains and narrow valleys or ravines which hasten runoff” (WMO, 2007). As such, most flood events in Dominica usually take the form of flash floods. The geographical and hydro-meteorological conditions characteristic of the island supports the view that there is a low possibility of “zero risk” (Motoyoshi, 2006: 125-127) from floods and would strengthen the need for greater individual and community responsibility toward flood protection.

2.1.2 The concept of risk

Jones and Hood (1996) are of the view that risk is a complex term to define with some researchers even putting forward contradictory meanings. A widely accepted definition of risk is provided by Warner who defined the term as “the combination of the probability or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence” (Warner, 1992: 4). Of the many dimensions to risk, two of the most commonly debated areas are the objective and subjective nature of risk. As outlined by Pidgeon *et al.* (1992: 89), the “objective or statistical aspect exhibits a greater reliance on ‘expert’ knowledge. On the other hand, the subjective aspect has a higher emphasis on the qualitative characteristics of risk thus providing more emphasis on public perception”. It is, therefore, the subjective aspect of risk which will be the focus of the review.

2.1.3 Risk Perception

Schanze (2007) cited by Kellens *et al.* (2011: 1056 – 1057) noted that "risk perception is essential to flood risk management". Risk perception explores "people's attitudes, judgements, feelings and cultural values towards hazards…specific to the field of psychology, risk perception examines the way in which individuals make sense of or learns to know the environment" (Pidgeon *et al*., 1992: 89, 98). Risk perception study is summarized by Kellens *et al.*, (2011: 1056) as "the examination of people's awareness, emotions, and behaviour with regard to hazards". Slovic *et al.*, in their work outlined three objectives or goals of risk perception research as:

> Firstly, to improve the methods for obtaining information about risks, secondly, to provide a basis for understanding and anticipating public responses to hazards and finally to improve the communication of risk information among lay people, technical experts and decision-makers (Slovic *et al.*, 1982: 83).

Given the complex nature of risk, the study of risk perception also proves to be a diverse field where research is carried out either from the psychometric perspective or the mental models approach. The Psychometric paradigm "provides a quantitative representation of risk attitudes by quantifying people's judgement of current and desired riskiness of various hazards" (Slovic, 1987: 281). Mental model is said to provide a more central role for risk communication (Module 2, Unit 2: 2-9) and is generally used to describe "intuitive theories that aim to generate predictions or explanations in diverse circumstances" (Fischhoff *et al.,* 1993: 194). Commenting on the mental models approach, Kolkman (2007), cited by Buchecker *et al.*, is of the view that:

> ..both lay people as well as experts mental models of risks are shaped by information available to them and by their position such as their personal, social or institutional background (Buchecker *et al*., 2013: 3016).

Regardless of the methodology, researchers have assessed varying attributes of a particular hazard such as "the likelihood and consequence of occurrence, dread and voluntariness of the hazard and vulnerability to the hazard" (Brewer *et al.*, 2004:125;

Shreve and Fordham, 2014; Slovic *et al.*, 1982: 83; Wachinger and Renn, 2010). Risk perception is considered to be a well-established discipline (Pidgeon *et al.*, 1992: 90). Work began in the field of risk perception from as early as the 1940's by Gilbert White and was continued by Starr in the 1960's (Kellens *et al.,* 2013: 25). White's work alluded to the concept of revealed preferences when he outlined that the "factors that affect human adjustment to floods are linked to considerations of the advantages and disadvantages of occupying a flood plain" (White, 1945: 50). Starr's research on risk perception was said to have a more political focus aimed at policy development, but more importantly he delved more decisively in the area of assessment based on revealed preferences and opened the way for exploration of how assessment of cost and benefits affect risk acceptance or tolerability (Kellens *et al.*, 2013: 25).

The increased thrust towards "integrated flood management" (Bubeck *et al.*, 2012: 1482; Buchecker *et al.*, 2013: 3015) has strengthened the need to incorporate public perception of flood risk. WMO noted that:

> The concept of Integrated Flood Management has led to a paradigm shift acknowledging that absolute protection from floods is a myth…the aim should therefore be to maximize net benefits from the use of flood plains rather than trying to fully control floods (WMO, 2011b).

While showing agreement on the importance of the public's flood risk perception, Kellens *et al.* (2013: 24-25) added that "risk communication plays a critical role in preparedness, response and flood risk mitigation". Central to the research, therefore, is the need to explore possible associations between flood risk perception and protective behaviour and the interconnected role of flood risk communication.

2.2 Risk perception and behaviour motivation theories

The literature review uncovered several studies that have made reference to behaviour modification specifically towards adopting flood protection or mitigation practices. Kellens *et al.*, (2013) carried out a comprehensive review of 57 empirical articles that focused on risk perception and communication towards flood following a rigorous selection process. Common risk perception variables uncovered included "awareness, likelihood, impact, affect, controllability, dread, severity of

consequences, perceived probability and fear" (Kellens *et al.*, 2013: 27-34). The behavioural variables prominent in the articles included "preparedness, insurance, risk behaviour, information seeking and evacuation" (Kellens *et al.*, 2013: 27-34). Several of these variables were considered applicable to this research and were utilized in constructing the questionnaire to garner data from in the research area. In his work on "operationalizing risk perception" (Shreve *et al.*, 2016) provided a review of several research and attendant theories employed in the study of risk perception more so as it relates to motivating protective behaviour. Theories most commonly cited include Protection Motivation Theory (PMT) put forward by Rogers (1975); the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) and the Theory of Planned Behaviour (TPB) (Ajzen, 1985). Shreve and Fordham (2014) also carried out a review of flood risk perception that draws heavily upon the work done by Kellens *et al.* (2013) as well as providing additional insights and criticisms of perception research.

The decision by an individual to adopt protective behaviour towards natural hazards, and flood in particular, is influenced by many factors. Prominent among them is previous experience with the hazard (Burns and Slovic, 2012: 582; Terpstra *et al.*, 2009: 1143; Whitmarsh, 2008: 353). Economic status or having access to the resources to move from intent to action (Grothmann and Reusswig, 2006: 106; Nathan, 2010: 151), social status, culture, information available about the hazard, trust in the organization providing hazard information and acceptability of flood risk are also considered to have a bearing on "protection behaviour" (Brilly and Polic, 2005).In his research on flood risk perception in Japan, Motoyoshi (2006: 126), found that participants were more willing to purchase flood insurance as a protection mechanism once they have accepted that flooding could occur and they are likely to be affected. Specific to this research, flood protection behaviours that are considered feasible and sometimes practised across the country and Caribbean region in general would include cancelling or limiting outdoor activities, clearing of drains around homes and ensuring flood water barriers are intact, relaying flood warning information to others in the community by various means, being aware of shelter locations, accessing flood warning information and general hazard information seeking behaviour and buying flood insurance. In some cases, evacuation from a vulnerable area is the only way to protect lives. Additionally, the willingness to assist

in community flood preparedness and placing importance on flood warning messages are also seen in part as evidence of protection behaviour.

2.2.1 Theoretical application: Protection Motivation Theory

Several researchers highlighted Protection Motivation Theory as being the launching pad to studies on the process by which persons adopt measures or take actions to protect themselves from the effects of a hazard. In his research on risk perception and protective behaviour, Grothmann (2006: 104) found that the application of "Protection Motivation Theory to natural hazards has been quite limited though liberally applied in the field of health research for which the theory was originally developed". Protection Motivation Theory, as initially laid out by Rogers, looked at three components that drive fear to include "the magnitude or intensity of a hazardous event, the probability of the hazard occurring and the effectiveness of response to the hazard" (Rogers 1975: 93). The theory depends, to a considerable extent, on the modulation of fear where "a higher degree of fear is more likely to promote behaviour change than a lower degree of fear" (Rogers, 1975: 94). He further clarified that fear would in turn be influenced by the "severity of the hazard, the level of vulnerability or exposure of those likely to be affected, the value of the avoidance response and how concern one is about being affected" (Rogers 1975: 94). Fear, in the context of the theory, is defined as "a relational construct aroused to what is considered as a dangerous situation and for which protective action is taken" (Rogers, 975: 96). It therefore means that if a hazard has not been "appraised as severe, is not likely to occur and in any event nothing can be done about the hazard, then no protective motivation would be activated resulting in no change in behaviour" (Rogers, 1975: 99).

The theory was reviewed and modified by Maddux and Rogers (1983). In addition to the three components, a forth was added that of 'self-efficacy' adopted from Self-efficacy Theory by Bandura *et al.*, (1977). The researchers believe that by incorporating self-efficacy, Protection Motivation Theory would become more generalizable. Self-efficacy is described as "the belief that one can execute a particular behaviour or action to achieve a desired outcome…and that the level of

belief in an individual's effectiveness will determine if protective behaviour will initially be attempted" (Bandura *et al*., 1977: 126). Self-efficacy theory also made reference to the contribution of experience. Maddux and Rogers in their experiment found that:

> Self-efficacy expectancy significantly influences intentions to adopt the recommended coping behavior and proved to be the most powerful predictor of behavioral intention (Maddux and Rogers, 1983: 476).

The Protection Motivation Theory is considered applicable to this research. One of the objectives is to explore the association between risk perception, risk communication and protective behaviour especially how persons respond to flood warning messages. All three components of the theory as well as the fourth added from the revised 1983 version can be referenced in some form to the research. Protection Motivation Theory will therefore form the basis or framework of the analysis of whether or not individuals or groups vulnerable to flood in the community of Coulibistrie adopt protective behaviour. While conducting field work for the research, the factors of 'fear' and 'emotion' were regularly displayed in the consideration toward adopting protective behaviour from future flooding. This of course was found to be linked to experience with the hazard, in this case the recent flood damage from Tropical Storm Erika. Drawing on Rogers Protection Motivation Theory, the research uncovered where the unprecedented magnitude of the recent flood event (severe hazard), the fact that some respondents believe that flooding can occur in the future (probability of occurrence) and there is no consensus on how effective future response is likely to be (efficacy of response), suggests that fear will remain a prominent feature to influence respondents decision to act or demand mitigation measures from political representatives. Self-efficacy was judged by the level of preparedness indicated by respondents, the purchasing of insurance and the popularity of the view that the government should cover the cost of recovery from flooding.

This initial observation lends support to the argument that experience and how easily past knowledge of floods could be readily recalled is likely to have an influence on risk perception level (Brilly and Polic, 2005; Siegrist and Gutscher, 2006: 972; Whitmarsh, 2008). It was interesting to note how respondents in the community expressed varying views on their flood experience. This in turn appears to have

some effect on future flood protection behaviour or consideration particularly as it relates to evacuation. The critical factor at work appears to be the level of damage experienced. Therefore, persons who received a greater degree of loss exhibited a higher level of willingness to evacuate. On the other hand, those who received less damage have a lower inclination toward evacuation even though they remain vulnerable. This finding is supported by Visschers and Meertens (2010: 73) who indicated that "different people may have different perceptions of the same risk, which may result in different levels of concern about this risk and different responses to it". Shreve and Fordham (2014) in their empirical review also found that:

> …'prior experience' with flooding was considered a factor influencing risk perception by several studies and results are 'mixed' as a variety of intervening variables have been recommended such as personal losses incurred during the experience, or time since the event. Therefore, prior experience can have varying effects on risk perception and preparedness, such as it can improve or decrease preparedness (Shreve and Fordham, 2014: 21).

Therefore, while experience is a pertinent factor the extent to which it is acted upon by other variables can affect future protection behaviour. The consideration of experience brings the discussion to look at some limitations of the Protection Motivation Theory. Rogers, in critiquing the theory (1975), noted that not all variables that influence fear are mentioned. The theory did not make any explicit reference to experience which the research considers to be a central factor that could modulate fear depending on the degree of the experience. Other factors, such as the cost of implementing protection or "response-cost" (Rogers, 1975: 110) were not incorporated or fully developed in the framework.

The review of empirical researches carried out by Bubeck *et al.*, (2012) took a different approach. This review examined the conclusion made by some studies that there is none or only weak correlation between risk perception and protective behaviour. However, as previously established, several variables are incorporated in the examination of risk perception. Therefore, while the variable of risk probability may indicate a weak correlation toward influencing behaviour, the effect of 'fear' remains an integral protection motivation factor (Bubeck *et al.*, 2012: 1484).

2.3 The role of risk communication

Incorporating risk communication in exploring the link between risk perception and protective behaviour can only provide a more holistic outcome (Watchinger and Renn, 2010). It is believed that an

> …understanding of how the public perceive risk is crucial in determining how appropriate flood related information should be disseminated to the public. This could build trust in authorities and increase resilience to floods. (Bradford *et al.*, 2012: 2300).

2.3.1 Defining the concept of risk communication

The National Research Council (NRC) describes risk communication as:

> An interactive process of exchange of information and opinion among individuals, groups and institutions. It usually involves multiple messages about the nature of risk that express concerns, opinions, or reactions to risk messages (NRC, 1989: 21)

The definition provided by the NRC would appear to be the most desirable format. However, Visschers and Meertens (2010: 72) define risk communication in the basic context of the "distribution of single risk messages from the communicator to the general public". This definition is aligned with the form of information transfer described by the "deficit model of risk communication where communication is unidirectional with little if any feedback from the receiver" (Module 2, Unit 3: 3.4-3.7). This is the form of risk communication currently employed in flood risk communication in Dominica which still holds to the "traditional 'top-down' approach of 'experts' providing information to 'non-experts'" (O'Neill, 2004: 5). A platform for two-way exchange or interactive setting is not yet fully developed for flood risk communication.

Similar to risk perception, there are several approaches to the study of risk communication, but only those considered applicable for this research are selected.

Lundgren and McMakin (2009) cited by Höppner *et al.,* outlined these approaches to include:

> The mental models approach which places emphasis on the characteristics and needs of the audience; the culture and ethnicity approach where there is the need to understand the general characteristics of ethnic subcultures in affected communities; crisis communication approach which is normally utilized to trigger the appropriate behavioral response in emergency situations and the social amplification of risk approach which is primarily concerned with risk amplification and attenuation by varying groups particularly the media (Höppner *et al*., 2010: 22-25).

These approaches to the study of risk communication are applied to the research either from the perspective of what is desirable or what is the observed practice. Therefore, from the mental models and culture and ethnicity approach, more can be done towards gaining a better understanding of who the message is intended for and any cultural characteristic that could enhance the effectiveness of the communication. The social amplification of risk is also highlighted given the increasingly complex and varying mediums, particularly social media, as well as shorter time frame in which information about a hazard can reach the public. In this regard, there is the need to convince the public to restrict their information seeking to designated authorities. Therefore, “trust and credibility of the information providing organization” (Renn, 2009; Seeger, 2007: 238-239) will be critical factors to consider. The crisis communication approach is seen as the most common format of risk communication practiced where the public is informed of a possible impending flood. In this scenario, information is provided within a short window of time and a protective behavior is solicited from the public. The communicator is therefore anticipating that upon the receipt of the hazard information, the public would take some form of protective action to reduce impact on life and property. However, many variables must be considered before an individual can get to the point of being motivated to act protectively.

2.3.2 Goals of risk communication

Rohrmann highlighted what he considered to be the three goals of risk communication to include “knowledge advancement to influence individual behaviours and to deal with risk problems on a communal level” (Rohrmann, 1998: 105). Renn, (2009: 87) added another goal that of “promoting or building trust and credibility towards institutions that handle risk or provide risk information”. The researcher acknowledges the importance of the goals listed above and varying questions were included in the research instrument to explore the applicability of such aspects among the respondents.

Risk communication can be carried out through several mediums and the issue of how to effectively communicate risk to the public remains a running battle. At a conference designed to explore effective risk communication, some participants were vying for the conventional “top-down approach where it is felt that the public or lay person need to be educated in a language tailored or simplified to their level” (Faulkner and Ball, 2007: 75). On the other hand, the view was expressed that:

> Oversimplification of risk communication language was patronising… ownership of the complexity of the message and likely uncertainties on the part of both communicator and recipient should be encouraged in risk communication (Faulkner and Ball, 2007: 75).

However, Renn, cited by Kellens *et al*., (2013: 25) advocated for tailoring risk communication to the particular need of the people. By adopting this method:

> …people are facilitated to judge their own risk situation and to make informed decisions according to preparedness and personal safety measures. Effective communication, or the absence of it, may have a major bearing on how well people are prepared for a disaster (Kellens *et al.*, 2013: 25).

As previously established, experience with a hazard is a pertinent factor. A differentiation is however made between “direct and vicarious experience” (Terpstra *et al.*, 2009: 1143) as it is believed that direct experience will have a greater effect on preparedness action. The literature review revealed that experience plays a double

role in that it affects risk perception and in turn helps to motivate protective action. The desire for protection may push individuals to seek more information which could increase the effectiveness of risk communication. Terpstra *et al.*, summarizes this view stating that:

> Increased protection motivation causes people to pay greater attention to relevant information, stimulates the collection of more information and makes them more likely to adopt hazard adjustments for protection (Terpstra *et al.*, 2009: 1143).

The research has particular interest in the role of risk communication to the extent that it promotes positive behavior change towards flood protection. Studies have shown that "simply providing the information is no guarantee that persons will act upon it" (Höppner *et al.*, 2010: 45; O'Neill, 2004: 6). What is sometimes lacking in the communication of flood risk, and was highlighted by respondents as an improvement to warning messages, is the provision of information on how to protect oneself from the hazard. This recommendation by survey respondents was supported by other studies where it was noted that "informing the public about flood hazards must be complemented by information about what people can do to prevent flood damages" (Siegrist and Gustcher, 2006: 978). Shreve and Fordham in their research found that:

> …many people do not have knowledge of protective measures particularly private precautionary measures…and this could have a bearing on important representations of risk for policy and decision makers for evaluating how public opinion of preparedness may or may not reduce or create additional risk (Shreve and Fordham, 2014: 38).

To enhance the mitigation motivation role of risk communication, it is believed that risk communication "should help people in flood-prone areas envisage the negative emotional effect of natural hazards" (Siegrist and Gustcher, 2006: 978). This approach could be linked to the modulation of fear from the Protection Motivation Theory. Rogers (1975: 95-102) imply that, in the communication process, generating fear in the message may not be intentional but a by-product of the process that pushes or motivate people to act to protect themselves.

CHAPTER 3. DATA AND METHODS

3.1 Conceptualization

The purpose of the research is to assess the public's perception of flood risk and flood risk communication in Dominica and to determine how this information can be used to inform flood management. Three objectives are outlined in the research. Firstly, to assess the local perception of the risk of flood in Dominica with a focus on the community of Coulibistrie. Secondly, to explore the association between risk perception, risk communication and protective behaviour. Behaviour in this context refers to "safety intentions" (Grothmann and Reusswig, 2006: 106), practices or protection response to flood warnings. Thirdly, to determine how the findings may help to inform flood management. The survey was conducted just over a year after the flood caused by Tropical Storm Erika in 2015 which means the event could be recalled with relative ease. A literature review was conducted to examine some of the researches already carried out on flood risk perception and flood risk communication as well as theories relating to protection behaviour. Importantly, the examined researches were mainly peer reviewed articles from relevant natural or social science journals. The terms utilized in the search included 'flood risk', 'flood risk perception', 'risk communication', 'flood risk communication', 'flood management', 'protective behaviour', 'flood risk perception and protective behaviour'.

The variables included in each section of the questionnaire were selected based on information garnered from the literature review particularly work done by Adelekan and Asiyanbi, (2016), Kellens *et al*., (2013) and Urcan, (2012). For this research, selected perception variables included frequency of flood hazard, perceived likelihood of future occurrence, respondent's level of concern or fear of impact, cause of the hazard, damage experienced from the hazard and respondents view on vulnerability of the community. The risk communication variables garnered data on social responsibility of respondents, information seeking behaviour, awareness and understanding of warning messages, trust in warning agencies, input on how to improve warning messages and consideration towards taking protective action towards flood.

3.2 Sample and data collection process

The close knit community has a confined geographical spread with a population of approximately 419 persons. The aim was to interview at least 10% of the population. This limit was set based on time constraints regarding both gathering the data as well as for final analysis. The consideration of resources was also a factor. In the final outcome, 51 questionnaires were administered which represented approximately 12% of the population. The survey was done over a two month period and basically took the form of non-probability convenience sampling. The researcher however purposefully chose to represent mainly persons who have experienced flooding. To satisfy this scenario, the community of Coulibistrie was used as the case study to collect primary data for the research given that it was ravaged by a recent flood event. Two methods were used. Firstly, a "face-to-face interview schedule" (May, 2011: 103; Simmons, 2008: 188-187) was initially utilized with contact being made by a community walk-through. This process provided the distinct benefit of field observation both of the physical environment of the research area as well as the respondents displayed emotions (May, 2011: 104). Thereafter, a "self-completion questionnaire method" (May, 2011: 103) was selected to reduce time limitation.

3.2.1 Ethical considerations in the research

The researcher remained mindful that considering and addressing ethical issues are important features of social research (Bulmer, 2008: 146-152). The chosen data collection method by the use of surveys is considered to be "inherently intrusive and requires the researcher to assure respondents of their privacy" (Module 3, Unit 2: 2.22). This issue was addressed by informing participants that the information will be kept confidential and will only be shared where requested with the research supervisor. To fulfil this responsibility, a numbering system was used to maintain anonymity. "Informed consent" (McNiell and Chapman, 2005: 12) was sought from respondents who were made aware that their participation was voluntary. An informed consent form was provided to each participant stating the purpose of the research and use of data, possible length of the interview, assurance of confidentiality and freedom to withdraw from the process.

3.2.2 Operationalizing the research

The study conducted by Bird (2009), which focused on the use of questionnaires to obtain information on natural hazards, was particularly useful in the design of the survey instrument. This research indicated the various segments on a questionnaire such as “demographic or classification details, behavioural, knowledge, perception and feeling information” (Bird, 2009: 1312). A “mixed methodology approach of both quantitative and qualitative data collection, specifically of the sequential format” (Alexander *et al.*, 2008: 126-133) was utilized in the study. While most of the data was gathered through the use of questionnaires, two “semi-structured interviews” (Fielding and Thomas, 2008: 246-247) were carried out prior to the main survey with representatives from the local disaster office. The interview questions focused on vulnerability due to social practices, current flood management techniques, measures to obtain community involvement and views on flood risk communication. These interviews were done to firstly, gain a better understanding of any flood management work being done in the community or what they envisage could be done to alleviate the effects of floods. This is considered important particularly from a flood early warning and risk communication perspective. Secondly, to ensure that the variables included in the research instrument are relevant to the local situation and will capture the desired information. This attempt at “triangulation seeks to address the issue of validity and reliability” (May, 2011: 97-98; Module 3: Unit 5: 5.32) of the research.

The survey instrument was constructed with approximately 38 questions distributed across 6 demographic information questions to include age, sex, education, employment, income and type of dwelling ownership. Eleven (11) flood risk perception questions gathered data on flood experience and frequency, likelihood of future flooding, belief of being affected by future flood, level of concern or fear of future impact, knowledge on cause of flood, views on vulnerability and level of damage experienced. The 13 risk communication questions explored social responsibility, information seeking behaviour, views on best means to provide the public with warning messages, level of seriousness toward warning messages, consideration to take protective action and type of protective action. The 8 flood management questions primarily focused on possible flood management measures,

willingness of respondents to assist, views on ‘zero-risk’ from flood and level of preparedness.

The instrument comprised of both closed and open ended questions. The format of the questions ranged from simple ‘yes’ or ‘no’ responses to closed questions that provided options for the respondents mostly on a 5 point Likert scale. There were three open-ended questions and four questions that asked the respondents to select all that applied. Open ended and check all that apply questions were kept to a minimum due to the consideration of time consumption during analysis. By way of a pilot test of the questionnaire, a respondent from the study area was asked to complete the survey instrument and to provide feedback. Though limited in number, the feedback was helpful and provided assistance to better “clarify questions, and remove ambiguities” (Punch, 2003: 34). The feedback also resulted in a few questions being added to ensure that adequate data was collected. A questionnaire took approximately 15 to 20 minutes to be administered depending on the respondent.

3.3 Coding

Following the field collection, the next stage was to code the data or “classify responses into analyzable categories” (May, 2011: 114). This included specifying “variable names, variable and value labels and assigning missing or no response values” (May, 2011: 116). Each question was treated as a variable and the aim was to achieve consistency in coding throughout. As a result, for questions that solicited ‘yes’ and ‘no’ responses, ‘1’ was assigned for yes and ‘2’ for ‘no’. Similarly, questions that provided response in the Likert scale format were also assigned a number starting with ‘1’ and continued up to ‘5’ or ‘6’ as the case warranted. Missing values or no responses were represented by the “number ‘9’ and not applicable questions were represented by ‘0’” (Fielding, 2008: 328-329). Open ended questions were coded following the coding format for qualitative analysis by “extracting and grouping common words or terms” (Fielding, 2008: 335). Given that the groping was small, it was possible to assign a number starting from ‘1’ to allow for quantitative analysis.

For questions that asked respondents to check all that apply, each response was treated as a variable and assigned ‘1’ for yes being ticked and ‘2’ for no, not ticked.

3.4 Analysis

After the data was coded it was entered in the Statistical Package for the Social Sciences (SPSS) version 24 for analysis. Descriptive and correlation statistical processes were the main statistical operations on the data to achieve or explore the desired objectives. Descriptive and frequency analysis show the “distribution of the variables across the sample” (Punch, 2003: 45) and also help to analyze survey responses by providing an overview of “under or over-representation of a particular variable such as sex or age” (May, 2011: 123). By utilizing selected variables that were highlighted in the theoretical framework, the research aimed to explore possible correlations between flood risk perception and protective behaviour. For example, experience with the hazard and level of concern were tested for correlation and the level of significance. Correlation analyses were carried out using either the “Pearson product-moment correlation coefficient or the Spearman correlation” (Module 3, Unit 8: 8.25 – 8.27).

CHAPTER 4. ANALYSIS AND RESULTS

The following section outlines the analysis and evaluation of the responses to the questionnaires. Descriptive analyses are first generated on demographic variables. This is followed by frequency distribution of other variables demarcated as risk perception, risk communication and flood management variables. Finally, correlation statistics will be generated. This is geared towards exploring any association between risk perception and risk communication factors and actions deemed as protective behaviour (Kellens *et al.*, 2013). The variables selected for correlation analysis are quite similar to those explored by researchers highlighted in the literature review as well as the Protection Motivating Theory. Fear, which is named as a factor to drive protective behaviour (Rogers, 1975), is assessed by the degree of concern of being impacted by future flood and the level of seriousness towards flood warning messages. The level of damage from Tropical Storm Erika will be utilized as the degree of experience.

4.1 Demographic attributes and distribution

Five age ranges were provided on the questionnaire starting from 20 years to above 59 years. The lowest of 20 was selected to ensure that the respondent was cable of providing personal consent to participate in the survey. In addition, the survey wanted to capture input in relation to flood frequency and experience. It was therefore important to include some respondents from the older age group. The summary of age range (Appendix D: Table 1) showed that from a total of 51 respondents the most frequent age range was 40-49 years which accounted for approximately 25% followed closely by respondents above 59 years representing 24%. There was an equal distribution of respondents across the remaining three age ranges. Twenty-one (21) respondents were male and 30 were females (Appendix D: table 2). Forty-eight (48) respondents completed some type of formal education with 43% completing up to primary and 33% up to high school or associate college level (Appendix D: Table 3). Employment was included among the questions with the intention to explore correlation with the number of respondents who possess flood insurance. Data indicated that approximately 16 respondents were self-employed, 19 were employed in either the private or public sector and 9 were unemployed

(Appendix D: Table 4). Not surprising, monthly income (Appendix D: Table 5), which the research also thought could be linked to purchasing of flood insurance, had a high rate (33%) of no response. Approximately 10% of respondents monthly income was less than 1000 Eastern Caribbean dollars (XCD), 24% earn between 1000-1999 monthly, 10% earn 2000-2999, 12% earn 3000-3999 and only 2% of respondents earn 4000XCD and above. The type of dwelling ownership was considered to have an influence on protective behaviour since "owners have more to lose because of floods, but more so the power to take independent action" (Grothmann and Patt, 2005: 206). Frequency distribution for dwelling ownership (Appendix D: Table 6) showed that 43% of respondents resided in privately owned single units, 22% are paying mortgages, 29% are living in joint or family owned homes while 6% are living in rented units. Pearson coefficient correlation showed that there is a weak and negative correlation between dwelling ownership and views on likelihood of future flooding as well as level of concern on being impacted by future flood. However, there is a positive but still weak correlation between dwelling ownership and consideration to take some form of protective action (Appendix D: Table 7). The correlation is not seen as statistically significant which means that other variables may have a stronger influence.

4.2 Risk Perception Variables: analyses and evaluation

Recalling from the Data and Methods section, the variables utilized to assess risk perception are: experience and frequency of flood hazard, perceived likelihood of future occurrence, respondent's level of concern or fear of impact, cause of the hazard, damage experienced from the hazard and respondents view on vulnerability of the community. Flooding in the community was experienced by 98% of the respondents. Only one respondent did not experience direct flooding due to being located in an elevated area of the community. The number of flood events experienced by respondents ranged from 1-2 events, 3-4 events and above 4 events (Appendix D: Table 8). Experience of 1-2 events was selected by 90% of the respondents and could be a case of "availability heuristics due to the very recent occurrence of a major flood event" (Tversky and Khanemann, 1974: 1127-1128) and "affect heuristics" (Slovic *et al.*, 2004: 312).

Perception on the cause of flooding of the study area was explored through a multiple response question (Appendix D: Table 9). Thirty-seven (37) participants believe that heavy or prolonged rainfall is the main cause of flooding, 32 believe it is caused by climate variability and change and 30 respondents express the belief that flooding resulted from the limited capacity of waterways to carry high a volume of water. As it relates to the current level of vulnerability of the community to floods, approximately 92% of the respondents believe that the community is vulnerable with 39% choosing very vulnerable and 41% extremely vulnerable (Appendix D: Table 10). Approximately 94% of the respondents are of the view that Coulibistrie has become even more vulnerable since the impact of Tropical Storm Erika and is said to be mainly due to the elevated river bed and lack of flood water barriers (Appendix D: Table 12). Most of the respondents believe that their community could be flooded in the future with 45% believing this is likely and 41% extremely likely (Appendix D: Table 13). Given that the community is considered to be more vulnerable post Tropical Storm Erika, a correlation test was done to explore possible association between perception of future flooding of Coulibistrie and the perceived increased level of vulnerability outlined by the respondents. The Pearson correlation showed a moderate but negative correlation ($r = -0.401$) which was considered significant at 0.01 significance level between perceived increased vulnerability of the study area and perception of future flooding (Appendix D: Table14).

Of the total number of respondents (51), 38 believe that they will be affected by future floods, 9 are uncertain while 3 respondents believe that they will not be affected (Appendix D: Table 15). Extensive damage was experienced by 47% of the respondents while moderate and completely damaged were respectively reported by 9 respondents each (Appendix D: Table 16). Due to the high number of respondents who believe they are likely to be affected by future floods, the next logical step in line with the objectives of the research was to assess how concerned respondents were about being directly affected by a future flood event. As previously stated, the level of concern is one of the variables utilized to explore the degree of fear expressed by survey participants. Based on the Pearson correlation results shown in Appendix D (Table 18), there is a positive and strong correlation between likelihood of future flooding of Coulibistrie and degree of concern (fear) of future personal impact where $r = 0.548$. Similarly, the correlation between level of damage (degree of experience)

and degree of concern is positive and strong where r = 0.498. Both correlations are considered very significant at the 0.01 significance level. Research has shown that the degree of experience with a hazard plays a significant role in how individuals perceive the hazard (Siegrist and Gutscher, 2008: 772). Some respondents in the survey showed indication of being affected by their flood experience particularly in having a high level of concern about future impact. Several respondents stated that, having experienced a recent catastrophic flood event, their feeling of dread and emotional or mental strain with regards to floods have increased significantly. According to research carried out by Grothmann and Reusswig (2006: 107-108), recent experience may force individuals to have a high risk perception. This research was conducted one year after the impact of Tropical Storm Erika. Therefore, the flood was still very vivid in the minds of persons who were in the community during the event. Some thought must be given to the level of objectivity that respondents are able to apply to flood "threat appraisal" (Grothmann and Reusswig, 2006: 108) because of the very recent impact.

4.3 Risk Communication Variables: analyses and evaluation

In any disaster risk reduction effort, including flood management, "early warning is seen as a critical component" (Fowler, 2015a). Similarly, risk communication is integral to the effectiveness of early warning system. Hainsworth (2015), cited by Fowler (2015a), noted that "having the best warning system in the world without the message getting through to the person on the ground is of no use". To assess the contribution of risk communication, statistical analyses are carried out on respondents view on the importance of accessing warning information, frequency of access and understanding of the message, degree of trust in warning agencies and whether the warning prompts protective action. The research attempts to investigate the extent to which respondents consider accessing or seeking out warning information, a socially responsible behaviour that is beneficial to both the individual and the wider society. This question is in line with the view of how much an individual considers their personal protection against a hazard as their responsibility (Kellens *et al.*, 2013:43). Of the respondents, 76% are in agreement of which 14 % strongly

agree that it is considered being socially responsible to seek out warning information (Appendix D: Table 20).

Following the high agreement on the need to obtain flood warning information, the results on the frequency of listening to the weather report was almost equally distributed (Appendix D: Table 21). Weather reports were rarely to occasionally accessed by 49% of the respondents and a similar 49% listened quite often to always. Radio and television broadcast are the most frequent options used to obtain flood warning messages with 74% and 69% of the cases, respectively. Other options such as email, calling in directly to the local meteorological office and social media are utilized to a much lesser extent (Appendix D: Table 22). Respondent's view on the most effective way to receive messages did not see much change on the current methods being used (Appendix D: Table 22). Radio and television were again selected as the best methods equally selected in 71% of the cases. However, other options were seen as quite beneficial with social media selected in 47% of the cases and interestingly the use of indigenous methods was selected in 17% of the cases.

Nearly half the respondents (22) exhibited a low level of awareness regarding warning messages while 28 respondents vary from being very aware to extremely aware of issued warning messages (Appendix D: Table 23). The extent to which respondents understand warning messages is also quite important. This in part helps to determine the effectiveness of risk communication and possible prompting protective behaviour. At a Sendai Framework meeting, Sy (2015), cited by Fowler (2015b), stated that "there is a need to take the scientific information to communities in a way that is comprehensible". The frequency distribution of how well respondents understand flood warning messages (Appendix D: Table 24) indicted that approximately 10% had a limited understanding of the message, 20% indicated fair, approximately 56% indicated good to very good and 14% said they have an excellent understanding of the message.

Although most of the respondents indicated that they have a good understanding of the message, it is important to know how the message can be improved to increase effectiveness especially towards taking protective action. Unfortunately, this question had a high no response rate. However, for the 12 who answered, two improvements were emphasized (Appendix D: Table 25). The first given by 5 of the respondents is

that the message should contain more specific impact based information and what measures to take in order to protect themselves. This recommendation corroborates the findings of the TACTIC research carried out by Shreve and Fordham (2014). The authors also found that there is a need to provide the public with information on specific measures to secure personal protection.

The second improvement stated by 7 respondents is to simplify the language used in the messages. Though the responses are limited, they are in line with one of the main impediment to effective risk communication. This issue of language specification was also highlighted in the literature review by Faulkner and Ball (2007: 75) where there is a debate on 'top-down' approach to informing the public of hazards. The language or technical terms used in the message given to the public was also discussed at the Sendai Framework meeting where Jarraud (2015) cited by Fowler (2015b) is of the view that "meteorological services should move away from mechanistic warnings riddled with technical terms and place greater focus on intelligible impact based warnings". It is felt that messages will be more readily received if they are "tailored to reflect people's learning style, cultural identity and certain demographic characteristics" (Burns and Slovic, 2012: 582). The responses also bring into focus one the shortcomings of the "deficit model of risk communication where risk assessments and arguments are presented in technical terms and language that are unfamiliar to the average citizen" (Module 2, Unit 3: 3.4 – 3.5).

The level of seriousness, the second fear assessment factor, given to warning messages or how receptive respondents are to the information provided was also explored. It is believed that if the message is given due diligence then some form of protective action will be taken or at least considered. As shown in Appendix D (Table: 26), approximately 60% of respondents take warning messages very serious and 20% extremely serious. The decision to place importance on flood warning message is considered to be a useful step in the process towards "private flood mitigation behaviour" (Kellens *et al.*, 2013: 42-43). Trust in warning authority or agency providing flood warning messages has a role to play in risk communication and how receptive the public is to the message. The issue of trust is even more critical due to the plethora of sources from which information can be obtained (Renn, 2009: 87). This, Jarraud (2015) cited by Fowler (2015b), summed up as "having

multiple sources of warning are a source of confusion not a source of warning". The survey data (Appendix D: Table 27) indicates that approximately 29% of the respondents have a high level of trust in the warning authority, 28% very high and 10% completely trust the authority and the message provided. On the other hand, 2% of the respondents did not trust at all, 4% very low trust and 23% have a low trust.

Association between risk perception, risk communication and protective behaviour is the central theme of the research. Therefore, it is necessary to ascertain how many respondents consider taking any form of protective action upon receiving flood warning information. Of the 51 respondents, 49 consider taking some form of protection from flooding when the warning message is received (Appendix D: Table 28). Respondents were given the option to select multiple protection measures normally practiced or considered (Appendix D: Table 29). A high information seeking and sharing behaviour was indicated where 38 survey participants selected staying abreast of warning information and 32 indicated that they share information with others. Cancelling outdoor activities and travel plans also had a high selection rate of 37 and 28, respectively. Measures that appear to require more resources to execute had a lower selection rate where 19 respondents indicate that they clear drains around home and only 4 would try to know where the assigned shelter is located.

Obeying evacuation orders and the purchase of flood insurance, which are also considered as protection behaviour, were analysed separately. Approximately 91% indicated that they would be willing to evacuate, but with varying degrees and 8% indicated that they were not willing to leave their homes (Appendix D: Table30). Based on field observation and expressed views by respondents, the decision not to leave home was based on the level of impact experienced during Tropical Storm Erika. Some respondents believe that if they did not evacuate during that major flood event, it is not necessary to do so in the future. Only 12% had flood insurance not withstanding that most respondents believe that the community is even more vulnerable to flooding.

Correlation tests were done to determine association between several risk communication variables (Appendix D: Table 31). The results showed a weak but positive correlation between sense of personal responsibility to access warning message and frequency of access where r = 0.189. However, awareness of warning messages has a positive and strong correlation with frequency of access where r = 0.512. There is also a positive and moderate correlation between awareness and level of understanding of the message where r = 0.435. Both values are significant at the 0.01 level of significance. Understanding of warning messages showed a weak but positive correlation with frequency of accessing weather information (r = 0.0175). Consideration of protection action against flood impact showed a positive but weak correlation (r = 0.083) with how much respondents understand the message Appendix D: Table 32).

4.4 Risk perception, risk communication and protective behaviour

An attempt was made to determine the association between selected risk perception and risk communication variables as well as any variable deemed to promote protection against flood hazard. The risk perception variable of likelihood of future flooding of the community showed positive but weak correlation with the risk communication variable of level of seriousness toward warning message (r = 0.270) (Appendix D: Table 33). Level of concern (fear) of being personally affected by future flooding has a weak but positive correlation with frequency of accessing weather information (r = 0.020), as well as with the extent to which respondents consider protection against floods (r = 0.152). Concern of personal impact did however show a moderate and positive correlation with the level of seriousness applied to flood warning messages where r = 0.449 (Appendix D: Table 34). This correlation is significant at the 0.01 level of significance. The level of attention or seriousness placed on the message as previously stated serve a dual role. On one hand, the degree of importance given to the message indicates some amount of fear of future impact. On the other hand, the act or process of giving serious thought to the message could be viewed as a first step in deciding the course of protective action, if any, that should be taken. The research is, however, cognizant of the fact that the correlation between the level of seriousness placed on the message and

consideration to take protective action has a weak and negative correlation (r = -0.150). This, however, points to the possible need for other necessary conditions to be in place or a case of “non-protection response” (Grothmann and Reusswig, 2006: 106) likely associated with other social and or economic factors.

The literature review highlighted the point that receiving or being made aware of a warning message does not guarantee that the public will act on the information for varying reasons (Höppner *et al*., 2010: 45). The research also corroborates with this finding. Pearson correlation test between respondent’s awareness of the warning message and whether they consider protection showed a weak and negative correlation where r = -0.079 (Appendix D: Table 35). Recalling that experience has an influence on protective behaviour, correlation was done between damage experienced from Tropical Storm Erica and how serious the respondents view the warning messages as well as if protection is considered when the message is received (Appendix D: Table 36). The result showed that level of damage experienced had a weak but positive association with the level of importance placed on the message (r=0.264). Damage experienced also had weak and positive association with whether respondents consider protection from flooding where r = 0.176. Another perception variable, level of vulnerability of Coulibistrie to flooding (Appendix D: Table 37), showed a weak and positive association with frequency of accessing weather information (r = 0.105). Vulnerability also showed a weak but positive association with considering flood protection (r = 0.125). However, correlation between level of vulnerability and how serious warning messages are viewed showed a moderate and positive association where r = 0.377 which is significant at 0.01 level of significance.

Given that the theoretical framework of the research is linked to the Protection Motivation theory (Rogers, 1975), it is prudent to draw reference to key findings that either support or detract from some assumptions of the theory. Utilizing the flood event precipitated by Tropical Storm Erika, all but one respondent have experience of a severe event that they can relate to. An overwhelming 86% of the respondents perceive that the community could be flooded in the future and since Coulibistrie is now considered to be even more vulnerable, with little being done for flood protection, the research bears some similarity to the central tenets of the theory. An elevated level of fear which is deemed necessary to drive protection motivation

should therefore be evidenced. However, the results showed that the 'fear' factor of concern of future flood impact had a weak association with the decision to take protective action. It would seem to suggest that even though fear is present, the degree to which it is modulated is insufficient to generate a greater push or override other limiting factors in order to give more consideration to flood protection. It does however provide the opportunity to look at the effects of other variables that could present a limitation on adopting protective action. The theory postulated that no protective action or no change in behaviour would take place if the "hazard is not viewed as severe, is not likely to occur and nothing can be done about the hazard" (Rogers, 1975: 99). Since this is not the scenario observed in the research, the issue of self-efficacy (Maddux and Rogers, 1983: 476) could be explored to determine the extent to which it may have an influence on considering flood protection.

4.5 Flood Management: the public's perspective

The final section of the analysis will focus on flood management for the study area. The views of respondents were solicited on the possibility of the study area enjoying "zero risk" (Motoyoshi, 2006: 125-127) from flooding. Of the respondents, 25% believe that flood risk can be completely removed while 71% are of the view that flood will always pose a risk to Coulibistrie (Appendix D: Table 38). The research explored possible flood management measures for Coulibistrie by providing five options to select multiple responses (Appendix D: Table 39). The most frequent option was to build flood barriers which was selected by 44 respondents. This was followed closely by river training and dredging selected by 21 persons. Most of the respondents are in favour of 'hard' flood management measures rather than 'soft' measures such as increasing flood awareness which was selected by 11 participants. Answers to the open ended question on why the community is more vulnerable post Tropical Storm Erika saw most persons mentioning elevated river bed and the absence of flood barriers. This means that the options provided for flood management in the survey instrument are indeed applicable and relevant to the local situation and in part addresses validity of the research. A willingness to help authorities to manage flooding of the community (Appendix D: Table 40) was expressed by 94% of respondents, 26% were very willing, 20% extremely willing to

assist and 41%, the majority, were simply willing to help in implementing flood protection.

Proactive behaviour towards flood preparation was partially assessed by the number of respondents who took part in any form of community disaster training. Of the 51 respondents, only 22% have had some form of exposure to disaster training while 78% had no training (Appendix D: Table 41). The reasons behind the lack of participation in disaster training exercises ranged from 6% of the participants were not interested in training, 14% were physically unable to take part in training and the majority, 49%, declared that they were not aware of when any form of disaster preparedness training was conducted (Appendix D: Table 41). Assessing the level of preparedness against future flood is pertinent given the high number of respondents who believe the risk will always exist and that they are very likely to suffer personal impact. Distribution of the responses (Appendix D: Table 42) showed that approximately 27% of the respondents believe that they are unprepared to deal with anther flood event, 16% somewhat prepared, 33% say they are prepared and 22% are well prepared.

In an age where risk transfer is an important component of disaster risk reduction and in some situations the only preparedness mechanism, the research seeks to assess the number of respondents who have flood insurance. One of the initial reasons for interest in the research was to look at the social responsibility of the public in taking ownership of their personal protection from flood. The purchase of flood insurance was considered to be one of the most feasible options in this regard. Additionally, the reason for those who did not purchase flood insurance was ascertained (Appendix D: Table 43). Only 12% of the respondents had flood insurance and an overwhelming 86% did not have insurance, 20% of the respondents believe the flood insurance is too costly and 29% believe that the options offered by insurance companies are limited. The research found that 28% of the respondents are of the view that the government should stand the cost of their recovery from flood events.

CHAPTER 5. DISCUSSION AND CONCLUSIONS

5.1 Summary

The noted increase in the number of flood events that affect Dominica and in particular the catastrophic flooding caused by Tropical Storm Erika supported the necessity of a flood research in Dominica. This research assessed the risk perception and risk communication of flooding in Dominica. Importantly, the research intends to contribute to flood management efforts by way of the research findings. In reference to the background of the research, concerns have been raised with regards to the level of social responsibility exhibited by the public towards their personal flood protection. A review of the literature on flood risk perception and communication allowed the research to recognize that this concern is widely studied under the theme of protection motivation behaviour. Therefore, particular attention was given to variables that are commonly used to assess how the public respond to possible threats from hazard such as level of experience with impending hazard, fear, concern, processing of warning messages and any form of protection response.

5.1.1 Discussion on risk perception results

The variables used to guide the research are similar to those used in previous flood perception research. During the analysis process, it was prudent to bear in mind previous findings to ascertain similarities or new developments in this research. As stated above, the risk perception variables that were analysed include respondent's experience with flood hazard, frequency of flood event, perceived likelihood of occurrence, concern or fear of future personal impact, damage experienced from flood hazard, perceived cause of flooding of the study area and perception on the vulnerability of the community.

The frequency distribution showed that most of the respondents (92%) believe that the community of Coulibistrie is vulnerable. A higher amount (94%) believes that the level of vulnerability has increased since the impact of the storm. It is therefore a reasonable expectation that perception of the likelihood of flooding in the future

would be high as indicated by approximately 76% of the respondents in favour of occurrence. Additionally, 75% of the respondents believe that they are likely to be affected and an overwhelming majority of 96% expressed concern or fear of being affected by future flood events (Appendix D: Table 17). Pearson correlation test indicated a moderate and positive association where both the possibility of the hazard occurring and concern of impact or fear increases. The correlation test for degree of damage which is used as the modulation of experience returned a significant and strong association where level of concern or fear increase as damage experienced increases. Similarly, the association was strong and significant between perception of likelihood of flood occurrence and level of damage and both are positive. What these results indicate is that there is a high level of risk perception among respondents. Importantly, this heightened level of risk perception is associated with the level of damage or degree of experience with flood hazard. These findings returned similar results to the conclusion drawn by previous researchers whose empirical work was reviewed by Kellens *et al.*, (2013: 34) and Shreve and Fordham (2014).

One association test was found particularly interesting. The correlation test between increased vulnerability specifically from Tropical Storm Erika and respondent's perception of likelihood of future flooding returned a moderate and negative association which is significant at the 0.01 significance level. What this may seem to suggest is a strong presence of "avoidance behaviour, wishful thinking or threat denial" (Grothmann and Patt, 2005: 203) in that such a catastrophic event occurred very recently therefore it is not likely in the near future.

Given that the correlations indicate a high level of risk perception, the research also explored the association between concern (fear) of impact and if respondents actually consider to take protective action when flood warnings are issued. The correlation test indicated a weak but positive correlation that is not considered statistically significant. Similarly, experience with flood or level of damage showed a weak but positive correlation with consideration of flood protection. Even though the results showed some correlation between fear and protection behaviour, the association is weak. This as previously stated means other factors could be having greater influence on decision to protect against flood.

5.1.2 Discussion on risk communication results

Influencing behaviour change towards adopting protection from impending hazards is one of the key goals of risk communication. Recalling that the type of flood risk communication now utilized is of the deficit model, this research provides the opportunity to gain feedback from a segment of the population. How serious the respondents view the warning message showed a moderate but significant and also positive association with the perception of how vulnerable the community is to flooding and also with how frequent respondents access weather information. This finding is similar to the aspect of the Protection Motivation Theory where vulnerability and fear should motivate protective behaviour in this case placing importance on flood warning messages.

Exploring if the increase in accessing information was translated to protection intention or action yielded a weak but negative association. A weak and negative correlation also exists between frequency of access and level of seriousness given to warning messages. How much the respondents understand warnings indicated a marginal but positive correlation with how much consideration is given to protection. However, understanding of warning messages indicated a statistically significant and positive association with frequency of accessing weather information. These correlation results appear to corroborate the view that receiving and even understanding the message will not automatically translate to protective action (O'Neill, 2004: 6). The finding also point to the need to assess other variables that could push protection motivation such as "coping appraisal" as suggested by (Bubeck *et al.*, 2012: 1492).

5.1.3 Concluding statement

The analysis of the variables produced mixed results in terms of the strength and direction of some correlations. The overall view is that respondents indicate a high risk perception but as found in previous studies, it does not automatically prompt respondents to display protective behaviour. This conclusion is drawn due to the

high number of respondents who selected responses that supports being vulnerable, the possibility that flood can occur, a high possibility of personal impact and a high level of concern about being affected.

5.2 Theoretical implications

Researching on risk perception and risk communication, as was previously established is not a new phenomenon. The research however is new in the sense that these concepts have not been studied before in Dominica in particular the exploration of protection motivation and response to flood warning. It therefore provides a seminal framework upon which further work can be done. Reference is made to the underpinning theory of Protection Motivation where the components of hazard severity, vulnerability, avoidance response and concern of impact are essential. The test of associations in this research has validated the contribution of these variables to heighten risk perception. However, there are variations in the correlations of key variables that are considered essential to transition from high risk perception to motivate protection behaviour. For example, the degree to which fear was initially thought to produce a statistically higher influence on protection motivation, though present in the findings, was found to be weak. This is similar to findings of (Bubeck *et al.*, 2012: 1484). A research shortfall was highlighted with regards to the study of fear and how it contributes to protection motivation. This is the "inconsistency in defining variables to contextualize and measure the concept of fear" (Rogers, 1975: 101-102). It is felt that further research on fear with specific constructs could produce a higher correlation of the influence of fear on protection motivation.

5.3 Practical implications

5.3.1 Enhancing flood risk communication

The analysis of risk perception variables in the research provided an opportunity to view a portion of the public's thoughts and feelings on the issue of flooding in

Dominica. The risk communication and flood management responses have also provided very useful and practical thoughts and recommendations that can be used to inform flood management and policies. In the area of risk communication, the recommendations on how to improve warning messages should be given due diligence. There is no guarantee that making the changes recommended, such as simplifying the language used in flood warning messages and providing the public with specific protection measures, will solve all the issues pertaining to social responsibility towards personal protection from floods. There are underlying socio-cultural factors that must be realigned to appreciate the significance and potential benefits of taking greater responsibility for personal protection from flood hazard. Additionally, to implement the recommended change further research will be necessary preferably using a focus group setting to garner more information on the type of language the public will be more comfortable with. Similarly, utilizing such a forum will also provide better insight on practical protection measures as seen through the eyes of the utility group. This process therefore calls for the establishment of an interactive process of information exchange and clearly a shift away from the "deficit model of risk communication" (Module 2, Unit 3: 3.4). In this setting, both risk managers and persons who are likely to be affected will receive the opportunity to be informed from the 'expert' and 'non-expert' perspective.

Nearly half of the participants did not have any exposure to community disaster training because they were not aware of when the training is conducted. Public education and awareness therefore remain a key component in disaster risk communication and management.

5.3.2 A case for risk transfer

It was previously noted that 28% of the respondents who did not purchase flood insurance are of the view that the cost of their personal recovery from flooding should be the government's responsibility. This choice by respondents to rely on the government was also found in empirical reviews by Kellens *et al.*, (2013: 33). The finding has several implications including the need for public education on the benefits of the natural hazard insurance product and also insurance companies need

to provide greater product diversity. This scenario strengthens the role being played by companies that currently provide specially tailored insurance products to aid quick recovery from natural hazards such as the Caribbean Catastrophe Risk Insurance Facility (CCRIF) SPC. The platform operated by CCRIF that provide some products that catered particularly to lower income groups could be further extended or replicated. Given that the government is expected to bear the cost, this cost sharing could come in the form of tax incentive for persons who act proactively and obtain some form of natural hazard insurance.

5.4 Limitations

The extent to which a research can be generalized is strongly related to the choice of "sampling method and usually requires knowledge of the size of the population" (May, 2011: 99). Probability sampling method is regarded as "the only statistical method that supports generalizability from the sample to the population" (May, 2011: 99). Due to time limitation, the research was forced to utilize the non-probability sampling technique of "convenience sampling" (Punch 2003: 39). However, a research that is "carefully and thoroughly carried out will yield meaningful information from any sample" (Punch, 2003: 39). Arguably, all is not loss as there is some knowledge of the population in the study area. Apart from the statistical criteria for generalizability, It is believed that a "research can be generalized of the variables used in contextualizing and operationalizing the study are embedded within a broader theoretical framework" (Ferguson, 2004: 20). On the basis of "construct validity and the setting of the research" (Ferguson, 2004:18) the findings of the research could be generalized to some degree.

Aside from this limitation, however, the research has set the framework upon which further work can be carried out possible verifying this research as well as to further expand on the variables established. One route that could be taken to extend on this research is to explore other factors that limit protection motivation behaviour even though the hazard, vulnerability and fear are evident but the expected protection action does not follow through. Therefore, factors such as social and economic conditions that could have an influence on resources to promote protection, the level

of “self-efficacy” (Maddux and Rogers, 1983: 471) and “avoidance behaviour” (Burns and Slovic, 2012: 581) would provide valuable input.

5.5 Reflections

The overall research process was quite fulfilling and provided the opportunity to apply the knowledge and research skills garnered in the degree program. Importantly it provided a platform to make a meaningful contribution in the field of disaster risk reduction and management in the Commonwealth of Dominica. Going through the research process one is able to develop a greater appreciation for the field of study and to see the real association between policies and the lived reality of the public.

The research set out to explore flood risk perception and risk communication in Dominica by utilizing the community of Coulibistrie as the study area. The objectives of the research were achieved based on the data collected and the results of the analyses. The research was able to understand risk perception among the respondents streamlined by formerly established variables. The critical contribution of risk communication was also explored. Importantly the research was able to examine the interconnectedness between flood risk perception, flood risk communication and the ultimate outcome of flood protection behaviour.

Entering into a research process is normally accompanied by preconceived biases as to what the outcome will be. However, by perusing the literature it was easier streamline concepts and thought process and biases gradually dissipate. Thereafter the research process can be approach from a more objective perspective with a better appreciation of concepts and outcomes from varying angles. It is also more feasible to select an approach that fits the setting of the research. For example, the research simple wanted to know how the public view their role in protecting themselves from flood hazard due to the common negative feedback on weather information. However the literature review provided a more robust and developing area of research, protection motivation behaviour and the many variables involved in an individual moving from perceiving the likelihood of being affected by flood hazard to actually taking precautionary measures.

The main difficulty experienced in the project was proper time management particularly with collecting the data and then to analyse the data. The initial data collection was face to face. But to save on time the process was transitioned to self-administered then collected after. There is of course room for improvement. One area is to be able to decide on research variables from a much earlier date. But as one goes further in the research process thoughts and concepts inevitably must be tweaked. A tremendous amount of data was collected on which much more analyses can be conducted. It would have been good to be able to explore more variables. However that aspect can be retained for future research. Another area that could be improved is better timing to ensure the concepts, analyses and desired outcomes are achieved in a more effective manner.

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APPENDIX A: INFORMED CONCENT FORM

University of Leicester

Institute of Lifelong Learning

Informed Consent Form for Research Project

Dear Prospective Participant,

As part of the research I am conducting on flood management I would like to find out your perception of flood risk to Dominica and your community in particular, as well as your views on flood risk communication.

You are therefore being asked to complete this questionnaire as part of the survey process. The survey should take approximately 25 minutes.

This research does not offer/provide financial compensation or material gains.

Any views expressed would be given in confidence and any quotes used would be anonymised and used solely to help myself conduct, publish and disseminate the research. Some information may also be sheared with my research supervisor where necessary.

It is important to note that you can withdraw from the research at any time.

If you are willing to take part in this research, please sign below. If you would like to ask any questions concerning this process, please feel free to contact me:

Name: Viola Pascal
Tel: 1-767-3176000

Yours sincerely,

_____
Viola Pascal (Mrs)

I agree to participate in this research on the basis outlined.

Signature:_____ Date:_____

Print name of interviewee:_____

Print address:_____

_____

APPENDIX B: FOCUSED INTERVIEW QUESTIONS

Focused Interview Questions

The purpose of the research is to assess the public perception of flood risk and flood risk communication in Dominica and how this information can be used to inform flood management.

1. What are the local social practices that may promote vulnerability to flooding in Coulibistrie / Dominica?

2. What are the techniques/measures used in flood management in Coulibistrie / vulnerable communities?

3. What are the measures employed to gain community involvement in flood management?

4. How receptive are residents to the concept of volunteerism or assisting in community flood management?

5. What is your expectation of a warning message on possible flood occurrence and how do you utilize this information?

6. What mediums are employed to inform persons of possible flood events and to what extent do you consider them to be effective?

7. Is there any provision to gain feedback from the public about warning messages and if so, how is such information is utilized?

8. What are some of the ways you can improve communication about possible flood events to the public or persons in your village?

9. In flood management, response is often considered to receive greater focus thus the effort is seen as reactive. What more can be done in the preparedness phase to be more proactive and effective?

10. Dominica is prone to flood hazard due to its physical terrain. Do you believe people see flood as a hazard they must live with and how do you see this choice influencing the level of vulnerability and impact?

APPENDIX C: QUESTIONNAIRE

Questionnaire

The purpose of the research is to assess the public perception of flood risk and flood risk communication in Dominica and how this information can be used to inform flood management.

Demographic Information

1. What age group were you in on your last birthday?

☐ 20 - 29
☐ 30 - 39
☐ 40 - 49
☐ 50 - 59
☐ Above 59

2. Gender: please check the appropriate box

☐ Male
☐ Female

3. What is the highest level of education you completed?

☐ No schooling completed
☐ Primary
☐ Trade or vocational training
☐ High school / college
☐ Bachelors
☐ Beyond Bachelors

4. What is your employment status?

☐ Unemployed
☐ Self employed
☐ Employed (Private/Public sector)
☐ Student
☐ Retired

5. What is your monthly salary range?

☐ Less than 1000
☐ 1000-1999
☐ 2000-2999
☐ 3000-3999
☐ 4000-4999
☐ 5000-5999
☐ 6000 and above

6. Type of dwelling ownership?

☐ Private single ownership
☐ Mortgage
☐ Rent
☐ Lease

☐ Joint/family ownership

Local Flood Perception

7. Have you experienced flooding in your community?

☐ Yes
☐ No (if no move to question 8)

8. How many flood events have you experienced?

☐ 1-2
☐ 3-4
☐ Greater than 4

9. What do you perceive to be the likelihood of your community being flooded in the future?

☐ Extremely unlikely ☐ Unlikely ☐ Don't know ☐ Likely ☐ Extremely likely

10. Do you believe that you will be affected by future flood events?

☐ Yes
☐ No
☐ Not sure

11. How concerned are you of being impacted by a future flood event?

☐ Not concerned
☐ Slightly concerned
☐ Moderately concerned
☐ Very concerned
☐ Extremely concerned

12. What do you think cause flooding in your community? (Check all that apply)

☐ Climate variability and change
☐ Heavy and or prolonged rainfall
☐ Inability of rivers and other waterways to carry high volumes of water
☐ Improper land use
☐ Poor building practices (eg. building in on river bank)
☐ Improper garbage disposal

13. How vulnerable do you think your community is to flooding?

☐ Don't know
☐ Not vulnerable
☐ Slightly vulnerable
☐ Very vulnerable
☐ Extremely vulnerable

14. Do you believe your community was vulnerable to flooding before the passage of Tropical Storm Erika?

☐ Yes
☐ No

15a. Do you believe that your community has become more vulnerable to flooding since the impacts of Tropical Storm Erika?

☐ Yes
☐ No

15b. If so why? _____

_____

16. What was the level of damage you experienced from Tropical Storm Erika?

☐ No damage
☐ Slight damage
☐ Moderate damage
☐ Extensive damage
☐ Completely damaged

Risk communication and early warning

17. Do you know who (Organization) is responsible for issuing flood warning information for your community or Dominica?

☐ Yes
☐ No

18. What is your level of agreement that accessing flood warning message is a socially responsible act (for your benefit and for the benefit of Dominica)?

☐ Strongly disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

19. How frequent per week do you listen to the weather report?

☐ Never ☐ Rarely ☐ Occasionally ☐ Often (more than 4 times) ☐ Always

20. How aware are you of warning messages about possible flooding whenever issued?

☐ Not aware
☐ Slightly aware
☐ Somewhat aware
☐ Very aware
☐ Extremely aware

21. How well do you understand warning messages about flood events?

☐ Limited ☐ Fair ☐ Good ☐ Very good ☐ Excellent

22. How can the responsible agencies improve the warning messages (content, format etc) provided to you and the general public?

_____

23. How do you normally receive flood warning information (by what medium)?

_____

24. What do you think is the most effective way for you to receive information about possible flood occurrence?

☐ Radio
☐ Television
☐ News Paper
☐ Social media - whatsapp, facebook etc.
☐ Email
☐ SMS (text)
☐ Indigenous methods (Warning system developed between community/disaster agency)

25. How serious do you take warning messages from the responsible agency?

☐ Not serious ☐ Somewhat serious ☐ Neutral ☐ Very Serious ☐ Extremely serious

26. To what degree do you trust the warning agencies providing the messages?

☐ Don't trust at all
☐ Very low
☐ Low
☐ High
☐ Very High
☐ Completely trust

27a. When a weather/flood advisory is issued does it prompt you to consider/take protective action?

☐ Yes
☐ No

28b. If yes, select applicable action(s) taken below?

☐ Cancel travel plans
☐ Cancel outdoor activities
☐ Clear drains around home and ensure flood water barriers are intact
☐ Relay flood warning information to other members of the community
☐ Know where shelters are located
☐ Ensure that you remain abreast of information from the responsible agencies
☐ Other _____

29. When or if an evacuation order is issued, how willing are you to obey the order?

☐ Not willing
☐ Slightly willing
☐ Willing
☐ Very willing
☐ Extremely willing

Flood management and preparedness

30. What are some flood management measures that can be implemented in your community?

☐ Building flood barriers
☐ River training and dredging elevated river beds
☐ Terracing and slope re-enforcement to reduce landslide and damming effect upstream
☐ Clear blocked waterways
☐ Increase community knowledge and awareness on floods

☐ Other _____

31. How willing are you to assist the authorities in managing the risk of flooding in your community?

☐ Not willing
☐ Slightly willing
☐ Willing
☐ Very willing
☐ Extremely willing

32. Have you ever participated in any disaster management training exercise?

☐ Yes
☐ No

33. If no, why not?

☐ Not interested
☐ Physically unable
☐ Don't know when training is held
☐ Don't believe the training will be helpful
☐ Other (please specify)

34. Do you believe that flood risk/hazard can be completely removed from your community / Dominica?

☐ Yes
☐ No

35. How prepared are you for another flood in your community?

☐ Not prepared
☐ Somewhat prepared
☐ Prepared
☐ Well prepared

36a. Do you have flood insurance?

☐ Yes
☐ No

36b. If no, why?

☐ Too costly
☐ Don't think it is necessary
☐ Options offered by insurance company are limited in coverage
☐ The government should stand the cost of my recovery

APPENDIX D: TABLES OF QUESTIONNAIRE RESPONSE ANALYSIS RESULTS

Age Range	Frequency	Percent
20-29	8	15.7
30-39	9	17.6
40-49	13	25.5
50-59	8	15.7
>59	12	23.5
Total	50	98
Missing	1	2

Table 1. Age distribution of respondents

Sex		
	Frequency	Percent
Male	21	41.2
Female	30	58.8
Total	51	100.0

Table 2. Respondents categorized by sex

Level of education completed		
Options	Frequency	Percent
No Schooling	3	5.9
Primary	22	43.1
Trade or vocational training	4	7.8
High School / college	17	33.3
Bachelors	4	7.8
Beyond bachelors	1	2
Total	51	100

Table 3. Level of education complete by respondents

Employment status		
Options	Frequency	Percent
Unemployed	9	17.6
Self employed	16	31.4
Employed	19	37.3
Student	2	3.9
Retired	5	9.8
Total	51	100

Table 4. Employment status of respondents

Monthly income ($XCD)		
Salary range	Frequency	Percent
Not applicable	17	33.3
less than 1000	5	9.8
1000-1999	12	23.5
2000-2999	5	9.8
3000-3999	6	11.8
4000-4999	1	2
Total	46	90.2
Missing	5	9.8
Total	51	100

Table 5. Monthly income range of respondents

Type dwelling ownership		
Options	Frequency	Percent
Private single ownership	22	43.1
Mortgage	11	21.6
Rent	3	5.9
Joint/ family ownership	15	29.4
Total	51	100

Table 6. Type of dwelling ownership

Variables	Likelihood of future flood	Level of concern of future impact	Consider protective action
Dwelling Ownership	-0.073	-0.129	0.207

Table 7. Pearson Correlation test for association between dwelling ownership, concern of future flooding and consideration towards protective action

Number of flood events experienced		
	Frequency	Percent
Not applicable	1	2
1-2	46	90.2
3-4	2	3.9
>4	1	2
Total	50	98
Missing	1	2
Total	51	100

Table 8. Frequency of flood events experienced by respondents

Cause of flooding	N	Percent	Percent of Cases
Climate variability and change	31	26.3%	60.8%
Heavy rainfall	37	31.4%	72.5%
Limited capacity of river channels	30	25.4%	58.8%
Improper land use	5	4.2%	9.8%
Poor building practice	10	8.5%	19.6%
Improper garbage disposal	5	4.2%	9.8%
Total	118	100.0%	231.4%

Table 9. Perception on the cause of flooding of Coulibistrie

View on current level of vulnerability of the community to floods		
Response	Frequency	Percent
Don't know	2	3.9
Not vulnerable	2	3.9
Slightly vulnerable	6	11.8
Very Vulnerable	20	39.2
Extremely Vulnerable	21	41.2
Total	51	100.0

Table 10. Respondents view on current level of vulnerability of the community to floods

Vulnerable post TS Erika		
Response	Frequency	Percent
Yes	48	94.1
No	2	3.9
Total	50	98.0
9	1	2.0
Total	51	100.0

Table 11. Distribution of respondents who believe Coulibistrie is more vulnerable post Tropical Storm Erika

Why community more vulnerable post TS Erika		
Responses	Frequency	Percent
Not applicable	2	3.9
Mental/emotional influence	2	3.9
Elevated river bed	22	43.1
No flood barrier	9	17.6
No preparedness	1	2.0
Total	36	70.6
Missing	15	29.4
Total	51	100.0

Table12. Reason for post TS Erika increased vulnerability of Coulibistrie

Likelihood of future flooding of community		
Response	Frequency	Percent
Extremely unlikely	1	2.0
Unlikely	2	3.9
Don't know	3	5.9
Likely	23	45.1
Extremely likely	21	41.2
Total	50	98.0
Missing	1	2.0
Total	51	100.0

Table 13. Likelihood of the community to flood in the future

Variables		Vulnerability post TS Erika	Likelihood of future flooding
Vulnerability post TS Erika	Pearson Correlation	1	-.401**
	Sig. (2-tailed)		0.004
	N	50	49
Likelihood of future flood	Pearson Correlation	-.401**	1
	Sig. (2-tailed)	0.004	
	N	49	50

Table 14. Pearson Correlation between increased vulnerability and likelihood of future flooding

Likely to be affected by future floods		
Response	Frequency	Percent
Yes	38	74.5
No	3	5.9
Not sure	9	17.6
Total	50	98.0
Missing	1	2.0
Total	51	100.0

Table 15. Likelihood of being personally affected by future flood events

Damage experienced from TS Erika		
Responses	Frequency	Percent
No damage	6	11.8
Slight damage	3	5.9
Moderate damage	9	17.6
Extensive damage	24	47.1
Completely damaged	9	17.6
Total	51	100.0

Table 16. Level of damage experienced from Tropical Storm Erika

Level of concern about future flood impact		
Response	Frequency	Percent
Not concerned	2	3.9
Moderately concerned	10	19.6
Very concerned	22	43.1
Extremely concerned	17	33.3
Total	51	100.0

Table 17. Degree of concern (fear) of being personally affected by flood

Correlations between concern, experience and likelihood of future flood				
Variables		Level of concern (fear)	Damage experienced from TS Erika	Likelihood of future flood
Level of concern	Pearson Correlation	1	.498**	.548**
	Sig. (2-tailed)		0.000	0.000
	N	51	51	50
Damage experienced from TS Erika	Pearson Correlation	.498**	1	0.209
	Sig. (2-tailed)	0.000		0.145
	N	51	51	50
Likelihood of future flood	Pearson Correlation	.548**	0.209	1
	Sig. (2-tailed)	0.000	0.145	
	N	50	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

Table 18. Pearson Correlation Coefficient between concern of future impact, degree of damage and likelihood of future flooding.

Do you know who issue flood warning for your community/Dominica		
Responses	Frequency	Percent
Yes	29	56.9
No	21	41.2
missing	1	2.0
Total	51	100.0

Table 19. Knowledge on who issues flood warning information

Agreement on social responsibility to access warning messages		
Responses	Frequency	Percent
Strongly disagree	1	2.0
Neither agree or disagree	8	15.7
Agree	32	62.7
Strongly agree	7	13.7
Total	48	94.1
Missing	3	5.9
Total	51	100.0

Table 20. Extent of agreement on being socially responsible through seeking out warning information

Frequency of listening to weather report		
Responses	Frequency	Percent
Rarely	10	19.6
Occasionally	15	29.4
Often >4 times	12	23.5
Always	13	25.5
Total	50	98.0
Missing	1	2.0
Total	51	100.0

Table 21. Frequency of listening to or accessing weather report

Current means of obtaining warning messages			
Options	N	Percent	Percent of Cases
Radio	36	39.6%	73.5%
Television	34	37.4%	69.4%
Email	1	1.1%	2.0%
Met Office	4	4.4%	8.2%
Internet	9	9.9%	18.4%
Social Media	4	4.4%	8.2%
Word of mouth	3	3.3%	6.1%
Total	91	100.0%	185.7%
Most effective means to receive warning messages			
Options	N	Percent	Percent of Cases
Radio	36	27.5%	70.6%
Television	36	27.5%	70.6%
News Paper	1	0.8%	2.0%
Social Media	24	18.3%	47.1%
Email	7	5.3%	13.7%
Text messages	10	7.6%	19.6%
Indigenous methods	17	13.0%	33.3%
Total	131	100.0%	256.9%

Table 22. Current means of obtaining warning messages and most effective means to obtain warning messages.

Awareness of warning messages when issued		
Response	Frequency	Percent
Not aware	1	2.0
Slightly aware	6	11.8
Somewhat aware	15	29.4
Very aware	23	45.1
Extremely aware	5	9.8
Total	50	98.0
Missing	1	2.0
Total	51	100.0

Tables 23. Respondents level of awareness pertaining to warning message whenever issued

Level of understanding of warning message		
	Frequency	Percent
Limited	5	9.8
Fair	10	19.6
Good	9	17.6
Very good	20	39.2
Excellent	7	13.7
Total	51	100.0

Table 24. Extent to which respondents understand flood warning messages when issued.

How to improve warning messages		
Responses	Frequency	Percent
Specific impact/measures	5	9.8
Simple language	7	13.7
Not Sure	1	2.0
Total	13	25.5
Missing	38	74.5
Total	51	100.0

Table 25. Respondents view on how to improve the content of warning messages

Level of seriousness towards warning messages		
Responses	Frequency	Percent
Somewhat serious	6	11.8
Neutral	3	5.9
Very serious	31	60.8
Extremely serious	10	19.6
Total	50	98.0
Missing	1	2.0
Total	51	100.0

Table 26. Level of serious displayed towards flood warning messages

Degree of trust in warning authority		
Responses	Frequency	Percent
Don't trust at all	1	2.0
Very low	2	3.9
Low	12	23.5
High	15	29.4
Very high	14	27.5
Completely trust	5	9.8
Missing	2	3.9
Total	51	100.0

Table 27. Degree of trust in flood warning authority.

Consider to take protective action		
Responses	Frequency	Percent
Yes	49	96.1
No	1	2.0
Total	50	98.0
Missing	1	2.0
Total	51	100.0

Table 28. Number of respondents who consider to take protective action

Protection measure	N	Percent	Percent of Cases
Cancel travel	28	17.5%	56.0%
Cancel outdoor activities	37	23.1%	74.0%
Clear drains	19	11.9%	38.0%
Share warning information	32	20.0%	64.0%
Locate shelters	4	2.5%	8.0%
Keep informed	38	23.8%	76.0%
Other	2	1.3%	4.0%
Total	160	100.0%	320.0%

Table 29. Protection measures practiced by respondents

Willingness to obey evacuation order		
Responses	Frequency	Percent
Not willing	4	7.8
Slightly willing	12	23.5
Willing	5	9.8
Very willing	18	35.3
Extremely willing	11	21.6
Missing	1	2.0
Total	51	100.0

Table 30. How willing are respondents to obey evacuation orders

Pearson Correlation results among selected risk communication variables				
Variables	Agreement on social responsibility	Frequency of listening to weather report	Awareness of warning messages	Level of understanding of warning message
Agreement on social responsibility	1	0.189	0.130	0.186
Frequency of listening to weather report	0.189	1	.512**	0.175
Awareness of warning messages	0.130	.512**	1	.435**
Level of understanding of warning message	0.186	0.175	.435**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 31. Pearson Correlation results between selected risk communication variables

Variables	Awareness of warning messages	Level of understanding of warning message	Consideration to take protective action
Awareness of warning messages	1	.435**	-0.079
Level of understanding of warning message	.435**	1	0.083
Consideration to take protective action	-0.079	0.083	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 32. Pearson correlation between awareness, understanding of message and consideration to take protective action

Variables	Consider to take protective action	Level of seriousness towards warning messages	Frequency of listening to weather report	Likelihood of future flood
Consider to take protective action	1	-0.150	-0.208	0.126
Level of seriousness towards warning messages	-0.150	1	.452**	0.270
Frequency of listening to weather report	-0.208	.452**	1	0.002
Likelihood of future flood	0.126	0.270	0.002	1

Table 33. Pearson correlation test between likelihood of future floods and selected risk communication variables

Variables	Consider to take protective action	Level of concern	Frequency of listening to weather report	Level of seriousness towards warning messages
Consider to take protective action	1	0.152	-0.208	-0.150
Level of concern of future flood impact	0.152	1	0.020	.449**
Frequency of listening to weather report	-0.208	0.020	1	.452**
Level of seriousness towards warning messages	-0.150	.449**	.452**	1

Table 34. Pearson correlation test between level of concern (fear) of future impact and selected risk communication variables

Variables	Awareness of warning messages	Consider to take protective action	Level of seriousness towards warning messages
Awareness of warning messages	1	-0.079	.429**
Consider to take protective action	-0.079	1	-0.150
Level of seriousness towards warning messages	.429**	-0.150	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 35. Pearson correlation test among selected risk communication variables

Variables	Consideration to take protective action	Damage experienced from TS Erika	Level of seriousness towards warning messages
Consider to take protective action	1	0.176	-0.150
Level of seriousness towards warning messages	-0.150	0.264	1

Table 36. Pearson correlation test between level of damage (degree of experience) and selected risk communication variables

Variables	Consider to take protective action	Level of seriousness towards warning messages	Perception of current vulnerability	Frequency of listening to weather report
Consider to take protective action	1	-0.150	0.125	-0.208
Level of seriousness towards warning messages	-0.150	1	.377**	.452**
Perception of current vulnerability	0.125	.377**	1	0.105
Frequency of listening to weather report	-0.208	.452**	0.105	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 37. Pearson correlation test between Perception of current vulnerability and selected risk communication variables

Possibility of zero flood risk		
Responses	Frequency	Percent
Yes	13	25.5
No	36	70.6
Missing	2	3.9
Total	51	100.0

Table 38. Possibility of zero risk to flooding

Flood Management measures	N	Percent	Percent of Cases
Build flood barriers	44	36.4%	88.0%
River training and dredging	36	29.8%	72.0%
Terracing upslope	8	6.6%	16.0%
Clear waterways	21	17.4%	42.0%
Increase awareness	11	9.1%	22.0%
Other	1	0.8%	2.0%
Total	121	100.0%	242.0%

Table 39. Possible flood management measures for Coulibistrie

Willingness to assist in flood management		
Responses	Frequency	Percent
Not willing	2	3.9
Slightly willing	4	7.8
Willing	21	41.2
Very willing	13	25.5
Extremely willing	10	19.6
Total	50	98.0
Missing	1	2.0
Total	51	100.0

Table 40. Respondents level of willingness to assist authorities in managing flooding of community

Disaster training		
Responses	Frequency	Percent
Yes	11	21.6
No	40	78.4
Total	51	100.0
If no disaster training, why?		
Responses	Frequency	Percent
Not applicable	11	21.6
Not interested	3	5.9
Physically unable	7	13.7
Don't know when training is held	25	49.0
Other	4	7.8
Missing	1	2.0
Total	51	100.0

Table 41. Exposure of respondents to community disaster training and reason for no training

Level of preparedness against future flooding		
Response	Frequency	Percent
Not prepared	14	27.5
Somewhat prepared	8	15.7
Prepared	17	33.3
Well prepared	11	21.6
Total	50	98.0
Missing	1	2.0
Total	51	100.0

Table 42. Level of preparedness against future flooding

Possess flood insurance		
Response	Frequency	Percent
Yes	6	11.8
No	44	86.3
Total	50	98.0
Missing	1	2.0
Total	51	100.0
Reason for no flood insurance		
Response	Frequency	Percent
Not applicable	7	13.7
Too costly	10	19.6
Don't think it is necessary	1	2.0
Limited options offered	15	29.4
Government should bear the cost	14	27.5
Total	47	92.2
Missing	4	7.8
Total	51	100.0

Table 43. Number of respondents who has flood insurance and reason for no flood insurance